**CL2**

**THE OXFORDSHIRE COUNTY COUNCIL (DIDCOT GARDEN TOWN HIGHWAYS INFRASTRUCTURE – A4130 IMPROVEMENT (MILTON GATE TO COLLETT ROUNDABOUT), A4197 DIDCOT TO CULHAM LINK ROAD, AND A415 CLIFTON HAMPDEN BYPASS) COMPULSORY PURCHASE ORDER 2022**

**THE OXFORDSHIRE COUNTY COUNCIL (DIDCOT TO CULHAM THAMES BRIDGE) Scheme 2022**

**THE OXFORDSHIRE COUNTY COUNCIL (DIDCOT GARDEN TOWN HIGHWAYS INFRASTRUCTURE – A4130 IMPROVEMENT (MILTON GATE TO COLLETT ROUNDABOUT), A4197 DIDCOT TO CULHAM LINK ROAD, AND A415 CLIFTON HAMPDEN BYPASS) (SIDE ROADS) ORDER 2022**

**AND**

**THE CALLED-IN PLANNING APPLICATION BY OXFORDSHIRE COUNTY COUNCIL FOR THE DUALLING OF THE A4130 CARRIAGEWAY, CONSTRUCTION OF THE DIDCOT SCIENCE BRIDGE, ROAD BRIDGE OVER THE APPLEFORD RAILWAY SIDINGS AND ROAD BRIDGE OVER THE RIVER THAMES, AND ASSOCIATED WORKS BETWEEN THE A34 MILTON INTERCHANGE AND THE B4015 NORTH OF CLIFTON HAMPDEN, OXFORDSHIRE (APPLICATION NO: R3.0138/21)**

**PLANNING INSPECTORATE REFERENCE:**

**APP/U3100/V/23/3326625 and NATTRAN/SE/HAO/286 (DPI/U3100/23/12)**

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# CHRIS LANDSBURGH

# (Climate Change)

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# Appendices to the Proof of Evidence of

# CHRIS LANDSBURGH

## (Climate Change)

## (Part 1)

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**Appendix CL2.1**

**Chris Landsburgh's CV**

# Chris **Landsburgh** CEnv FIEMA CEng MICE FICRS

Technical Director, Carbon and ESG Practice

Chris Landsburgh is a recognised leader in sustainability and decarbonisation, bringing cross-sector innovation and experience. With over a decade of experience designing, delivering, and maintaining highways and infrastructure projects, Chris brings knowledge and expertise to any organisation.

As a Technical Director at AECOM, Chris has an impressive track record of accomplishments, including being the first Chartered Infrastructure Engineer with the ICE (CEng MICE), leading one of the first PAS 2080 projects through the Design and Construction process and guiding his organisation to become the first UN Certified Carbon Neutral Organisation (PAS 2060). His technical and strategic input has been instrumental in shaping AECOM's Global Net Zero (ScopeX), carbon management, and climate strategies for businesses, Infrastructure, designs, construction, and engagement through the supply chain.

Before AECOM, Chris served as the Group Environmental and Sustainability Lead for a leading Principal Designer and Principal Contractor; Chris was pivotal in overseeing technical, commercial, delivery, and business development matters in sustainability, carbon management, ecology, and environmental collaboration.

Chris is highly respected in the industry and has been appointed to several committees, including the Carbon and Environmental Committee for CECA, the ICE Future Leadership Program, and the ICE Carbon Project and Carbon Champions Committees. The BSI Greenhouse Gas Committee recently elected him to represent the UK as an Expert to the European Committee on Climate Change Mitigation and Decarbonization (CEN/TC 467/WG 1). He also serves as a standing member of the PAS 2080 Technical Advisory Panel, the UN's Industrial Deep Decarbonization Initiative, and the Built Environment Carbon Database Technical Panel (Buildings and Infrastructure).

As a Chartered Environmentalist and Chartered Engineer, Chris is well-equipped to provide leadership qualities, expert technical insight, and strategic guidance to any organisation seeking to develop and implement effective management and strategies.

**Clients**

Department for Transport
National Highways
Transport Scotland
Network Rail
HS2, TRU, NEOM, Alula
UNFCCC
Local Councils UK-Wide
Hong Kong Government

**Qualifications**

PhD Carbon Responsibility (Ongoing)
MEng Civil Engineering
BSc (Hons) Environmental Management and Planning
IEMA Auditing Certificate
CEEQUAL Assessor
BREEAM Assessor (Multiple)
OneClick LCA Certified

**Professional Affiliations**

CEnv FIEMA
CEng MICE
C.WEM MCIWEM [Lapsed]
FICRS

**Security Clearance Level**

BPSS & SC

***Key Experience***

**Technical Director, Infrastructure Decarbonisation (EMEA), AECOM, Aug 2021 - Present**
Chris collaborates with the Climate team at AECOM on several global projects. He provides technical guidance, advises on, and manages the delivery of life cycle assessments (LCAs) and carbon management plans tailored for the infrastructure sector. Chris also develops and implements PAS 2080 plans, conducts audits, and ensures they are integrated within projects. Additionally, he plays a pivotal role in developing sustainability initiatives and is a Technical Reviewer for various carbon-centric projects. This includes Environmental Impact Assessments, Development Consent Orders, Planning Inquiries, and broader organisational guidance and improvement. A few examples of projects he has worked on include:

**High-Speed Rail 2 (2022+):** Chris provides climate expertise to several HS2 Packages, details he cannot disclose.

**Transport Scotland: Various Highways Projects at Varying Stages of Life Cycle (Clyde Metro, Sherifhall), (2021+)** Chris has provided technical inputs on several Transport Scotland projects, including the Clyde Metro Project, Sherrifhall, and others. Support has included whole-life carbon accounting and target setting for schemes, advice on Design and Construction Decarbonisation, PAS 2080 Carbon Management in Infrastructure, and assessment of Risks and Opportunities Identification. Chris is representing Transport Scotland as an expert witness for Climate Change and Carbon on major infrastructure projects.

**National Highways: Various Highways Projects at Varying Stages of Life Cycle (A428, A3, A19, A614, A303, M32, M60, Lower Thames Crossing etc), (2021+):** Chris has provided technical inputs on several National Highways projects, including the A428 Blackcat, A303 Stonehenge and Lower Thames Crossing. Support has included whole-life carbon accounting and target setting for schemes, advice on Design and Construction Decarbonisation, and PAS 2080 Carbon Management in Infrastructure. Chris has represented National Highways as a climate specialist and expert witness on Planning Inspectorate DCO hearings.

**NEOM/EPM: NEOM, Kingdom of Saudi Arabia & Dubai, (2021):** Chris is a technical carbon lead for the design element of this project. In this role, Chris acts as Lead Verifier for the whole-life carbon footprint of various designs and provides low-carbon design and construction advice. Further, he provided Whole-life Carbon Footprinting, carbon management and decarbonisation advice, which are being undertaken in line with PAS 2080 Carbon Management requirements.

**Department for Transport: Shared Digital Carbon Architecture Programme (SDCA), (2021-2023):** Chris led a critical initiative for DfT as part of the SDCA project and DfT's decarbonisation strategy. The Project aimed to assist policymakers in decision-making on decarbonisation plans, delivering sustainable communities and harmonising carbon reporting. Chris worked with DfT partners, including National Highways and Network Rail, to establish their Greenhouse Gases understood through Whole Life Carbon Assessment and Life Cycle Analysis. Here, he provided technical advice for other areas the Project is assessing, including GHG Accounting methods, Design and Construction Advice, and integration of PAS 2080 Carbon Management in Infrastructure.

In addition to his infrastructure-focused responsibilities, Chris also contributes to non-infrastructure projects. These include verification efforts on the UNFCCC COP28 Sustainability Services contract, developing sustainability training modules, aiding AECOM's corporate ambitions and conducting audits in line with industry standards, among other initiatives.

### *Previous to AECOM:*

**Wills Bros: Group Environmental and Sustainability Lead (2018-2022)**
Chris was the lead Environmental Manager responsible for overseeing the environmental, Carbon, sustainability, ecological and archaeological issues relating to the organisation and the projects ranging from £1m to £300m in the UK and Ireland. This covered work was undertaken as Construction Design Management (CDM) Project Manager, Principal Designer and Principal Contractor.

This saw Chris developing various plans, including Environmental, Ecological, Drainage Design and Net Zero Carbon, for which they won several awards and industry firsts. As part of this role, he evaluated and audited these plans in alignment with his ISO 9001, 14001 and 45001 accreditations. With Wills Bros, he worked on over 20 projects, including:

**National Highways (via Costain):** A30 C2CC (T2 Contractor), (2021): Chris led the sustainability efforts as the Environmental Manager for the A30 C2CC road scheme. His work with Costain resulted in identifying and exploring carbon reduction opportunities such as Hydrogen Plant, Solar Pumps, and others. Chris also ensured that the Project's Risk Assessments and Method Statements (RAMS) prioritised Carbon and Environmental Protection.

**Transport Scotland: A77 Maybole Bypass (2019-2021):** As the Environmental and Sustainability Manager, Chris oversaw compliance with CDM requirements as Principal Designer and Principal Contractor. He led the design, implementation, and procurement of the 300% Biodiversity Net Gain and corresponding Carbon Bio Sequestration Gain, transforming a quarried area into a grassland habitat. SEPA recognised this initiative as good practice.

**Renfrewshire City Council: Glasgow Airport Investment Area (GAIA) (2019-2021):** Chris served as GAIA's Environmental and Sustainability Manager, responsible for ensuring CDM compliance for the Principal Designer and Principal Contractor positions. He implemented a PAS 2080-compliant Carbon Management System, reducing several design aspects associated with a Cable Crossing using recycled plastic Geotech crates and light clay fill, recognised by the New Civil Engineer and won Chris and team ICE Carbon Champion status.

**BRE: Graduate to Senior Sustainable Engineering Consultant (2015-2018)**
During his earlier tenure as a Consultant in Engineering and sustainability, Chris managed various environmental projects. He adeptly managed and delivered several BREEAM and CEEQUAL manuals and bespoke assessments. His hands-on involvement with landmark pilot projects, such as Crossrail, Thames Tideway Tunnels, and the avant-garde 400kV T Pylon project in Eakring, underscored his versatility and commitment to environmental excellence.

Furthermore, his consultancy role with the JFK Airport Upgrade highlighted his adeptness in melding CEEQUAL methodologies into custom, fit-for-purpose solutions. Chris's role within the Building Technology Group at BRE saw him gain experience in structural and civil engineering and environmental engineering, including wind, water, plume, and fluid dynamics.

### *Hobbies and Interests:*

Chris values spending time with his family outside of work. Further to the family, he channels his energy into playing rugby on weekends, showcasing his passion and team spirit. Alongside this, he's deeply engaged in a PhD centred on Carbon Responsibility, reflecting his commitment to environmental sustainability.

## Appendix CL2.2

## Review of Updates to Policy and Guidance

# Appendix CL2.2

## Review of Updates to Policy and Guidance

### 1 Introduction

1.1 This appendix presents a review of the impact of updated or newly relevant policies and guidance on the assessment presented in Chapter 15 of the Environmental Statement (ES) [CD A.15]. The focus is on how these updates pertain to greenhouse gas (GHG) emissions and climate vulnerability.

1.2 The analysis highlights any previously unconsidered policies that are now pertinent, and its goal is to identify potential influences on the Scheme's environmental impact and compliance.

### 2 National Policy

**National Planning Policy Framework (2023) and Planning Practice Guidance (PPG) (2023)**

2.1 The National Planning Policy Framework (NPPF) was updated on 18 December 2023 and sets out the government's planning policies for England and how these are expected to be applied. The updated NPPF States under Paragraph 157:

2.2 "*The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure*".

2.3 Overall, the updated NPPF places more emphasis on supporting renewable energy production and utilising carbon storage where available.

2.4 I do not consider this to be relevant to the Scheme. Therefore, this does not affect the conclusions of the GHG assessment presented in the ES.

2.5 The updated NPPF does not place additional requirements on climate resilience. Hence, I consider that there is no impact on the CCR assessment based on the updated NPPF.

2.6 In support of the NPPF, the Planning Practice Guidance (PPG) was also updated to help projects implement the correct requirements into their Schemes.

2.7 The PPG re-emphasises the importance of renewable and low-carbon energy production support via community-led renewable energy initiatives. It provides further guidance to the Department for Energy Security and Net Zero for a methodology for assessing capacity for renewable energy at a development. As this is irrelevant to the GHG or CCR assessments, this does not affect the conclusions presented in the ES.

**Decarbonising Transport Plan (2021) [Appendix CL2.19]**

2.8 In response to the Climate Change Act 2008 (2050 Target Amendment) Order 2019 [Appendix CL2.4], the Department of Transport (DfT) established the Decarbonising Transport Plan (DTP) to align England's transport emissions with the UK Government's net zero commitment.

2.9 The DTP sets out the government's commitments and the actions needed to decarbonise the entire transport system in the UK. This plan would impact the road users' GHG emissions in the assessment since it presents a more optimistic outlook where the UK emissions decarbonise in line with the Decarbonising Transport Plan.

2.10 I consider that the GHG emissions modelled for the ES, for the Do-Minimum (DM) and Do-Something (DS) scenarios, therefore, represent a conservative approach as the modelling does not fully account for the decarbonisation of the transport sector over its operational life.

2.11 While a reduction in road user emissions for both the DM and DS scenarios would result in a reduction in the absolute beneficial carbon impact of the Scheme (DS-DM), the proportionate carbon benefit (i.e. the reduction in emissions as a percentage of emissions without the scheme) would remain the same as reported in the ES, but with fewer GHG emissions overall. Therefore, the conclusion drawn in the ES that there is a beneficial impact on GHG emissions during operation remains true.

**National Policy Statement for National Networks (Draft 2023) [Appendix CL2.20]**

2.12 The draft NPSNN was released in March 2023 and is currently out for consultation. It reinforces under Paragraph 5.29 that a "*Whole life carbon assessment should be used to measure greenhouse gas emissions at every stage of the Scheme to ensure that emissions are minimised as far as possible as we transition to net zero*". The ES applies the BS EN 17472 whole lifecycle carbon methodology during construction and operation, so I consider that it is already captured in the carbon assessment of the Scheme in the ES.

2.13 The draft NPSNN references the Transport Appraisal Guidance Unit A3 guidance. This guidance has now been updated since the carbon assessment with a new Emissions Factor Toolkit (EFT) v11. The EFT v11 considers the UK net zero vehicle fleet trajectory under the DTP scenario.

2.14 However, as outlined in paragraph 2.10 of this Appendix, I consider that the assessment presented in the ES represents a conservative approach as the latest EFT v11 presents a more optimistic decarbonised trajectory for the vehicle fleet.

2.15 The draft NPSNN also states that a Carbon Management Plan should be produced as part of the submission of the Development Consent Order. Accordingly, the Applicant has committed to submitting, approving and implementing a Carbon Management Plan to provide further details on emissions and include details of how whole life carbon emissions will be reduced.

2.16 Paragraph 5.32 of the NPSNN states that mitigation is also required for design and construction to ensure that the carbon footprint is not unnecessarily high. Paragraphs 4.30 to 4.41 of the NPSNN also outline that mitigation is essential to minimise the most dangerous impacts of climate change, noting that new development should be planned to avoid increasing vulnerability to the range of impacts arising from this. The assessment presented in the ES meets these requirements as embedded mitigation measures are presented in section 15.9 of the ES [CD A.15, Chapter 15].

**Road Investment Strategy 2 (2020–2025) [Appendix CL2.21]**

2.17 The Road Investment Strategy 2 (RIS2) puts forward that Highways England (now known as National Highways) will be expected to reduce its carbon emissions in line with its new Greening Government Commitments. RIS2 identifies clear targets for National Highways to reduce its in-house operational emissions to levels defined by baselining and target-setting activities in 2020-21.

2.18 RIS2 supports the government's transition to decarbonise road transport to tackle emissions in line with the Climate Change Act. However, RIS2 does not provide an emission trajectory to reduce road user emissions.

2.19 National Highways commitments to its RIS2 operational carbon targets are supported by the embedded mitigation measures stated in Table 15.12 of the ES [CD A.15, Chapter 15]. These mitigation measures stipulate the Principal Contractor (PC) will develop and implement a plan to reduce energy consumption and associated carbon emissions.

2.20 Moreover, measures will be implemented to manage material resource use during construction. Where possible, use local construction staff to minimise commuting distances. The embedded measures also include good construction practices such as no idling, low-emission fleet vehicles and waste management strategies.

**National Infrastructure Strategy (2020) [Appendix CL2.22]**

2.21 As set out in the Prime Minister's Ten Point Plan for a Green Industrial Revolution, infrastructure investment is fundamental to delivering net zero emissions by 2050. The government will unlock private sector investment to accelerate the deployment of existing technology, such as retrofitting the UK's building stock and electrification of vehicles while advancing newer technologies, such as carbon capture and low-carbon hydrogen.

2.22 The Strategy acknowledges that the majority (over 80%) of the UK's emissions come from infrastructure sectors. The Strategy sets a pathway to decarbonise its main sectors, with transport being identified as key. The Strategy talks about the 2030 fossil fuel car and van ban, which has now been pushed back to 2035.

2.23 It states that the EV charging ecosystem will be one of the UK's future green industries, and the government wants to maximise private sector investment in the delivery of charging infrastructure. It sets out to achieve this via the delivery of a core rapid charging network across motorways and key A road service stations.

2.24 As well as decarbonising private vehicles, the government wants to increase the share of journeys taken by public transport, cycling and walking, and decarbonise buses and trains.

2.25 Regarding sustainable transport, the Scheme will encourage active travel by including footways and cycleways. Also, as outlined above, a commitment has been made since publication of the ES that all the proposed traffic signals (junctions and crossings) across the Scheme will be designed and implemented with an Urban Traffic Control (UTC) based bus priority system. This system has the ability to encourage modal shift by prioritising public transport over other modes, such as private cars.

2.26 The Strategy also covers climate change adaptation, which requires all policies, programmes and investment decisions to consider the possible extent of climate change this century.

2.27 I determine that the ES [CD A.15] effectively assesses the impact of climate change on the Scheme, in alignment with DMRB LA 114 [Appendix CL2.6] requirements, and implements sufficient adaptative capacity embedded into the Scheme's design (as presented in Section 15.9 of the ES [CD A.15, Chapter 15]) so aligns with the requirements in the Strategy.

## 3 Local planning policy

**Local Transport and Connectivity Plan 2022 – 2050** [CD G.4]

3.1 The LTCP [CD G.4] outlines Oxfordshire County Council's long-term vision for transport and travel in the county and the policies required to deliver this. It acknowledges that a net zero transport system is critical to contributing to UK targets and addressing the climate emergency. The LTCP states under Page 6 "*Our Local Transport and Connectivity Plan vision is for an inclusive and safe net-zero Oxfordshire transport system that enables all parts of the county to thrive*".

3.2 The plan sets out targets to achieve this with car use reduction being a central theme with targets such as:

- 2030 Replace or remove 1 out of every 4 current car trips in Oxfordshire and increase the number of cycling trips
- 2040 our targets are to: deliver a net-zero transport network and replace or remove an additional 1 out of 3 car trips in Oxfordshire
- 2050: Deliver a transport network that contributes to a climate positive future.

3.3 In line with the LTCP [CD G.4], the Scheme in the ES sets out to encourage low or carbon-neutral forms of transport by constructing additional shared cycle/footways. Also, as outlined above, a commitment has been made since the publication of the ES that all the proposed traffic signals (junctions and crossings) across the Scheme will be designed and implemented with an Urban Traffic Control (UTC) based bus priority system. This system has the ability to encourage modal shift by prioritising public transport over other modes such as private car.

3.4 In addition, the LTCP [CD G.4] references the Transport Decarbonisation Plan [Appendix CL2.19] as the key policy for achieving net zero, which is beyond the scope of this Scheme since it is implemented at a UK national level by the Government.

3.5 The LTCP [CD G.4] Policy 27 also states that a whole life assessment should be conducted, and schemes should be assessed against local carbon budgets. The ES applies the BS EN 17472 [Appendix CL2.18] whole lifecycle carbon methodology during construction and operation, before comparing the emissions against national carbon budgets.

3.6 Assessment against the Tyndall Centre local carbon budgets is not considered appropriate in this context. Such local carbon budgets have no status in law or policy. The hyper-localised Tyndall Centre data is not an appropriate comparator for the GHG assessment due to the cross-boundary nature of much of the GHG data included in the assessment. For example, Oxfordshire's carbon budget is confined to the local administrative area of Oxfordshire, and does not account for wider emissions outside the local boundary of the project.

3.7 As detailed in the ES, it is anticipated that the majority (83%) of the construction emissions would be located in embodied carbon in raw materials, which will most likely be procured outside the boundary of Oxfordshire due to the nature of global supply chains. Many of the transportation emissions would, therefore, also likely occur outside the boundary of Oxfordshire. As the majority of emissions included within the GHG assessment would be outside the scope of the local carbon budgets, the local budgets do not represent an appropriate, like-for-like comparison.

3.8 Further, the use of national carbon budgets for the assessment of carbon emissions has been confirmed as a lawful approach through the High Court decision in R (Boswell) v SS for Transport [2023] EWHC 1710. Paragraph 6 (point v) states:

"*Recent case law confirms that, on the basis of current policy and law, it is permissible for a decision maker to look at the scale of carbon emissions relative to a national target. The proposition that the impact of carbon emissions is not limited to a geographical boundary is a scientific assessment to which the Court should afford respect*."

3.9 Legislation does not require testing a scheme against local or regional budgets. Legally binding carbon budgets are set at a national level.

3.10 Furthermore, the GHG assessment concluded that there would be a beneficial GHG impact from the Scheme during operation due to efficiencies of traffic flow. Therefore, if Oxfordshire's Carbon Budget was relevant (which it is not in this context), operational emissions would have a beneficial impact against the budget during operation.

3.11 Based on the reasoning provided above, I consider the GHG assessment provided in the ES to be in alignment with this policy, as appropriate for a Scheme of this type.

**Vale of White Horse District Council Climate Action Plan 2022-2024 (Published 2022) [Appendix CL2.23]**

3.12 The Vale of White Horse District Council (VoWHDC) Climate Action Plan 2022-2024 was published in 2022 and sets out how VoWHDC will achieve its targets of becoming a carbon-neutral council by 2030, with a 75 per cent reduction in its emissions by 2025 and becoming a carbon neutral district by 2045, with a 75 per cent reduction in emissions across the district by 2030.

3.13 The Climate Action Plan presents a set of actions that will help the VoWHDC achieve its carbon neutrality target through direct initiatives using our statutory powers, strategic policymaking, or enabling behaviours and working with others.

3.14 The Climate Action Plan is limited to the boundary of the VoWHDC and does not account for surface transport or road infrastructure emissions. The Climate Action Plan refers to another document named the Pathways to a Zero Carbon Oxfordshire to address how Oxfordshire can achieve net zero emissions by 2050. This document states on Page 24:

3.15 "*The Greenhouse Gas (GHG) Protocol categorises emissions into three categories, or 'Scopes'. When referring to a geographical region, Scope 1 includes direct emissions occurring within the county boundary, including fossil fuels combusted in vehicles or boilers. Scope 2 refers to the emissions associated with energy used locally but generated elsewhere (e.g. electricity). To avoid issues such as double counting, this report focuses on Scope 1 and 2*".

3.16 As the GHG assessment concludes that the Scheme has a beneficial GHG impact during its operational lifetime, the Scheme is considered to contribute positively towards VoWHDC's and Oxfordshire's carbon reduction ambitions.

**Climate Action Plan for South Oxfordshire District Council 2022-2024 [Appendix CL2.25]**

3.17 South Oxfordshire District Council Climate Change Strategy and Carbon Management Plan sets out how South Oxfordshire District Council will achieve its targets of becoming a carbon-neutral council within its own operations by 2025 and becoming a carbon-neutral district by 2030. Quarterly reports will be published to outline progress against the measures in the plan.

3.18 As the scheme during the operation has a beneficial GHG impact, I consider it to contribute positively towards South Oxfordshire District Council's decarbonisation goals.

## 4 Other Guidance

### Pathways to zero carbon Oxfordshire (Pazco) [Appendix CL2.26]

4.1 The Pathways to a zero carbon Oxfordshire document sets out how the Oxfordshire county can achieve net-zero emissions. The emission scope boundary of the document is constrained to scope 1 (mainly fuel use including transport) and scope 2 (electrical energy) emissions within the geographical boundary of the Oxfordshire country. This is set out to be achieved via 3 known pathways comprising:

- Societal Transformation is led from the bottom up, with householders adopting new technologies and practices and community groups corralling action;
- Technological Transformation, by contrast, relies on systemic changes driven at the national level, including the deployment of hydrogen for heating and other technical solutions which require the least change to individual behaviour; and
- Oxfordshire Leading the Way mirrors the widespread cultural and behavioural changes seen in Societal Transformation and combines this with high deployment of new local electricity generation using solar photovoltaics.

4.2 On Page 6, it states that "*Which pathway Oxfordshire will take depends on a variety of factors, including technological innovation, macro-economic trends following COVID-19, public support, changing social norms and behaviours, and policy decisions taken at the local, national and international levels.*"

4.3 The document also states on Page 138 that "*switching to cleaner fuels is insufficient for net zero. We also need to reduce our transport demand and complete more of our journeys by walking, cycling public and shared transport*."

4.4 Moreover, the three relevant net zero pathways determine Oxfordshire county's trajectory for the transportation sector, as summarised below:

- Societal Transformation: Energy demand is reduced, with significant increases in walking and cycling for shorter trips and widespread home working. Incentives and communications campaigns are needed to drive up the use of public transport.
- Technological Transformation: Relies upon the electrification of the private vehicle fleet, with car usage remaining high.
- Oxfordshire Leading the Way: Oxfordshire residents incorporate walking and cycling into their daily routines, with more amenities being provided locally and businesses supporting remote working. Reduced car usage is also driven by extensive pedestrianisation measures implemented by Oxford City and the market towns, workplace charging levies, and the proliferation of low traffic and higher density.

4.5 In alignment with this, the Scheme will encourage active travel by including footways and cycleways. Also, as outlined above, a commitment has been made since the publication of the ES that all the proposed traffic signals (junctions and crossings) across the Scheme will be designed and implemented with an Urban Traffic Control (UTC) based bus priority system. This system has the ability to encourage modal shift by prioritising public transport over other modes, such as private cars.

4.6 I consider that this provides evidence that the Scheme supports the Oxfordshire Leading the Way net zero pathway by supporting active walking and cycling modes of travel and low-carbon or carbon-neutral forms of transport.

4.7 In addition, since the Scheme is proposing to result in increased efficiencies, which results in negative carbon emissions relative to the baseline line. Thus, I view the Scheme as compliant with the net zero Oxfordshire Leading the Way trajectory.

**Oxfordshire Infrastructure Strategy (Stage 1 Report, 2021) [Appendix CL2.27]**

4.8 The Oxfordshire Infrastructure Strategy was commissioned on behalf of the Oxfordshire Growth Board to support the emerging Oxfordshire Plan 2050. This OxIS Stage 1 Report provides a strategic framework for Oxfordshire County Council (OCC), Oxfordshire's five District Councils and key strategic partners to prioritise currently proposed infrastructure scheme investment aligned to the five OxIS themes as well as identify potential delivery and funding opportunities to 2040.

4.9 For the environmental segment, the Oxfordshire Infrastructure Strategy sets out to maximise opportunities to build lasting resilience to Climate Changes and support the ambition towards next zero whilst enhancing the natural environment as set out under:

- E1. Net zero carbon emissions;
- E2. Resilience to Climate Change;
- E3. Enhance Natural Environment and Biodiversity;
- E4. Efficient Waste and Recycling; and
- E5. Reduce Water and Noise Pollution

4.10 In order to achieve these policies, the Strategy identifies where funding is required to align with these goals and identifies that there is a significant funding gap in relation to Transport infrastructure sector.

4.11 The Strategy sets out that the carbon emission inventory indicates a need to reduce emissions, particularly road transport tailpipe emissions. Hence, since the Scheme in the ES does help reduce tail pipe emissions via having a negative operational carbon footprint it is viewed that the Scheme is in alignment with the wider Strategy's goals.

4.12 In addition, I consider that the Scheme has implemented satisfactory embedded climate adaptation measures in alignment with DMRB LA 114 [Appendix CL2.6], which aligns with the Resilience to Climate Change goals set out in the Strategy.

**Oxfordshire Climate Action Framework (2020) [Appendix CL2.28]**

4.13 The 2020 Climate Action Framework sets out the guiding principles and interventions for and how Oxfordshire County Council will achieve net zero emissions by 2030 for its operations and enable net zero carbon in Oxfordshire by 2050.

4.14 Streetlights, illuminated signs, and traffic signals are indicated to be within the operational council's emission scope boundary. Within the Scheme, energy-efficient road lighting is noted to be detailed as an embedded mitigation measure within Table 15.13 of the ES [CD A.15, Chapter 15]. This indicated that the Scheme was being designed in alignment with the 'energy hierarchy' approach detailed in the Climate Action Framework.

4.15 The Climate Action Framework stipulates prioritising digital infrastructure over road building and increasing active modes of transport. While it is a road-building project, the Scheme will encourage active travel by including footways and cycleways. Also, as outlined above, a commitment has been made since the publication of the ES that all the proposed traffic signals (junctions and crossings) across the Scheme will be designed and implemented with an Urban Traffic Control (UTC) based bus priority system. This system has the ability to encourage modal shift by prioritising public transport over other modes, such as private cars.

**COP28 – UNECE**

4.16 COP28 reinforced that to get on track with Net Zero Emissions (NZE) by 2050, drastic reductions in emissions and guaranteed high transport accessibility levels are needed. It outlined that these can only be achieved through a mix of policies and measures, including:

- Strong regulations (to discourage high emitting operations) and fiscal incentives (to help boost the lower-emitting ones);
- Investment in infrastructure to enable low- and zero-emission vehicle operations;
- A real push towards a modal shift from road towards less emitting rail and inland waterway and away from passenger vehicle-based mobility towards active mobility and public transport and
- Enhanced cross-sectoral cooperation.

4.17 The Scheme will encourage active travel through the inclusion of footways and cycleways. Also, as outlined above, a commitment has been made since the publication of the ES that all the proposed traffic signals (junctions and crossings) across the Scheme will be designed and implemented with an Urban Traffic Control (UTC) based bus priority system. This system has the ability to encourage a modal shift by prioritising public transport over other modes, such as private cars. Also, as discussed, due to the negative operational carbon footprint of the Scheme, I consider the Scheme to be aligned with the UK's net zero commitments.

## 5 Methodology

### Design Manual for Roads and Bridges (DMRB) LA 114 (2021) [Appendix CL2.6]

5.1 Fundamentally, the methodology in the updated DMRB LA 114 GHG assessment requirements remains the same as the ES (2019 version), with the variation in the DM-DS scenario and comparison to the UK Carbon budgets remaining the same significance test determined as "*the assessment of projects on climate shall only report significant effects where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets*" (Paragraph 3.20).

5.2 PAS 2080:2016 is referred to in DMRB LA 114 2019 and 2021 documents. This has now been superseded in both DMRB documents by PAS 2080:2023 [Appendix CL2.12], published in April 2023. This update provided updates to the methodology, which emphasises decisions and actions that reduce whole-life carbon rather than looking at capital (or embodied), operational or user carbon in isolation. Additionally, it revises the procurement mechanisms to accelerate decarbonisation and implements more clauses that need to be considered within the GHG Assessment.

5.3 Additionally, the methodology in the updated DMRB LA 114 [Appendix CL2.6] climate vulnerability assessment requirements remains fundamentally the same as what was used in the ES, with the risk assessment and significance test remaining the same, but some minor changes to the methodology.

5.4 It is noted that the CCR assessment was not detailed and did not cover all of the potential climate impacts noted in the updated LA 114 examples. However, it should be stated that these are just examples in the guidance, and there are no stipulations about what should be assessed. I do not consider these minor to have a material impact on the outcome of the CCR assessment presented in the ES.

### IEMA (2022) GHG Assessment Guidance [Appendix CL2.14]

5.5 In 2022, IEMA released new guidance on undertaking a Greenhouse Gas (GHG) Assessment. The update has implications for assessing significance. The primary consideration when assessing significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050.

5.6 The updated IEMA guidance also recommends that any embedded/committed mitigation measures that form part of the design should be considered when determining significance.

5.7 Box 3, on page 26 of the guidance, provides the following example definition of a project with a minor adverse impact: "*the project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero*."

5.8 The Scheme is considered to be in line with existing and emerging policy requirements, as laid out in this section. It is also considered to be in line with good practice design standards, following the GHG mitigation measures implemented during construction (as outlined in section 15.9 of the ES [CD A.15, Chapter 15]).

5.9 During operation, the Scheme is shown to have a beneficial impact on GHG emissions.

5.10 Therefore, I consider that applying the updated IEMA guidance on assessing significance of GHG emissions would not have a material impact on the outcome of the GHG assessment as presented in the ES.

**IEMA (2020) Climate Change Adaptation Practitioner Guidance [Appendix CL2.17]**

5.11 This adaptation guidance builds on previously updated guidance in 2020 by IEMA for how to consider adaptation in an EIA. Since IEMA's first guide published in 2009, the field has developed rapidly, with significantly improved evidence based on risks, impacts, and adaptation options and more mature frameworks and approaches.

5.12 The IEMA guidance builds on information from the IPCC's AR6 report, which goes on to explain the risk propellor, which states that risks can compound other risks (a), compound two risks together (b), cascade into one another (c) or aggregate together (d). The overall effects of this can be the creation of non-linear behaviour, feedback loops, or tipping points. The risk assessment guidance goes on to acknowledge that whilst these concepts are complex, they are increasingly important to be familiar with for a thorough and robust approach to risk management. However, building an understanding of these concepts still requires a strong baseline risk assessment built on an assessment of the components within the risk propellor.

5.13 Currently, the Scheme does not consider the risk propellor within the ES since this method is not present under DMRB LA 114 [Appendix CL2.6]. The risk propellor is a complex climate risk model, which would identify numerous potential climate risks to the Scheme and would be a much more detailed analysis.

5.14 Furthermore, the IEMA guidance identifies 61 risks and opportunities to people and the built environment, business and the built environment, and 8 priority areas which overlap between public and private scope for action.

5.15 The guidance details a 3 stage process, which should be implemented to ensure sufficient adaptation capacity is constructed into the design, including:

- Initial Stage 1 – Low Regret Actions and Assessment of Risks and Adaptive Capacity
- Intermediate Stage 2 – Detailed Adaptation Planning and Initiating Implementation
- Advanced Stage 3 – Implementation, Monitoring and Evaluation

5.16 Under DMRB LA 114 [Appendix CL2.5] implemented in the ES, climate adaptation measures are embedded into the Scheme as detailed in Table 15.14 in the ES [CD A.15, Chapter 15]. However, the embedded measures are not comprehensive and do not go through the three implementation stages recommended under IEMA.

5.17 The IEMA (2020) Climate Change Adaptation Practitioner Guidance [Appendix CL2.14] provides a much more detailed complex framework for the CCR Assessment, which could result in identifying new climate hazards.

5.18 However, I consider that the CCR assessment conducted in the ES represents an appropriate and proportionate approach, which is in line with the Climate Change vulnerability DMRB LA 114 [Appendix CL2.6] assessment requirements. There is no specific regulation that determines that the IEMA (2022) Climate Change Adaptation Practitioner Guidance must be applied to road schemes.

5.19 Moreover, I think the ES assesses all of the main climate hazards in relation to the Scheme and was conducted in line with DMRB LA 114 [Appendix CL2.6] assessment requirements, which is mandatory on all DfT road Scheme EIA Applications in the UK.

**National Highways – Project Control Framework (PCF) (2022) Carbon Management update [Appendix CL2.29]**

5.20 Department for Transport (DfT) has stipulated that, by 2023, National Highways and all of its arm's length bodies must implement a carbon management system accredited to PAS 2080 Carbon Management in Infrastructure [Appendix CL2.12].

5.21 The Scheme in the ES does not have a Carbon Management Plan (CMP) accredited to PAS 2080 in line with DfT's latest requirements. To satisfy this requirement a commitment has now been made to develop a CMP aligned with PAS 2080 for the Scheme to help lower GHG emissions associated with the Scheme, predominantly during construction.

5.22 DfT has mandated that, by the end of 2022, all projects must report their whole life carbon. Projects are already required to report whole-life carbon in accordance with the requirements of DMRB Standard LA114: Climate [Appendix CL2.6].

5.23 Therefore, the Scheme is already compliant with this measure since a whole-life carbon assessment was developed in line with the scope of PAS 2080 and DMRB LA 114.

**Climate Change Committee - Progress Report to Parliament [Appendix CL2.17]**

5.24 In this report, the Climate Change Committee recommends the Government to take more drastic action in relation to GHG emissions reduction.

5.25 It is noted that the purpose of the EIA is to assess the Scheme against existing policy as well as sector specific guidance. Given the nature of the Climate Change Committee's June 2023 Report to Parliament [Appendix CL2.17] constituting advice to the government, there is no requirement to fulfil the recommendations outlined within it.

5.26 Please note, however, that in October 2023, the Government responded to the recommendations outlined in the Climate Change Committee's June 2023 Report to Parliament [Appendix CL2.17]. In this response, the Government has indicated that they supports motorists and seek to "*improve the experience of driving and services provided for motorists*" (see Annex A: R2023-148).

5.27 The Government also stated that they are "*committed to ensuring that transport plays its part in decarbonising the economy and protecting the environment*" (see Annex A: R2023-148) but suggested that it is through Roads Investment Strategy 3 (RIS3) that they will ensure alignment to their legally binding net zero obligations.

5.28 Therefore, I consider it not to be the responsibility of individual schemes to reduce demand on the road or decarbonise the transport sector as a whole, but more so the role of Government policy. This was underlined and reinforced by the Government's Infrastructure Carbon Review (2013) document, wherein they underline that infrastructure schemes have less influence over end-user emissions than capital and operational emissions. Chart 1.A in section 1.1 of the Infrastructure Carbon Review states: "*The infrastructure industry has control over capital and operational carbon emissions that are associated with the construction, operation and maintenance of infrastructure assets*". However, in relation to end-user emissions, it states: "*The infrastructure industry can influence end-user carbon emissions, but typically action is required by others to reduce them*".

5.29 This will be achieved, in large part, by non-planning measures, rather than through individual road schemes. The Transport Decarbonisation Plan outlines such measures that the Government will implement to decarbonise the transport sector as a whole, including the following 6 priorities:

1. ***Accelerating modal shift to public and active transport***
2. ***Decarbonisation of road vehicles***, such as the phasing out of new petrol and diesel cars
3. ***Decarbonising how we get our goods***, through innovative fuels, zero or low emissions technologies and new industrial opportunities
4. ***Place-based solutions***, by empowering communities to develop local zero carbon networks
5. ***UK as a hub for green transport, technology, and innovation***
6. ***Reducing carbon in a global economy***, by reducing emissions from aviation and shipping

5.30 In their response to the CCC report, the Government also states, "*As set out in the Transport Decarbonisation Plan* [Appendix CL2.19]*, the Government will continue to adapt and take further action if needed to decarbonise transport*" (see Annex A: R2023-148). The Government has therefore committed to taking further action to decarbonise the transport sector if the sector falls out of alignment with their net zero commitments for any reason.

**Climate Change Committee – Seventh Carbon Budget [Appendix CL2.30]**

5.31 The Climate Change Committee is preparing its methodology in advance of its publication of the Seventh Carbon Budget (for the years 2038 to 2042) to advise the UK Government on its next pledge to commit the UK to reduce its carbon emissions in alignment with net zero.

5.32 The Climate Change Committee highlights that surface transport is one of the key sectors that currently dominates the UK's emissions.

5.33 The Climate Change Committee, at this stage, has not set out the details of how it anticipates the UK should decarbonise to comply with this pledge. However, the Climate Change Committee does expect surface transport to decarbonise by 2050.

## 6 Conclusion

6.1 I have conducted a review of the impact on the Scheme of updated or newly relevant policies and methodologies since the ES was produced. My conclusion is that, in each case, this new material does not have a material impact on the outcomes of the assessment presented in Chapter 15 of the ES [CD A.15].

**Appendix CL2.3**

**Climate Review of The Climate Change Committee’s June 2023 Report and Welsh Assembly Criteria**

# 1 Introduction

**Executive Summary**

1.1 This Technical Note has been developed to clarify how the Climate Assessment of the Didcot Garden Housing Infrastructure Fund (SCHEME) Scheme remains robust and valid in light of the Climate Change Committee's (CCC) recommendations, the Welsh Government's Road Building Test, and latest guidance emerging on climate impacts of infrastructure projects such as HIF 1 Didcot Garden Town Scheme.

1.2 The Environmental Impact Assessment (EIA) conducted for the Didcot Garden scheme is captured across three key documents: the Environmental Statement (ES) (November 2021)[1], the first EIA Regulation 25 response (November 2022)[2], and the second EIA Regulation 25 response (April 2023)[3].

1.3 These documents collectively detail the projected greenhouse gas (GHG) emissions, encompassing both Capital and Operational Carbon, as outlined in Volume 1, Chapter 15 of the Environmental Statement.[4] Supporting these core documents are assessments, including a scheme-specific Climate Change Assessment and a Climate Impact Assessment, supplemented by information provided in response to two Regulation 25 requests (request for further information).

1.4 In light of emerging policy, this note examines the potential impact of two significant developments: the Climate Change Committee's (CCC) Progress Report to Parliament (June 2023)[5] and the Welsh Government's Road Tests[6]. These documents, relevant to Transport, Energy, and Industrial Sectors, are assessed for their applicability to the HIF 1 Didcot Garden Town Scheme.

1.5 The Technical Note is outlined as follows:

**Section 1** Introduction
**Section 2** Welsh Government Future Road Building Tests
**Section 3** Climate Change Committee 2023 progress report
**Section 4** Recommendations
**Section 5** Future Policy Observations
**Section 6** Conclusion

**Concluding Statement**

1.6 Our conclusion underlines that the recommendations by the CCC and the stipulations of the Welsh Government's Road Tests do not alter the fundamental assessment outcomes.

1.7 It is noted that given the nature of the Climate Change Committee's June 2023 Report to Parliament constituting advice to the Government, there is no requirement to fulfil its

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[1] The Environmental Statement (ES), November 2021
[2] Didcot Garden Town HIF 1 Scheme EIA Regulation 25 Response, November 2022
[3] Didcot Garden Town HIF 1 Scheme Environmental Statement (ES), April 2023
[4] Didcot Garden Town HIF 1 Scheme Environmental Statement (ES), Volume 1, Chapter 15 Climate, September 2021
[5] Climate Change Committee (CCC) Progress in reducing emissions 2023 Report to Parliament, June 2023 Progress in reducing UK emissions - 2023 Report to Parliament (theccc.org.uk)
[6] Welsh Government response to the Roads Review. 14 February 2023. Welsh Government response to the Roads Review [HTML] | GOV.WALES

recommendations. Further to this, it is also noted that the Welsh Roads Review is not applicable to this Scheme, given the geographical placement of the Scheme.

1.8 Thus, the EIA remains robust, affirming that the HIF 1 Didcot Garden Town Scheme aligns with existing statutory obligations and environmental standards.

## 2 Welsh Gov. Future Roads Tests

**Overview**

In June 2021, the Welsh Deputy Minister for Climate Change, Lee Waters, announced a review of new road schemes funded by the Welsh Government. The Welsh Roads Review panel was established with a membership of independent experts in transport policy, climate change, highway engineering, and the freight and logistics sector.

Dr Lynn Sloman MBE chaired the panel and submitted its Final Report to the Welsh Government in September 2022. The Welsh Government's response to the Roads Review submission, published in February 2023, guided the Future of Road Investment in Wales to evaluate road building and infrastructure projects against sustainability, environmental, and societal impact criteria.

The response focused on considering long-term consequences and benefits for future generations, prioritising sustainable development, and minimising environmental harm.

The approach aimed to incorporate diverse perspectives and prioritise investments that align with Wales' goals for a sustainable future. This resulted in the Welsh Government Future Road Building Tests, explained below.

**The Welsh Future Road Building Test (WFRBT) Summary**

Under the Welsh Future Road Building Test (WFRBT), the Welsh Government recognises the role of road investment in supporting the 'wellbeing economy' – which drives prosperity, is environmentally sound, and helps everyone realise their potential.

It underlined that all new roads need to contribute towards achieving a modal shift to tackle climate change and reduce congestion on the road network.

As a result, the Welsh Government will continue to consider road investment in roads (both new and existing) in the following circumstances:

- **To support modal shifts and reduce carbon emissions.** This is about ensuring that future road investment does not simply increase the demand for private car travel. Instead, we need to deliver schemes that contribute meaningfully to modal shifts, which will require different approaches in different parts of Wales.
- **To improve safety through small-scale changes.** Safety on the road network must be paramount. Investments for safety should focus on specific safety issues to be addressed (rather than wider road improvements and increases in road capacity). Speed limits should be considered as one of the primary tools for improving safety.
- **To adapt to the impacts of climate change.** Climate change is already impacting our road network and will likely become an increasing issue in future decades. Road investment can be justified to adapt to these circumstances to ensure roads can continue functioning and contribute meaningfully to modal shifts.
- **To provide access and connectivity to jobs and centres of economic activity in a way that supports modal shifts**. In particular, new and existing access roads will be necessary to connect new developments, including Freeports, to the existing network. The location of new developments needs to be consistent with Future Wales / PPW11, which includes the

principle of maximising the opportunity of access by sustainable means and should be designed to prevent 'rat-running'.

## Relevance of the WFRBT to SCHEME Didcot Garden Town

The Welsh Government has introduced the WFRBT in Wales as good practice. It is underlined that England has no legal or policy requirement to fulfil the same tests. The planning requirements this Scheme must address have been addressed in full within the Environmental Statement (referenced above).

To understand whether these tests would impact HIF 1 Didcot Garden Town if it was applicable within England, the four Future Road Building tests set out above have been applied to SCHEME Didcot Garden Town to demonstrate evidence in place and highlight any gaps that need further consideration.

*Table 1: Future Roads Building Tests*

| Future Road Building Test Criteria | Evidence | Further discussion |
|---|---|---|
| To support modal shifts and reduce carbon emissions. | **Climate Impact Assessment** (P3-4)[7]<br>The Scheme creates and improves 11km of cycle and pedestrian provisions, linking major housing and employment sites<br>18 new bus stops created & improved journey time reliability with villages<br>Accelerates electrification of transport | Planning requirement for Contractor to produce carbon management plan conforming to PAS 2080: 2023 and monitor progress. This has been suggested as a condition by the Local Planning Authority in their Statement of Common Ground. The Applicant is content with this condition. |
| To improve safety through small-scale changes. Safety on the road network is paramount. | Supports behavioural change – high-quality pedestrian and cycle routes linking key hotspots (housing and employment) and existing cycle infrastructure, allowing those wanting to travel, say from Didcot to Culham Science Centre, the opportunity to do so sustainably. Currently, there is not a safe and convenient option to do so | Road investment is justifiable to adapt to these circumstances to ensure roads can continue functioning and contribute meaningfully to modal shifts. |
| To adapt to the impacts of climate change. | **ES, Vol 1 Chapter 15 Climate Change**[8]<br>Climate Vulnerability Assessment Table 15.18 Significance matrix page 24 and paragraph 15.10.1 (page 25) "The climate assessment has concluded that the scheme will not result in significant climate effects being generated, and as such, no monitoring is required" | Road investment is justifiable to adapt to these circumstances to ensure roads can continue functioning and contribute meaningfully to modal shifts.<br>Paragraph 16.10.49 of ES Chapter 16: Transport, states *"operational traffic flows are predicted to have an overall moderate beneficial effect on accidents and safety on the local road network, which is significant"*. |

[7] Reg 25 Response Appendix : Climate Impact Assessment
[8] Didcot Garden Town HIF 1 Scheme Environmental Statement (ES), Volume 1, Chapter 15 Climate, September 2021

| Future Road Building Test Criteria | Evidence | Further discussion |
|---|---|---|
| | Page 23 notes "17 No climate impacts to vulnerable safety critical features identified". | |
| To provide access and connectivity to jobs and centres of economic activity in a way that supports modal shift. | **Climate Impact Assessment** [9]– page 7<br>Supports the expansion of the Fusion Energy at Culham Science Centre.<br>Pedestrian and cycling provisions; accessibility to green spaces and support delivery of 6000 affordable homes.<br>Accessibility to jobs which cannot take place due to severance by the River Thames. | Planning Statement[10], paragraphs 7.1.3 and 7.1.4:<br>"*The Scheme provides a strategic solution to enhance the connectivity between key housing sites and areas of employment growth*."<br>"*The Scheme will directly unlock the potential for 11,711 new homes and support the delivery of more than 18,000 new homes in total in the Didcot Town and the wider area through improved transport links. It will also promote Didcot as the gateway to the Science Vale, enhancing and improving access to Didcot and surrounding areas by all sustainable modes of transport*." |

## Concluding Remarks

Based on the analysis and evidence presented, it is clear that the SCHEME Didcot Garden Town Scheme aligns with the WFRBT, confirming its commitment to sustainable development, safety, climate resilience, and improved connectivity.

The Scheme's extensive measures, including enhanced cycle and pedestrian provisions, new bus stops, and a focus on electrification of transport, not only meet but exceed the criteria set by these tests. Furthermore, incorporating climate impact assessments and a carbon management plan demonstrates a proactive approach to environmental stewardship.

In the realm of safety, the Scheme's investment in high-quality pedestrian and cycle routes, coupled with road network improvements, significantly advances the safety agenda. This aligns with the Welsh Government's emphasis on small-scale changes for substantial safety improvements, underlining the Scheme's potential to serve as a benchmark for future road developments.

Moreover, the Scheme's focus on adapting to climate change and enhancing access to economic centres supports a pivotal modal shift, aligning with the core objectives of the Welsh Road Tests. The evidence provided, such as the Climate Vulnerability Assessment and the Climate Impact Assessment, indicates a thorough consideration of climate implications, ensuring the Scheme's resilience and relevance in a rapidly changing environment.

In summary, the Didcot Garden Scheme fulfils the requirements outlined in the Welsh Road Tests and sets a high standard for sustainable and safe road development. Its comprehensive approach is a compelling model that could be emulated in Wales or England should similar legislative frameworks be considered.

### CCC's Progress Report Roads Impact

[9] Reg 25 Response Appendix : Climate Impact Assessment
[10] Didcot Garden Town Housing Infrastructure Fund Programme Planing Statement, Oxfordshire County Council, September 2021

## Overview

The CCC operates as an independent statutory body established under the Climate Change Act 2008 provisions. Its primary mandate involves advising the UK Government and devolved administrations on setting emissions targets and providing comprehensive reports to Parliament regarding progress in reducing greenhouse gas emissions.

Moreover, the CCC plays a crucial role in guiding strategies for adapting to the multifaceted impacts of climate change.

While the recommendations issued by the CCC form part of the overarching legal framework established by the Climate Change Act, it is imperative to recognise that the CCC's role remains advisory. Consequently, the recommendations presented within this report do not carry a legal mandate.

## The CCC Progress Report Summary

In June 2023, the CCC published its 2023 Climate Change Committee Progress Report to Parliament[11]. This document, particularly Chapter 4, found on page 107, delves into the specifics of surface transport emissions.

The CCC outlines its key messages and findings on surface transport within this chapter, providing advice for shaping future policy and legislative measures. CCC's critical messages on surface transport are:

- **Emissions**: Surface transport emissions rose by 3% in 2022, yet they are still 8% lower than in 2019, indicating a new 'steady state' influenced by reduced car demand post-COVID-19.
- **Delayed Policy Progress**: The sector has experienced delays in policy implementation, increasing risks by compressing timelines for regulatory development and reducing policy ambition.
- **Zero-Emission Vehicle Markets**: The electric car market share is growing beyond expectations, with most manufacturers expanding their electric offerings. Electric van uptake is slower but optimistic.
- **Zero-Emission Vehicle Policy:** The 2035 deadline for phasing out new conventional vehicles is crucial. The Zero-Emission Vehicle (ZEV) mandate, vital for scaling up EV sales, needs swift implementation despite its flexibilities. Further, expanding zero-emission regulations to heavy goods vehicles (HGVs) could have significant benefits.
- **Electric Vehicle Charging:** The UK's EV charging network has grown significantly but faces coverage consistency, reliability, and cost challenges. Accelerated ChargePoint deployment is essential to match EV adoption and ensure consumer confidence.
- **Conventional and Hybrid Vehicles**: The current proposal for regulating remaining conventional and hybrid vehicle sales might miss an opportunity to encourage manufacturers to reduce vehicle size and weight, which is also beneficial for Evs.
- **Limiting Traffic Growth:** No significant progress on reducing car demand, with mixed developments in areas like road-building, taxation, and local authority initiatives.

The priority recommendation for surface transport is the transport zero emission vehicle (ZEV) mandate[12]. In September, the UK government set a path to zero-emission vehicles by 2035. 80% of new cars and 70% of new vans sold in Great Britain are set to have zero emissions by 2030, increasing to 100% by 2035.

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[11] Climate Change Committee (CCC) Progress in reducing emissions 2023 Report to Parliament, June 2023 Progress in reducing UK emissions - 2023 Report to Parliament (theccc.org.uk)
[12] A zero emission vehicle (ZEV) mandate and CO2 emissions regulation for new cars and vans in the UK. 25 October 2023

Drawing upon the priority recommendation and the key message outlined above, the report highlights three required outcomes:

- Reduced demand for carbon-intensive modes of travel through a shift to low-carbon modes
- Shift to low carbon modes (Active travel and public transport use; Travel by mode) and
- More efficient use of vehicle occupancy and sharing and Heavy Goods Vehicle (HGV) utilisation

We review these against the Scheme in further detail below.

**Relevance of CCC's Transport Recommendations to SCHEME Didcot Garden Town**

The table below sets out some of the key CCC monitoring criteria that are relevant to roads[13], including the SCHEME Scheme, although noting that the CCC's recommendations are not legally binding:

*Table 2 CCC Progress Report Monitoring Criteria*

| CCC Report Monitoring Criteria | Evidence base |
|---|---|
| Reduced vehicle emissions intensities through rapid uptake of zero emissions vehicles | Within the Climate Impact Assessment[14] it has been noted that: "*the Scheme accelerates electrification of transport Scheme and helps to unlock commercial development sites that are proposing EV charging station in accordance with OCC policy. Equipment to allow for CAG vehicles to be installed at signalised junctions to future proof the scheme"* (Page 4, Transport & connectivity)<br>The Environmental Statement notes that the Design and Construction team will implement the following measures:<br>• *"During Construction: the project shall use contractors and suppliers with low emission fleet vehicles"* (page 18); and<br>• *"During Operation that: encouragement of low or carbon neutral forms of transport through the construction of additional shared cycle/ footway"* (page 19).<br>Page 22 also underlines "*that the modelling conducted thus far does not fully capture the electric vehicle uptake and improved technologies since Government Announcing Ban on Diesel/Petrol vehicles – and thus the modelling scenarios of future road traffic emissions*." |
| Reduced demand for carbon-intensive modes of travel through a shift to low-carbon modes | Within the Climate Impact Assessment[15] (P6) the Scheme notes that *"the project looks to deliver pedestrian and cycle infrastructure first to ensure that the homes released, as a result of the Scheme, have the opportunity to use these before the main carriageway is opened. This will allow for greater mode shift."*<br>The Carbon Impact Assessment also underlines *"that high quality cycle and pedestrian infrastructure is also being built to offer residents real modal choice. The Scheme creates and improves over 11km of cycle and pedestrian provisions. With the majority being segregated and adequate buffer from the carriageway. This will link major housing and employment sites whereby users will not need to leave this high quality facility to reach their destination.*<br>*18 new bus stops are being created to allow for new routes to be proposed once the housing sites come forward. The Scheme also removes traffic off existing bus* |

[13] CCC Report Figure 4.1 Monitoring Map for Surface Transport, sets out policies, enablers and required outcomes for a successful transition. The report focuses on 11 indicators (supplementary materials presented alongside report). The monitoring framework documents the indicators tracked and approach for assessing progress.
[14] Reg 25 Response Appendix : Climate Impact Assessment
[15] Reg 25 Response Appendix : Climate Impact Assessment

| CCC Report Monitoring Criteria | Evidence base |
|---|---|
| | *routes that will improve public transport journey time reliability within the surrounding villages. This may also lead to an increase in frequency of the existing routes."* |
| More efficient use of vehicle occupancy and sharing and Heavy Goods Vehicle (HGV) utilisation | As outlined above there are a number of facilitating and enabling results of this Scheme which support the end users in making the correct decisions when choosing transportation options. This is supported by policies and plans such as the Local Plan. |

## Government Response to CCC

It is noted that in October 2023, the Government provided a response to the recommendations outlined in the Climate Change Committee's June 2023 Report to Parliament. In this response, the Government has indicated that it supports motorists and seeks to *"improve the experience of driving and services provided for motorists"*.

The Government also stated that they are *"committed to ensuring that transport plays its part in decarbonising the economy and protecting the environment"* but suggested that it is through Roads Investment Strategy 3 (RIS3) that they will ensure alignment to their legally binding net zero obligations.

Annex A (page 36)[16] sets out the CCC Recommendations and Responses to the CCC's priority and non-priority recommendations and outlines progress since the March publication of Powering Up Britain[17]. It is anticipated that policy will change throughout 2024 to reflect some of the responses; however, thus far, no policies have changed due to the recommendations or the response.

Examples of the Government's response[18] to the CCC report include:

Reiterates the Government's priorities, demonstrating the UK will continue to have one of the most ambitious targets in the G20, cutting emissions by at least 68% by 2030 on 1990 levels.
Demonstrates the actions we will be taking this year, addresses the CCC's main areas of concern, and responds to all the CCC's recommendations.
Demonstrates our progress towards net zero against the metrics outlined in the Net Zero Strategy.
CCC Surface transport recommendations included the Zero Emissions Vehicle (ZEV) Mandate, and the government response included actions Phasing out the sale of new non-zero emission vehicles by 2035

## Concluding Remarks

Considering the outlined evidence and the CCC monitoring criteria (figure 4.1) the Scheme presents itself as a forward-thinking project, proactively anticipating and aligning with the CCC's advisory benchmarks. Annex A: Sets responses to the CCC's priority and non-priority recommendations

[16] Responding to the Climate Change Committee's (CCC) 2023 Annual Progress Report to Parliament. Annex A: Responses to the CCC's priority and non-priority recommendations.
[17] Policy paper Powering up Britain, Department for Energy Security and Net Zero published 30th March 2023
[18] Responding to the Climate Change Committee's (CCC) 2023 Annual Progress Report to Parliament. March 2023. https://assets.publishing.service.gov.uk/media/65393f4ae6c968000daa9b0e/ccc-annual-progress-report-2023-government-response.pdf

Even though these monitoring criteria are not a legal requirement for the Scheme, in fact the Scheme's initiatives for reducing emissions, promoting zero-emission vehicles, and enhancing transport efficiency closely mirror the CCC's vision for a sustainable transport future.

The Scheme's comprehensive measures to reduce vehicle emission intensities encourage a shift to low-carbon travel modes, representing a step towards the kind of sustainable transport infrastructure that the CCC advocates.

Notably, the Scheme's support for electrification within the Climate Impact Assessment, as evidenced by the consideration for electric buses, and the creation of new cycling and pedestrian infrastructure, demonstrates a clear alignment with the CCC's emphasis on zero-emission vehicle uptake.

Furthermore, the Scheme's detailed attention to gaps and recommendations—including narratives on car sharing and addressing the need for a carbon management plan—exemplifies a proactive approach to potential future statutory requirements. By doing so, the Scheme meets the CCC's current advisory recommendations and positions itself well for compliance with any future legal or statutory requirements that may arise from these recommendations.

In conclusion, with its strategic initiatives and responsiveness to the CCC's advisory framework, the Scheme is an example of how infrastructure projects can adhere to current guidelines and be prepared to meet and exceed future environmental and transport standards, should they transition from advisory to mandatory status.

**Actions Taken**

**Proactive Measures**

The Didcot Climate Change Position Statement[19] (referenced in Appendix K) exemplifies the proactive approach. It outlines comprehensive mechanisms to incorporate whole-life carbon and energy considerations into the specifications for contractors (including detailed designers and contractors) during the procurement process. This allows for sustainability to be integrated at every step of the project lifecycle.

**Contractor Requirements and Planning:**

To provide environmental integrity and adherence to sustainability goals, three pivotal contractor requirements have been established:

1) Planning Requirements: Construction Environment Management Plan (CEMP): This secures specific management plans to address and mitigate sustainability impacts associated with the construction phase. The CEMP will encompass a range of targeted environmental method statements or management plans, such as a detailed Construction Traffic Management Plan, ensuring minimal disruption and environmental impact.
2) Carbon Management Plan (CMP): Contractors are required to develop a CMP in alignment with PAS 2080:2023, the Publicly Available Standard for managing whole-life carbon in infrastructure. This plan should comprehensively cover Clauses 5-12, including a declaration of conformity to these standards.
3) Energy Consumption and Carbon Emissions Reduction: The Principal Contractor (PC) is tasked with developing and executing a strategy to reduce energy consumption and associated carbon emissions. This strategy may include:
    a. Exploration and integration of renewable, low, or zero-carbon energy sources.
    b. Monitoring and documenting the percentage of energy savings achieved.

[19] Reg 25 Response Appendix K Climate Change Position Statement

c. Construction phase.

Continuous monitoring and reporting of energy and material usage from the supply chain to the client during the SCHEME Didcot Garden Scheme construction ensures environmental standards are met and supports decarbonisation, setting a benchmark for sustainability in infrastructure projects.

**Future Policy Direction**

**<u>CCC 7$^{th}$ Carbon Budget</u>**

The 7$^{th}$ carbon budget (for the years 2038 to 2042) is in the developmental stage and not yet legally binding. However, considering the lifespan of the SCHEME Didcot Garden Scheme, which extends through and beyond the 7$^{th}$ carbon budget period, alignment with future environmental policy changes is being considered.

Further to the above changes, the Applicant is aware of the CCC's current preparations for developing a methodology before its publication to advise the UK government on its next pledge to commit the UK to reduce its carbon emissions in alignment with Net Zero. The CCC highlights that surface transport is one of the key sectors currently dominating the UK's emissions.

The Applicant will review the remaining supportive changes here to determine the impact of the decisions made on the overall outcome of the Scheme.

At this stage, the CCC has not identified how it anticipates the UK should decarbonise to comply with this budget. However, the CCC does expect surface transport to decarbonise by 2050.

Within England, the Transport Decarbonisation Plan (TDP) is a document that sets out government policy on how it will decarbonise transport, but it is not a legal commitment; it is only the 2050 target and the carbon budgets that are legal duties on the Government. This document enables the UK government to drive decarbonisation in surface transport effectively.

The TDP, aligned with the CCC's recommendations, specifically targets road transport emissions, recognising their substantial impact on the nation's carbon footprint.

By integrating legal precedents that support enforceable road planning permissions, the TDP stands as a cornerstone policy, reinforcing the UK's ambition to meet Net Zero targets by 2050 and ensuring sustained progress in reducing emissions from surface transport.

**Conclusion**

The Scheme, as outlined in this document, represents a forward-looking and environmentally conscious project, demonstrating a strong alignment with current and emerging policies and recommendations in the realms of sustainable development and climate change mitigation.

The Scheme has been evaluated against the backdrop of the Climate Change Committee's (CCC) monitoring criteria, the Welsh Government's Road Building Test, and the latest guidelines on the climate impacts of infrastructure projects. Despite these evolving benchmarks, the Environmental Impact Assessment (EIA) and subsequent addendums confirm the Scheme's resilience and compliance with environmental standards, ensuring its robustness in light of these developments.

The Scheme has proactively incorporated mechanisms for reducing carbon emissions and promoting sustainable transport methods. This includes encouraging zero-emission vehicles, enhanced cycling and pedestrian infrastructure, and a comprehensive focus on the electrification of transport. These initiatives meet and exceed Welsh Future Roads Building Test criteria and align with the CCC's vision for a sustainable transport future.

The Scheme demonstrates a commitment to adapting to climate change impacts, as evidenced by its proposed detailed Climate Vulnerability Assessment and the inclusion of a Carbon Management Plan conforming to PAS 2080:2023. This adaptive approach ensures that the Scheme remains resilient and relevant in a rapidly evolving environmental context.

While the CCC's monitoring criteria are currently advisory, the Scheme is strategically positioned to comply with any future legal or statutory requirements that may arise. This forward-thinking approach ensures the project's longevity and relevance despite potential regulatory changes.

Our conclusion underlines that the recommendations by the CCC and the stipulations of the Welsh Government's Road Tests do not alter the fundamental assessment outcomes. Thus, the EIA remains robust, affirming that the HIF 1 Didcot Garden Town Scheme aligns with existing statutory obligations and environmental standards.

**Appendix CL2.4**

**Climate Change Act 2008**

# Climate Change Act 2008

## CHAPTER 27

## CONTENTS

PART 6

GENERAL SUPPLEMENTARY PROVISIONS

# Climate Change Act 2008

**2008 CHAPTER 27**

An Act to set a target for the year 2050 for the reduction of targeted greenhouse gas emissions; to provide for a system of carbon budgeting; to establish a Committee on Climate Change; to confer powers to establish trading schemes for the purpose of limiting greenhouse gas emissions or encouraging activities that reduce such emissions or remove greenhouse gas from the atmosphere; to make provision about adaptation to climate change; to confer powers to make schemes for providing financial incentives to produce less domestic waste and to recycle more of what is produced; to make provision about the collection of household waste; to confer powers to make provision about charging for single use carrier bags; to amend the provisions of the Energy Act 2004 about renewable transport fuel obligations; to make provision about carbon emissions reduction targets; to make other provision about climate change; and for connected purposes. [26th November 2008]

BE IT ENACTED by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

## PART 1

### CARBON TARGET AND BUDGETING

*The target for 2050*

**1 The target for 2050**

(1) It is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline.

(2) "The 1990 baseline" means the aggregate amount of—

(a) net UK emissions of carbon dioxide for that year, and

(b) net UK emissions of each of the other targeted greenhouse gases for the year that is the base year for that gas.

**2 Amendment of 2050 target or baseline year**

(1) The Secretary of State may by order—
(a) amend the percentage specified in section 1(1);
(b) amend section 1 to provide for a different year to be the baseline year.

(2) The power in subsection (1)(a) may only be exercised—
(a) if it appears to the Secretary of State that there have been significant developments in—
(i) scientific knowledge about climate change, or
(ii) European or international law or policy,
that make it appropriate to do so, or
(b) in connection with the making of—
(i) an order under section 24 (designation of further greenhouse gases as targeted greenhouse gases), or
(ii) regulations under section 30 (emissions from international aviation or international shipping).

(3) The developments in scientific knowledge referred to in subsection (2) are—
(a) in relation to the first exercise of the power in subsection (1)(a), developments since the passing of this Act;
(b) in relation to a subsequent exercise of that power, developments since the evidential basis for the previous exercise was established.

(4) The power in subsection (1)(b) may only be exercised if it appears to the Secretary of State that there have been significant developments in European or international law or policy that make it appropriate to do so.

(5) An order under subsection (1)(b) may make consequential amendments of other references in this Act to the baseline year.

(6) An order under this section is subject to affirmative resolution procedure.

**3 Consultation on order amending 2050 target or baseline year**

(1) Before laying before Parliament a draft of a statutory instrument containing an order under section 2 (order amending the 2050 target or the baseline year), the Secretary of State must—
(a) obtain, and take into account, the advice of the Committee on Climate Change, and
(b) take into account any representations made by the other national authorities.

(2) The Committee must, at the time it gives its advice to the Secretary of State, send a copy to the other national authorities.

(3) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

(4) The Secretary of State may proceed to lay such a draft statutory instrument before Parliament without having received a national authority's

representations if the authority does not provide them before the end of the period of three months beginning with the date the Committee's advice was sent to the authority.

(5) At the same time as laying such a draft statutory instrument before Parliament, the Secretary of State must publish a statement setting out whether and how the order takes account of any representations made by the other national authorities.

(6) If the order makes provision different from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.

(7) A statement under this section may be published in such manner as the Secretary of State thinks fit.

*Carbon budgeting*

**4 Carbon budgets**

(1) It is the duty of the Secretary of State—
- (a) to set for each succeeding period of five years beginning with the period 2008-2012 ("budgetary periods") an amount for the net UK carbon account (the "carbon budget"), and
- (b) to ensure that the net UK carbon account for a budgetary period does not exceed the carbon budget.

(2) The carbon budget for a budgetary period may be set at any time after this Part comes into force, and must be set—
- (a) for the periods 2008-2012, 2013-2017 and 2018-2022, before 1st June 2009;
- (b) for any later period, not later than 30th June in the 12th year before the beginning of the period in question.

**5 Level of carbon budgets**

(1) The carbon budget—
- (a) for the budgetary period including the year 2020, must be such that the annual equivalent of the carbon budget for the period is at least 26% lower than the 1990 baseline;
- (b) for the budgetary period including the year 2050, must be such that the annual equivalent of the carbon budget for the period is lower than the 1990 baseline by at least the percentage specified in section 1 (the target for 2050);
- (c) for the budgetary period including any later year specified by order of the Secretary of State, must be such that the annual equivalent of the carbon budget for the period is—
  - (i) lower than the 1990 baseline by at least the percentage so specified, or
  - (ii) at least the minimum percentage so specified, and not more than the maximum percentage so specified, lower than the 1990 baseline.

(2) The "annual equivalent", in relation to the carbon budget for a period, means the amount of the carbon budget for the period divided by the number of years in the period.

(3) An order under this section is subject to affirmative resolution procedure.

(4) For the purposes of subsection (1)(a) there shall be left out of account—
(a) so much of the carbon budget for the budgetary period including the year 2020 as the Secretary of State may determine relates to targeted greenhouse gases other than carbon dioxide, and
(b) so much of the 1990 baseline as is attributable to targeted greenhouse gases other than carbon dioxide.

**6 Amendment of target percentages**

(1) The Secretary of State may by order amend—
(a) the percentage specified in section 5(1)(a);
(b) any percentage specified under section 5(1)(c).

(2) That power may only be exercised—
(a) if it appears to the Secretary of State that there have been significant developments in—
(i) scientific knowledge about climate change, or
(ii) European or international law or policy,
that make it appropriate to do so, or
(b) in connection with the making of—
(i) an order under section 24 (designation of further greenhouse gases as targeted greenhouse gases), or
(ii) regulations under section 30 (emissions from international aviation or international shipping).

(3) The developments in scientific knowledge referred to in subsection (2)(a) are—
(a) in relation to the first exercise of the power conferred by this section in relation to the percentage specified in section 5(1)(a), developments since June 2000 (the date of the Royal Commission on Environmental Pollution's 22nd Report, "Energy - the Changing Climate");
(b) in relation to the first exercise of the power conferred by this section in relation to any percentage specified under section 5(1)(c), developments since the evidential basis for the order setting that percentage was established;
(c) in relation to a subsequent exercise of any of those powers, developments since the evidential basis for the previous exercise was established.

(4) The power conferred by this section to amend the percentage in section 5(1)(a) includes power to amend or repeal section 5(4) (which directs that targeted greenhouse gases other than carbon dioxide are to be left out of account for the purposes of that provision).

(5) An order under this section is subject to affirmative resolution procedure.

**7 Consultation on order setting or amending target percentages**

(1) Before laying before Parliament a draft of a statutory instrument containing an order under section 5(1)(c) (order setting target percentage) or section 6 (order amending target percentage), the Secretary of State must—
   (a) obtain, and take into account, the advice of the Committee on Climate Change, and
   (b) take into account any representations made by the other national authorities.

(2) The Committee must, at the time it gives its advice to the Secretary of State, send a copy to the other national authorities.

(3) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

(4) The Secretary of State may proceed to lay such a draft statutory instrument before Parliament without having received a national authority's representations if the authority does not provide them before the end of the period of three months beginning with the date the Committee's advice was sent to the authority.

(5) At the same time as laying such a draft statutory instrument before Parliament, the Secretary of State must publish a statement setting out whether and how the order takes account of any representations made by the other national authorities.

(6) If the order makes provision different from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.

(7) A statement under this section may be published in such manner as the Secretary of State thinks fit.

**8 Setting of carbon budgets for budgetary periods**

(1) The Secretary of State must set the carbon budget for a budgetary period by order.

(2) The carbon budget for a period must be set with a view to meeting—
   (a) the target in section 1 (the target for 2050), and
   (b) the requirements of section 5 (requirements as to level of carbon budgets),

   and complying with the European and international obligations of the United Kingdom.

(3) An order setting a carbon budget is subject to affirmative resolution procedure.

**9 Consultation on carbon budgets**

(1) Before laying before Parliament a draft of a statutory instrument containing an order under section 8 (order setting carbon budget), the Secretary of State must—
   (a) take into account the advice of the Committee on Climate Change under section 34 (advice in connection with carbon budgets), and

(b) take into account any representations made by the other national authorities.

(2) The Secretary of State may proceed to lay such a draft statutory instrument before Parliament without having received a national authority's representations if the authority does not provide them before the end of the period of three months beginning with the date the Committee's advice was sent to the authority.

(3) At the same time as laying such a draft statutory instrument before Parliament, the Secretary of State must publish a statement setting out whether and how the order takes account of any representations made by the other national authorities.

(4) If the order sets the carbon budget at a different level from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.

(5) A statement under this section may be published in such manner as the Secretary of State thinks fit.

**10 Matters to be taken into account in connection with carbon budgets**

(1) The following matters must be taken into account—
(a) by the Secretary of State in coming to any decision under this Part relating to carbon budgets, and
(b) by the Committee on Climate Change in considering its advice in relation to any such decision.

(2) The matters to be taken into account are—
(a) scientific knowledge about climate change;
(b) technology relevant to climate change;
(c) economic circumstances, and in particular the likely impact of the decision on the economy and the competitiveness of particular sectors of the economy;
(d) fiscal circumstances, and in particular the likely impact of the decision on taxation, public spending and public borrowing;
(e) social circumstances, and in particular the likely impact of the decision on fuel poverty;
(f) energy policy, and in particular the likely impact of the decision on energy supplies and the carbon and energy intensity of the economy;
(g) differences in circumstances between England, Wales, Scotland and Northern Ireland;
(h) circumstances at European and international level;
(i) the estimated amount of reportable emissions from international aviation and international shipping for the budgetary period or periods in question.

(3) In subsection (2)(i) "the estimated amount of reportable emissions from international aviation and international shipping", in relation to a budgetary period, means the aggregate of the amounts relating to emissions of targeted greenhouse gases from international aviation and international shipping that the Secretary or State or (as the case may be) the Committee estimates the United Kingdom will be required to report for that period in accordance with international carbon reporting practice.

(4) Such amounts may be estimated using such reasonable method or methods as the Secretary of State or (as the case may be) the Committee considers appropriate.

(5) The duty in subsection (2)(i) applies if and to the extent that regulations under section 30 do not provide for emissions of targeted greenhouse gases from international aviation and international shipping in the budgetary period or periods in question to be treated as emissions from sources in the United Kingdom for the purposes of this Part.

(6) Section 30(1) (emissions from international aviation and international shipping not to count as emissions from UK sources for the purposes of this Part, except as provided by regulations) does not prevent the Secretary of State or the Committee from taking into account the matter referred to in subsection (2)(i) for the purposes of this section.

(7) Nothing in this section is to be read as restricting the matters that the Secretary of State or the Committee may take into account.

*Limit on use of carbon units*

**11 Limit on use of carbon units**

(1) It is the duty of the Secretary of State to set a limit on the net amount of carbon units that may be credited to the net UK carbon account for each budgetary period.

(2) The "net amount of carbon units" means—
- (a) the amount of carbon units credited to the net UK carbon account for the period in accordance with regulations under section 27, less
- (b) the amount of carbon units debited from the net UK carbon account for the period in accordance with such regulations.

(3) The limit for a budgetary period must be set—
- (a) for the period 2008-2012, not later than 1st June 2009, and
- (b) for any later period, not later than 18 months before the beginning of the period in question.

(4) The Secretary of State must set a limit under this section by order.

(5) The order may provide that carbon units of a description specified in the order do not count towards the limit.

(6) An order under this section is subject to affirmative resolution procedure.

(7) Before laying before Parliament a draft of a statutory instrument containing an order under this section in relation to a budgetary period, the Secretary of State must—
- (a) take into account the advice of the Committee on Climate Change under section 34(1)(b) (advice on use of carbon units) in relation to that period, and
- (b) consult the other national authorities.

*Indicative annual ranges*

**12 Duty to provide indicative annual ranges for net UK carbon account**

(1) As soon as is reasonably practicable after making an order setting the carbon budget for a budgetary period, the Secretary of State must lay before Parliament a report setting out an indicative annual range for the net UK carbon account for each year within the period.

(2) An "indicative annual range", in relation to a year, is a range within which the Secretary of State expects the amount of the net UK carbon account for the year to fall.

(3) Before laying a report under this section before Parliament, the Secretary of State must consult the other national authorities on the indicative annual ranges set out in the report.

(4) The Secretary of State must send a copy of the report to those authorities.

*Proposals and policies for meeting carbon budgets*

**13 Duty to prepare proposals and policies for meeting carbon budgets**

(1) The Secretary of State must prepare such proposals and policies as the Secretary of State considers will enable the carbon budgets that have been set under this Act to be met.

(2) The proposals and policies must be prepared with a view to meeting—
  (a) the target in section 1 (the target for 2050), and
  (b) any target set under section 5(1)(c) (power to set targets for later years).

(3) The proposals and policies, taken as a whole, must be such as to contribute to sustainable development.

(4) In preparing the proposals and policies, the Secretary of State may take into account the proposals and policies the Secretary of State considers may be prepared by other national authorities.

**14 Duty to report on proposals and policies for meeting carbon budgets**

(1) As soon as is reasonably practicable after making an order setting the carbon budget for a budgetary period, the Secretary of State must lay before Parliament a report setting out proposals and policies for meeting the carbon budgets for the current and future budgetary periods up to and including that period.

(2) The report must, in particular, set out—
  (a) the Secretary of State's current proposals and policies under section 13, and
  (b) the time-scales over which those proposals and policies are expected to take effect.

(3) The report must explain how the proposals and policies set out in the report affect different sectors of the economy.

(4) The report must outline the implications of the proposals and policies as regards the crediting of carbon units to the net UK carbon account for each budgetary period covered by the report.

(5) So far as the report relates to proposals and policies of the Scottish Ministers, the Welsh Ministers or a Northern Ireland department, it must be prepared in consultation with that authority.

(6) The Secretary of State must send a copy of the report to those authorities.

**15 Duty to have regard to need for UK domestic action on climate change**

(1) In exercising functions under this Part involving consideration of how to meet—
   (a) the target in section 1(1) (the target for 2050), or
   (b) the carbon budget for any period,

the Secretary of State must have regard to the need for UK domestic action on climate change.

(2) "UK domestic action on climate change" means reductions in UK emissions of targeted greenhouse gases or increases in UK removals of such gases (or both).

*Determination whether objectives met*

**16 Annual statement of UK emissions**

(1) It is the duty of the Secretary of State to lay before Parliament in respect of each year, beginning with the year 2008, a statement containing the following information.

(2) In respect of each greenhouse gas (whether or not a targeted greenhouse gas), it must—
   (a) state the amount for the year of UK emissions, UK removals and net UK emissions of that gas,
   (b) identify the methods used to measure or calculate those amounts, and
   (c) state whether any of those amounts represents an increase or decrease compared to the equivalent amount for the previous year.

(3) It must state the aggregate amount for the year of UK emissions, UK removals and net UK emissions of all greenhouse gases.

(4) If in accordance with international carbon reporting practice a change of method is such as to require adjustment of an amount for an earlier year in the same budgetary period, it must specify the adjustment required and state the adjusted amount.

(5) If emissions of a greenhouse gas from international aviation or international shipping are not required to be included in the statement by virtue of subsection (2), it must state any amounts relating to such emissions that the United Kingdom is required to report for the year in accordance with international carbon reporting practice.

(6) It must—
   (a) state the total amount of carbon units that have been credited to or debited from the net UK carbon account for the year, and
   (b) give details of the number and type of those carbon units.

(7) It must state the amount of the net UK carbon account for the year.

(8) It must state—
(a) the amount of net UK emissions of carbon dioxide for the year 1990,
(b) the amount of net UK emissions of each targeted greenhouse gas other than carbon dioxide for the year that is the base year for that gas, and
(c) a baseline amount for each greenhouse gas that is not a targeted greenhouse gas, determined on such basis as the Secretary of State considers appropriate.

(9) The amount referred to in subsection (8)(c) may be—
(a) the amount of net UK emissions of the gas for the year 1990 or a different year, or
(b) the average amount of net UK emissions of the gas for a number of years.

(10) The statement required by this section must be laid before Parliament not later than 31st March in the second year following that to which it relates.

(11) The Secretary of State must send a copy of the statement to the other national authorities.

**17 Powers to carry amounts from one budgetary period to another**

(1) The Secretary of State may decide to carry back part of the carbon budget for a budgetary period to the preceding budgetary period.
The carbon budget for the later period is reduced, and that for the earlier period increased, by the amount carried back.

(2) The amount carried back under subsection (1) must not exceed 1% of the carbon budget for the later period.

(3) The Secretary of State may decide to carry forward the whole or part of any amount by which the carbon budget for a budgetary period exceeds the net UK carbon account for the period.
The amount of the carbon budget for the next budgetary period is increased by the amount carried forward.

(4) Before deciding to carry an amount back or forward under this section, the Secretary of State must—
(a) consult the other national authorities, and
(b) obtain, and take into account, the advice of the Committee on Climate Change.

(5) Any such decision must be made no later than 31st May in the second year after the end of the earlier of the two budgetary periods affected.

**18 Final statement for budgetary period**

(1) It is the duty of the Secretary of State to lay before Parliament in respect of each budgetary period a statement containing the following information.

(2) In respect of each targeted greenhouse gas, it must state the final amount for the period of UK emissions, UK removals and net UK emissions of that gas.

That is the total of the amounts (or adjusted amounts) stated under section 16 (annual statement of UK emissions) in respect of that gas for the years included in the period.

(3) It must—

(a) state the final amount of carbon units that have been credited to or debited from the net UK carbon account for the period, and

(b) give details of the number and type of those carbon units.

(4) It must state the final amount of the net UK carbon account for the period.

(5) It must state whether the Secretary of State has decided to carry an amount back under section 17(1) (power to carry amount back from the budget for the next budgetary period), and if so what amount.

(6) It must state the amount of the carbon budget for the period.

That is the amount originally set, subject to any exercise of the powers conferred by section 17 (powers to carry amounts from one budgetary period to another) and any alteration of the budget under section 21.

(7) Whether the carbon budget for a period has been met shall be determined by reference to the figures given in the statement laid before Parliament under this section in respect of that period.

(8) If the carbon budget for the period has not been met, the statement must explain why it has not been met.

(9) The statement required by this section must be laid before Parliament not later than 31st May in the second year following the end of the period to which it relates.

(10) The Secretary of State must send a copy of the statement to the other national authorities.

**19 Duty to report on proposals and policies for compensating for budget excess**

(1) As soon as is reasonably practicable after laying a statement before Parliament under section 18 in respect of a period for which the net UK carbon account exceeds the carbon budget, the Secretary of State must lay before Parliament a report setting out proposals and policies to compensate in future periods for the excess emissions.

(2) So far as the report relates to proposals and policies of the Scottish Ministers, the Welsh Ministers or a Northern Ireland department, it must be prepared in consultation with that authority.

(3) The Secretary of State must send a copy of the report to those authorities.

**20 Final statement for 2050**

(1) It is the duty of the Secretary of State to lay before Parliament in respect of the year 2050 a statement containing the following information.

(2) In respect of each targeted greenhouse gas, it must state the amount for that year of UK emissions, UK removals and net UK emissions of that gas.

That is the amount stated for that year in respect of that gas under section 16 (annual statement of UK emissions).

(3) It must—
  (a) state the amount of carbon units that have been credited to or debited from the net UK carbon account for the year, and
  (b) give details of the number and type of those carbon units.

(4) It must state the amount of the net UK carbon account for that year.

(5) Whether the target in section 1 (the target for 2050) has been met shall be determined by reference to the figures given in the statement laid before Parliament under this section.

(6) If the target has not been met, the statement must explain why it has not been met.

(7) The statement required by this section must be laid before Parliament not later than 31st May 2052.

(8) The Secretary of State must send a copy of the statement to the other national authorities.

*Alteration of budgets or budgetary periods*

### 21 Alteration of carbon budgets

(1) An order setting the carbon budget for a period may not be revoked after the date by which a budget for the period was required to be set.

(2) An order setting the carbon budget for a period may be amended after the date by which a budget for the period was required to be set only if it appears to the Secretary of State that, since the budget was originally set (or previously altered), there have been significant changes affecting the basis on which the previous decision was made.

(3) An order setting the carbon budget for a period may be amended after the period has begun only if it appears to the Secretary of State that there have been such changes since the period began.

(4) An order setting the carbon budget for a period may not be amended after the period has ended.

(5) An order revoking or amending an order setting a carbon budget is subject to affirmative resolution procedure.

### 22 Consultation on alteration of carbon budgets

(1) Before laying before Parliament a draft of a statutory instrument containing an order under section 21 (alteration of carbon budgets), the Secretary of State must—
  (a) obtain, and take into account, the advice of the Committee on Climate Change, and
  (b) take into account any representations made by the other national authorities.

(2) The Committee must, at the time it gives its advice to the Secretary of State, send a copy to the other national authorities.

(3) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

(4) The Secretary of State may proceed to lay such a draft statutory instrument before Parliament without having received a national authority's representations if the authority does not provide them before the end of the relevant period.

(5) The relevant period is—
  (a) if the budgetary period to which the order relates has begun, one month beginning with the date the Committee's advice was sent to the authority, or
  (b) otherwise, three months beginning with that date.

(6) At the same time as laying such a draft statutory instrument before Parliament, the Secretary of State must publish a statement setting out whether and how the order takes account of any representations made by the other national authorities.

(7) If the order makes provision different from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.

(8) A statement under this section may be published in such manner as the Secretary of State thinks fit.

**23 Alteration of budgetary periods**

(1) The Secretary of State may by order amend section 4(1)(a) so as to alter—
  (a) the length of the budgetary periods, or
  (b) the dates in the calendar year on which the budgetary periods begin and end.

(2) This power may only be exercised if it appears to the Secretary of State necessary to do so in order to keep the budgetary periods under this Part in line with similar periods under any agreement at European or international level to which the United Kingdom is a party.

(3) The power may not be exercised in such a way that any period falls outside a budgetary period.

(4) An order may make such consequential amendments of the provisions of this Act as appear to the Secretary of State to be necessary or expedient.

(5) Before making an order under this section the Secretary of State must consult the other national authorities.

(6) An order under this section is subject to affirmative resolution procedure.

*Targeted greenhouse gases*

**24 Targeted greenhouse gases**

(1) In this Part a "targeted greenhouse gas" means—
  (a) carbon dioxide,
  (b) methane,

(c) nitrous oxide,
(d) hydrofluorocarbons,
(e) perfluorocarbons,
(f) sulphur hexafluoride, and
(g) any other greenhouse gas designated as a targeted greenhouse gas by order made by the Secretary of State.

(2) The order may make such consequential amendments of the provisions of this Act as appear to the Secretary of State to be necessary or expedient.

(3) Before making an order under this section, the Secretary of State must—
(a) consult the other national authorities, and
(b) obtain, and take into account, the advice of the Committee on Climate Change.

(4) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

(5) If the order makes provision different from that recommended by the Committee, the Secretary of State must publish a statement setting out the reasons for that decision.

(6) The statement may be published in such manner as the Secretary of State thinks fit.

(7) An order under this section is subject to affirmative resolution procedure.

**25 Base years for targeted greenhouse gases other than $CO_2$**

(1) The base years for the purposes of this Act for targeted greenhouse gases other than carbon dioxide are—

| *Gas* | *Base year* |
|---|---|
| methane | 1990 |
| nitrous oxide | 1990 |
| hydrofluorocarbons | 1995 |
| perfluorocarbons | 1995 |
| sulphur hexafluoride | 1995 |

(2) The Secretary of State may make provision by order amending the table in subsection (1) so as to—
(a) specify the base year for a gas designated as a targeted greenhouse gas by order under section 24(1), or
(b) specify a different base year from that for the time being specified in relation to any targeted greenhouse gas other than carbon dioxide.

(3) An order may—
(a) designate a particular base year, or

(b) designate a number of base years and provide that the average amount of net UK emissions of a gas for those years is to be treated for the purposes of this Act as the amount of net UK emissions for the base year.

(4) The power in subsection (2)(b) may only be exercised if it appears to the Secretary of State that there have been significant developments in European or international law or policy that make it appropriate to do so.

(5) Before making an order under this section, the Secretary of State must—
(a) consult the other national authorities, and
(b) obtain, and take into account, the advice of the Committee on Climate Change.

(6) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

(7) If the order makes provision different from that recommended by the Committee, the Secretary of State must publish a statement setting out the reasons for that decision.

(8) The statement may be published in such manner as the Secretary of State thinks fit.

(9) An order under this section is subject to affirmative resolution procedure.

*Carbon units, carbon accounting and the net UK carbon account*

**26 Carbon units and carbon accounting**

(1) In this Part a "carbon unit" means a unit of a kind specified in regulations made by the Secretary of State and representing—
(a) a reduction in an amount of greenhouse gas emissions,
(b) the removal of an amount of greenhouse gas from the atmosphere, or
(c) an amount of greenhouse gas emissions allowed under a scheme or arrangement imposing a limit on such emissions.

(2) The Secretary of State may make provision by regulations for a scheme—
(a) for registering or otherwise keeping track of carbon units, or
(b) for establishing and maintaining accounts in which carbon units may be held, and between which they may be transferred, by the Secretary of State.

The regulations may, in particular, provide for an existing scheme to be adapted for these purposes.

(3) The regulations may make provision—
(a) appointing a body to administer the scheme;
(b) establishing a body for that purpose and making such provision in relation to the appointment of members, staffing, expenditure, procedure and otherwise as the Secretary of State considers appropriate;
(c) conferring power on the Secretary of State to give guidance or directions to the body administering the scheme;

(d) conferring power on the Secretary of State to delegate the performance of any of the functions conferred or imposed on the Secretary of State by the regulations;

(e) requiring the payment by persons using the scheme of charges (of an amount determined by or under the regulations) towards the cost of operating it.

(4) If an existing body is appointed to administer the scheme, the regulations may make such modifications of any enactment relating to that body as the Secretary of State considers appropriate.

**27 Net UK carbon account**

(1) In this Part the "net UK carbon account" for a period means the amount of net UK emissions of targeted greenhouse gases for the period—

(a) reduced by the amount of carbon units credited to the net UK carbon account for the period in accordance with regulations under this section, and

(b) increased by the amount of carbon units that in accordance with such regulations are to be debited from the net UK carbon account for the period.

(2) The net amount of carbon units credited to the net UK carbon account for a budgetary period must not exceed the limit set under section 11 (limit on use of carbon units) for the period.

(3) The Secretary of State must make provision by regulations about—

(a) the circumstances in which carbon units may be credited to the net UK carbon account for a period,

(b) the circumstances in which such units must be debited from that account for a period, and

(c) the manner in which this is to be done.

(4) The regulations must contain provision for ensuring that carbon units that are credited to the net UK carbon account for a period cease to be available to offset other greenhouse gas emissions.

(5) The regulations must contain provision—

(a) for determining whether the total amount of carbon units allocated to the United Kingdom for each budgetary period under schemes or arrangements imposing a limit on emissions from sources in the United Kingdom represent an amount of net UK emissions of targeted greenhouse gases for the period greater than the carbon budget for the period, and

(b) for ensuring that, if this is the case, carbon units representing the amount of such emissions in excess of the budget are not used to offset greenhouse gas emissions in the United Kingdom or elsewhere.

**28 Procedure for regulations under section 26 or 27**

(1) The following provisions apply in relation to regulations under section 26 (carbon units and carbon accounting) or section 27 (net UK carbon account).

(2) The regulations are subject to affirmative resolution procedure if—

(a) they are the first regulations to be made under those sections,

(b) they specify a carbon unit of a kind not previously specified in regulations made under those sections,

(c) they alter the amount by which—

(i) a carbon unit that is credited to the net UK carbon account for a period reduces the net UK carbon account for that period, or

(ii) a carbon unit that is debited from the net UK carbon account for a period increases the net UK carbon account for that period, or

(d) they make modifications of an enactment contained in primary legislation.

(3) Otherwise the regulations are subject to negative resolution procedure.

(4) The Secretary of State must consult the other national authorities—

(a) in the case of regulations subject to affirmative resolution procedure, before laying before Parliament a draft of a statutory instrument containing the regulations;

(b) in the case of regulations subject to negative resolution procedure, before making the regulations.

(5) The Secretary of State must obtain, and take into account, the advice of the Committee on Climate Change before laying before Parliament a draft of a statutory instrument containing—

(a) the first regulations to be made under those sections, or

(b) regulations making provision of the kind described in paragraph (b) or (c) of subsection (2).

*Other supplementary provisions*

**29 UK emissions and removals of greenhouse gases**

(1) In this Part—

(a) "UK emissions", in relation to a greenhouse gas, means emissions of that gas from sources in the United Kingdom;

(b) "UK removals", in relation to a greenhouse gas, means removals of that gas from the atmosphere due to land use, land-use change or forestry activities in the United Kingdom;

(c) the "net UK emissions" for a period, in relation to a greenhouse gas, means the amount of UK emissions of that gas for the period reduced by the amount for the period of UK removals of that gas.

(2) The amount of UK emissions and UK removals of a greenhouse gas for a period must be determined consistently with international carbon reporting practice.

**30 Emissions from international aviation or international shipping**

(1) Emissions of greenhouse gases from international aviation or international shipping do not count as emissions from sources in the United Kingdom for the purposes of this Part, except as provided by regulations made by the Secretary of State.

(2) The Secretary of State may by order define what is to be regarded for this purpose as international aviation or international shipping.
Any such order is subject to affirmative resolution procedure.

(3) The Secretary of State must, before expiry of the period ending with 31st December 2012—
(a) make provision by regulations as to the circumstances in which, and the extent to which, emissions from international aviation or international shipping are to be regarded for the purposes of this Part as emissions from sources in the United Kingdom, or
(b) lay before Parliament a report explaining why regulations making such provision have not been made.

(4) The expiry of the period mentioned in subsection (3) does not affect the power of the Secretary of State to make regulations under this section.

(5) Regulations under this section—
(a) may make provision only in relation to emissions of a targeted greenhouse gas;
(b) may, in particular, provide for such emissions to be regarded as emissions from sources in the United Kingdom if they relate to the transport of passengers or goods to or from the United Kingdom.

(6) Regulations under this section may make provision—
(a) as to the period or periods (whether past or future) in which emissions of the targeted greenhouse gas are to be taken into account as UK emissions of that gas, and
(b) as to the manner in which such emissions are to be taken into account in determining UK emissions of that gas for the year that is the base year for that gas.

(7) They may, in particular—
(a) designate a different base year, or
(b) designate a number of base years,
and provide for the emissions in that year, or the average amount of emissions in those years, to be treated for the purposes of this Act as UK emissions of that gas for the year that is the base year for that gas.

(8) For the purposes of this section the base year for carbon dioxide is the year that is the baseline year for the purposes of this Part.

**31 Procedure for regulations under section 30**

(1) Before making regulations under section 30, the Secretary of State must obtain, and take into account, the advice of the Committee on Climate Change.

(2) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

(3) If the regulations make provision different from that recommended by the Committee, the Secretary of State must publish a statement setting out the reasons for that decision.

(4) The statement may be published in such manner as the Secretary of State thinks fit.

(5) Regulations under section 30 are subject to affirmative resolution procedure.

# PART 2

## THE COMMITTEE ON CLIMATE CHANGE

*The Committee*

### 32 The Committee on Climate Change

(1) There shall be a body corporate to be known as the Committee on Climate Change or, in Welsh, as y Pwyllgor ar Newid Hinsawdd (referred to in this Part as "the Committee").

(2) Schedule 1 contains further provisions about the Committee.

*Functions of the Committee*

### 33 Advice on level of 2050 target

(1) It is the duty of the Committee to advise the Secretary of State on—
   (a) whether the percentage specified in section 1(1) (the target for 2050) should be amended, and
   (b) if so, what the amended percentage should be.

(2) Advice given by the Committee under this section must also contain the reasons for that advice.

(3) The Committee must give its advice under this section not later than 1st December 2008.

(4) The Committee must, at the time it gives its advice under this section to the Secretary of State, send a copy to the other national authorities.

(5) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

### 34 Advice in connection with carbon budgets

(1) It is the duty of the Committee to advise the Secretary of State, in relation to each budgetary period, on—
   (a) the level of the carbon budget for the period,
   (b) the extent to which the carbon budget for the period should be met—
      (i) by reducing the amount of net UK emissions of targeted greenhouse gases, or
      (ii) by the use of carbon units that in accordance with regulations under sections 26 and 27 may be credited to the net UK carbon account for the period,
   (c) the respective contributions towards meeting the carbon budget for the period that should be made—
      (i) by the sectors of the economy covered by trading schemes (taken as a whole);
      (ii) by the sectors of the economy not so covered (taken as a whole), and

(d) the sectors of the economy in which there are particular opportunities for contributions to be made towards meeting the carbon budget for the period through reductions in emissions of targeted greenhouse gases.

(2) In relation to the budgetary period 2008-2012, the Committee must also advise the Secretary of State on—

(a) whether it would be consistent with its advice on the level of the carbon budget for the period to set a carbon budget such that the annual equivalent for the period was lower than the 1990 baseline by 20%, and

(b) the costs and benefits of setting such a budget.

(3) Advice given by the Committee under this section must also contain the reasons for that advice.

(4) The Committee must give its advice under this section—

(a) for the budgetary periods 2008-2012, 2013-2017 and 2018-2022, not later than 1st December 2008;

(b) for any later period, not later than six months before the last date for setting the carbon budget for the period (see section 4(2)(b)).

(5) The Committee must, at the time it gives its advice under this section to the Secretary of State, send a copy to the other national authorities.

(6) As soon as is reasonably practicable after giving its advice under this section the Committee must publish that advice in such manner as it considers appropriate.

**35 Advice on emissions from international aviation and international shipping**

(1) It is the duty of the Committee to advise the Secretary of State on the consequences of treating emissions of targeted greenhouse gases from—

(a) international aviation, and

(b) international shipping,

as emissions from sources in the United Kingdom for the purposes of Part 1.

(2) The duty applies if and to the extent that regulations under section 30 do not provide for such emissions to be so treated.

(3) Advice given by the Committee under this section must also contain the reasons for that advice.

(4) The Committee must give its advice under this section—

(a) when it gives its advice under section 34 for the budgetary period 2023-2027, and

(b) when it gives its advice under that section for each subsequent budgetary period.

(5) The Committee must, at the time it gives its advice under this section to the Secretary of State, send a copy to the other national authorities.

(6) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

**36 Reports on progress**

(1) It is the duty of the Committee to lay before Parliament and each of the devolved legislatures each year, beginning with the year 2009, a report setting out the Committee's views on—

(a) the progress that has been made towards meeting the carbon budgets that have been set under Part 1 and the target in section 1 (the target for 2050),

(b) the further progress that is needed to meet those budgets and that target, and

(c) whether those budgets and that target are likely to be met.

(2) The Committee's report in the second year after the end of a budgetary period must also set out the Committee's general views on—

(a) the way in which the budget for the period was or was not met, and

(b) action taken during the period to reduce net UK emissions of targeted greenhouse gases.

(3) The first report under this section must be laid before Parliament and the devolved legislatures not later than 30th September 2009.

(4) Each subsequent report under this section, other than one in the second year after the end of a budgetary period, must be laid before Parliament and the devolved legislatures not later than 30th June in the year in which it is made.

(5) A report in the second year after the end of a budgetary period must be laid before Parliament and the devolved legislatures not later than 15th July in the year in which it is made.

(6) The Secretary of State may by order extend the period mentioned in subsection (4) or (5).

(7) Before making such an order the Secretary of State must consult the other national authorities.

(8) Any such order is subject to negative resolution procedure.

**37 Response to Committee's reports on progress**

(1) The Secretary of State must lay before Parliament a response to the points raised by each report of the Committee under section 36 (reports on progress).

(2) Before doing so, the Secretary of State must consult the other national authorities on a draft of the response.

(3) The response to the Committee's first report under section 36 must be laid before Parliament not later than 15th January 2010.

(4) Each subsequent response must be laid before Parliament not later than 15th October in the year in which the Committee's report is made.

(5) The Secretary of State may by order extend that period.

(6) Any such order is subject to negative resolution procedure.

### 38 Duty to provide advice or other assistance on request

(1) The Committee must, at the request of a national authority, provide advice, analysis, information or other assistance to the authority in connection with—
 (a) the authority's functions under this Act,
 (b) the progress made towards meeting the objectives set by or under this Act,
 (c) adaptation to climate change, or
 (d) any other matter relating to climate change.

(2) In particular, the Committee must, at the request of a national authority—
 (a) advise the authority about any limit proposed to be set by a trading scheme on the total amount of the activities to which the scheme applies, or
 (b) assist the authority in connection with the preparation of statistics relating to greenhouse gas emissions.

(3) The Committee must, at the request of a national authority other than the Secretary of State, provide advice, analysis, information or other assistance to the authority in connection with any target, budget or similar requirement relating to emissions of greenhouse gas that has been adopted by the authority or to which the authority is otherwise subject.

*Supplementary provisions*

### 39 General ancillary powers

(1) The Committee may do anything that appears to it necessary or appropriate for the purpose of, or in connection with, the carrying out of its functions.

(2) In particular the Committee may—
 (a) enter into contracts,
 (b) acquire, hold and dispose of property,
 (c) borrow money,
 (d) accept gifts, and
 (e) invest money.

(3) In exercising its functions, the Committee may—
 (a) gather information and carry out research and analysis,
 (b) commission others to carry out such activities, and
 (c) publish the results of such activities carried out by the Committee or others.

(4) The Committee must have regard to the desirability of involving the public in the exercise of its functions.

### 40 Grants to the Committee

A national authority may make grants to the Committee of such amount and subject to such conditions as the authority thinks fit.

**41 Powers to give guidance**

(1) The national authorities may give the Committee guidance as to the matters it is to take into account in the exercise of—

(a) its functions generally, or

(b) any of its functions under Schedule 1.

(2) The Secretary of State may give the Committee guidance as to the matters it is to take into account in the exercise of its functions under—

(a) Part 1 (carbon target and budgeting),

(b) section 33 (advice on level of 2050 target),

(c) section 34 (advice in connection with carbon budgets),

(d) section 35 (advice on emissions from international aviation and international shipping),

(e) section 36 (reports on progress),

(f) section 57 (advice on report on impact of climate change), or

(g) section 59 (reporting on progress in connection with adaptation).

Before giving guidance under any of paragraphs (a) to (f), the Secretary of State must consult the other national authorities.

(3) A national authority that requests the Committee to provide advice, analysis, information or other assistance under—

(a) section 38 (duty to provide advice or assistance on request), or

(b) section 48 (advice on trading scheme regulations),

may give the Committee guidance as to the matters it is to take into account in responding to that request.

If the request is made by two or more national authorities, the guidance must be given by them jointly.

(4) The power to give guidance under this section includes power to vary or revoke it.

(5) In performing its functions the Committee must have regard to any guidance given under this section.

**42 Powers to give directions**

(1) The national authorities may give the Committee directions as to the exercise of—

(a) its functions generally, or

(b) any of its functions under Schedule 1.

(2) The Secretary of State may give the Committee directions as to the exercise of its functions under—

(a) Part 1 (carbon target and budgeting),

(b) section 33 (advice on level of 2050 target),

(c) section 34 (advice in connection with carbon budgets),

(d) section 35 (advice on emissions from international aviation and international shipping),

(e) section 36 (reports on progress),

(f) section 57 (advice on report on impact of climate change), or

(g) section 59 (reporting on progress in connection with adaptation).

Before giving directions under any of paragraphs (a) to (f), the Secretary of State must consult the other national authorities.

(3) A national authority that requests the Committee to provide advice, analysis, information or other assistance under—

(a) section 38 (duty to provide advice or assistance on request), or

(b) section 48 (advice on trading scheme regulations),

may give the Committee directions as to the exercise of its functions in responding to that request.

If the request is made by two or more national authorities, the directions must be given by them jointly.

(4) The power to give directions under this section does not include power to direct the Committee as to the content of any advice or report.

(5) The power to give directions under this section includes power to vary or revoke the directions.

(6) The Committee must comply with any directions given under this section.

*Interpretation*

### 43 Interpretation of Part 2

Expressions used in this Part that are defined in Part 1 (carbon target and budgeting) have the same meaning as in that Part.

## PART 3

## TRADING SCHEMES

*Trading schemes*

### 44 Trading schemes

(1) The relevant national authority may make provision by regulations for trading schemes relating to greenhouse gas emissions.

(2) A "trading scheme" is a scheme that operates by—

(a) limiting or encouraging the limitation of activities that consist of the emission of greenhouse gas or that cause or contribute, directly or indirectly, to such emissions, or

(b) encouraging activities that consist of, or that cause or contribute, directly or indirectly, to reductions in greenhouse gas emissions or the removal of greenhouse gas from the atmosphere.

### 45 Activities to which trading schemes may apply

(1) For the purposes of this Part activities are regarded as indirectly causing or contributing to greenhouse gas emissions if they involve, in particular—

(a) the consumption of energy,

(b) the use of materials in whose production energy was consumed,

(c) the disposal otherwise than for recycling of materials in whose production energy was consumed, or

(d) the production or supply of anything whose subsequent use directly causes or contributes to greenhouse gas emissions.

(2) Correspondingly, for the purposes of this Part activities are regarded as indirectly causing or contributing to the reduction of greenhouse gas emissions if they involve a reduction under any of those heads.

(3) This Part applies to activities carried on in the United Kingdom, regardless of where the related emissions, reductions or removals of greenhouse gas occur.

**46 Matters that may or must be provided for in regulations**

(1) Schedule 2 specifies matters that may or must be provided for in regulations under section 44.

(2) In that Schedule—

Part 1 deals with schemes that operate by limiting or encouraging the limitation of activities that consist of the emission of greenhouse gas or that cause or contribute, directly or indirectly, to such emissions;

Part 2 deals with schemes that operate by encouraging activities that consist of, or that cause or contribute, directly or indirectly, to reductions in greenhouse gas emissions or the removal of greenhouse gas from the atmosphere;

Part 3 deals with administration and enforcement.

(3) Regulations under section 44 may also make provision about the application of the regulations to the Crown.

*Authorities and regulations*

**47 Relevant national authorities**

(1) This section identifies "the relevant national authority" for the purposes of this Part.

(2) The Scottish Ministers are the relevant national authority in relation to matters within the legislative competence of the Scottish Parliament.

(3) The Welsh Ministers are the relevant national authority in relation to matters that—

(a) are within the legislative competence of the National Assembly for Wales, or

(b) relate to limiting or encouraging the limitation of activities in Wales that consist of the emission of greenhouse gas, other than activities in connection with offshore oil and gas exploration and exploitation.

(4) In subsection (3)(b)—

"Wales" has the same meaning as in the Government of Wales Act 2006 (c. 32); and

"offshore oil and gas exploration and exploitation" has the same meaning as in the National Assembly for Wales (Transfer of Functions) Order 2005 (S.I. 2005/1958).

(5) The Secretary of State or the relevant Northern Ireland department is the relevant authority in relation to reserved matters within the meaning of the Northern Ireland Act 1998 (c. 47).

(6) The relevant Northern Ireland department is the relevant authority in relation to all other matters within the legislative competence of the Northern Ireland Assembly.

(7) The Secretary of State is the relevant national authority in relation to all other matters.

### 48 Procedure for making regulations

(1) Before making regulations under this Part, a national authority must—
  (a) obtain, and take into account, the advice of the Committee on Climate Change, and
  (b) consult such persons likely to be affected by the regulations as the authority considers appropriate.

(2) In particular, before making regulations under this Part that set a limit on the total amount of the activities to which a trading scheme applies for a trading period or periods, a national authority must obtain, and take into account, the advice of the Committee on Climate Change on the amount of that limit.

(3) Regulations under this Part are subject to affirmative resolution procedure if they contain provision—
  (a) setting up a trading scheme,
  (b) extending the class of participants or activities to which a trading scheme applies,
  (c) extending the duration of a trading scheme,
  (d) making the overall requirements of a trading scheme significantly more onerous,
  (e) conferring new powers to enforce the requirements of a trading scheme,
  (f) imposing or providing for the imposition of new financial or other penalties or increasing the amount of existing financial penalties,
  (g) creating an offence or increasing the penalties for an existing offence, or
  (h) amending or repealing a provision of an enactment contained in primary legislation.

(4) Regulations under this Part are subject to affirmative resolution procedure if they are the first such regulations to contain provision under paragraph 31 of Schedule 2 (appeals).

(5) Other regulations under this Part are subject to negative resolution procedure.

(6) The relevant Northern Ireland department may only make regulations under this Part dealing with a reserved matter within the meaning of the Northern Ireland Act 1998 (c. 47) with the consent of the Secretary of State.

### 49 Further provisions about regulations

(1) Schedule 3 makes further provision about regulations under this Part.

(2) In that Schedule—
    Part 1 relates to regulations made by a single national authority;
    Part 2 relates to regulations made by two or more national authorities; and
    Part 3 confers power to make provision by Order in Council.

*Other supplementary provisions*

**50 Information**

(1) Schedule 4 confers powers to require information for the purposes of enabling a trading scheme to be established.

(2) Paragraphs 1 to 5 of that Schedule shall cease to have effect on 1st January 2011.

**51 Powers to give guidance**

(1) The relevant national authority may give guidance to the administrator of a trading scheme.

(2) The power to give guidance under this section includes power to vary or revoke it.

(3) The administrator must have regard to any guidance given under this section.

**52 Powers to give directions**

(1) The relevant national authority may give directions to the administrator of a trading scheme.

(2) The power to give directions under this section includes power to vary or revoke the directions.

(3) The administrator must comply with any directions given under this section.

**53 Grants to administrators and participants**

(1) A national authority may make, or arrange for the making of, grants to—
   (a) the administrator of a trading scheme, or
   (b) the participants in a trading scheme.

(2) A grant under this section may be made subject to such conditions as may be determined by, or in accordance with arrangements made by, the national authority that makes the grant.

**54 Power to make consequential provision**

A national authority may by regulations—
   (a) make such provision amending, repealing or revoking any enactment as the authority considers appropriate in consequence of provision made by that authority by regulations under section 44 (trading schemes);
   (b) make such transitional provision and savings as the authority considers appropriate in connection with the coming into effect of such provision.

*Interpretation*

**55 Interpretation of Part 3**

In this Part—

"administrator", in relation to a trading scheme, means a person appointed as the administrator of the scheme by regulations under paragraph 21 of Schedule 2;

"participant", in relation to a trading scheme, means a person to whom the scheme applies by virtue of regulations under paragraph 4 or 15 of Schedule 2;

"trading period", in relation to a trading scheme, means a period by reference to which the scheme is to operate by virtue of regulations under paragraph 2 or 13 of Schedule 2.

## PART 4

## IMPACT OF AND ADAPTATION TO CLIMATE CHANGE

*National reports and programmes*

### 56 Report on impact of climate change

(1) It is the duty of the Secretary of State to lay reports before Parliament containing an assessment of the risks for the United Kingdom of the current and predicted impact of climate change.

(2) The first report under this section must be laid before Parliament no later than three years after this section comes into force.

(3) Subsequent reports must be laid before Parliament no later than five years after the previous report was so laid.

(4) The Secretary of State may extend the period for laying any such report, but must publish a statement setting out the reasons for the delay and specifying when the report will be laid before Parliament.

(5) Before laying a report under this section before Parliament, the Secretary of State must take into account the advice of the Committee on Climate Change under section 57.

(6) The Secretary of State must send a copy of each report under this section to the other national authorities.

### 57 Advice of Committee on Climate Change on impact report

(1) It is the duty of the Committee on Climate Change to advise the Secretary of State on the preparation of each of the Secretary of State's reports under section 56.

(2) The Committee must give its advice under this section in relation to a report not later than six months before the last date for laying the report before Parliament (see subsections (2) to (4) of section 56).

(3) The Committee must, at the time it gives its advice under this section to the Secretary of State, send a copy to the other national authorities.

(4) As soon as is reasonably practicable after giving its advice under this section the Committee must publish that advice in such manner as it considers appropriate.

**58 Programme for adaptation to climate change**

(1) It is the duty of the Secretary of State to lay programmes before Parliament setting out —

(a) the objectives of Her Majesty's Government in the United Kingdom in relation to adaptation to climate change,

(b) the Government's proposals and policies for meeting those objectives, and

(c) the time-scales for introducing those proposals and policies,

addressing the risks identified in the most recent report under section 56.

(2) The objectives, proposals and policies must be such as to contribute to sustainable development.

(3) Each programme under this section must be laid before Parliament as soon as is reasonably practicable after the laying of the report under section 56 to which it relates.

(4) The Secretary of State must send a copy of each programme under this section to the other national authorities.

**59 Reporting on progress in connection with adaptation**

(1) Each report of the Committee on Climate Change under section 36 to which this section applies must contain an assessment of the progress made towards implementing the objectives, proposals and policies set out in the programmes laid before Parliament under section 58 (adaptation to climate change).

(2) This section applies to the report in the second year after that in which the Secretary of State lays the first programme under section 58 before Parliament.

(3) After that, this section applies to the report under section 36 in every second year after that in which the Committee last made a report to which this section applies, subject to any order under subsection (4).

(4) The Secretary of State may by order provide that this section shall apply to the report under section 36 in the year specified in the order and in every subsequent year.

(5) An order under subsection (4) is subject to negative resolution procedure.

**60 Programme for adaptation to climate change: Northern Ireland**

(1) It is the duty of the relevant Northern Ireland department to lay programmes before the Northern Ireland Assembly setting out—

(a) the objectives of the department in relation to adaptation to climate change,

(b) the department's proposals and policies for meeting those objectives, and

(c) the time-scales for introducing those proposals and policies,

addressing the risks identified in the most recent report under section 56.

(2) The objectives, proposals and policies must be such as to contribute to sustainable development.

(3) The second and each subsequent programme under this section must contain an assessment of the progress made towards implementing the objectives, proposals and policies set out in earlier programmes.

(4) Each programme under this section must be laid before the Northern Ireland Assembly as soon as is reasonably practicable after the laying before Parliament of the report under section 56 to which it relates.

(5) The relevant Northern Ireland department must send a copy of each programme under this section to the other national authorities.

*Reporting authorities: non-devolved functions*

**61 Guidance by Secretary of State to reporting authorities**

(1) The Secretary of State may issue guidance to reporting authorities about—
 (a) assessing the current and predicted impact of climate change in relation to the authorities' functions,
 (b) preparing proposals and policies for adapting to climate change in the exercise of their functions, and
 (c) co-operating with other reporting authorities for that purpose.

(2) This section does not apply to devolved functions.

**62 Directions by Secretary of State to prepare reports**

(1) The Secretary of State may direct a reporting authority to prepare a report containing any of the following—
 (a) an assessment of the current and predicted impact of climate change in relation to the authority's functions;
 (b) a statement of the authority's proposals and policies for adapting to climate change in the exercise of its functions and the time-scales for introducing those proposals and policies;
 (c) an assessment of the progress made by the authority towards implementing the proposals and policies set out in its previous reports.

(2) The Secretary of State may direct two or more reporting authorities to prepare a joint report.

(3) The Secretary of State may give directions about—
 (a) the time within which a report must be prepared, and
 (b) its content,

and may, in particular, require it to cover a particular geographical area.

(4) This section does not apply to devolved functions.

**63 Compliance with Secretary of State's directions**

(1) A reporting authority must comply with any directions under section 62.

(2) Where two or more reporting authorities are directed to prepare a joint report, they must take reasonable steps to co-operate with each other for that purpose.

(3) In preparing a report, a reporting authority must have regard to the following, so far as relevant—

(a) the most recent report under section 56 (report on impact of climate change);
(b) the most recent programme under section 58 (programme for adaptation to climate change);
(c) any guidance issued by the Secretary of State under section 61.

(4) If the authority—
(a) has functions that are exercisable in or as regards Wales, or
(b) has devolved Welsh functions,
it must also have regard, so far as relevant, to any guidance issued by the Welsh Ministers under section 66 and the most recent report under section 80 (report on climate change: Wales).

(5) The authority must send a copy of the report to the Secretary of State.

(6) The Secretary of State must publish the report in such manner as the Secretary of State considers appropriate.

(7) This does not require the Secretary of State to publish—
(a) information the Secretary of State could refuse to disclose in response to a request under—
(i) the Freedom of Information Act 2000 (c. 36), or
(ii) the Environmental Information Regulations 2004 (S.I. 2004/3391) or any regulations replacing those regulations;
(b) information whose disclosure is prohibited by any enactment.

(8) The authority must have regard to the report in exercising its functions other than its devolved functions.

**64 Consent of, or consultation with, devolved authorities**

(1) The Secretary of State must obtain the consent of a devolved authority before issuing guidance under section 61 or giving a direction under section 62 relating to functions in relation to which—
(a) functions are exercisable jointly by that devolved authority and a Minister of the Crown, or
(b) functions are exercisable by a Minister of the Crown only with the agreement of that devolved authority.

(2) The Secretary of State must consult a devolved authority before issuing guidance under section 61 or giving a direction under section 62 relating to functions in relation to which—
(a) functions are exercisable by that devolved authority other than jointly with a Minister of the Crown, or
(b) functions are exercisable by a Minister of the Crown only after consultation with that devolved authority.

**65 Report on exercise of power to give directions**

(1) It is the duty of the Secretary of State to lay reports before Parliament setting out how the Secretary of State intends to exercise the power under section 62 to give directions to reporting authorities.

(2) The reports must, in particular, identify—
(a) the circumstances in which directions are likely to be given, and

(b) the authorities or kinds of authority to whom the Secretary of State considers directions should be given as a matter of priority.

(3) Nothing in a report under this section affects the exercise of the Secretary of State's power under section 62.

(4) Before laying a report under this section before Parliament the Secretary of State must consult such persons likely to be affected by the report as the Secretary of State considers appropriate.

(5) The first report under this section must be laid before Parliament no later than 12 months after this Act is passed.

(6) Subsequent reports must be laid before Parliament no later than the time when the next programme under section 58 is so laid.

(7) The Secretary of State must send a copy of each report under this section to the other national authorities.

*Reporting authorities: devolved Welsh functions*

### 66 Guidance by Welsh Ministers to reporting authorities

The Welsh Ministers may issue guidance to reporting authorities about—

(a) assessing the current and predicted impact of climate change in relation to the authorities' devolved Welsh functions,

(b) preparing proposals and policies for adapting to climate change in the exercise of those functions, and

(c) co-operating with other reporting authorities for that purpose.

### 67 Directions by Welsh Ministers to prepare reports

(1) The Welsh Ministers may direct a reporting authority to prepare a report containing any of the following—

(a) an assessment of the current and predicted impact of climate change in relation to the authority's devolved Welsh functions;

(b) a statement of the authority's proposals and policies for adapting to climate change in the exercise of those functions and the time-scales for introducing those proposals and policies;

(c) an assessment of the progress made by the authority towards implementing the proposals and policies set out in its previous reports.

(2) The Welsh Ministers may direct two or more reporting authorities to prepare a joint report.

(3) The Welsh Ministers may give directions about—

(a) the time within which a report must be prepared, and

(b) its content,

and may, in particular, require it to cover a particular geographical area.

### 68 Compliance with Welsh Ministers' directions

(1) A reporting authority must comply with any directions under section 67.

(2) Where two or more reporting authorities are directed to prepare a joint report, they must take reasonable steps to co-operate with each other for that purpose.

(3) In preparing a report, a reporting authority must have regard to the following, so far as relevant—
   (a) the most recent report under section 56 (report on impact of climate change);
   (b) the most recent programme under section 58 (programme for adaptation to climate change);
   (c) any guidance issued by the Secretary of State under section 61;
   (d) any guidance issued by the Welsh Ministers under section 66;
   (e) the most recent report under section 80 (report on climate change: Wales).

(4) The authority must send a copy of the report to the Welsh Ministers.

(5) The Welsh Ministers must publish the report in such manner as they consider appropriate.

(6) This does not require the Welsh Ministers to publish—
   (a) information they could refuse to disclose in response to a request under—
      (i) the Freedom of Information Act 2000 (c. 36), or
      (ii) the Environmental Information Regulations 2004 (S.I. 2004/3391) or any regulations replacing those regulations;
   (b) information whose disclosure is prohibited by any enactment.

(7) The authority must have regard to the report in exercising its devolved Welsh functions.

**69 Consent of, or consultation with, Secretary of State**

(1) The Welsh Ministers must obtain the consent of the Secretary of State before issuing guidance under section 66 or giving a direction under section 67 relating to functions in relation to which—
   (a) functions are exercisable by a Minister of the Crown jointly with the Welsh Ministers, the First Minister or the Counsel General, or
   (b) functions are exercisable by the Welsh Ministers, the First Minister or the Counsel General only with the agreement of a Minister of the Crown.

(2) The Welsh Ministers must consult the Secretary of State before issuing guidance under section 66 or giving a direction under section 67 relating to functions in relation to which—
   (a) functions are exercisable by a Minister of the Crown other than jointly with the Welsh Ministers, the First Minister or the Counsel General, or
   (b) functions are exercisable by the Welsh Ministers, the First Minister or the Counsel General only after consultation with a Minister of the Crown.

*Interpretation*

**70 Interpretation**

(1) In sections 61 to 69 and this section “reporting authority” means—
(a) a person or body with functions of a public nature,
(b) a person who is or is deemed to be a statutory undertaker for the purposes of any provision of—
(i) Part 11 of the Town and Country Planning Act 1990 (c. 8) (see section 262 of that Act), or
(ii) Part 10 of the Town and Country Planning (Scotland) Act 1997 (c. 8) (see section 214 of that Act), or
(c) a person who is a statutory undertaker within the meaning of the Planning (Northern Ireland) Order 1991 (S.I. 1991/1220 (N.I. 11)) (see Article 2(1) of that Order).

(2) None of the following are reporting authorities for the purposes of those sections and this section—
(a) a Minister of the Crown;
(b) either House of Parliament;
(c) a devolved authority;
(d) a devolved legislature.

(3) In those sections and this section “devolved authority” means—
(a) the Welsh Ministers, the First Minister or the Counsel General,
(b) the Scottish Ministers, the First Minister, the Lord Advocate or the Solicitor General for Scotland, or
(c) a Minister within the meaning of the Northern Ireland Act 1998 (c. 47) or a Northern Ireland department.

(4) References in those sections to a reporting authority’s “devolved functions” are to functions—
(a) conferred or imposed by or under a Measure or Act of the National Assembly for Wales,
(b) exercisable in or as regards Wales and relating to matters within the legislative competence of the National Assembly for Wales,
(c) exercisable in or as regards Scotland and relating to matters within the legislative competence of the Scottish Parliament,
(d) exercisable in or as regards Northern Ireland and relating to transferred matters within the meaning of the Northern Ireland Act 1998, or
(e) in relation to which functions are exercisable by a devolved authority,

and in relation to which no functions are exercisable by a Minister of the Crown.

(5) For this purpose functions are not to be regarded as exercisable by a Minister of the Crown in relation to a reporting authority’s functions merely because—
(a) the Minister of the Crown may exercise functions—
(i) under section 2(2) of the European Communities Act 1972 (c. 68),
(ii) by virtue of section 57(1) or under section 58 of the Scotland Act 1998 (c. 46) (Community and international obligations),
(iii) under section 27 or 28 of the Northern Ireland Act 1998 (international etc obligations),

(iv) by virtue of paragraph 5 of Schedule 3 to the Government of Wales Act 2006 (c. 32) or under section 82 of that Act (Community and international obligations), or

(v) under section 152 of that Act (intervention in case of functions relating to water etc),

in relation to the reporting authority's functions,

(b) the Minister of the Crown's agreement is required to the exercise of a function by a devolved authority in relation to the reporting authority's functions, or

(c) the Minister of the Crown must be consulted by a devolved authority about the exercise of a function in relation to the reporting authority's functions.

(6) References in those sections to a reporting authority's "devolved Welsh functions" are to functions—

(a) conferred or imposed by or under a Measure or Act of the National Assembly for Wales,

(b) exercisable in or as regards Wales and relating to matters within the legislative competence of the National Assembly for Wales, or

(c) in relation to which functions are exercisable by the Welsh Ministers, the First Minister or the Counsel General.

(7) For this purpose functions are not to be regarded as exercisable by the Welsh Ministers, the First Minister or the Counsel General in relation to a reporting authority's functions merely because—

(a) the agreement of the Welsh Ministers, the First Minister or the Counsel General is required to the exercise of a function by a Minister of the Crown in relation to the reporting authority's functions, or

(b) the Welsh Ministers, the First Minister or the Counsel General must be consulted by a Minister of the Crown about the exercise of a function in relation to the reporting authority's functions.

(8) In those sections and this section—

(a) "Counsel General" and "Wales" have the same meanings as in the Government of Wales Act 2006 (c. 32);

(b) "Minister of the Crown" includes a government department.

## PART 5

## OTHER PROVISIONS

### *Waste reduction schemes*

### 71 Waste reduction schemes

(1) Schedule 5 amends the Environmental Protection Act 1990 (c. 43) to provide for the making of waste reduction schemes.

(2) The provisions inserted by that Schedule come into force in accordance with sections 72 to 75 below.

(3) In those sections "the waste reduction provisions" means the provisions inserted by that Schedule and any subordinate legislation made under those provisions.

**72 Waste reduction provisions: piloting**

(1) If a waste collection authority submits to the Secretary of State proposals for a waste reduction scheme and the proposals are approved by the Secretary of State as suitable for piloting one or more aspects of the waste reduction provisions—

(a) the Secretary of State may by order designate the area of that authority as a pilot area, and

(b) the authority may make a scheme in accordance with the proposals.

(2) Not more than five areas may be so designated.

(3) The order designating a pilot area shall provide that the waste reduction provisions have effect in relation to that area, for the purpose of enabling the authority to make and operate the proposed scheme, for such period as may be specified in the order.

(4) Any power to make subordinate legislation or issue guidance under the waste reduction provisions—

(a) may be exercised so as to make different provision for different pilot areas, and

(b) may be exercised at any time after the coming into force of this section.

(5) If a draft of an instrument containing such subordinate legislation would, apart from this subsection, be treated for the purposes of the standing orders of either House of Parliament as a hybrid instrument, it is to proceed in that House as if it were not such an instrument.

**73 Waste reduction provisions: report and review**

(1) The Secretary of State shall lay before Parliament a report on the operation of the waste reduction provisions in each pilot area.

(2) The report must contain, in respect of each pilot area to which it relates—

(a) a description of the scheme and of the respects in which the provision made by it differed from that made by the schemes in other pilot areas;

(b) a copy of the order made by the Secretary of State under section 72;

(c) a description of the respects in which the relevant enactments and guidance applying in that area differed from that applying—

(i) in other pilot areas, and

(ii) in areas not designated as pilot areas; and

(d) an assessment of the scheme's success or otherwise.

(3) The report must also contain a review of the waste reduction provisions in the light of their operation in the pilot area or areas to which the report relates.

**74 Waste reduction provisions: interim report**

(1) If it appears to the Secretary of State that it will not be possible to lay a report under section 73 in relation to a pilot area before the end of three years beginning with the day this Act is passed, the Secretary of State must lay before Parliament an interim report in relation to that pilot area before the end of that period.

(2) The interim report must contain—

(a) a description of the scheme and of the respects in which the provision made or to be made by it differs from that made by the schemes in other pilot areas,
(b) a copy of the order made by the Secretary of State under section 72; and
(c) a description of the respects in which the relevant enactments and guidance applying in that area differ from that applying—
(i) in other pilot areas, and
(ii) in areas not designated as pilot areas.

(3) If the scheme has not been implemented, the interim report must contain a description of the progress made towards its implementation.

(4) Otherwise, the interim report must contain—
(a) a description of the scheme's operation, and
(b) an assessment of the progress made towards achieving the scheme's objectives, if such an assessment can reasonably be made.

**75 Waste reduction provisions: roll-out or repeal**

(1) The following provisions apply after section 73 has been complied with in relation to one or more pilot areas.

(2) The Secretary of State may by order—
(a) provide that the waste reduction provisions shall come into force generally on such date as is specified in the order; or
(b) make such amendments of the waste reduction provisions as appear to the Secretary of State to be necessary or expedient having regard to the operation of the provisions in the pilot areas, and provide that those provisions as amended shall come into force generally on such date as is specified in the order.

(3) The amendments may include provision conferring power on the Secretary of State to make subordinate legislation.

(4) Where the amendments include such provision, they must also include provision—
(a) for a statutory instrument containing the subordinate legislation to be subject to annulment in pursuance of a resolution of either House of Parliament, or
(b) requiring a draft of such an instrument to be laid before and approved by resolution of each House of Parliament before the subordinate legislation is made,

as the Secretary of State thinks fit.

(5) If the Secretary of State decides not to make an order under subsection (2), the Secretary of State must make an order repealing the waste reduction provisions.

(6) Any order under subsection (2)(b) or (5) is subject to affirmative resolution procedure.

*Collection of household waste*

**76 Collection of household waste**

In section 46 of the Environmental Protection Act 1990 (c. 43) (receptacles for household waste), after subsection (10) insert—

“(11) A waste collection authority is not obliged to collect household waste that is placed for collection in contravention of a requirement under this section.”.

*Charges for single use carrier bags*

**77 Charges for single use carrier bags**

(1) Schedule 6 makes provision about charges for single use carrier bags.

(2) In that Schedule—

Part 1 confers power on the relevant national authority to make regulations about charges for single use carrier bags;

Part 2 makes provision about civil sanctions;

Part 3 makes provision about the procedures applying to regulations under the Schedule.

(3) In that Schedule “the relevant national authority” means—

(a) the Secretary of State in relation to England;

(b) the Welsh Ministers in relation to Wales;

(c) the Department of the Environment in Northern Ireland in relation to Northern Ireland.

(4) Regulations under that Schedule are subject to affirmative resolution procedure if—

(a) they are the first regulations to be made by the relevant national authority in question under the Schedule,

(b) they contain provision imposing or providing for the imposition of new civil sanctions,

(c) they increase the amount or maximum amount of a monetary penalty or change the basis on which such an amount or maximum is to be determined, or

(d) they amend or repeal a provision of an enactment contained in primary legislation.

(5) Otherwise regulations under that Schedule are subject to negative resolution procedure.

*Renewable transport fuel obligations*

**78 Renewable transport fuel obligations**

Schedule 7 contains amendments to the provisions of the Energy Act 2004 (c. 20) relating to renewable transport fuel obligations.

*Carbon emissions reduction targets*

**79 Carbon emissions reduction targets**

Schedule 8 contains amendments to the provisions of the Gas Act 1986 (c. 44), the Electricity Act 1989 (c. 29) and the Utilities Act 2000 (c. 27) relating to carbon emissions reduction targets.

*Miscellaneous*

**80 Report on climate change: Wales**

(1) It is the duty of the Welsh Ministers to lay before the National Assembly for Wales from time to time a report on—

(a) the objectives of the Welsh Ministers in relation to greenhouse gas emissions and the impact of climate change in Wales,

(b) the action that has been taken by the Welsh Ministers and others to deal with such emissions and that impact, and

(c) the future priorities for the Welsh Ministers and others for dealing with such emissions and that impact.

(2) The report must, in particular, set out how the Welsh Ministers intend to exercise the power to give directions under section 67 (directions to reporting authorities to prepare adaptation reports).

(3) Nothing in a report under this section affects the exercise of the Welsh Ministers' power under that section.

(4) The second and each subsequent report under this section must contain an assessment of the progress made towards implementing the objectives mentioned in the earlier reports.

(5) In this section "Wales" has the same meaning as in the Government of Wales Act 2006 (c. 32).

**81 Climate change measures reports in Wales**

(1) The Climate Change and Sustainable Energy Act 2006 (c. 19) is amended as follows.

(2) After section 3 insert—

**"3A Local authorities in Wales to have regard to climate change measures reports**

(1) The Welsh Ministers must from time to time publish a climate change measures report.

(2) A local authority in Wales must, in exercising its functions, have regard to any current climate change measures report.

(3) A "climate change measures report" means a report containing information about the local authority measures the Welsh Ministers consider would or might have any of the following effects—

(a) improving efficiency in the use of any description or source of energy;

(b) increasing the amount of energy generated, or heat produced, by microgeneration;
(c) increasing the amount of energy generated, or heat produced, by plant that relies wholly or mainly on a source of energy or a technology listed in section 26(2);
(d) reducing emissions of greenhouse gases;
(e) reducing the number of households in which one or more persons are living in fuel poverty;
(f) addressing the impact of climate change.

(4) Before publishing a climate change measures report, the Welsh Ministers must consult such representatives of local government, and such other persons, as the Welsh Ministers consider appropriate.

(5) The Secretary of State's consent is required to the publication in a climate change measures report of information about a local authority measure to which subsection (6) applies.

(6) This subsection applies to a local authority measure if the Secretary of State has a function in relation to the measure of—
(a) making subordinate legislation,
(b) issuing guidance or directions, or
(c) making determinations or hearing appeals,
and that function is exercisable in relation to Wales.

(7) In this section—
"local authority" means any of the following—
(a) a county council;
(b) a county borough council;
(c) a community council;
"local authority measure" means anything a local authority in Wales may do in the exercise of its functions (including deciding not to exercise a power).".

(3) In section 3 of that Act (local authorities to have regard to information on energy in exercising functions)—
(a) for the heading substitute "Local authorities in England to have regard to energy measures reports",
(b) in subsection (2), after "local authority" insert "in England",
(c) in subsection (4), in the definition of "local authority measure", for "a local authority" substitute "a local authority in England",
(d) in subsection (5) omit "the National Assembly for Wales and", and
(e) in subsection (6) omit paragraphs (b) and (h).

**82 Repeal of previous reporting obligation**

Section 2 of the Climate Change and Sustainable Energy Act 2006 (c. 19) (annual report on greenhouse gas emissions) is repealed.

### 83 Guidance on reporting

(1) The Secretary of State must publish guidance on the measurement or calculation of greenhouse gas emissions to assist the reporting by persons on such emissions from activities for which they are responsible.

(2) The guidance must be published not later than 1st October 2009.

(3) The Secretary of State may from time to time publish revisions to guidance under this section or revised guidance.

(4) Before publishing guidance under this section or revisions to it, the Secretary of State must consult the other national authorities.

(5) Guidance under this section and revisions to it may be published in such manner as the Secretary of State thinks fit.

### 84 Report on contribution of reporting to climate change objectives

(1) The Secretary of State must—
(a) review the contribution that reporting on greenhouse gas emissions may make to the achievement of the objectives of Her Majesty's Government in the United Kingdom in relation to climate change, and
(b) lay a report before Parliament setting out the conclusions of that review.

(2) The report must be laid before Parliament not later than 1st December 2010.

(3) In complying with this section the Secretary of State must consult the other national authorities.

### 85 Regulations about reporting by companies

(1) The Secretary of State must, not later than 6th April 2012—
(a) make regulations under section 416(4) of the Companies Act 2006 (c. 46) requiring the directors' report of a company to contain such information as may be specified in the regulations about emissions of greenhouse gases from activities for which the company is responsible, or
(b) lay before Parliament a report explaining why no such regulations have been made.

(2) Subsection (1)(a) is complied with if regulations are made containing provision in relation to companies, and emissions, of a description specified in the regulations.

### 86 Report on the civil estate

(1) It is the duty of the Treasury to lay before Parliament in respect of each year, beginning with the year 2008, a report containing an assessment of the progress made in the year towards improving the efficiency and contribution to sustainability of buildings that are part of the civil estate.

(2) The report must, in particular, include an assessment of the progress made in the year to which it relates towards—
(a) reducing the size of the civil estate, and

(b) ensuring that buildings that become part of the civil estate fall within the top quartile of energy performance.

(3) If a building that does not fall within the top quartile of energy performance becomes part of the civil estate in the year to which the report relates, the report must state the reasons why the building has nevertheless become part of the civil estate.

(4) A report under this section must be laid before Parliament not later than 1st June in the year following the year to which it relates.

(5) In this section "building" means a building that uses energy for heating or cooling the whole or any part of its interior.

(6) For the purposes of this section, a building is part of the civil estate if it is—
(a) used for the purposes of central government administration, and
(b) of a description of buildings for which, at the passing of this Act, the Treasury has responsibilities in relation to efficiency and sustainability.

(7) The Treasury may by order provide for buildings of a specified description to be treated as being, or as not being, part of the civil estate for the purposes of this section.

(8) Any such order is subject to affirmative resolution procedure.

**87 Power of Ministers and departments to offset greenhouse gas emissions**

(1) An authority to which this section applies may acquire and dispose of units or interests in units representing—
(a) a reduction in an amount of greenhouse gas emissions,
(b) the removal of an amount of greenhouse gas from the atmosphere, or
(c) an amount of greenhouse gas emissions allowed under a scheme or arrangement imposing a limit on such emissions.

(2) This section applies to—
(a) any Minister of the Crown or government department;
(b) the Scottish Ministers;
(c) the Welsh Ministers;
(d) any Northern Ireland department.

(3) If the Treasury acquire such units or interests in units, until they are disposed of they shall be treated as held by the persons for the time being constituting the Treasury.

**88 Fines for offences relating to pollution**

(1) In section 105(2) of the Clean Neighbourhoods and Environment Act 2005 (c. 16) (which postpones the increase by subsection (1)(b) in maximum fines under regulations under the Pollution Prevention and Control Act 1999 (c. 24) pending the commencement of section 154(1) of the Criminal Justice Act 2003 (c. 44)), for "Subsection (1)" substitute "Subsection (1)(a)".

(2) Regulation 39(2)(a) of the Environmental Permitting (England and Wales) Regulations 2007 (S.I. 2007/3538) (maximum fine on summary conviction of an offence committed before the commencement of section 154(1) of the Criminal Justice Act 2003) is revoked.

## PART 6

### GENERAL SUPPLEMENTARY PROVISIONS

*Territorial scope of provisions relating to greenhouse gas emissions*

**89 Territorial scope of provisions relating to greenhouse gas emissions**

(1) The provisions of this Act relating to emissions of greenhouse gases apply to emissions from sources or other matters occurring in, above or below—
 (a) UK coastal waters, or
 (b) the UK sector of the continental shelf,

as they apply to emissions from sources or matters occurring in the United Kingdom.

(2) In subsection (1)—
 "UK coastal waters" means areas landward of the seaward limit of the territorial sea adjacent to the United Kingdom;
 "the UK sector of the continental shelf" means the areas designated under section 1(7) of the Continental Shelf Act 1964 (c. 29).

(3) This section is subject to section 30 (emissions from international aviation or international shipping not to count as emissions from UK sources for the purposes of Part 1, except as provided by regulations).

*Orders and regulations*

**90 Orders and regulations**

(1) Orders and regulations under this Act must be made by statutory instrument, subject as follows.

(2) The power of a Northern Ireland department to make regulations under Part 3 (trading schemes) or Schedule 6 (charges for single use carrier bags)—
 (a) is exercisable by statutory instrument if the instrument also contains regulations under that Part or Schedule made or to be made by another national authority, and
 (b) otherwise, is exercisable by statutory rule for the purposes of the Statutory Rules (Northern Ireland) Order 1979 (S.I. 1979/1573 (N.I. 12)).

(3) An order or regulations under this Act may—
 (a) make different provision for different cases or circumstances,
 (b) include supplementary, incidental and consequential provision, and
 (c) make transitional provision and savings.

(4) Any provision that may be made by order under this Act may be made by regulations.

(5) Any provision that may be made by regulations under this Act may be made by order.

## 91 Affirmative and negative resolution procedure

(1) Where orders or regulations under this Act are subject to "affirmative resolution procedure" the order or regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of each House of Parliament.

(2) Where orders or regulations under this Act are subject to "negative resolution procedure" the statutory instrument containing the order or regulations is subject to annulment in pursuance of a resolution of either House of Parliament.

(3) Any provision that may be made by an order or regulations under this Act subject to negative resolution procedure may be made by an order or regulations subject to affirmative resolution procedure.

(4) This section does not apply to—
- (a) regulations under Part 3 (trading schemes) (but see Schedule 3), or
- (b) regulations under Schedule 6 (but see Part 3 of that Schedule).

*Interpretation*

## 92 Meaning of "greenhouse gas"

(1) In this Act "greenhouse gas" means any of the following—
- (a) carbon dioxide ($CO_2$),
- (b) methane ($CH_4$),
- (c) nitrous oxide ($N_2O$),
- (d) hydrofluorocarbons (HFCs),
- (e) perfluorocarbons (PFCs),
- (f) sulphur hexafluoride ($SF_6$).

(2) The Secretary of State may by order amend the definition of "greenhouse gas" in subsection (1) to add to the gases listed in that definition.

(3) That power may only be exercised if it appears to the Secretary of State that an agreement or arrangement at European or international level recognises that the gas to be added contributes to climate change.

(4) An order under this section is subject to negative resolution procedure.

## 93 Measurement of emissions etc by reference to carbon dioxide equivalent

(1) For the purposes of this Act greenhouse gas emissions, reductions of such emissions and removals of greenhouse gas from the atmosphere shall be measured or calculated in tonnes of carbon dioxide equivalent.

(2) A "tonne of carbon dioxide equivalent" means one metric tonne of carbon dioxide or an amount of any other greenhouse gas with an equivalent global warming potential (calculated consistently with international carbon reporting practice).

### 94 Meaning of "international carbon reporting practice"

(1) In this Act "international carbon reporting practice" means accepted practice in relation to reporting for the purposes of the protocols to the United Nations Framework Convention on Climate Change or such other agreements or arrangements at European or international level as the Secretary of State may specify by order.

(2) An order under this section is subject to negative resolution procedure.

### 95 Meaning of "national authority"

(1) In this Act "national authority" means any of the following—
- (a) the Secretary of State;
- (b) the Scottish Ministers;
- (c) the Welsh Ministers;
- (d) the relevant Northern Ireland department.

(2) Functions conferred or imposed by this Act on "the national authorities" are to be exercised by all of them jointly.

### 96 Meaning of "relevant Northern Ireland department"

(1) In this Act "the relevant Northern Ireland department", in relation to a matter or provision, means the Northern Ireland department responsible for the matter or, as the case may be, for the matters to which the provision relates.

(2) If more than one department is responsible, the reference is to all of them.

(3) Any question as to the Northern Ireland department responsible for a matter is to be determined by the Department of Finance and Personnel in Northern Ireland.

### 97 Minor definitions

In this Act—

"devolved legislature" means—
- (a) the Scottish Parliament,
- (b) the National Assembly for Wales, or
- (c) the Northern Ireland Assembly;

"emissions", in relation to a greenhouse gas, means emissions of that gas into the atmosphere that are attributable to human activity;

"enactment" includes—
- (a) an enactment contained in subordinate legislation within the meaning of the Interpretation Act 1978 (c. 30),
- (b) an enactment contained in, or in an instrument made under, an Act of the Scottish Parliament,
- (c) an enactment contained in, or in an instrument made under, Northern Ireland legislation, and
- (d) an enactment contained in, or in an instrument made under, a Measure or Act of the National Assembly for Wales;

"European law" means—

(a) all the rights, powers, liabilities, obligations and restrictions from time to time created or arising by or under the Community Treaties, and

(b) all the remedies and procedures from time to time provided for by or under the Community Treaties,

and "European policy" has a corresponding meaning;

"modifications", in relation to an enactment, includes additions or amendments to, or omissions from, the enactment;

"primary legislation" means—

(a) an Act of Parliament,

(b) an Act of the Scottish Parliament,

(c) a Measure or Act of the National Assembly for Wales, or

(d) Northern Ireland legislation.

**98 Index of defined expressions**

In this Act the following expressions are defined or otherwise explained by the provisions indicated—

| | |
|---|---|
| "the 1990 baseline" (in Parts 1 and 2) | section 1(2) |
| "administrator" (in Part 3) | section 55 |
| "administrator" (in Schedule 6) | paragraph 6(1) and (4) of Schedule 6 |
| "affirmative resolution procedure" (except in Part 3 and Schedule 6) | section 91(1) |
| "annual equivalent", in relation to the carbon budget for a period (in Parts 1 and 2) | section 5(2) |
| "budgetary periods" (in Parts 1 and 2) | section 4(1) |
| "carbon budget" (in Parts 1 and 2) | section 4(1) |
| "carbon unit" (in Parts 1 and 2) | section 26(1) |
| "the chair" (in Schedule 1) | paragraph 1(1) of Schedule 1 |
| "civil sanction" (in Schedule 6) | paragraph 9(3) of Schedule 6 |
| "the Committee" (in Part 2) | section 32 |
| "Counsel General" (in sections 61 to 70) | section 70(8) |

| | |
|---|---|
| "the deputy chair" (in Schedule 1) | paragraph 2 of Schedule 1 |
| "devolved authority" (in sections 61 to 70) | section 70(3) |
| "devolved functions", in relation to a reporting authority (in sections 61 to 69) | section 70(4) and (5) |
| "devolved legislature" | section 97 |
| "devolved Welsh functions", in relation to a reporting authority (in sections 61 to 69) | section 70(6) and (7) |
| "discretionary requirement" (in Schedule 6) | paragraph 12(3) of Schedule 6 |
| "electricity distributor" (in Schedule 4) | paragraph 2(3) of Schedule 4 |
| "electricity supplier" (in Schedule 4) | paragraph 2(2) of Schedule 4 |
| "emissions" | section 97 |
| "enactment" | section 97 |
| "environmental authority" (in Schedule 4) | paragraph 1(2) of Schedule 4 |
| "European law" | section 97 |
| "European policy" | section 97 |
| "financial year" (in Schedule 1) | paragraph 23 of Schedule 1 |
| "fixed monetary penalty" (in Schedule 6) | paragraph 10(3) of Schedule 6 |
| "greenhouse gas" | section 92 |
| "international carbon reporting practice" | section 94 |
| "Minister of the Crown" (in sections 61 to 70) | section 70(8) |
| "modifications", in relation to an enactment | section 97 |
| "national authority" | section 95 |
| "negative resolution procedure" (except in Part 3 and Schedule 6) | section 91(2) |
| "net UK carbon account" (in Parts 1 and 2) | section 27(1) |

| | |
|---|---|
| “net UK emissions” for a period, in relation to a greenhouse gas (in Parts 1 and 2) | section 29(1) |
| “non-monetary discretionary requirement” (in Schedule 6) | paragraph 12(4) of Schedule 6 |
| “participant” (in Part 3) | section 55 |
| “potential participant” (in Schedule 4) | paragraph 3(2) of Schedule 4 |
| “primary legislation” | section 97 |
| “the relevant national authority” (in Part 3) | section 47 |
| “the relevant national authority” (in Schedule 6) | section 77(3) |
| “the relevant Northern Ireland department” | section 96 |
| “reporting authority” (in sections 61 to 70) | section 70(1) and (2) |
| “seller” (in Schedule 6) | paragraph 3 of Schedule 6 |
| “single use carrier bag” (in Schedule 6) | paragraph 5 of Schedule 6 |
| “specified” (in Schedule 6) | paragraph 3(4) of Schedule 6 |
| “targeted greenhouse gas” (in Parts 1 and 2) | section 24(1) |
| “trading period” (in Part 3) | section 55 |
| “trading scheme” | section 44(2) |
| “UK emissions”, in relation to a greenhouse gas (in Part 1) | section 29(1) |
| “UK removals”, in relation to a greenhouse gas (in Part 1) | section 29(1) |
| “variable monetary penalty” (in Schedule 6) | paragraph 12(4) of Schedule 6 |
| “Wales” (in sections 61 to 70) | section 70(8) |
| “the waste reduction provisions” (in sections 72 to 75) | section 71(3) |

*Final provisions*

**99 Extent**

(1) This Act, apart from the provisions listed below, extends to the whole of the United Kingdom.

(2) The following provisions of this Act extend to England and Wales only—
  (a) sections 71 to 75 and Schedule 5 (waste reduction schemes);
  (b) section 76 (collection of household waste);
  (c) section 81 (climate change measures reports in Wales);
  (d) section 88 (fines for offences relating to pollution).

(3) Section 77 and Schedule 6 (charges for single use carrier bags) extend to England and Wales and Northern Ireland only.

(4) Section 79 and Schedule 8 (carbon emissions reduction targets) extend to England and Wales and Scotland only.

**100 Commencement**

(1) Part 1 (carbon target and budgeting), Part 2 (the Committee on Climate Change) and this Part come into force on the day this Act is passed.

(2) Section 71(1) and Schedule 5 (waste reduction schemes) come into force in accordance with sections 72 to 75.

(3) Section 81 (climate change measures reports in Wales) comes into force on such day as may be appointed by order made by the Welsh Ministers.

(4) Section 82 (repeal of previous reporting obligation) comes into force on 1st January 2009.

(5) The other provisions of this Act come into force at the end of two months beginning with the day it is passed.

**101 Short title**

The short title of this Act is the Climate Change Act 2008.

# SCHEDULES

## SCHEDULE 1

Section 32

### THE COMMITTEE ON CLIMATE CHANGE

*Membership*

1 (1) The Committee shall consist of—

(a) a person appointed by the national authorities to chair the Committee ("the chair"), and

(b) not less than five and not more than eight other members appointed by the national authorities.

(2) The national authorities must consult the chair before appointing the other members.

(3) In appointing a member, the national authorities must have regard to the desirability of securing that the Committee (taken as a whole) has experience in or knowledge of the following—

(a) business competitiveness;

(b) climate change policy at national and international level, and in particular the social impacts of such policy;

(c) climate science, and other branches of environmental science;

(d) differences in circumstances between England, Wales, Scotland and Northern Ireland and the capacity of national authorities to take action in relation to climate change;

(e) economic analysis and forecasting;

(f) emissions trading;

(g) energy production and supply;

(h) financial investment;

(i) technology development and diffusion.

(4) The Secretary of State may by order amend sub-paragraph (1)(b) so as to alter the minimum or maximum number of members of the Committee.

(5) Such an order may only be made with the consent of the other national authorities.

(6) Any such order is subject to negative resolution procedure.

2 The national authorities may, after consulting the chair, appoint one of the members as deputy to the chair ("the deputy chair").

*Term of office*

3 A member holds and vacates office in accordance with the terms of the member's appointment.

4 A member may resign by giving written notice to the Secretary of State.

5 The national authorities may remove a member—
(a) who has been absent from meetings of the Committee without its permission for a period of 6 months or more,
(b) who has become bankrupt or has made an arrangement with creditors,
(c) whose estate has been sequestrated in Scotland or who, under Scots law, has made a composition or arrangement with, or granted a trust deed for, creditors, or
(d) who in the opinion of the national authorities is otherwise unable or unfit to carry out the duties of that member.

6 A person ceases to be the chair or the deputy chair if the person—
(a) resigns that office by giving written notice to the Secretary of State, or
(b) ceases to be a member.

7 A person who—
(a) ceases to be a member, or
(b) ceases to be the chair or the deputy chair,
may be reappointed to that office.

*Remuneration and pensions etc*

8 The Committee may pay to the members such remuneration and allowances as the national authorities may determine.

9 The Committee must, if required to do so by the national authorities—
(a) pay such pensions, gratuities or allowances as the national authorities may determine to or in respect of any person who is or has been a member, or
(b) pay such sums as the national authorities may determine towards provision for the payment of pensions, gratuities or allowances to or in respect of such a person.

10 If the national authorities consider there are special circumstances which make it right for a person who has ceased to be a member to receive compensation, the Committee must pay the person such compensation as the national authorities may determine.

*Staff*

11 (1) The Committee must appoint a person to be chief executive, but may only appoint a person who has been approved by the national authorities.

(2) The chief executive is an employee of the Committee.

12 The Committee may appoint other employees.

13 The Committee must, if required to do so by the national authorities—
(a) pay such pensions, gratuities or allowances as the national authorities may determine to or in respect of any employee or former employee, or
(b) pay such sums as the national authorities may determine towards provision for the payment of pensions, gratuities or allowances to or in respect of any employee or former employee.

14 (1) In Schedule 1 to the Superannuation Act 1972 (c. 11) (kinds of employment to which section 1 of that Act applies), in the list of other bodies, at the appropriate place insert—

"The Committee on Climate Change."

(2) The Committee must pay to the Minister for the Civil Service, at such times as the Minister may direct, such sums as the Minister may determine in respect of any increase attributable to sub-paragraph (1) in the sums payable out of money provided by Parliament under the Superannuation Act 1972.

*Sub-committees*

15 (1) The Committee may establish sub-committees.

(2) A sub-committee may include persons who are not members of the Committee.

(3) The Committee may pay such remuneration and allowances as the national authorities may determine to any person who—

(a) is a member of a sub-committee, but

(b) is not a member of the Committee.

(4) This paragraph does not apply in relation to the Adaptation Sub-Committee.

*The Adaptation Sub-Committee*

16 (1) There shall be a sub-committee of the Committee, to be known as the Adaptation Sub-Committee or, in Welsh, as yr Is-bwyllgor Addasu (referred to in this paragraph as "the ASC").

(2) The ASC shall consist of—

(a) a person appointed by the national authorities to chair the ASC ("the ASC chair"), and

(b) not less than five other members appointed by the national authorities.

(3) The national authorities must—

(a) consult the chair before appointing the ASC chair, and

(b) consult the ASC chair before appointing the other members of the ASC.

(4) A person ceases to be the ASC chair if the person—

(a) resigns that office by giving written notice to the Secretary of State, or

(b) ceases to be a member of the ASC.

(5) The ASC may include persons who are not members of the Committee.

(6) Paragraphs 3 to 5 (term of office) apply to a person who is—

(a) a member of the Committee, and

(b) a member of the ASC,

in that person's capacity as a member of the ASC.

(7) Those paragraphs and paragraphs 8 to 10 (remuneration and pensions etc) apply to a member of the ASC who is not a member of the Committee as they apply to a member of the Committee.

(8) In the application of paragraph 5(a) by virtue of this paragraph, the reference to the Committee is a reference to the ASC.

(9) A person who—
  (a) ceases to be a member of the ASC, or
  (b) ceases to be the ASC chair,
may be reappointed to that office.

(10) The ASC must provide the Committee with such advice, analysis, information or other assistance as the Committee may require in connection with the exercise of its functions under—
  (a) section 38(1)(c) (advice etc to national authorities on adaptation to climate change),
  (b) section 57 (advice on report on impact of climate change), or
  (c) section 59 (reporting on progress in connection with adaptation).

*Proceedings*

17 The Committee may regulate—
  (a) its own procedure (including quorum), and
  (b) the procedure of any sub-committee (including quorum).

18 The validity of anything done by the Committee or any sub-committee is not affected by—
  (a) any vacancy in the membership of the Committee or sub-committee, or
  (b) any defect in the appointment of any member of the Committee or sub-committee.

19 The Committee must publish the minutes of its meetings in such manner as it considers appropriate.

*Discharge of functions*

20 The Committee may authorise a sub-committee, member or employee to exercise any of the Committee's functions.

*Application of seal and proof of documents*

21 (1) The application of the Committee's seal must be authenticated by the signature of—
  (a) a member of the Committee who is authorised (generally or specially) for that purpose, or
  (b) an employee who is so authorised.

(2) A document purporting to be duly executed under the seal of the Committee or to be signed on behalf of the Committee shall be received in evidence and treated as so executed or signed unless the contrary is shown.

(3) This paragraph does not apply in relation to Scotland.

*Reports and accounts*

22 (1) For each financial year the Committee must—

(a) prepare an annual report on the discharge of its functions during the year, and
(b) send a copy to the national authorities within such period as the national authorities may direct.

(2) A copy of each report received under this paragraph must be laid—
(a) by the Secretary of State before Parliament,
(b) by the Scottish Ministers before the Scottish Parliament,
(c) by the Welsh Ministers before the National Assembly for Wales, and
(d) by the relevant Northern Ireland department before the Northern Ireland Assembly.

23 In this Schedule "financial year" means—
(a) the period beginning with the day the Committee is established and ending with the next 31st March, and
(b) each subsequent period of 12 months ending with 31st March.

24 (1) The Committee must keep proper accounts and proper records in relation to the accounts.

(2) For each financial year the Committee must—
(a) prepare a statement of accounts in respect of that financial year, and
(b) send a copy of the statement to the national authorities and the Comptroller and Auditor General within such period as the national authorities direct.

(3) The statement must be in such form as the national authorities may direct.

(4) The Comptroller and Auditor General must—
(a) examine, certify and report on the statement, and
(b) send a copy of the certified statement and the report to the national authorities as soon as possible.

(5) A copy of each statement received under sub-paragraph (4) must be laid—
(a) by the Secretary of State before Parliament,
(b) by the Scottish Ministers before the Scottish Parliament,
(c) by the Welsh Ministers before the National Assembly for Wales, and
(d) by the relevant Northern Ireland department before the Northern Ireland Assembly.

*Information*

25 (1) The Committee must provide the national authorities with such information as they may request about its property.

(2) The Committee must provide the Secretary of State with such information as the Secretary of State may request about the exercise or proposed exercise of its functions under—
(a) Part 1 (carbon target and budgeting),
(b) section 33 (advice on level of 2050 target),
(c) section 34 (advice in connection with carbon budgets),
(d) section 35 (advice on emissions from international aviation and international shipping),
(e) section 36 (reports on progress),

(f) section 57 (advice on report on impact of climate change), or
(g) section 59 (reporting on progress in connection with adaptation).

(3) The Committee must provide a national authority with such information as the national authority may request about the exercise or proposed exercise of the Committee's functions under—
(a) section 38 (duty to provide advice or assistance on request), or
(b) section 48 (advice on trading scheme regulations),
in relation to that national authority.
If the information relates to the exercise or proposed exercise of those functions in relation to two or more national authorities, the request must be made by all of them jointly.

(4) The Committee must provide the national authorities with such information as they may request about the exercise or proposed exercise of any of its other functions.

(5) The Committee must also—
(a) permit any person authorised by a national authority to inspect and make copies of any accounts or other documents of the Committee, and
(b) provide such explanation of them as that person or the national authority may require.

(6) Before exercising a function under sub-paragraph (5), the national authority must consult the other national authorities.

*Publication of advice etc*

26 A requirement under this Act for the Committee to publish anything does not oblige it to publish—
(a) information it could refuse to disclose in response to a request under—
(i) the Freedom of Information Act 2000 (c. 36), or
(ii) the Environmental Information Regulations 2004 (S.I. 2004/3391) or any regulations replacing those regulations;
(b) information whose disclosure is prohibited by any enactment.

*Status*

27 (1) The Committee is not to be regarded as the servant or agent of the Crown or as enjoying any status, privilege or immunity of the Crown.

(2) The Committee is to be treated as a cross-border public authority within the meaning of the Scotland Act 1998 (c. 46) for the purposes of the following provisions of that Act—
(a) section 23(2)(b) (power of Scottish Parliament to require persons outside Scotland to attend to give evidence or produce documents);
(b) section 70(6) (legislation of Scottish Parliament not to require certain cross-border public authorities to prepare accounts).

*Public Records Act 1958 (c. 51)*

28 In Schedule 1 to the Public Records Act 1958 (definition of public records), in Part 2 of the Table at the end of paragraph 3, at the appropriate place

insert—

"The Committee on Climate Change."

*Parliamentary Commissioner Act 1967 (c. 13)*

29 In Schedule 2 to the Parliamentary Commissioner Act 1967 (departments etc subject to investigation)—

(a) at the appropriate place insert—

"The Committee on Climate Change.", and

(b) in the notes at the appropriate place insert—

"*Committee on Climate Change*

In the case of the Committee on Climate Change, no investigation is to be conducted in respect of any action taken by or on behalf of the Committee—

(a) in the exercise in or as regards Scotland of any function to the extent that the function is exercisable within devolved competence (within the meaning of section 54 of the Scotland Act 1998), or

(b) in connection with functions of the Committee in relation to Wales (within the meaning of the Government of Wales Act 2006)."

*House of Commons Disqualification Act 1975 (c. 24)*

30 In Part 2 of Schedule 1 to the House of Commons Disqualification Act 1975 (bodies of which all members are disqualified), at the appropriate place insert—

"The Committee on Climate Change."

*Northern Ireland Assembly Disqualification Act 1975 (c. 25)*

31 In Part 2 of Schedule 1 to the Northern Ireland Assembly Disqualification Act 1975 (bodies of which all members are disqualified), at the appropriate place insert—

"The Committee on Climate Change."

*Race Relations Act 1976 (c. 74)*

32 In Part 2 of Schedule 1A to the Race Relations Act 1976 (bodies and other persons subject to general statutory duty), at the appropriate place insert—

"The Committee on Climate Change."

*Freedom of Information Act 2000 (c. 36)*

33 In Part 6 of Schedule 1 to the Freedom of Information Act 2000 (other public bodies and offices which are public authorities), at the appropriate place insert—

"The Committee on Climate Change."

*Scottish Public Services Ombudsman Act 2002 (asp 11)*

34 (1) The Scottish Public Services Ombudsman Act 2002 is amended as follows.

(2) In section 7 (matters which may be investigated: restrictions), after subsection (6B) insert—

"(6C) The Ombudsman must not investigate action taken by or on behalf of the Committee on Climate Change in the exercise in or as regards Scotland of any function to the extent that the function is not exercisable within devolved competence (within the meaning of section 54 of the Scotland Act 1998)."

(3) In Schedule 2 (persons liable to investigation), after paragraph 91A insert—

"91B The Committee on Climate Change."

*Public Services Ombudsman (Wales) Act 2005 (c. 10)*

35 In Schedule 3 to the Public Services Ombudsman (Wales) Act 2005 (listed authorities), after the heading "Environment" insert—

"The Committee on Climate Change."

## SCHEDULE 2

Section 46

## TRADING SCHEMES

### PART 1

### SCHEMES LIMITING ACTIVITIES

*Introductory*

1 This Part of this Schedule deals with trading schemes that operate by limiting or encouraging the limitation of activities that consist of the emission of greenhouse gas or that cause or contribute, directly or indirectly, to such emissions.

*Trading periods*

2 The regulations must specify the period or periods by reference to which the scheme is to operate (a "trading period").

*Activities*

3 (1) The regulations must identify the activities to which the trading scheme applies.

(2) The regulations may identify the activities by reference to any, or any combination of, criteria and in particular—

(a) may identify the activities by reference to the locations or locations at which they are carried on, or

(b) may be expressed to apply to all activities of a particular kind carried on in the United Kingdom or a part of the United Kingdom.

(3) The regulations must specify the units of measurement of the activities for the purposes of the scheme.

(4) The regulations may specify units of measurement by reference to—
(a) the activities themselves,
(b) anything consumed or used for the purposes of the activities,
(c) anything produced by the activities, or
(d) any other consequence of the activities.

(5) The regulations may, in particular, make provision—
(a) for activities to be measured by reference to the amount (in tonnes of carbon dioxide equivalent) of the greenhouse gas emissions for which those activities are to be regarded as responsible; and
(b) as to the method by which that amount is to be measured or calculated.

(6) The regulations may make different provision in relation to different descriptions of activity to which the scheme applies.

*Participants*

4 (1) The regulations must identify the persons to whom the trading scheme applies (the "participants").

(2) The regulations—
(a) may identify the participants by reference to any, or any combination of, criteria, or
(b) provide for their identification by a specified person or body.

(3) The regulations may, in particular, identify or provide for the identification of the participants by reference to their responsibility for activities to which the trading scheme applies.

(4) The regulations may provide for more than one person to be treated as a single participant.

(5) The regulations may provide for persons to cease to be participants in circumstances specified in the regulations.

*Allocation of allowances*

5 (1) The regulations may provide for the allocation among the participants of allowances representing the right to carry on a specified amount of the activities in a trading period.

(2) The regulations may set a limit on—
(a) the total amount of the activities for a trading period, and
(b) the total amount of the allowances to be allocated for the period.

(3) The regulations may specify the method of allocation or provide for it to be determined in accordance with the regulations.

(4) The regulations may not provide for allowances to be allocated in return for consideration.

*Use of allowances*

6 (1) The regulations may require each participant to have or acquire enough allowances to match the participant's activities in a trading period, subject to any offsetting in accordance with provision made under paragraph 7.

(2) The regulations—

(a) may permit allowances held by a participant at the end of a trading period in excess of the participant's activities in the period to be used to cover the participant's activities in a later trading period,

(b) may permit allowances allocated to a participant for a trading period to be used to cover the participant's activities in an earlier trading period, and

(c) may in either case provide for such use of allowances to be subject to such conditions and limitations as may be specified in or determined in accordance with the regulations.

(3) The regulations must contain provision for ensuring that allowances used by a participant for the purposes of a trading scheme cannot be used by the participant for any other purpose.

(4) The regulations—

(a) may provide for the expiry of allowances after such period as may be specified in or determined in accordance with the regulations;

(b) may enable allowances to be cancelled by a person by whom they are held instead of being used for the purposes of a trading scheme.

*Credits*

7 (1) The regulations may enable participants to offset the carrying on of the activities in a trading period by acquiring credits representing—

(a) a reduction in an amount of greenhouse gas emissions, or

(b) the removal of an amount of greenhouse gas from the atmosphere.

(2) Regulations that make provision under this paragraph for a trading period must set a limit on the total amount of the activities for the period.

(3) If the regulations also provide for the allocation of allowances for the period, they must—

(a) set a limit on the total amount of the allowances to be allocated for the period, and

(b) require each participant to acquire enough credits to offset any activities carried on by the participant in the period in excess of those for which the participant has or has acquired allowances.

(4) Otherwise, such regulations must—

(a) set a limit on the amount of the activities that each participant may carry on in the period, and

(b) require each participant to acquire enough credits to offset any activities carried on by the participant in the period in excess of that limit.

(5) The regulations must specify—

(a) the descriptions of credits that may be used for offsetting a participant's activities,

(b) the value of different descriptions of credit as regards the amount of the activities they are treated as offsetting, and

(c) the circumstances in which credits of any description may be used for the purposes of the trading scheme.

(6) The regulations—

(a) must contain provision for ensuring that credits used to offset activities under a trading scheme cannot be used by the participant for any other purpose;

(b) may enable credits to be cancelled by a person by whom they are held instead of being used for that purpose.

*Payments*

8 (1) The regulations may provide that a participant who does not have or acquire enough allowances or credits to match or offset the participant's activities in a trading period must pay an amount specified in or determined in accordance with the regulations within the period so specified.

(2) The regulations may require the payment to be made to—

(a) the administrator, or

(b) such other person as the regulations may specify.

(3) The provision that may be made about the amount of the payment includes, in particular, provision—

(a) for the amount to be determined by the administrator or a national authority;

(b) in a case where the payment is not made within the period specified in the regulations, for the amount to increase at the rate so specified until payment;

(c) for the amount of the payment, or of any amount by reference to which it is to be calculated, to be adjusted from time to time by reference to inflation or some other factor.

(4) Provision within sub-paragraph (3)(c) may refer, in particular, to an index or data specified in the regulations (including as modified from time to time after the regulations come into force).

(5) If the regulations provide for payments to be made to a person other than a national authority, they must provide for that person to pay the sums received to the national authority or authorities specified in or determined in accordance with the regulations.

*Trading*

9 (1) The regulations must provide for the participants in a trading scheme to trade in any allowances or credits under the scheme.

(2) The regulations may also provide for trading in the allowances or credits by third parties authorised in accordance with the regulations.

(3) The regulations must specify the circumstances in which trading is permitted.

(4) The regulations may require trading to be notified to the administrator of the trading scheme.

*Permits*

10 (1) The regulations may provide that participants may only carry on activities to which the trading scheme applies, or specified activities to which the scheme applies, if they hold a permit.

(2) The regulations may make provision about the issue, variation, transfer, surrender and revocation of permits.

(3) The regulations may provide for conditions to be attached to permits.

(4) References in this Schedule to the requirements of the scheme include requirements imposed by conditions attached to a permit.

*Units under other schemes*

11 (1) The regulations may make provision for recognising any of the following as equivalent to allowances or credits under the trading scheme—

(a) allowances, credits or certificates under another trading scheme for which provision is made by regulations under this Part of this Act;

(b) units under any other trading scheme (at United Kingdom, European or international level) relating to greenhouse gas emissions.

(2) The regulations may provide—

(a) for determining the value for the purposes of the scheme of any such allowances, credits, certificates or units, and

(b) for the use for the purposes of the scheme of any such allowances, credits, certificates or units to be subject to such conditions and limitations as may be specified in or determined in accordance with the regulations.

## PART 2

## SCHEMES ENCOURAGING ACTIVITIES

*Introductory*

12 This Part of this Schedule deals with trading schemes that operate by encouraging activities that consist of, or that cause or contribute, directly or indirectly to—

(a) reductions in greenhouse gas emissions, or

(b) the removal of greenhouse gas from the atmosphere.

*Trading periods*

13 The regulations must specify the period or periods by reference to which the scheme is to operate (a “trading period”).

*Activities*

14 (1) The regulations must identify the activities to which the trading scheme applies.

(2) The regulations may identify the activities by reference to any, or any combination of, criteria and in particular—

(a) may identify the activities by reference to the locations or locations at which they are carried on, or
(b) may be expressed to apply to all activities of a particular kind carried on in the United Kingdom or a part of the United Kingdom.

(3) The regulations must specify the units of measurement of the activities for the purposes of the scheme.

(4) The regulations may specify units of measurement by reference to—
(a) the activities themselves,
(b) anything consumed or used for the purposes of the activities,
(c) anything produced by the activities, or
(d) any other consequence of the activities.

(5) The regulations may, in particular, make provision—
(a) for activities to be measured by reference to the amount (in tonnes of carbon dioxide equivalent) of the reduction of greenhouse gas emissions, or removals of greenhouse gas from the atmosphere, for which those activities are to be regarded as responsible; and
(b) as to the method by which that amount is to be measured or calculated.

(6) The regulations may make different provision in relation to different descriptions of activity to which the scheme applies.

*Participants*

15 (1) The regulations must identify the persons to whom the trading scheme applies (the "participants").

(2) The regulations—
(a) may identify the participants by reference to any, or any combination of, criteria, or
(b) provide for their identification by a specified person or body.

(3) The regulations may provide for more than one person to be treated as a single participant.

(4) The regulations may provide for persons to cease to be participants in circumstances specified in the regulations.

*Targets and obligations*

16 The regulations must, for each trading period—
(a) set a target for the total amount of the activities, and
(b) impose, or provide for the imposition of, an obligation on each participant in relation to the carrying on of a specified amount of the activities in the period.

*Certificates*

17 (1) The regulations must provide for the issue of certificates evidencing the carrying on of the activities in a trading period.

(2) The regulations may provide for certificates to evidence the carrying on of the activities—

(a) by the participant in question,

(b) by another participant in the trading scheme, or

(c) by a third party authorised in accordance with the regulations to obtain certificates for the purposes of the scheme.

(3) The regulations must require each participant to have enough certificates at the end of each trading period to comply with the participant's obligations under the trading scheme.

(4) The regulations must contain provision for ensuring that certificates used by a participant for that purpose cannot be used by the participant for any other purpose.

(5) The regulations—

(a) may provide for the expiry of certificates after such period as may be specified in or determined in accordance with the regulations;

(b) may enable certificates to be cancelled by a person by whom they are held instead of being used for the purposes of a trading scheme.

*Payments*

18 (1) The regulations may provide that a participant who does not have enough certificates at the end of a trading period to comply with the participant's obligations under the trading scheme must pay an amount specified in or determined in accordance with the regulations within the period so specified.

(2) The regulations may require the payment to be made to—

(a) the administrator, or

(b) such other person as the regulations may specify.

(3) The provision that may be made about the amount of the payment includes, in particular, provision—

(a) for the amount to be determined by the administrator or a national authority;

(b) in a case where the payment is not made within the period specified in the regulations, for the amount to increase at the rate so specified until payment;

(c) for the amount of the payment, or of any amount by reference to which it is to be calculated, to be adjusted from time to time by reference to inflation or some other factor.

(4) Provision within sub-paragraph (3)(c) may refer, in particular, to an index or data specified in the regulations (including as modified from time to time after the regulations come into force).

(5) If the regulations provide for payments to be made to a person other than a national authority, they must provide for that person to pay the sums received to the national authority or authorities specified in or determined in accordance with the regulations.

*Trading*

19 (1) The regulations must provide for the participants in a trading scheme to trade in certificates.

(2) The regulations may also provide for trading in certificates by third parties authorised in accordance with the regulations.

(3) The regulations must specify the circumstances in which trading is permitted.

(4) The regulations may require trading to be notified to the administrator of the trading scheme.

*Units under other schemes*

20 (1) The regulations may make provision for recognising any of the following as equivalent to certificates under the trading scheme—
(a) allowances, credits or certificates under another trading scheme for which provision is made by regulations under this Part of this Act;
(b) units under any other trading scheme (at United Kingdom, European or international level) relating to greenhouse gas emissions.

(2) The regulations may provide—
(a) for determining the value for the purposes of the scheme of any such allowances, credits, certificates or units, and
(b) for the use for the purposes of the scheme of any such allowances, credits, certificates or units to be subject to such conditions and limitations as may be specified in or determined in accordance with the regulations.

## PART 3

## ADMINISTRATION AND ENFORCEMENT

*The administrator*

21 (1) The regulations may appoint a person as the administrator of a trading scheme.

(2) The regulations may confer or impose functions on the administrator for the purposes of the scheme.

(3) Only the following may be appointed as the administrator of a trading scheme—
(a) the Secretary of State,
(b) the Scottish Ministers,
(c) the Welsh Ministers,
(d) the relevant Northern Ireland department,
(e) a body established by an enactment, or
(f) any combination of the above.

(4) The same person may be appointed as the administrator of more than one trading scheme.

(5) More than one person may be appointed as the administrator of the same trading scheme.

*Information*

22 (1) The regulations may require such information as may be specified in or determined in accordance with the regulations to be provided to—
(a) the administrator of a trading scheme,
(b) a national authority, or
(c) participants or potential participants in the scheme,
for purposes connected with the scheme.

(2) The regulations may confer power on the administrator of a trading scheme to require information to be provided to any of those persons for those purposes.

(3) The regulations must provide for a requirement by the administrator to provide information to be notified in writing to the person to whom it is made.

(4) If the regulations confer functions on the administrator for the purposes of this paragraph, they may provide for the administrator to delegate the performance of any of those functions.

(5) The regulations may provide for information held by or on behalf of the administrator of a trading scheme in connection with the administrator's functions to be disclosed to—
(a) any other administrator of the scheme,
(b) the administrator of another trading scheme, or
(c) a national authority.

*Registers*

23 (1) The regulations may provide for the creation and maintenance of a register or registers of information relating to a trading scheme and, in particular, for the register or registers to keep track of any of the following—
(a) the participants in a trading scheme;
(b) any limits on or obligations applying to the participants' activities under the scheme;
(c) any allocation of allowances among the participants;
(d) the allowances, credits, certificates or other units held by the participants or others;
(e) trading in allowances, credits, certificates or other units;
(f) the use by the participants or others of allowances, credits, certificates or other units for the purposes of the scheme;
(g) the cancellation of allowances, credits, certificates or other units;
(h) permits held by the participants, and any conditions attached to those permits.

(2) The regulations may, in particular, provide for the establishment and maintenance of accounts in which allowances, credits, certificates or other units may be held by the participants, the administrator or others and between which they may be transferred.

(3) The regulations may provide for the same register to operate in relation to more than one trading scheme.

(4) The regulations may make provision for the disclosure of information held in or derived from a register relating to a trading scheme—
(a) for the purposes of the administration of another trading scheme for which provision is made by regulations under this Part of this Act, or
(b) for the purposes of the administration of any other trading scheme (at United Kingdom, European or international level) relating to greenhouse gas emissions.

*Publication of information*

24 The regulations may confer or impose functions on the administrator of a trading scheme in relation to the publication of information relating to the scheme or its participants (including, in particular, information supplied to the administrator by the participants and others).

*Acquisition of units by the administrator*

25 The regulations may confer powers on the administrator of a trading scheme to acquire—
(a) allowances, credits or certificates under another trading scheme for which provision is made by regulations under this Part of this Act, or
(b) units under any other trading scheme (at United Kingdom, European or international level) relating to greenhouse gas emissions.

*Charges*

26 (1) The regulations may—
(a) require the payment by participants or other persons authorised to trade in allowances, credits or certificates of charges of an amount determined by or under the regulations by reference to the costs of operating the scheme, and
(b) provide for such charges to be imposed by—
(i) a national authority,
(ii) the administrator of the scheme, or
(iii) such other person as may be specified in or determined in accordance with the regulations.

(2) If the regulations provide for charges to be payable to a person other than a national authority, they must provide for that person to pay the sums received to the national authority or authorities specified in or determined in accordance with the regulations.

*Monitoring compliance*

27 (1) The regulations may make provision for monitoring compliance with the requirements of a trading scheme.

(2) The regulations may, in particular, make provision about—
(a) the keeping of records by the participants,
(b) the provision of information by the participants and others,
(c) the audit and verification of that information, and
(d) the inspection of premises.

(3) If the regulations confer functions on the administrator of the scheme for the purposes of this paragraph, they may provide for the administrator to delegate the performance of any of those functions.

*Enforcement*

28 (1) The regulations may confer powers on a person to whom this paragraph applies to—
(a) require the production of documents or the provision of information,
(b) question the officers of a company,
(c) enter premises with a warrant, or
(d) seize documents or records.

(2) The regulations must provide that the power in question may only be exercised where the person on whom it is conferred reasonably believes there has been a failure to comply with the requirements of a trading scheme.

(3) This paragraph applies to—
(a) a national authority,
(b) the administrator of the scheme, and
(c) such other person as may be specified in or determined in accordance with the regulations.

*Penalties*

29 (1) The regulations may provide that a person is liable to a financial or other penalty if the person fails to comply with the requirements of a trading scheme.

(2) The regulations may—
(a) specify the amount of any financial penalty, or
(b) provide for the amount of any financial penalty to be determined in accordance with the regulations.

(3) If the regulations provide for financial penalties to be payable to a person other than a national authority, they must provide for that person to pay the sums received to the national authority or authorities specified in or determined in accordance with the regulations.

*Offences*

30 (1) The regulations may create offences relating to trading schemes.

(2) The regulations may provide for such an offence to be triable—
(a) only summarily, or
(b) either summarily or on indictment.

(3) The regulations may provide for such an offence to be punishable on summary conviction—
(a) with imprisonment for a term not exceeding such period as is specified in the regulations (which may not exceed the normal maximum term),
(b) with a fine not exceeding such amount as is so specified (which may not exceed £50,000), or

(c) with both.

(4) The "normal maximum term" means—

(a) in relation to England and Wales—

(i) in the case of an offence triable only summarily, 51 weeks, and

(ii) in the case of an offence triable either summarily or on indictment, twelve months;

(b) in relation to Scotland—

(i) in the case of an offence triable only summarily, 6 months, and

(ii) in the case of an offence triable either summarily or on indictment, twelve months;

(c) in relation to Northern Ireland, six months.

(5) Regulations that—

(a) are made before the date on which section 281(5) of the Criminal Justice Act 2003 (c. 44) comes into force, and

(b) in relation to England and Wales, make provision for a summary offence to be punishable with a term of imprisonment exceeding six months,

must provide that, where the offence is committed before that date, it is punishable with imprisonment for a term not exceeding six months.

(6) Regulations that—

(a) are made before the date on which section 154(1) of the Criminal Justice Act 2003 comes into force, and

(b) in relation to England and Wales, make provision for an offence triable either summarily or on indictment to be punishable on summary conviction with a term of imprisonment exceeding six months,

must provide that, where the offence is committed before that date, it is punishable on summary conviction with imprisonment for a term not exceeding six months.

(7) The regulations may provide for an offence to be punishable on indictment—

(a) with imprisonment for a term not exceeding such period as is specified in the regulations (which may not exceed five years),

(b) with a fine, or

(c) with both.

(8) The regulations may—

(a) provide for defences against offences, and

(b) make provision about matters of procedure and evidence in proceedings relating to offences.

*Appeals*

31 (1) The regulations may confer rights of appeal against—

(a) decisions made in relation to a trading scheme, and

(b) civil penalties imposed or enforcement action taken for failure to comply with the requirements of a trading scheme.

(2) The regulations must specify the court, tribunal or person who is to hear and determine appeals in relation to a trading scheme.

(3) The regulations may, in particular, provide for appeals in relation to a trading scheme to be heard by—

(a) a national authority, if not the administrator of the trading scheme, or

(b) a person appointed by a national authority for that purpose.

(4) They may provide for an appeal to be determined by a person other than the person by whom the appeal was heard.

## SCHEDULE 3

Section 49

### TRADING SCHEMES REGULATIONS: FURTHER PROVISIONS

### PART 1

### REGULATIONS MADE BY A SINGLE NATIONAL AUTHORITY

1 This Part of this Schedule applies in relation to an instrument containing regulations under this Part of this Act made by a single national authority.

2 (1) Where the instrument contains regulations that—

(a) are to be made by the Secretary of State, and

(b) are subject to affirmative resolution procedure,

the regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of each House of Parliament.

(2) Where the instrument contains regulations that—

(a) are to be made by a national authority other than the Secretary of State, and

(b) are subject to affirmative resolution procedure,

the regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of the relevant devolved legislature.

3 (1) An instrument containing regulations made by the Secretary of State that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of either House of Parliament.

(2) An instrument containing regulations made by the Scottish Ministers that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of the Scottish Parliament.

(3) An instrument containing regulations made by the Welsh Ministers that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of the National Assembly for Wales.

(4) An instrument containing regulations made by a Northern Ireland department that are subject to negative resolution procedure is subject to negative resolution within the meaning of section 41(6) of the Interpretation

Act (Northern Ireland) 1954 (c. 33 (N.I.)) as if it were a statutory instrument within the meaning of that Act.

4 Any provision that may be made by regulations subject to negative resolution procedure may be made by regulations subject to affirmative resolution procedure.

## PART 2

## REGULATIONS MADE BY TWO OR MORE NATIONAL AUTHORITIES

5 This Part of this Schedule applies in relation to an instrument containing regulations under this Part of this Act made or to be made by any two or more of—

(a) the Secretary of State,

(b) the Welsh Ministers, and

(c) a Northern Ireland department.

6 If any of the regulations are subject to affirmative resolution procedure, all of them are subject to that procedure.

7 Paragraphs 2 and 3 (affirmative and negative resolution procedure) apply to the instrument as they apply to an instrument containing regulations made by a single national authority.

8 (1) If in accordance with paragraph 3 (negative resolution procedure)—

(a) either House of Parliament resolves that an address be presented to Her Majesty praying that an instrument containing regulations made by the Secretary of State be annulled, or

(b) a devolved legislature resolves that an instrument containing regulations made by a national authority be annulled,

nothing further is to be done under the instrument after the date of the resolution and Her Majesty may by Order in Council revoke the instrument.

(2) This is without prejudice to the validity of anything previously done under the instrument or to the making of a new instrument.

(3) This paragraph applies in place of provision made by any other enactment about the effect of such a resolution.

## PART 3

## POWER TO MAKE PROVISION BY ORDER IN COUNCIL

9 (1) Her Majesty may by Order in Council make provision for trading schemes.

(2) That power may only be exercised to make an Order in Council—

(a) that extends or applies both to Scotland and to one or more of England, Wales and Northern Ireland, or

(b) that extends to Scotland only and contains both provision within the legislative competence of the Scottish Parliament and provision outside that competence.

(3) The provision that may be made by an Order in Council under this paragraph includes any provision that may be made by a national authority by regulations under this Part of this Act.

10 No recommendation is to be made to Her Majesty in Council to make an Order in Council under paragraph 9 unless the requirements of section 48(1) and (2) as to advice and consultation have been complied with.

11 (1) This paragraph applies to an Order in Council under paragraph 9 containing any provision that, were it to be made by regulations under this Part of this Act, would be subject to affirmative resolution procedure.

(2) No recommendation is to be made to Her Majesty in Council to make an Order in Council to which this paragraph applies unless—

(a) in the case of an Order in Council containing provision that may be made by the Secretary of State by regulations under this Part of this Act, a draft of the statutory instrument containing the Order in Council has been laid before, and approved by a resolution of, each House of Parliament, and

(b) in the case of an Order in Council containing provision that may be made by a national authority other than the Secretary of State by regulations under this Part of this Act, a draft of the statutory instrument containing the Order in Council has been laid before, and approved by a resolution of, the relevant devolved legislature.

12 (1) This paragraph applies to an Order in Council under paragraph 9 other than one to which paragraph 11 applies.

(2) An Order in Council to which this paragraph applies containing provision that may be made by the Secretary of State by regulations under this Part of this Act is subject to annulment in pursuance of a resolution of either House of Parliament.

(3) An Order in Council to which this paragraph applies containing provision that may be made by the Scottish Ministers by regulations under this Part of this Act is subject to annulment in pursuance of a resolution of the Scottish Parliament.

(4) An Order in Council to which this paragraph applies containing provision that may be made by the Welsh Ministers by regulations under this Part of this Act is subject to annulment in pursuance of a resolution of the National Assembly for Wales.

(5) An Order in Council to which this paragraph applies containing provision that may be made by a Northern Ireland department by regulations under this Part of this Act is subject to negative resolution within the meaning of section 41(6) of the Interpretation Act (Northern Ireland) 1954 (c. 33 (N.I.)) as if it were a statutory instrument within the meaning of that Act.

13 (1) If in accordance with paragraph 12—

(a) either House of Parliament resolves that an address be presented to Her Majesty praying that an Order in Council be annulled, or

(b) a devolved legislature resolves that an Order in Council be annulled,

nothing further is to be done under the Order in Council after the date of the resolution and Her Majesty may by Order in Council revoke it.

(2) This is without prejudice to the validity of anything previously done under the Order in Council or to the making of a new Order in Council.

(3) This paragraph applies in place of provision made by any other enactment about the effect of such a resolution.

## SCHEDULE 4

Section 50

### TRADING SCHEMES: POWERS TO REQUIRE INFORMATION

*Introductory*

1 (1) The powers conferred by this Schedule are exercisable by the following authorities—
(a) the Secretary of State;
(b) the Scottish Ministers;
(c) the relevant Northern Ireland department;
(d) the Welsh Ministers;
(e) the Environment Agency;
(f) the Scottish Environment Protection Agency.

(2) References in this Schedule to an "environmental authority" are to any of those authorities.

*Information from electricity suppliers and distributors*

2 (1) An environmental authority may, for the purposes of enabling a trading scheme to be established, by notice require an electricity supplier or electricity distributor to provide any of the following information—
(a) information about the electricity meters and metering systems for which the supplier or distributor is responsible, including (in particular) their locations and any identifying features;
(b) information about the persons to whom electricity measured by those meters or systems is supplied or who purchase such electricity;
(c) information about the consumption by those persons of that electricity;
(d) any other information that the environmental authority considers necessary for identifying the potential participants in the scheme.

(2) An "electricity supplier"—
(a) in relation to England and Wales and Scotland means an authorised supplier within the meaning of the Electricity Act 1989 (c. 29) (see section 64(1) of that Act);
(b) in relation to Northern Ireland means—
(i) an electricity supplier within the meaning of the Electricity (Northern Ireland) Order 1992 (S.I. 1992/231) (N.I. 1) (see Article 3 of that Order), or
(ii) a person who may supply electricity to premises without a licence by virtue of an exemption under Article 9 of that Order.

(3) An "electricity distributor"—
(a) in relation to England and Wales and Scotland means an authorised distributor within the meaning of the Electricity Act 1989 (see section 64(1) of that Act);
(b) in relation to Northern Ireland means an electricity distributor within the meaning of the Electricity (Northern Ireland) Order 1992 (see Article 3 of that Order).

(4) References in this Schedule to an electricity supplier or electricity distributor include an agent of such a supplier or distributor.

*Information from potential participants in a trading scheme*

3 (1) An environmental authority may, for the purposes of enabling a trading scheme to be established, by notice require a potential participant in the scheme to provide any of the following information—

(a) information about whether the criteria specified in the notice are met by the potential participant, either alone or together with any other person or persons;

(b) information identifying any potential co-participant;

(c) contact details for the potential participant and any potential co-participant;

(d) information about the meters that measure electricity supplied to or purchased by the potential participant or any potential co-participant;

(e) information about the consumption of electricity by the potential participant and any potential co-participant;

(f) information about any climate change agreement (within the meaning of Schedule 6 to the Finance Act 2000 (c. 17)) entered into by or on behalf of the potential participant or any potential co-participant.

(2) A "potential participant", in relation to a trading scheme, means a person who the environmental authority considers—

(a) will or may be a participant in the scheme, or

(b) will or may fall to be treated together with any other person or persons (a "potential co-participant") as such a participant.

*Requirements for a valid notice*

4 (1) A notice under this Schedule must comply with the following requirements.

(2) The notice must—

(a) be in writing,

(b) specify the information to be provided,

(c) specify the name and address of the person to whom the information is to be provided,

(d) specify the date by which the information is to be provided, and

(e) explain the consequences of failure to comply with the notice.

(3) An environmental authority must not give a notice requiring information from a person unless—

(a) the authority has previously sent the person a request in writing for the information, and

(b) the person has failed to provide the information within the period of 28 days beginning with the day on which the request was sent.

*Failure to comply with notice etc an offence*

5 (1) A person who—

(a) fails without reasonable excuse to comply with a notice under this Schedule, or

(b) provides information in response to such a notice that the person knows or suspects to be false or misleading,

commits an offence.

(2) A person guilty of such an offence is liable on summary conviction to a fine not exceeding level 5 on the standard scale.

*Disclosure of information*

6 (1) This paragraph applies to information obtained by an environmental authority (whether or not pursuant to a notice under this Schedule) from—

(a) an electricity supplier or electricity distributor, or

(b) a potential participant,

for the purposes of enabling a trading scheme to be established.

(2) The information may be disclosed for the purposes of or in connection with the establishment, operation or enforcement of a trading scheme—

(a) by an environmental authority to another environmental authority or the administrator of the scheme, or

(b) by the administrator of the scheme to any other administrator of the scheme or an environmental authority.

(3) This does not affect any other right to disclose information within sub-paragraph (1) apart from this paragraph.

## SCHEDULE 5

Section 71

### WASTE REDUCTION SCHEMES

### PART 1

### MAIN PROVISIONS

1 After section 60 of the Environmental Protection Act 1990 (c. 43) insert—

*"Waste reduction schemes*

**60A Waste reduction schemes**

A waste collection authority whose area is in England may make a waste reduction scheme in accordance with Schedule 2AA to this Act.".

2 After Schedule 2A to that Act insert—

"SCHEDULE 2AA

WASTE REDUCTION SCHEMES

*Introductory*

1 (1) The purpose of a waste reduction scheme is to provide a financial incentive—

(a) to produce less domestic waste, and

(b) to recycle more of what is produced,

and accordingly to reduce the amount of residual domestic waste.

(2) A waste reduction scheme—

(a) may cover the whole or any part of the area of a waste collection authority, and

(b) may apply to all domestic premises, to domestic premises other than those of a specified description or to specified descriptions of domestic premises.

*Conditions for making waste reduction scheme*

2 (1) A waste collection authority may make a waste reduction scheme only if—

(a) a good recycling service is available to the occupiers of premises to which the scheme applies,

(b) the scheme takes account of the needs of groups who might be unduly disadvantaged by it, and

(c) the authority has a strategy for preventing, minimising or otherwise dealing with the unauthorised deposit or disposal of waste.

(2) In sub-paragraph (1)(a) above—

(a) a "recycling service" means arrangements for the collection of recyclable domestic waste from premises separately from other waste; and

(b) a "good" recycling service means a recycling service that meets the standards specified for the purposes of this definition in guidance issued by the Secretary of State.

(3) The Secretary of State may by order amend sub-paragraphs (1) and (2) above.

*Incentive under waste reduction scheme*

3 (1) A waste reduction scheme must provide for a financial incentive that the authority considers will be effective to achieve the purpose of the scheme.

(2) The scheme may provide for the incentive to be provided—

(a) by means of rebates from council tax or by other payments, or

(b) by means of charges under paragraph 4,

or by any combination of those means.

*Charges in respect of residual domestic waste*

4 (1) A waste reduction scheme may include provision for charging by reference to—
(a) the amount of residual domestic waste collected from premises,
(b) the size of receptacles used for the purposes of the collection of residual domestic waste from premises,
(c) the number of receptacles used for such purposes, or
(d) the frequency with which residual domestic waste is collected from premises,

or by reference to any combination of those factors.

(2) The scheme may, in particular, make provision for occupiers of premises—
(a) to be required (by notice under section 46) to place residual domestic waste for collection in receptacles of a specified kind,
(b) to be required (by such notice) to place such waste in receptacles that are identified by such means as may be specified, or
(c) to be required to do both,

and for a charge to be made by the authority in respect of the receptacles, the means of identifying them or both.

(3) A charge under this paragraph in respect of a receptacle is in addition to any charge under section 46 in respect of the cost of providing the receptacle.

(4) The amount of any charge under this paragraph need not be related to the authority's costs.

(5) The scheme may make provision as to the person or persons by whom any charge is payable.

(6) The scheme may—
(a) require any charge to be paid in advance on the basis of an estimate of the amount that is likely to be payable in respect of any premises; or
(b) require payments in respect of any charge to be made on account or by instalments.

*Charging: supplementary provisions*

5 (1) The Secretary of State may by order set a limit on the amount of the charge under paragraph 4 that may be imposed in respect of any premises in any financial year.

(2) A failure to pay a charge under paragraph 4 does not affect the authority's duty under section 45(1)(a) (general duty to arrange for collection of household waste).

(3) Section 45(3) (general prohibition on charging for collection of household waste) has effect subject to paragraph 4.

*Requirement of revenue neutrality*

6 (1) From year to year, and taking one year with another, the aggregate amount of charges under a waste reduction scheme must not exceed the aggregate amount of the rebates or other payments under the scheme.

(2) The Secretary of State may by order amend sub-paragraph (1) above.

(3) Any such order may make any amendments of paragraph 4(4) that appear to the Secretary of State to be necessary or expedient in consequence of, or in connection with, the amendment of sub-paragraph (1) above.

*Procedure for putting scheme in place*

7 (1) The authority must comply with the following requirements after making a waste reduction scheme and before it is brought into operation.

(2) The authority must publish the scheme in such manner as it considers appropriate.

(3) The authority must send to the occupier of any premises to which the scheme applies a notice setting out—

(a) the requirements applicable under the scheme in relation to the collection of domestic waste from premises to which the scheme applies;

(b) any rebates or other payments available under the scheme and the manner in which they are to be made; and

(c) any charges provided for by the scheme and the manner in which they are to be collected.

*Appeals*

8 A waste reduction scheme must contain provision enabling a person to appeal against any decision affecting, directly or indirectly, that person's entitlement to a rebate or other payment, or liability to pay a charge, under the scheme.

*Separate account to be kept*

9 (1) A waste collection authority that operates a waste reduction scheme must keep a separate account of—

(a) any rebates or other payments under the scheme, and

(b) any charges received by it under the scheme.

(2) Any person interested may at any reasonable time and without payment inspect the account and make copies of it or any part of it.

(3) A person having custody of the account who intentionally obstructs a person in the exercise of the rights conferred by sub-paragraph (2) above commits an offence.

(4) A person guilty of such an offence is liable on summary conviction to a fine not exceeding level 3 on the standard scale.

*Contributions by waste disposal authority*

10 (1) Where a waste collection authority that operates a waste reduction scheme is not also the waste disposal authority, the waste disposal authority may pay to the collection authority contributions of such amounts as the disposal authority may determine towards expenditure of the collection authority attributable to the scheme.

(2) The collection authority must supply to the disposal authority such information as the disposal authority may reasonably require for the purpose of determining amounts under this paragraph.

*Power to make provision as to administration etc*

11 (1) The Secretary of State may by regulations make provision as to—
(a) the manner in which the amount of any rebate or other payment is to be determined, and any rebate or payment is to be given, and
(b) the manner in which—
(i) the amount of any charge is to be determined, and
(ii) any charge is to be collected or enforced.

(2) The regulations may in particular provide—
(a) for appeals against determinations or any failure to make a determination,
(b) for the appointment of persons or bodies to hear appeals, and
(c) for charges to be recoverable, if a county court so orders, as if they were payable under a county court order.

(3) The regulations may include provision—
(a) for integrating the administration of the scheme with the administration of council tax, and
(b) for that purpose modifying, to such extent as appears to the Secretary of State to be necessary or expedient, any of the enactments relating to council tax.

In paragraph (b) "modifying" includes making additions, amendments or omissions.

(4) The regulations may in particular provide—
(a) for including material relating to the scheme in the notice containing the council tax demand,
(b) for applying to questions arising under the scheme the procedure for appeals about liability to council tax, and
(c) for applying to any liability under the scheme the procedures for the enforcement of liability for council tax.

*Use of information obtained for council tax purposes*

12 An authority may use for the purpose of administering a waste reduction scheme information it has obtained for the purpose of carrying out its functions under the enactments relating to council tax.

*Amendment or revocation of waste reduction scheme*

13 (1) An authority that has made a waste reduction scheme may amend or revoke the scheme.

(2) After amending a scheme and before bringing the amendment into operation, the authority must—
(a) publish the amended scheme in such manner as it thinks appropriate, and
(b) if the amendment affects any of the matters previously notified to occupiers, send to the occupier of any premises to which the scheme applies a notice setting out the effect of the amendment.

(3) The amendment or revocation of a scheme does not affect any entitlement or liability under the scheme in respect of a period before the amendment or revocation takes effect.

(4) The revocation of a scheme does not affect the duty of the authority to comply with paragraph 6(1).

*Guidance*

14 (1) The Secretary of State may issue guidance to waste collection authorities and waste disposal authorities as respects the exercise of their functions under this Schedule.

(2) Any such guidance issued—
(a) must be published in such manner as the Secretary of State considers appropriate, and
(b) may be amended or replaced by further guidance, or revoked.

(3) In exercising their functions under this Schedule waste collection authorities and waste disposal authorities must have regard to any guidance in force under this paragraph.

*Interpretation*

15 (1) In this Schedule—
"domestic premises" means—
(a) a building or self-contained part of a building which is used wholly for the purposes of living accommodation,
(b) a caravan (as defined in section 29(1) of the Caravan Sites and Control of Development Act 1960 (c. 62)) that usually and for the time being is situated on a caravan site (within the meaning of that Act), or
(c) a moored vessel used wholly for the purposes of living accommodation;
"domestic waste" means household waste from domestic premises;
"enactment" includes an enactment contained in subordinate legislation;

"recyclable waste" means waste that is capable of being recycled;

"residual domestic waste" means domestic waste that is not—

(a) waste meeting the conditions for collection by the authority as recyclable waste, or

(b) waste for which a charge may be made by virtue of regulations under section 45(3) (power to charge for collection of household waste in prescribed cases);

"specified" means specified in the waste reduction scheme.

(2) The Secretary of State may by order amend the definition of "domestic premises" in sub-paragraph (1).

(3) References in this Schedule to recycling include re-using and composting.

*Orders and regulations*

16 (1) An order under paragraph 2(3), 6(2) or 15(2) is subject to affirmative resolution procedure.

(2) Section 161(3) (negative resolution procedure: orders) applies in relation to an order under paragraph 5(1), subject as follows.

(3) An order under that paragraph is subject to affirmative resolution procedure if—

(a) it is the first order to be made under that paragraph, or

(b) it increases the limit for the time being set by an order under that paragraph by more than is necessary to reflect changes in the value of money since that limit was set.

(4) Section 161(2) (negative resolution procedure: regulations) applies in relation to regulations under paragraph 11, subject as follows.

(5) Regulations under that paragraph are subject to affirmative resolution procedure if they modify an enactment contained in an Act of Parliament.

(6) Where an order or regulations are subject to "affirmative resolution procedure" the Secretary of State must not make the order or regulations unless a draft of the statutory instrument containing them has been laid before and approved by resolution of each House of Parliament.".

## PART 2

## CONSEQUENTIAL AMENDMENTS

3 (1) Section 46 of the Environmental Protection Act 1990 (c. 43) (receptacles for household waste) is amended as follows.

(2) After subsection (1) insert—

"(1A) Where—

(a) subsection (1) applies to a waste collection authority, and

(b) a waste reduction scheme under Schedule 2AA to this Act is in operation in the authority's area,

the authority may require the occupier to place the waste for collection in receptacles identified by such means as may be specified.

(1B) A requirement under subsection (1A)—

(a) must be imposed by notice served on the occupier;

(b) may be imposed instead of, or in addition to, any requirement imposed on the occupier under subsection (1).".

(3) In subsection (6) (penalties for failure to comply with requirements under subsection (1) etc) after "subsection (1)," insert "(1A),".

(4) In subsection (10) (interpretation), in the definition of "specified", after "subsection (1)" insert "or (1A)".

4 (1) Section 161 of that Act (regulations, orders and directions) is amended as follows.

(2) After subsection (2) (negative resolution procedure: regulations) insert—

"(2ZA) Subsection (2) does not apply to a statutory instrument containing regulations under paragraph 11 of Schedule 2AA to this Act to which paragraph 16(5) of that Schedule applies."

(3) In subsection (4) (instruments not subject to negative resolution procedure), after paragraph (a) insert—

"(aa) which contains—

(i) an order under paragraph 2(3), 6(2) or 15(2) of Schedule 2AA to this Act, or

(ii) an order under paragraph 5(1) of that Schedule to which paragraph 16(3) of that Schedule applies, or".

## SCHEDULE 6

Section 77

### CHARGES FOR SINGLE USE CARRIER BAGS

### PART 1

### POWERS TO MAKE REGULATIONS ABOUT CHARGES

*General power*

1 The relevant national authority may make provision by regulations about charging by sellers of goods for the supply of single use carrier bags.

*Requirement to charge*

2 The regulations may make provision requiring sellers of goods to charge for single use carrier bags supplied—

(a) at the place where the goods are sold, for the purpose of enabling the goods to be taken away, or

(b) for the purpose of enabling the goods to be delivered.

*Sellers of goods*

3 (1) "Seller", in relation to goods, has the meaning given by the regulations which may define that term by reference (in particular) to—
(a) a person's involvement in selling the goods,
(b) a person's interest in the goods, or
(c) a person's interest in the place at or from which the goods are sold,
or any combination of those factors.

(2) The regulations may make provision for regulations under this Schedule to apply—
(a) to all sellers of goods,
(b) to sellers of goods named in the regulations,
(c) to sellers of goods identified by reference to specified factors, or
(d) to sellers of goods within paragraph (b) and sellers of goods within paragraph (c).

(3) The specified factors may include—
(a) the place or places at or from which a seller supplies goods;
(b) the type of goods that a seller supplies;
(c) the value of goods that a seller supplies;
(d) a seller's turnover or any part of that turnover.

(4) In this Schedule "specified" means specified in regulations under this Schedule.

*Amount of charge*

4 The regulations may specify the minimum amount that a seller must charge for each single use carrier bag, or provide for that amount to be determined in accordance with the regulations.

*Single use carrier bags*

5 "Single use carrier bag" has the meaning given by the regulations, which may define that term by reference (in particular) to—
(a) a bag's size, thickness, construction, composition or other characteristics, or
(b) its intended use,
or any combination of those factors.

*Administration*

6 (1) The regulations may appoint a person (an "administrator") to administer provision made by regulations under this Schedule.

(2) More than one person may be appointed as administrator.

(3) The regulations may confer or impose powers or duties on an administrator and may (in particular) do so—
(a) by making modifications to any enactment applying to the administrator, or
(b) by providing for any such enactment to apply, with or without modifications, for the purposes of regulations under this Schedule.

(4) References in this Schedule to an administrator include a person appointed by an administrator.

*Record-keeping and publication of records*

7 (1) The regulations may require records to be kept relating to charges made for single use carrier bags.

(2) The regulations may require—

(a) the records, or such other information as may be specified, to be published at such times and in such manner as may be specified;

(b) the records, or such other information as may be specified, to be supplied on request and in such manner as may be specified to—

(i) the relevant national authority,

(ii) an administrator, or

(iii) members of the public.

(3) The regulations may (in particular) require the publication or supply of records or information relating to any of the following—

(a) the amount received by a seller by way of charges for single use carrier bags;

(b) the seller's gross or net proceeds of the charge;

(c) the uses to which the net proceeds of the charge have been put.

(4) In this paragraph—

"gross proceeds of the charge" means the amount received by the seller by way of charges for single use carrier bags;

"net proceeds of the charge" means the seller's gross proceeds of the charge reduced by such amounts as may be specified.

*Enforcement*

8 (1) The regulations may confer or impose powers or duties on an administrator to enforce provision made by regulations under this Schedule.

(2) The regulations may (in particular) confer powers on an administrator to—

(a) require the production of documents or the provision of information, or

(b) question a seller or officers or employees of a seller.

(3) Regulations under sub-paragraph (2) must contain provision for ensuring that the power in question is exercised by a person only where the person reasonably believes there has been a failure to comply with a requirement of regulations under this Schedule.

## PART 2

## CIVIL SANCTIONS

*Civil sanctions*

9 (1) The relevant national authority may make provision by regulations about civil sanctions for breaches of regulations under this Schedule.

(2) For the purposes of this Schedule a person breaches regulations under this Schedule if, in such circumstances as may be specified, the person—
  (a) fails to comply with a requirement made by or under the regulations, or
  (b) obstructs or fails to assist an administrator.

(3) In this Schedule "civil sanction" means—
  (a) a fixed monetary penalty (see paragraph 10), or
  (b) a discretionary requirement (see paragraph 12).

*Fixed monetary penalties*

10 (1) The regulations may make provision conferring on an administrator the power by notice to impose a fixed monetary penalty on a person who breaches regulations under this Schedule.

(2) The regulations may only confer such a power in relation to a case where the administrator is satisfied on the balance of probabilities that the breach has occurred.

(3) For the purposes of this Schedule a "fixed monetary penalty" is a requirement to pay to an administrator a penalty of an amount specified in or determined in accordance with the regulations.

(4) The regulations may not provide for the imposition of a fixed monetary penalty in excess of £5,000.

*Fixed monetary penalties: procedure*

11 (1) Provision under paragraph 10 must secure that—
  (a) where an administrator proposes to impose a fixed monetary penalty on a person, the administrator must serve on that person a notice of what is proposed (a "notice of intent") that complies with sub-paragraph (2),
  (b) the notice of intent also offers the person the opportunity to discharge the person's liability for the fixed monetary penalty by payment of a specified sum (which must be less than or equal to the amount of the penalty),
  (c) if the person does not so discharge liability—
    (i) the person may make written representations and objections to the administrator in relation to the proposed imposition of the fixed monetary penalty, and
    (ii) the administrator must at the end of the period for making representations and objections decide whether to impose the fixed monetary penalty,
  (d) where the administrator decides to impose the fixed monetary penalty, the notice imposing it ("the final notice") complies with sub-paragraph (4), and
  (e) the person on whom a fixed monetary penalty is imposed may appeal against the decision to impose it.

(2) To comply with this sub-paragraph the notice of intent must include information as to—
  (a) the grounds for the proposal to impose the fixed monetary penalty,
  (b) the effect of payment of the sum referred to in sub-paragraph (1)(b),

(c) the right to make representations and objections,

(d) the circumstances in which the administrator may not impose the fixed monetary penalty,

(e) the period within which liability to the fixed monetary penalty may be discharged, which may not exceed the period of 28 days beginning with the day on which the notice of intent was received, and

(f) the period within which representations and objections may be made, which may not exceed the period of 28 days beginning with the day on which the notice of intent was received.

(3) Provision pursuant to sub-paragraph (1)(c)(ii) must include provision for circumstances in which the administrator may not decide to impose a fixed monetary penalty.

(4) To comply with this sub-paragraph the final notice referred to in sub-paragraph (1)(d) must include information as to—

(a) the grounds for imposing the penalty,

(b) how payment may be made,

(c) the period within which payment must be made,

(d) any early payment discounts or late payment penalties,

(e) rights of appeal, and

(f) the consequences of non-payment.

(5) Provision pursuant to sub-paragraph (1)(e) must secure that the grounds on which a person may appeal against a decision of the administrator include the following—

(a) that the decision was based on an error of fact;

(b) that the decision was wrong in law;

(c) that the decision was unreasonable.

*Discretionary requirements*

12 (1) The regulations may make provision conferring on an administrator the power by notice to impose one or more discretionary requirements on a person who breaches regulations under this Schedule.

(2) The regulations may only confer such a power in relation to a case where the administrator is satisfied on the balance of probabilities that the breach has occurred.

(3) For the purposes of this Schedule a "discretionary requirement" means—

(a) a requirement to pay a monetary penalty to an administrator of such amount as the administrator may determine, or

(b) a requirement to take such steps as an administrator may specify, within such period as the administrator may specify, to secure that the breach does not continue or recur.

(4) In this Schedule—

"variable monetary penalty" means a requirement referred to in sub-paragraph (3)(a);

"non-monetary discretionary requirement" means a requirement referred to in sub-paragraph (3)(b).

(5) The regulations must, in relation to each kind of breach of regulations under this Schedule for which a variable monetary penalty may be imposed—
   (a) specify the maximum penalty that may be imposed for a breach of that kind, or
   (b) provide for that maximum to be determined in accordance with the regulations.

(6) The regulations may not permit discretionary requirements to be imposed on a person on more than one occasion in relation to the same act or omission.

*Discretionary requirements: procedure*

13 (1) Provision under paragraph 12 must secure that—
   (a) where an administrator proposes to impose a discretionary requirement on a person, the administrator must serve on that person a notice of what is proposed (a "notice of intent") that complies with sub-paragraph (2),
   (b) that person may make written representations and objections to the administrator in relation to the proposed imposition of the discretionary requirement,
   (c) after the end of the period for making such representations and objections, the administrator must decide whether to—
      (i) impose the discretionary requirement, with or without modifications, or
      (ii) impose any other discretionary requirement that the administrator has power to impose under paragraph 12,
   (d) where the administrator decides to impose a discretionary requirement, the notice imposing it (the "final notice") complies with sub-paragraph (4), and
   (e) the person on whom a discretionary requirement is imposed may appeal against the decision to impose it.

(2) To comply with this sub-paragraph the notice of intent must include information as to—
   (a) the grounds for the proposal to impose the discretionary requirement,
   (b) the right to make representations and objections,
   (c) the circumstances in which the administrator may not impose the discretionary requirement,
   (d) the period within which representations and objections may be made, which may not be less than the period of 28 days beginning with the day on which the notice of intent is received.

(3) Provision pursuant to sub-paragraph (1)(c) must include provision for circumstances in which the administrator may not decide to impose a fixed monetary penalty.

(4) To comply with this sub-paragraph the final notice referred to in sub-paragraph (1)(d) must include information as to—
   (a) the grounds for imposing the discretionary requirement,
   (b) where the discretionary requirement is a variable monetary penalty—
      (i) how payment may be made,

(ii) the period within which payment must be made, and
(iii) any early payment discounts or late payment penalties,
(c) rights of appeal, and
(d) the consequences of non-compliance.

(5) Provision pursuant to sub-paragraph (1)(e) must secure that the grounds on which a person may appeal against a decision of the administrator include the following—
(a) that the decision was based on an error of fact;
(b) that the decision was wrong in law;
(c) in the case of a variable monetary penalty, that the amount of the penalty is unreasonable;
(d) in the case of a non-monetary discretionary requirement, that the nature of the requirement is unreasonable;
(e) that the decision was unreasonable for any other reason.

*Discretionary requirements: enforcement*

14 (1) Provision under paragraph 12 may include provision for a person to pay a monetary penalty (a "non-compliance penalty") to an administrator if the person fails to comply with a non-monetary discretionary requirement imposed on the person.

(2) Provision under sub-paragraph (1) may—
(a) specify the amount of the non-compliance penalty or provide for that amount to be determined in accordance with the regulations, or
(b) provide for the amount to be determined by the administrator or in some other way.

(3) If the regulations make provision within sub-paragraph (2)(b), they must, in relation to each kind of failure for which a non-compliance penalty may be imposed—
(a) specify the maximum penalty that may be imposed for a failure of that kind, or
(b) provide for that maximum to be determined in accordance with the regulations.

(4) Provision under sub-paragraph (1) must secure that—
(a) the non-compliance penalty is imposed by notice served by the administrator, and
(b) the person on whom it is imposed may appeal against that notice.

(5) Provision pursuant to paragraph (b) of sub-paragraph (4) must secure that the grounds on which a person may appeal against a notice referred to in that sub-paragraph include the following—
(a) that the decision to serve the notice was based on an error of fact;
(b) that the decision was wrong in law;
(c) that the decision was unfair or unreasonable for any reason (including, in a case where the amount of the non-compliance penalty was determined by the administrator, that the amount is unreasonable).

*Combination of sanctions*

15 (1) Provision may not be made under paragraphs 10 and 12 conferring powers on an administrator in relation to the same kind of breach of regulations under this Schedule unless it complies with the following requirements.

(2) The provision must secure that the administrator may not serve a notice of intent referred to in paragraph 11(1)(a) on a person in relation to a breach where a discretionary requirement has been imposed on that person in relation to the same breach.

(3) Such provision must secure that the administrator may not serve a notice of intent referred to in paragraph 13(1)(a) on a person in relation to a breach where—

(a) a fixed monetary penalty has been imposed on that person in relation to the same breach, or

(b) the person has discharged liability to a fixed monetary penalty in relation to that breach pursuant to paragraph 11(1)(b).

*Monetary penalties*

16 (1) If the regulations confer power on an administrator to require a person to pay a fixed monetary penalty, a variable monetary penalty or a non-compliance penalty under paragraph 14(1), they may include provision—

(a) for early payment discounts;

(b) for the payment of interest or other financial penalties for late payment of the penalty, such interest or other financial penalties not in total to exceed the amount of that penalty;

(c) for enforcement of the penalty.

(2) Provision under sub-paragraph (1)(c) may include—

(a) provision for the administrator to recover the penalty, and any interest or other financial penalty for late payment, as a civil debt;

(b) provision for the penalty, and any interest or other financial penalty for late payment to be recoverable, on the order of a court, as if payable under a court order.

*Costs recovery*

17 (1) Provision under paragraph 12 may include provision for an administrator, by notice, to require a person on whom a discretionary requirement is imposed to pay the costs incurred by the administrator in relation to the imposition of the discretionary requirement up to the time of its imposition.

(2) In sub-paragraph (1), the reference to costs includes in particular—

(a) investigation costs;

(b) administration costs;

(c) costs of obtaining expert advice (including legal advice).

(3) Provision under this paragraph must secure that, in any case where a notice requiring payment of costs is served—

(a) the notice specifies the amount required to be paid;

(b) the administrator may be required to provide a detailed breakdown of that amount;

(c) the person required to pay costs is not liable to pay any costs shown by the person to have been unnecessarily incurred;
(d) the person required to pay costs may appeal against—
(i) the decision of the administrator to impose the requirement to pay costs;
(ii) the decision of the administrator as to the amount of those costs.

(4) Provision under this paragraph may include the provision referred to in paragraph 16(1)(b) and (c) and (2).

(5) Provision under this paragraph must secure that the administrator is required to publish guidance about how the administrator will exercise the power conferred by the provision.

*Appeals*

18 (1) The regulations may not provide for the making of an appeal other than to—
(a) the First-tier Tribunal, or
(b) another tribunal created under an enactment.

(2) In sub-paragraph (1)(b) "tribunal" does not include an ordinary court of law.

(3) If the regulations make provision for an appeal in relation to the imposition of any requirement or service of any notice, they may include—
(a) provision suspending the requirement or notice pending determination of the appeal;
(b) provision as to the powers of the tribunal to which the appeal is made;
(c) provision as to how any sum payable in pursuance of a decision of that tribunal is to be recoverable.

(4) The provision referred to in sub-paragraph (3)(b) includes provision conferring on the tribunal to which the appeal is made power—
(a) to withdraw the requirement or notice;
(b) to confirm the requirement or notice;
(c) to take such steps as the administrator could take in relation to the act or omission giving rise to the requirement or notice;
(d) to remit the decision whether to confirm the requirement or notice, or any matter relating to that decision, to the administrator;
(e) to award costs.

*Publicity for imposition of civil sanctions*

19 (1) The regulations may make provision enabling an administrator to give a publicity notice to a person on whom a civil sanction has been imposed in accordance with regulations under this Schedule.

(2) A "publicity notice" is a notice requiring the person to publicise—
(a) the fact that the civil sanction has been imposed, and
(b) such other information as may be specified in the regulations,
in such manner as may be specified in the notice.

(3) The regulations may provide for a publicity notice to—
(a) specify the time for compliance with the notice, and

(b) require the person to whom it is given to supply an administrator with evidence of compliance within such time as may be specified in the notice.

(4) The regulations may provide that, if a person fails to comply with a publicity notice, an administrator may—
(a) publicise the information required to be publicised by the notice, and
(b) recover the costs of doing so from that person.

*Persons liable to civil sanctions*

20 The regulations may make provision about the persons liable to civil sanctions under regulations under this Schedule and may (in particular) provide for—
(a) the officers of a body corporate to be so liable as well the body corporate itself, and
(b) for the partners of a partnership to be liable as well as the partnership itself,
in such circumstances as may be specified.

*Guidance as to use of civil sanctions*

21 (1) Where power is conferred on an administrator by the regulations to impose a civil sanction in relation to a breach of regulations under this Schedule, the provision conferring the power must secure that—
(a) the administrator must publish guidance about the administrator's use of the civil sanction,
(b) the guidance must contain the relevant information,
(c) the administrator must revise the guidance where appropriate,
(d) the administrator must consult such persons as the provision may specify before publishing any guidance or revised guidance, and
(e) the administrator must have regard to the guidance or revised guidance in exercising the administrator's functions.

(2) In the case of guidance relating to a fixed monetary penalty, the relevant information referred to in sub-paragraph (1)(b) is information as to—
(a) the circumstances in which the penalty is likely to be imposed,
(b) the circumstances in which it may not be imposed,
(c) the amount of the penalty,
(d) how liability for the penalty may be discharged and the effect of discharge, and
(e) rights to make representations and objections and rights of appeal.

(3) In the case of guidance relating to a discretionary requirement, the relevant information referred to in sub-paragraph (1)(b) is information as to—
(a) the circumstances in which the requirement is likely to be imposed,
(b) the circumstances in which it may not be imposed,
(c) in the case of a variable monetary penalty, the matters likely to be taken into account by the administrator in determining the amount of the penalty (including, where relevant, any discounts for voluntary reporting of non-compliance), and
(d) rights to make representations and objections and rights of appeal.

*Publication of enforcement action*

22 (1) Where power is conferred on an administrator by the regulations to impose a civil sanction in relation to a breach of regulations under this Schedule, the provision conferring the power must, subject to this paragraph, secure that the administrator must from time to time publish reports specifying—

(a) the cases in which the civil sanction has been imposed, and

(b) where the civil sanction is a fixed monetary penalty, the cases in which liability to the penalty has been discharged pursuant to paragraph 11(1)(b).

(2) In sub-paragraph (1)(a), the reference to cases in which the civil sanction has been imposed do not include cases where the sanction has been imposed but overturned on appeal.

(3) The provision conferring the power need not secure the result in sub-paragraph (1) in cases where the relevant authority considers that it would be inappropriate to do so.

*Compliance with regulatory principles*

23 A relevant national authority may not make any provision conferring power on an administrator to impose a civil sanction in relation to a breach of regulations under this Schedule unless the authority is satisfied that the administrator will act in accordance with the principles that—

(a) regulatory activities should be carried out in a way that is transparent, accountable, proportionate and consistent;

(b) regulatory activities should be targeted only at cases in which action is needed.

*Review*

24 (1) A relevant national authority must in accordance with this paragraph review the operation of any provision made by the authority conferring power on an administrator to impose a civil sanction in relation to a breach of regulations under this Schedule.

(2) The review must take place as soon as practicable after the end of the period of three years beginning with the day on which the provision comes into force.

(3) The review must in particular consider whether the provision has implemented its objectives efficiently and effectively.

(4) In conducting a review under this paragraph the relevant national authority must consult such persons as the authority considers appropriate.

(5) The relevant national authority must publish the results of a review under this section.

(6) The relevant national authority must lay a copy of a review under this paragraph before—

(a) Parliament (where the relevant national authority is the Secretary of State);

(b) the National Assembly for Wales (where the relevant national authority is the Welsh Ministers);

(c) the Northern Ireland Assembly (where the relevant national authority is the Department of the Environment in Northern Ireland).

*Suspension*

25 (1) Where provision has been made by a relevant national authority conferring power on an administrator to impose a civil sanction in relation to a breach of regulations under this Schedule, the authority may direct the administrator—

(a) where the power is power to impose a fixed monetary penalty, not to serve any further notice of intent referred to in paragraph 11(1)(a) in relation to a breach of that kind, and

(b) where the power is power to impose a discretionary requirement, not to serve any further notice of intent referred to in paragraph 13(1)(a) in relation to a breach of that kind.

(2) The relevant national authority may only give a direction under sub-paragraph (1) in relation to a breach of regulations under this Schedule if it is satisfied that the administrator has failed on more than one occasion—

(a) to comply with any duty imposed on it under or by virtue of this Schedule in relation to a breach of that kind,

(b) to act in accordance with the guidance it has published in relation to a breach of that kind (in particular, the guidance published under paragraph 21), or

(c) to act in accordance with the principles referred to in paragraph 23 or with other principles of best practice in relation to the enforcement of a breach of that kind.

(3) The relevant national authority may by direction revoke a direction given by it under sub-paragraph (1) if satisfied that the administrator has taken the appropriate steps to remedy the failure to which that direction related.

(4) Before giving a direction under sub-paragraph (1) or (3) the relevant national authority must consult—

(a) the administrator, and

(b) such other persons as the authority considers appropriate.

(5) Where the relevant national authority gives a direction under this section, the authority must lay a copy before—

(a) Parliament (where the relevant national authority is the Secretary of State);

(b) the National Assembly for Wales (where the relevant national authority is the Welsh Ministers);

(c) the Northern Ireland Assembly (where the relevant national authority is the Department of the Environment in Northern Ireland).

(6) Where the relevant national authority gives a direction under this section, the administrator must—

(a) publish the direction in such manner as the authority thinks fit, and

(b) take such other steps as the administrator thinks fit or the authority may require to bring the direction to the attention of other persons likely to be affected by it.

*Payment of penalties into Consolidated Fund*

26 (1) Where pursuant to any provision made under this Schedule an administrator receives—
(a) a fixed monetary penalty, a variable monetary penalty or a non-compliance penalty under paragraph 14,
(b) any interest or other financial penalty for late payment of such a penalty, or
(c) a sum paid in discharge of liability to a fixed monetary penalty pursuant to paragraph 11(1)(b),

the administrator must pay it into the relevant Fund.

(2) In sub-paragraph (1) "relevant Fund" means—
(a) in a case where the administrator has functions only in relation to Wales, the Welsh Consolidated Fund,
(b) in a case where the administrator has functions only in relation to Northern Ireland, the Northern Ireland Consolidated Fund, and
(c) in any other case, the Consolidated Fund.

## PART 3

## PROCEDURES APPLYING TO REGULATIONS

*Regulations made by a single authority*

27 (1) This paragraph applies in relation to an instrument containing regulations under this Schedule made by a single national authority.

(2) Where the instrument contains regulations that—
(a) are to be made by the Secretary of State, and
(b) are subject to affirmative resolution procedure,

the regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of each House of Parliament.

(3) Where the instrument contains regulations that—
(a) are to be made by a national authority other than the Secretary of State, and
(b) are subject to affirmative resolution procedure,

the regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of the relevant devolved legislature.

(4) An instrument containing regulations made by the Secretary of State that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of either House of Parliament.

(5) An instrument containing regulations made by the Welsh Ministers that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of the National Assembly for Wales.

(6) An instrument containing regulations made by the Department of the Environment in Northern Ireland that are subject to negative resolution procedure is subject to negative resolution within the meaning of section

41(6) of the Interpretation Act (Northern Ireland) 1954 (c. 33 (N.I.)) as if it were a statutory instrument within the meaning of that Act.

(7) Any provision that may be made by regulations subject to negative resolution procedure may be made by regulations subject to affirmative resolution procedure.

*Regulations made by two or more national authorities*

28 (1) This paragraph applies in relation to an instrument containing regulations under this Schedule made or to be made by any two or more of—

(a) the Secretary of State,

(b) the Welsh Ministers, and

(c) the Department of the Environment in Northern Ireland.

(2) If any of the regulations are subject to affirmative resolution procedure, all of them are subject to that procedure.

(3) Sub-paragraphs (2) to (6) of paragraph 27 apply to the instrument as they apply to an instrument containing regulations made by a single national authority.

(4) If in accordance with that paragraph—

(a) either House of Parliament resolves that an address be presented to Her Majesty praying that an instrument containing regulations made by the Secretary of State be annulled, or

(b) a devolved legislature resolves that an instrument containing regulations made by a national authority be annulled,

nothing further is to be done under the instrument after the date of the resolution and Her Majesty may by Order in Council revoke the instrument.

(5) This is without prejudice to the validity of anything previously done under the instrument or to the making of a new instrument.

(6) This paragraph applies in place of provision made by any other enactment about the effect of such a resolution.

*Hybrid instruments*

29 If a draft of an instrument containing regulations under this Schedule would, apart from this paragraph, be treated for the purposes of the standing orders of either House of Parliament as a hybrid instrument, it is to proceed in that House as if it were not such an instrument.

## SCHEDULE 7

Section 78

### Renewable transport fuel obligations

*Introductory*

1 Chapter 5 of Part 2 of the Energy Act 2004 (c. 20) (renewable transport fuel obligations) is amended as follows.

*The Administrator*

2 For section 125 (the Administrator) substitute—

**"125 Appointment of the Administrator**

(1) For the purposes of provision made by or under this Chapter, an RTF order may—
(a) establish a body corporate, and
(b) appoint that body as the Administrator.

(2) An RTF order may—
(a) make provision for the appointment of members of the body;
(b) make provision in relation to the staffing of the body;
(c) make provision in relation to the expenditure of the body;
(d) make provision regulating the procedure of the body;
(e) make any other provision that the Secretary of State considers appropriate for purposes connected with the establishment and maintenance of the body.

(3) The provision that may be made by an RTF order by virtue of this section includes, in particular, provision conferring discretions on—
(a) the Secretary of State;
(b) the body itself; or
(c) members or staff of the body.

**125A General functions of the Administrator**

(1) An RTF order may—
(a) confer or impose powers and duties on the Administrator for purposes connected with the implementation of provision made by or under this Chapter;
(b) confer discretions on the Administrator in relation to the making of determinations under such an order and otherwise in relation to the Administrator's powers and duties; and
(c) impose duties on transport fuel suppliers for purposes connected with the Administrator's powers and duties (including, in particular, duties framed by reference to determinations made by the Administrator).

(2) It is the duty of the Administrator to promote the supply of renewable transport fuel whose production, supply or use—
(a) causes or contributes to the reduction of carbon emissions, and
(b) contributes to sustainable development or the protection or enhancement of the environment generally.

**125B Functions of the Administrator: supplementary**

(1) The powers that may be conferred on the Administrator by virtue of section 125A(1) include, in particular—
(a) power to require a transport fuel supplier to provide the Administrator with such information as the Administrator may require for purposes connected with the carrying out of the Administrator's functions;

(b) power to impose requirements as to the form in which such information must be provided and as to the period within which it must be provided;

(c) power to imposes charges of specified amounts on transport fuel suppliers.

(2) The Secretary of State may give written directions to the Administrator about the exercise of any power conferred on the Administrator by virtue of subsection (1)(a) or (b).

(3) The power to give directions under subsection (2) includes power to vary or revoke the directions.

(4) The Administrator must comply with any directions given under that subsection.

(5) Sums received by the Administrator by virtue of provision within subsection (1)(c)—

(a) where the Administrator is the Secretary of State, must be paid into the Consolidated Fund, and

(b) otherwise, must be used for the purpose of meeting costs incurred in carrying out the Administrator's functions.

(6) The Secretary of State may make grants to the Administrator on such terms as the Secretary of State may determine.

**125C Transfer of functions to new Administrator**

(1) The Secretary of State may by order—

(a) appoint a person as the Administrator ("the new Administrator") in place of a person previously so appointed by order under this Chapter ("the old Administrator"), and

(b) provide for the transfer of the functions of the old Administrator to the new Administrator.

(2) Only the following persons may be appointed as the Administrator by order under this section—

(a) the Secretary of State;

(b) a body or other person established or appointed by or under any enactment to carry out other functions;

(c) a body corporate established by the order for appointment as the Administrator.

(3) An order under this section that establishes a body for appointment as the Administrator may make any provision that may be made by an RTF order by virtue of section 125.

(4) An order under this section may provide for the transfer of staff of the old Administrator, and of any property, rights or liabilities to which the old Administrator is entitled or subject, to the new Administrator and may, in particular—

(a) provide for the transfer of any property, rights or liabilities to have effect subject to exceptions or reservations specified in or determined under the order;

(b) provide for the creation of interests in, or rights over, property transferred or retained or for the creation of new rights and liabilities;

(c) provide for the order to have effect in spite of anything that would prevent or restrict the transfer of the property, rights or liabilities otherwise than by the order.

(5) The order may, in particular—

(a) provide for anything done by or in relation to the old Administrator to have effect as if done by or in relation to the new Administrator;

(b) permit anything (which may include legal proceedings) which is in the process of being done by or in relation to the old Administrator when the transfer takes effect to be continued by or in relation to the new Administrator;

(c) provide for a reference to the old Administrator in an instrument or other document to be treated as a reference to the new Administrator;

(d) where the old Administrator was established by order under this Chapter, make provision for the dissolution of the old Administrator;

(e) make such modifications of any enactment relating to the old Administrator or the new Administrator as the Secretary of State considers appropriate for the purpose of facilitating the transfer.

(6) An order under this section that provides for the transfer of staff of the old Administrator to the new Administrator must make provision for the Transfer of Undertakings (Protection of Employment) Regulations 2006 to apply to the transfer.

(7) Subject to subsection (8), an order under this section is subject to the negative resolution procedure.

(8) The power to make an order under this section is subject to the affirmative resolution procedure if the order—

(a) contains provision by virtue of subsection (2)(c), or

(b) makes any modification of an enactment contained in—

(i) an Act of Parliament,

(ii) an Act of the Scottish Parliament,

(iii) a Measure or Act of the National Assembly for Wales, or

(iv) Northern Ireland legislation.”.

*Determination of amounts of transport fuel*

3 In section 126 (determination of amounts of transport fuel), after subsection (4) insert—

“(5) If an RTF order makes provision for the counting or determination of amounts of transport fuel for the purposes of provision made by or under this Chapter by reference to any document, it may provide for references to the document to have effect as references to it as revised or re-issued from time to time.

(6) The Secretary of State may give written directions to the Administrator about the exercise of any of the Administrator’s functions in connection with the counting or determination of

amounts of transport fuel for the purposes of provision made by or under this Chapter.

(7) The power to give directions under subsection (6) includes power to vary or revoke the directions.

(8) The Administrator must comply with any directions given under that subsection.”.

*Discharge of obligation by payment*

4 In section 128 (discharge of obligation by payment), for subsections (6) and (7) substitute—

“(6) Where the Administrator is the Secretary of State—

(a) sums received by the Administrator by virtue of this section must be paid into the Consolidated Fund, and

(b) an RTF order may make provision for sums to be paid by the Administrator to transport fuel suppliers, or to transport fuel suppliers of a specified description, in accordance with the specified system of allocation.

(7) Such an order must contain provision ensuring that the total of the sums so paid by the Administrator does not at any time exceed the total of the sums so received by the Administrator up to that time.

(8) Where the Administrator is a person other than the Secretary of State, an RTF order may—

(a) require the Administrator to use, to the specified extent, sums received by the Administrator by virtue of this section for the purpose of meeting costs incurred in carrying out the Administrator’s functions, or

(b) require the Administrator to pay, to the specified extent, sums so received to the Secretary of State.

(9) Sums so received which are not dealt with in accordance with provision made under subsection (8) must be paid by the Administrator to transport fuel suppliers, or to transport fuel suppliers of a specified description, in accordance with the specified system of allocation.

(10) The Secretary of State must pay sums received by the Secretary of State by virtue of provision made under subsection (8)(b) into the Consolidated Fund.”.

*Civil penalties*

5 In section 129 (imposition of civil penalties), for subsection (7) substitute—

“(7) Sums received by the Administrator by virtue of this section—

(a) where the Administrator is the Secretary of State, must be paid into the Consolidated Fund, and

(b) otherwise, must be paid to the Secretary of State, who must pay them into the Consolidated Fund.”.

*Disclosure of information*

6 After section 131 insert—

**"131A Disclosure of information held by Revenue and Customs**

(1) This section applies to information held by or on behalf of the Commissioners for Her Majesty's Revenue and Customs in connection with their functions under or by virtue of the Hydrocarbon Oil Duties Act 1979.

(2) Such information may be disclosed to—
(a) the Administrator, or
(b) an authorised person,
for the purposes of or in connection with the Administrator's functions.

(3) In this Chapter "authorised person" means a person who—
(a) provides services to, or exercises functions on behalf of, the Administrator, and
(b) is authorised by the Administrator to receive information to which this section applies.

(4) The Administrator may authorise such a person to receive information to which this section applies either generally or for a specific purpose.

**131B Further disclosure of information**

(1) This section applies to information disclosed under section 131A, other than information which is also provided to the Administrator or an authorised person otherwise than under that section.

(2) Information to which this section applies may not be disclosed—
(a) by the Administrator,
(b) by an authorised person, or
(c) by any other person who obtains it in the course of providing services to, or exercising functions on behalf of, the Administrator,
except as permitted by the following provisions of this section.

(3) Subsection (2) does not apply to a disclosure made—
(a) by the Administrator to an authorised person,
(b) by an authorised person to the Administrator, or
(c) by an authorised person to another authorised person,
for the purposes of, or in connection with, the discharge of the Administrator's functions.

(4) Subsection (2) does not apply to a disclosure if it is—
(a) authorised by an enactment,
(b) made in pursuance of an order of a court,
(c) made for the purposes of a criminal investigation or criminal proceedings (whether or not within the United Kingdom) relating to a matter in respect of which the Administrator has functions,

(d) made for the purposes of civil proceedings (whether or not within the United Kingdom) relating to a matter in respect of which the Administrator has functions,

(e) made with the consent of the Commissioners for Her Majesty's Revenue and Customs, or

(f) made with the consent of each person to whom the information relates.

**131C Wrongful disclosure**

(1) A person commits an offence if—

(a) he discloses information about a person in contravention of section 131B(2), and

(b) the person's identity is specified in the disclosure or can be deduced from it.

(2) In subsection (1) "information about a person" means revenue and customs information relating to a person within the meaning of section 19(2) of the Commissioners for Revenue and Customs Act 2005 (wrongful disclosure).

(3) It is a defence for a person charged with an offence under this section to prove that he reasonably believed—

(a) that the disclosure was lawful, or

(b) that the information had already and lawfully been made available to the public.

(4) A person guilty of an offence under this section is liable—

(a) on conviction on indictment, to imprisonment for a term not exceeding two years or a fine or both, or

(b) on summary conviction, to imprisonment for a term not exceeding twelve months or a fine not exceeding the statutory maximum or both.

(5) A prosecution for an offence under this section—

(a) may be brought in England and Wales only with the consent of the Director of Public Prosecutions;

(b) may be brought in Northern Ireland only with the consent of the Director of Public Prosecutions for Northern Ireland.

(6) In the application of this section—

(a) in England and Wales, in relation to an offence committed before the commencement of section 154(1) of the Criminal Justice Act 2003, or

(b) in Northern Ireland,

the reference in subsection (4)(b) to twelve months is to be read as a reference to six months.".

*Interpretation*

7 (1) Section 132(1) (interpretation of Chapter 5 of Part 2) is amended as follows.

(2) For the definition of "Administrator" substitute—

""Administrator" means the person for the time being appointed as the Administrator by order under this Chapter;".

(3) In the appropriate place insert—

""authorised person" has the meaning given by section 131A(3);";

""enactment" includes—

(a) an enactment contained in subordinate legislation,

(b) an enactment contained in, or in an instrument made under, an Act of the Scottish Parliament,

(c) an enactment contained in, or in an instrument made under, Northern Ireland legislation, and

(d) an enactment contained in, or in an instrument made under, a Measure or Act of the National Assembly for Wales;".

(4) In section 196(1) of the Energy Act 2004 (c. 20) (general interpretation), in the definition of "enactment", after ""enactment"" insert "(except in Chapter 5 of Part 2)".

## SCHEDULE 8

Section 79

### CARBON EMISSIONS REDUCTION TARGETS

*Gas Act 1986 (c. 44)*

1 (1) Section 33BC of the Gas Act 1986 (promotion of reductions in carbon emissions: gas transporters and gas suppliers) is amended as follows.

(2) After subsection (1) insert—

"(1A) The power to make orders under this section may be exercised so as to impose more than one carbon emissions reduction obligation on a person in relation to the same period or to periods that overlap to any extent.".

(3) In subsection (5) (provision that may be made by an order under section 33BC in relation to the obligations it imposes), after paragraph (b) insert—

"(ba) requiring the whole or any part of a carbon emissions reductions target to be met by action relating to—

(i) persons of a specified description,

(ii) specified areas or areas of a specified description, or

(iii) persons of a specified description in specified areas or areas of a specified description;".

(4) In subsection (13) (interpretation), at the appropriate place insert—

""specified" means specified in the order.".

*Electricity Act 1989 (c. 29)*

2 In section 6(9) of the Electricity Act 1989 (definition of "electricity

distributor" and "electricity supplier"), at the appropriate place insert—

""electricity generator" means any person who is authorised by a generation licence to generate electricity except where that person is acting otherwise than for purposes connected with the carrying on of activities authorised by the licence;".

3 (1) Section 41A of that Act (promotion of reductions in carbon emissions: electricity distributors and electricity suppliers) is amended as follows.

(2) In subsection (1) (power by order to impose obligations on distributors and suppliers to achieve carbon emissions reductions targets)—

(a) before paragraph (a) insert—

"(za) on each electricity generator (or each electricity generator of a specified description);", and

(b) in the closing words, before "distributor" insert "generator,".

(3) After that subsection insert—

"(1A) The power to make orders under this section may be exercised so as to impose more than one carbon emissions reduction obligation on a person in relation to the same period or to periods that overlap to any extent.".

(4) In subsection (3) (power for order to specify criteria by reference to which the Gas and Electricity Markets Authority is to determine targets), before "electricity distributors" insert "electricity generators,".

(5) In subsection (4) (duty of the Secretary of State and the Authority to carry out functions under the section in a way that does not inhibit competition), for the words from "no electricity distributor" to the end of the subsection substitute "—

(a) no electricity generator is unduly disadvantaged in competing with other electricity generators,

(b) no electricity distributor is unduly disadvantaged in competing with other electricity distributors, and

(c) no electricity supplier is unduly disadvantaged in competing with other electricity suppliers.".

(6) In subsection (5) (provision that may be made by an order in relation to the obligations it imposes)—

(a) in paragraph (a), before "electricity distributors" insert "electricity generators,",

(b) after paragraph (b) insert—

"(ba) requiring the whole or any part of a carbon emissions reductions target to be met by action relating to—

(i) persons of a specified description,

(ii) specified areas or areas of a specified description, or

(iii) persons of a specified description in specified areas or areas of a specified description;",

(c) in paragraph (d), before "distributors" insert "generators,", and

(d) in paragraph (f), before "distributors" insert "generators,".

(7) In subsection (6) (power for order to authorise the Authority to require the provision of information), before "distributor" insert "generator,".

(8) In subsection (7)(d) (power for order to make provision for transfer of person's target to another distributor or supplier or to a gas transporter or supplier), before "electricity distributor" insert "electricity generator,".

(9) In subsection (8)(d) (power for order to make different provision in relation to different distributors or suppliers), before "distributors" insert "generators,".

(10) In subsection (11) (duty to consult before making order), before "electricity distributors" insert "electricity generators,".

(11) In subsection (13) (interpretation), at the appropriate place insert—

""specified" means specified in the order.".

(12) In the heading, before "electricity distributors" insert "electricity generators,".

4 (1) Section 42AA of that Act (publication of statistical information about performance of suppliers and distributors) is amended as follows.

(2) In subsection (1) (duty of Gas and Electricity Consumer Council to publish information about performance and consumer complaints)—

(a) in paragraph (a), before "electricity suppliers" insert "electricity generators,", and

(b) in paragraph (b), before "suppliers" insert "generators,".

(3) In subsection (2) (definition of "complaints"), before "electricity suppliers" insert "electricity generators,".

5 In section 64(1) of that Act (interpretation etc of Part 1), in the definition of "electricity distributor" and "electricity supplier", after ""electricity distributor"" insert ", "electricity generator"".

*Utilities Act 2000 (c. 27)*

6 (1) Section 103 of the Utilities Act 2000 (overall carbon emissions reduction targets) is amended as follows.

(2) In subsection (1)(b) (power by order to specify overall target for the promotion of measures mentioned in section 41A(2) of the 1989 Act), before "distributors" insert "generators,".

(3) After subsection (1) insert—

"(1A) The power conferred by this section may be exercised so as to specify more than one overall target in relation to the same period or to periods that overlap to any extent.".

(4) In subsection (2)(b) (power for order to specify criteria for apportionment of overall target between electricity and gas sectors), before "electricity distributors" insert "electricity generators,".

(5) In subsection (4) (duty to consult before making order), before "electricity distributors" insert "electricity generators,".



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## Appendix CL2.5

## Design Manual for Roads and Bridges (DMRB) LA114 Climate (2019)

Sustainability & Environment
Appraisal

# LA 114
# Climate

Revision 0

**Summary**
This document sets out the requirements for assessing and reporting the effects of climate on highways (climate change resilience and adaptation), and the effect on climate of greenhouse gas from construction, operation and maintenance projects.

**Application by Overseeing Organisations**
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

**This is a controlled document.**

# Contents

## Release notes

| Version | Date | Details of amendments |
|---|---|---|
| 0 | Oct 2019 | LA 114 document created to set out the requirements for assessing and reporting the effects of climate on highways (climate change resilience and adaptation), and the effect on climate of greenhouse gas from construction, operation and maintenance projects. This full document has been written to comply with the new Highways England drafting rules. |

# Foreword

## Publishing information

This document is published by Highways England.

This document makes provision for requirements outlined within EU Directive 2011/92/EU as amended by 2014/52/EU [Ref 2.N] (hereafter referred to as the EIA Directive) and the Climate Change Act 2008 [Ref 1.N].

## Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

# Introduction

## Background

The UK has made commitments to tackle the root cause of climate change by reducing emissions of greenhouse gases (GHG), as well as to increase the resilience of development and infrastructure to the changing climate.

The Climate Change Act 2008 [Ref 1.N], [Ref 10.N] sets a target to reduce net GHG emissions by 100% from 1990 levels by the year 2050.

The effective assessment and management of impacts on climate, as well as the effects of climate change on projects offers the opportunity to:

1) improve the resilience of projects to future climate conditions, such as increased risk and severity of flooding, drought, heatwaves, intense rainfall events and other extreme weather events; and
2) reduce the impact of projects on climate by minimising the magnitude of GHG emissions as far as possible.

## Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 6.N] apply to this document.

# Abbreviations

**Abbreviations**

| Abbreviation | Definition |
|---|---|
| AADT | Average Annual Daily Traffic |
| CO2e | Carbon dioxide equivalent |
| GHG | Greenhouse gas |
| PAS2080 | Publicly Available Specification (2080): Carbon Management in Infrastructure |
| tCO2e | tonnes of Carbon dioxide equivalent |
| UKCP | United Kingdom Climate Projections |

# Terms and definitions

**Terms and definitions**

| Term | Definition |
|---|---|
| Actual data | GHG emission data derived from recorded / observed activities (rather than predicted). |
| Adaptive management | A process that enables uncertainty to be included in operational decision-making. |
| Authorities likely to be concerned | Authorities or organisations (statutory or non-statutory) that have environmental responsibilities or local and regional competences (as defined by the relevant consenting regime). |
| Bench marking | Comparison of project performance against other similar projects using consistent metrics. |
| Carbon account | The UK's net carbon emissions. |
| Carbon budgets | UK GHG targets over defined periods of time. |
| Carbon emissions / CO2e | Shorthand for emissions of any of the seven greenhouse gases (GHGs) that contribute to climate change.<br>NOTE 1: Definition from the Kyoto Protocol UNFCCC [Ref 7.N].<br>NOTE 2: Carbon emissions are usually expressed as CO2e (carbon dioxide equivalent). |
| Climate | Long-term weather conditions prevailing over a region.<br>NOTE: Measured in terms of average precipitation, maximum and minimum seasonal temperatures, and other factors, throughout a year. |
| Construction GHG emissions | GHG emissions associated with the construction phase of a project. |
| Decommissioning | The act of ceasing operation of an asset to a non-active status. |
| Disruption: national level | Closure/partial /obstruction of a strategic route restricting/preventing movement across multiple regions/counties. |
| Disruption: regional level | Closure/partial/obstruction of a strategic route restricting/preventing movement within a region or county. |
| Embodied carbon | Carbon (GHG) emissions associated with energy consumption and chemical processes during the extraction, transport and/or manufacture of construction materials or products.<br>NOTE: Typical embodied carbon datasets are 'cradle-to-gate' (i.e. all emissions to the point of delivery from the factory gate) and expressed in kilograms of CO2e per kilogram of product or material. |
| Extreme weather | A weather event which is significantly different from the average or usual weather pattern. |
| Future baseline | An outline of the likely evolution of the current state of the environment without implementation of the project. |

**Terms and definitions** (continued)

| Term | Definition |
|---|---|
| Greenhouse gas (GHG) | A gaseous compound that absorbs infrared radiation and traps heat in the atmosphere.<br>NOTE: Greenhouse gases are usually expressed in terms of carbon dioxide equivalents (see 'carbon emissions'). |
| H++ climate scenarios | Extreme climate change scenarios on the margins or outside of the 10th to 90th percentile range presented in the 2009 UK Climate Projections: Briefing Report UKCP18 [Ref 11.N]. |
| Low carbon | Activities/assets which minimise carbon footprint. |
| Material impact | An event/outcome that is a key decision making consideration. |
| Net GHG emissions | The difference in GHG emissions between the do minimum and do something scenarios taking into consideration carbon reduction measures (i.e. mitigation measures). |
| Operational GHG emissions | GHG emissions associated with<br>1) the operation and maintenance of the asset, i.e. lighting, maintenance activities etc); and<br>2) users of the asset (i.e vehicle emissions) |
| Regional | Geographical regions in the United Kingdom Climate Projections as follows:<br>1) North East England;<br>2) North West England;<br>3) Yorkshire and the Humber;<br>4) East Midlands;<br>5) West Midlands;<br>6) East of England;<br>7) London;<br>8) South East England;<br>9) South West England;<br>10) Wales;<br>11) Scotland; and<br>12) Northern Ireland. |
| Resilience | The capacity of a project (or lack thereof) to withstand the adverse effects of climate change. |
| Trans-boundary impacts | Any adverse effect on the environment resulting from human activity, the physical origin of which is situated wholly or in part within an area under the jurisdiction of another State. |
| UKCP | The name given to the UK Climate Projections.<br>NOTE 1: provides the future climate projections and observed (historical) climate data for UK regions.<br>NOTE 2: This will in turn be superseded by updates UKCP18 [Ref 11.N]. |

**Terms and definitions** (continued)

| Term | Definition |
|---|---|
| Vulnerability | The degree to which a system/asset is exposed and resilient to adverse effects of climate change. |

# 1. Scope

## Aspects covered

1.1 The requirements in this document shall be applied to the assessment, reporting and management of effects from projects on climate, along with the effects of climate on projects.

1.2 Environmental assessments must, as required by the EIA Directive [Ref 2.N], describe the likely significant effects of proposed projects on the environment resulting from the:

1) impact of the project on climate (GHG emissions); and
2) vulnerability of the project to climate change (adaptation).

1.3 The assessment of effects on climate shall be informed by relevant information collated by other environmental factors, notably material assets and waste.

1.4 The assessment of effects on climate shall be used to inform other environmental factors where appropriate.

1.5 The assessment of climate effects on the project shall be used to inform the assessment of project vulnerability to major accidents and disasters where appropriate.

1.6 An overview of the vulnerability of a project to major accidents and disasters (man-made and natural) shall be reported in environmental assessments within the description of the project.

1.7 Consequential changes in the predicted effects of a project on the environment as a result of major accidents and disasters shall be reported in relevant environmental topics.

## Implementation

1.8 This document shall be implemented forthwith on all schemes requiring an assessment of climate on the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 6.N].

## Use of GG 101

1.9 The requirements contained in GG 101 [Ref 6.N] shall be followed in respect of activities covered by this document.

# 2. Principles and purpose

## Integration with consent procedures and planning policy

2.1 Projects shall use the assessment and design process to demonstrate their contribution to reduced GHG emissions in line with the EIA Directive [Ref 2.N] and the Climate Change Act 2008 [Ref 1.N], [Ref 10.N].

*NOTE 1 The Climate Change Act 2008 [Ref 1.N], [Ref 10.N] sets out a target to reduce by 100% the net UK carbon account by 2050 when compared to the 1990 baseline, or the baseline of the relevant transposing national regulations.*

*NOTE 2 The assessment of GHG emissions early in the life cycle of a project offers the greatest potential for the reduction of GHGs.*

## Assessment and consultation

2.2 The assessment and reporting shall identify the scale and nature of GHG emissions across the whole project life cycle, taking into account design and mitigation measures already incorporated into the project.

2.2.1 The assessment should report on construction and operational (maintenance and user) GHG emissions.

2.3 Decommissioning associated with a proposed project shall be excluded from assessment of climate (for both impacts on climate and vulnerability of projects to climate change) due to the length of the asset operational phase.

2.3.1 The assessment of climate should report on demolition where an existing asset requires removal prior to construction of a proposed asset.

2.4 Projects shall minimise their vulnerability against the negative effects of projected climate change through appropriate design and mitigation measures.

2.5 The assessment and reporting of the effects on climate shall be undertaken in accordance with the sustainability principles outlined in GG 103 [Ref 4.N].

2.6 The assessment and reporting of the effects on climate shall be undertaken in accordance with the requirements in the four over-arching environmental assessment documents:

1) LA 101 [Ref 5.N] Introduction to environmental assessment;
2) LA 102 [Ref 9.N] Screening projects for Environmental Impact Assessment;
3) LA 103 [Ref 8.N] Scoping projects for environmental assessment;
4) LA 104 [Ref 3.N] Environmental assessment & monitoring.

2.7 The principles of PAS 2080:2016 specification on infrastructure carbon management PAS 2080:2016 2016 [Ref 1.I] (with the exception of setting project level carbon reduction targets) shall be used to inform the assessment of projects on climate and supplement the guidance contained herein.

2.8 Where potential trans-boundary impacts are predicted, projects shall consult with the relevant planning authorities likely to be concerned.

# 3. Assessment methodology

## Impact of projects on climate (GHG Emissions)

### Scoping

3.1 The scoping assessment shall report on the likely additional and avoided GHG emissions at each life cycle stage of the project, in comparison with current and future baseline GHG emissions.

3.2 The scoping assessment shall report on the nature and scale of GHG emissions (positive, neutral or negative) and the likelihood of significant effects.

3.3 The scoping assessment shall report on the following questions to gain an understanding of the need to undertake further assessment:

1) are construction GHG emissions (or GHG-emitting activity), compared to the baseline scenario (i.e. when compared to GHG emissions and energy use associated with existing maintenance activities), increasing by >1%?;
2) during operation, will roads meet or exceed any of the following criteria?
   a) a change of more than 10% in AADT;
   b) a change of more than 10% to the number of heavy duty vehicles; and
   c) a change in daily average speed of more than 20 km/hr.

3.4 Where the response to one or more of the scoping assessment questions is 'yes', further assessment shall be undertaken.

3.5 The scoping assessment shall report on life cycle stage or sub-stages for which the GHG emissions are not likely to be significant.

3.5.1 The scoping assessment should address the following:

1) is there (or is there likely to be, within the timescales of the assessment) sufficient certainty on the availability of quantitative GHG emissions information?;
2) will the availability of information allow the effects on climate resulting from GHG emissions to be assessed?

3.6 The scoping assessment shall identify the extent to which operational user GHG emissions are additional to the baseline in the absence of the project (do-minimum vs do-something), and the GHG emissions from traffic which are transferring from other roads in the surrounding area.

3.7 Where there is insufficient, reliable information for quantitative assessment for any life cycle stage of the project, a qualitative assessment of GHG emissions shall be completed in the early stages of project development.

### Study area

3.8 For construction and operational maintenance, the study area shall comprise GHG emissions associated with project construction related activities/materials and their associated transport.

3.9 For operational road user GHG emissions, the study area shall be consistent with the affected road network defined in a project's traffic model.

### Baseline scenario

3.10 The GHG emissions without the project shall be identified for the current and future baseline (do-minimum scenarios).

3.10.1 The boundary of the baseline GHG emissions should include current operational maintenance GHG emissions and operational user GHG emissions.

3.10.2 The baseline GHG emissions should be consistent with the study area outlined for the project.

**Data collection**

3.11 GHG emissions shall be calculated and reported for each of the project life cycle stages as required by the scope of the assessment to establish the 'do something' scenario.

3.11.1 Table 3.11.1 outlines the project life cycle stages and potential sources of GHG emission data that should be obtained to inform the assessment.

**Table 3.11.1 Sources and lifecycle stages for project GHG emissions**

| Main stage of project life cycle | Sub-stage of life cycle | Potential sources of GHG emissions (not exhaustive) | Examples of activity data |
|---|---|---|---|
| **Construction stage** | Product stage; including raw material supply, transport and manufacture. | Embodied GHG emissions associated with the required raw materials. | Materials quantities. |
| | Construction process stage; including transport to/from works site and construction /installation processes. | Activities for organisations conducting construction work. | Fuel/electricity consumption. Construction activity type/duration. Transportation of materials from point of purchase to site, mode/distance. Area of land use change. |
| | Land use change. | GHG emissions mobilised from vegetation or soil loss during construction. | Type and area of land subject to change in usage. |
| **Operation ('use-stage') (to extend 60yrs in line with appraisal period)** | Use of the infrastructure by the end-user (road user). | Vehicles using highways infrastructure. | Traffic count/speed by vehicle type for highway links. |
| | Operation and maintenance (including repair, replacement and refurbishment). | Energy consumption for infrastructure operation and activities of organisations conducting routine maintenance. | Fuel/electricity consumption for vehicles, lighting and plant. Raw material quantities and transport mode/distance. Waste and arisings quantities, transport mode/distance and disposal fate. |
| | Land use and forestry. | Ongoing land use GHG emissions/ sequestration each year. | Type and area of land subject to change in usage. Net change in vegetation. |
| **Opportunities for reduction** | GHG emissions potential of recovery including reuse and recycling GHG emissions potential of benefits and loads of additional functions associated with the study system. | Avoided GHG emissions through substitution of virgin raw materials with those from recovered sources. | Waste and arisings material quantities and recycling/reuse fate. |

NOTE 1 *The first life cycle stage is 'construction', which includes GHG emissions from the construction process and the manufacture/transport of materials.*

NOTE 2 *The second life cycle stage is 'operation' which includes:*

1) *operation and maintenance, repair, replacement, refurbishment and land use changed (operational maintenance GHG emissions); and*
2) *emissions from end-users (operational user GHG emissions).*

NOTE 3 *The third life cycle stage comprises opportunities to minimise production/use of GHG emissions i.e. the potential for reduction of GHG emissions through reuse and recycling during the construction of the scheme.*

3.12 A proportionate approach shall be applied to calculating and reporting GHG emissions from changes in land use and forestry (i.e reporting only where there is likely to be a substantial change).

3.13 The GHG emissions calculation for the project life cycle shall be completed using an industry recognised carbon calculation tool(s) in accordance with the Overseeing Organisation requirements.

3.14 A proportionate approach shall be applied to capture the principal contributing factors associated with GHG emissions.

3.15 The assessment of projects on climate shall report the quantities of GHG emissions in metric tonnes of carbon dioxide equivalents (tCO2e).

3.16 An appropriate validated traffic model shall be used to estimate operational road user GHG emissions.

3.17 Emissions factor data for user GHG emissions shall enable assessment of the base year, opening year and design (future) year scenarios.

### Significance criteria

3.18 An assessment of project GHG emissions against UK government or Overseeing Organisation carbon budgets shall be undertaken and presented as follows:

**Table 3.18 Project GHG emissions against relevant carbon budgets**

| Project stage | Estimated total carbon over carbon budget (tCO2e) ('Do something' Scenario) | Net CO2 project GHG emissions (tCO2e) (Do something - Do minimum) | Relevant carbon budget | | |
|---|---|---|---|---|---|
| Construction | | | | | |
| Operation | | | | | |
| Total | | | | | |

3.19 Where a project stage extends over multiple carbon budget periods, the projects GHG emissions shall be reported against each carbon budget for each project stage.

NOTE 1 *National policy states that "It is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets".*

NOTE 2 *In the context of NOTE 1, it is considered unlikely that projects will in isolation conclude significant effects on climate.*

3.20 The assessment of projects on climate shall only report significant effects where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets.

3.20.1 Where assessment conclusions indicate that there is likely to be a 'material impact' on the Government's carbon reduction targets, evidence to support this conclusion should be submitted to the Overseeing Organisation.

3.21 Bench marking of project performance shall be undertaken by comparing GHG emissions to other highway projects.

3.21.1 In comparing highways projects, GHG emissions should be normalised to take account of differences in size and scale.

**Design and mitigation**

3.22 Projects shall seek to minimise GHG emissions in all cases to contribute to the UK's target for net reduction in carbon emissions.

3.22.1 Projects should apply and develop the following options:

1) avoid / prevent:
   a) maximise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required, and/or explore alternative lower carbon options to deliver the project objectives (i.e. shorter route options with smaller construction footprints);
   b) identify through projects and delivery programmes opportunities to influence user GHG emissions;
2) reduce:
   a) apply low carbon and/or reduced resource consumption solutions (including technologies, materials and products) to minimise resource consumption during the construction, operation, and at end of life;
3) remediate:
   a) identify, assess and integrate measures to further reduce carbon through on or off-site offsetting or sequestration.

*NOTE 1 Minimising GHG emissions through design is a core principle of the Government's Infrastructure Carbon Review and the Specification on infrastructure carbon management PAS 2080:2016 2016 [Ref 1.I].*

*NOTE 2 Offsetting and sequestering can include measures such as adoption of renewable energy technologies or the creation of new habitats or employment of technologies with the capacity to absorb carbon.*

3.23 Where carbon offsetting/sequestration is employed to reduce GHG emissions, projects shall agree the long term viability of the scheme with the Overseeing Organisation.

## Vulnerability of projects to climate change

**Scoping**

3.24 The scoping assessment shall identify whether anticipated changing climate conditions and weather events are likely to have significant adverse effects on the project (or elements of the project) during construction and operation.

*NOTE 1 Scoping will focus on identification of any likely significant climate changes and likely project exposure to these changes.*

*NOTE 2 Scoping will identify vulnerable elements of a project that require further assessment.*

**Study area**

3.25 The study area for assessing a project's vulnerability to climate change shall be based on the construction footprint/project boundary (including compounds and temporary land take).

**Baseline scenario**

3.26 The assessment of a project's vulnerability to climate change shall use published historical regional weather data to demonstrate the current climate impacts on a study area.

*NOTE The Met Office provides information on observed and future climate change relative to the baseline period of 1961-1990, based on the latest scientific understanding UKCP18 [Ref 11.N].*

3.26.1 Recent weather patterns and extreme weather events should be identified, to provide an indication of how the project will account for climate change in the immediate future i.e. during construction.

3.27 Historical events as a result of weather patterns and extreme weather events, i.e. landslides after heavy rainfall, shall be identified to provide an indication of past vulnerability.

3.28 To identify the future changes to the climate baseline, the following factors shall be identified and used in the assessment:

1) the life span of the project (including timescales for construction and operational life cycle stages);
2) climate trends associated with the UKCP high emissions scenario (50% probability) projection (using the latest available projections);
3) the environmental baseline under future projected climate conditions.

*NOTE UKCP provides probabilistic projections for the whole of the UK, at regional level and at local level UK Climate Projections.*

3.29 The relevant climate variables shall be identified and included in the assessment.

*NOTE UKCP includes a range of different climate variables (e.g. mean daily temperature for summer and winter, mean daily maximum temperatures for summer and mean daily minimum temperatures for winter).*

3.30 Assessments shall use the H++ climate scenarios to test the sensitivity of vulnerable safety critical features, to ensure that such features will not be affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections.

3.31 The assessment of a project's vulnerability to climate change shall take the life span of the project to be 60 years.

3.32 The life cycle stages being assessed shall determine the relevant period over which the projections are selected (e.g. short term 2030, medium term 2050, long term 2080), and the extent to which they will change in comparison to the baseline.

3.33 For projects which are expected to remain in operation beyond the last period of projections, the assessment shall continue to use the last available period for the remainder of the design life of the project.

**Data collection**

3.34 Following identification of the future climate scenarios, the project receptors within the study area which are vulnerable to climate change shall be identified as below:

1) the construction process (e.g. workforce, plant, machinery etc);
2) the assets and their operation, maintenance and refurbishment (e.g. pavements, structures, earthworks and drainage, technology assets, etc);
3) end-users (e.g. members of public, commercial operators etc).

3.35 The vulnerability of the project to future climate scenarios shall be identified and reported for each phase of the project life cycle.

*NOTE Examples of climate change events and associated impacts that can be assessed during construction and operation are presented in Table 3.35N (not exhaustive).*

**Table 3.35N Examples of potential climate impacts during construction and operation**

| Climate event | Impact |
|---|---|
| **Construction** | |
| Increased frequency of extreme weather. | 1) Damage, delay, health and safety impacts, increased costs. |
| Increased temperatures, prolonged periods of hot weather. | 1) Warm and dry conditions exacerbate dust generation and dispersion, health risks to construction workers. |
| Increased precipitation, and intense periods of rainfall. | 1) Flooding of works and soil erosion;<br>2) Increased risk of contamination of waterbodies;<br>3) Disruption to supply of materials and goods;<br>4) Landslides |
| **Operation** | |
| Increased precipitation, especially in Winter. | 1) Flooding;<br>2) Water scour causing structural damage;<br>3) Weakening or wash-out of structural soils;<br>4) Change in ground water level and soil moisture. |
| Gales. | 1) Damage from wind borne debris;<br>2) Additional or uneven loading of structures;<br>3) Disruption and potential danger to crossing users (including pedestrians and cyclists);<br>4) Damage to trees / landscaping. |
| Temperature extremes / dry periods. | 1) Stress on structures and technology;<br>2) Stress on surfaces e.g. difficulties with maintaining required texture depth during construction and operation;<br>3) Challenges for maintenance regimes. |

**Table 3.35N Examples of potential climate impacts during construction and operation** (continued)

| Climate event | Impact |
|---|---|
| Increased sea level rise and wave height. | 1) Flooding, increased corrosion potential/impact stress of structures supporting water crossings. |
| Increased frequency of extreme weather events. | 1) Increased requirement for maintenance and 0pt repair, danger to road users;<br>2) Increased costs. |

### Significance criteria

3.36 Where the climate change impact on project receptors is potentially significant, a risk assessment shall be undertaken.

3.37 The risk assessment shall assess the likelihood and consequence of the impact occurring to each receptor, leading to evaluation of the significance of the effect.

3.38 The assessment of significance shall be carried out in accordance with the following steps:

1) the identification of hazards and benefits;
2) assessment of likelihood and consequences;
3) evaluation of significance.

3.39 Once the climate change impacts (hazards and opportunities) have been identified, a risk assessment of those impacts on the operational phase project shall be undertaken using the following framework in Table 3.39a (likelihood categories) and Table 3.39b (measure of consequence).

**Table 3.39a Likelihood categories**

| Likelihood category | Description (probability and frequency of occurrence) |
|---|---|
| Very high | The event occurs multiple times during the lifetime of the project (60 years) e.g. approximately annually, typically 60 events. |
| High | The event occurs several times during the lifetime of the project (60 years) e.g. approximately once every five years, typically 12 events. |
| Medium | The event occurs limited times during the lifetime of the project (60 years) e.g. approximately once every 15 years, typically 4 events. |
| Low | The event occurs during the lifetime of the project (60 years) e.g. once in 60 years. |
| Very low | The event can occur once during the lifetime of the project (60 years). |

**Table 3.39b Measure of consequence**

| Consequence of impact | Description |
|---|---|
| Very large adverse | Operation - national level (or greater) disruption to strategic route(s) lasting more than 1 week. |
| Large adverse | Operation - national level disruption to strategic route(s) lasting more than 1 day but less than 1 week or regional level disruption to strategic route(s) lasting more than 1 week. |
| Moderate adverse | Operation - regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week. |
| Minor adverse | Operation - regional level disruption to strategic route(s) lasting less than 1 day. |
| Negligible | Operation - disruption to an isolated section of a strategic route lasting less than 1 day. |

3.40 For the construction phase, a qualitative description of disruption risk shall be reported.

### Evaluation of significance

3.41 The likelihood and consequence of each impact shall be combined in the form of a matrix to identify the significance of each impact as outlined in table 3.41.

**Table 3.41 Significance matrix**

| | | Measure of likelihood | | | | |
|---|---|---|---|---|---|---|
| | | **Very low** | **Low** | **Medium** | **High** | **Very high** |
| **Measure of consequence** | **Very large** | NS | S | S | S | S |
| | **Large** | NS | NS | S | S | S |
| | **Moderate** | NS | NS | S | S | S |
| | **Minor** | NS | NS | NS | NS | NS |
| | **Negligible** | NS | NS | NS | NS | NS |

*NOTE* *NS = Not significant; S = Significant.*

3.42 Significance conclusions for each impact shall be based on and incorporate confirmed design and mitigation measures.

**Design and mitigation**

3.43 The environmental assessment shall identify how the project can be adapted to protect it from future climate scenarios.

*NOTE* *Early engagement between design engineers and environmental assessment professionals is the most effective way of eliminating and reducing impacts on the project from climate, thereby reducing the need for additional / subsequent design and mitigation measures.*

3.44 Where an effect has been concluded to be significant, the design and mitigation hierarchy outlined within LA 104 [Ref 3.N] shall be re-assessed to reduce the significance of impacts to an acceptable level (not significant).

3.45 Where residual (non-significant) climate impacts have been identified in the environmental assessment, measures to manage the ongoing risks shall be identified.

# 4. Monitoring

### Impact of projects on climate

4.1 Quarterly GHG emission returns required on projects during the construction and operation stages shall be reported in accordance with the Overseeing Organisation's requirements.

4.2 Actual data provided for the GHG returns shall be evaluated to inform any ongoing monitoring of GHG emissions and also feed back into future assessment of projects during design development and planning approval.

### Vulnerability of projects to climate change

4.3 Once a project is operational, asset data shall be managed, maintained and monitored to ensure the project design is operating as intended.

*NOTE Asset management measures can evolve (adaptive management) once the asset is operational as an appropriate response to climate impacts.*

4.3.1 Where a design issue is identified, an assessment should be made to determine if corrective action is required, i.e. drainage amendments to rectify a flooding hotspot that was not anticipated at design stage.

# 5. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

| | |
|---|---|
| Ref 1.N | HMSO. UK Parliament. 'Climate Change Act 2008' |
| Ref 2.N | 'Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014' |
| Ref 3.N | Highways England. LA 104, 'Environmental assessment and monitoring' |
| Ref 4.N | Highways England. GG 103, 'Introduction and general requirements for sustainable development and design' |
| Ref 5.N | Highways England. LA 101, 'Introduction to environmental assessment' |
| Ref 6.N | Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges' |
| Ref 7.N | United Nations. United Nations Framework Convention on Climate Change. UNFCCC, 'Kyoto Protocol' |
| Ref 8.N | Highways England. LA 103, 'Scoping projects for environmental assessment' |
| Ref 9.N | Highways England. LA 102, 'Screening projects for Environmental Impact Assessment' |
| Ref 10.N | legislation.gov.uk. 'The Climate Change Act 2008 (2050 Target Amendment) Order 2019' |
| Ref 11.N | https://www.metoffice.gov.uk/research/collaboration/ukcp/. UKCP18, 'UKCP18' |

# 6. Informative references

The following documents are informative references for this document and provide supporting information.

| | |
|---|---|
| Ref 1.I | HM Treasury . Construction Leadership Council. PAS 2080:2016, 'Carbon Management in Infrastructure' , 2016 |

Sustainability & Environment
Appraisal

# LA 114
# England National Application Annex to LA 114 Climate

Revision 0

**Summary**
There are no specific requirements for Highways England supplementary or alternative to those given in LA 114.



**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

**This is a controlled document.**

# Contents

## Release notes

| Version | Date | Details of amendments |
|---|---|---|
| 0 | Oct 2019 | Highways England National Application Annex to LA 114. |

Design Manual for Roads and Bridges

Sustainability & Environment
Appraisal

# LA 114
# Northern Ireland National Application Annex to LA 114 Climate

Revision 0

**Summary**
There are no specific requirements for Department for Infrastructure Northern Ireland supplementary or alternative to those given in LA 114.



**Application by Overseeing Organisations**
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

**This is a controlled document.**

# Contents

## Release notes

| Version | Date | Details of amendments |
|---|---|---|
| 0 | Oct 2019 | Department for Infrastructure, Northern Ireland National Application Annex to LA 114. |

Sustainability & Environment
Appraisal

# LA 114
# Scotland National Application Annex to LA 114 Climate

Revision 0

**Summary**
This National Application Annex sets out Transport Scotland's specific requirements for the assessment and management of the impacts that road projects can have on, and experience from, climate change.

**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Transport Scotland team. The email address for all enquiries and feedback is: TSStandardsBranch@transport.gov.scot

**This is a controlled document.**

# Contents

## Release notes

| Version | Date | Details of amendments |
|---|---|---|
| 0 | Oct 2019 | Tranport Scotland National Application Annex to LA 114. |

# Foreword

## Publishing information

This document is published by Highways England on behalf of Transport Scotland.

## Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

# Introduction

## Background

This National Application Annex sets out Transport Scotland's specific requirements for the assessment and management of the impacts that road projects can have on, and experience from, climate change.

## Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 1.N] apply to this document.

## S/1. Applicability of the document

S/1.1 Transport Scotland shall be contacted for the application of LA 114.

*NOTE The email address is: TSStandardsBranch@transport.gov.scot.*

## S/2. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

| | |
|---|---|
| Ref 1.N | Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges' |

Llywodraeth Cymru
Welsh Government

Sustainability & Environment
Appraisal

# LA 114
# Wales National Application Annex to LA 114 Climate

Revision 0

**Summary**
There are no specific requirements for Welsh Government supplementary or alternative to those given in LA 114.



**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Welsh Government team. The email address for all enquiries and feedback is: Standards_Feedback_and_Enquiries@gov.wales

**This is a controlled document.**

# Contents

## Release notes

| Version | Date | Details of amendments |
|---|---|---|
| 0 | Oct 2019 | Welsh Government National Application Annex to LA 114. |

## Appendix CL2.6

## Design Manual for Roads and Bridges (DMRB) LA114 Climate (2021)

Design Manual for Roads and Bridges

Sustainability & Environment
Appraisal

# LA 114
# Climate

(formerly New)

Version 0.0.1

**Summary**
This document sets out the requirements for assessing and reporting the effects of climate on highways (climate change resilience and adaptation), and the effect on climate of greenhouse gas from construction, operation and maintenance projects.

**Application by Overseeing Organisations**
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

**This is a controlled document.**

# Contents

## Latest release notes

| Document code | Version number | Date of publication of relevant change | Changes made to | Type of change |
|---|---|---|---|---|
| LA 114 | 0.0.**1** | June 2021 | Core document, Scotland NAA | Incremental change to notes and editorial updates |
| This release is for the publication of updated requirements in the Scotland National Application Annex only. | | | | |

## Previous versions

| Document code | Version number | Date of publication of relevant change | Changes made to | Type of change |
|---|---|---|---|---|
| LA 114 | 0 | October 2019 | | |

# Foreword

## Publishing information

This document is published by Highways England.

This document makes provision for requirements outlined within EU Directive 2011/92/EU as amended by 2014/52/EU 2011/92/EU [Ref 1.N] (hereafter referred to as the EIA Directive) and the Climate Change Act 2008 SI No. 1056 CCA 2008 [Ref 10.N].

## Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

# Introduction

## Background

The UK has made commitments to tackle the root cause of climate change by reducing emissions of greenhouse gases (GHG), as well as to increase the resilience of development and infrastructure to the changing climate.

The Climate Change Act 2008 SI No. 1056 CCA 2008 [Ref 10.N] sets a target to reduce net GHG emissions by 100% from 1990 levels by the year 2050.

The effective assessment and management of impacts on climate, as well as the effects of climate change on projects offers the opportunity to:

1) improve the resilience of projects to future climate conditions, such as increased risk and severity of flooding, drought, heatwaves, intense rainfall events and other extreme weather events; and
2) reduce the impact of projects on climate by minimising the magnitude of GHG emissions as far as possible.

## Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 6.N] apply to this document.

# Abbreviations

| Abbreviation | Definition |
|---|---|
| AADT | Average Annual Daily Traffic |
| $CO_2e$ | Carbon dioxide equivalent |
| GHG | Greenhouse gas |
| PAS2080 | Publicly Available Specification (2080): Carbon Management in Infrastructure |
| $tCO_2e$ | tonnes of Carbon dioxide equivalent |
| UKCP | United Kingdom Climate Projections |

# Terms and definitions

| Term | Definition |
|---|---|
| Actual data | GHG emission data derived from recorded / observed activities (rather than predicted) |
| Adaptive management | A process that enables uncertainty to be included in operational decision-making. |
| Authorities likely to be concerned | Authorities or organisations (statutory or non-statutory) that have environmental responsibilities or local and regional competences (as defined by the relevant consenting regime) |
| Benchmarking | Comparison of project performance against other similar projects using consistent metrics |
| Carbon account | The UK's net carbon emissions |
| Carbon budgets | UK GHG targets over defined periods of time |
| Carbon emissions / $CO_2e$ | Shorthand for emissions of any of the seven greenhouse gases (GHGs) that contribute to climate change<br>NOTE 1: Definition from the Kyoto Protocol UNFCCC [Ref 7.N]<br>NOTE 2: Carbon emissions are usually expressed as $CO_2e$ (carbon dioxide equivalent). |
| Climate | Long-term weather conditions prevailing over a region<br>NOTE: Measured in terms of average precipitation, maximum and minimum seasonal temperatures, and other factors, throughout a year |
| Construction GHG emissions | GHG emissions associated with the construction phase of a project |
| Decommissioning | The act of ceasing operation of an asset to a non-active status |
| Disruption: national level | Closure/partial /obstruction of a strategic route restricting/preventing movement across multiple regions/counties |
| Disruption: regional level | Closure/partial/obstruction of a strategic route restricting/preventing movement within a region or county |
| Embodied carbon | Carbon (GHG) emissions associated with energy consumption and chemical processes during the extraction, transport and/or manufacture of construction materials or products<br>NOTE: Typical embodied carbon datasets are 'cradle-to-gate' (i.e. all emissions to the point of delivery from the factory gate) and expressed in kilograms of $CO_2e$ per kilogram of product or material. |
| Extreme weather | A weather event which is significantly different from the average or usual weather pattern |
| Future baseline | An outline of the likely evolution of the current state of the environment without implementation of the project |
| Greenhouse gas (GHG) | A gaseous compound that absorbs infrared radiation and traps heat in the atmosphere<br>NOTE: Greenhouse gases are usually expressed in terms of carbon dioxide equivalents (see 'carbon emissions'). |

(continued)

| Term | Definition |
|---|---|
| H++ climate scenarios | Extreme climate change scenarios on the margins or outside of the 10th to 90th percentile range presented in the 2009 UK Climate Projections: Briefing Report UK CP18 [Ref 3.N] |
| Low carbon | Activities/assets which minimise carbon footprint |
| Material impact | An event/outcome that is a key decision making consideration |
| Net GHG emissions | The difference in GHG emissions between the do minimum and do something scenarios taking into consideration carbon reduction measures (i.e. mitigation measures) |
| Operational GHG emissions | GHG emissions associated with<br>1) the operation and maintenance of the asset, i.e. lighting, maintenance activities etc); and<br>2) users of the asset (i.e vehicle emissions) |
| Regional | Geographical regions in the United Kingdom Climate Projections as follows:<br>1) North East England;<br>2) North West England;<br>3) Yorkshire and the Humber;<br>4) East Midlands;<br>5) West Midlands;<br>6) East of England;<br>7) London;<br>8) South East England;<br>9) South West England;<br>10) Wales;<br>11) Scotland; and<br>12) Northern Ireland. |
| Resilience | The capacity of a project (or lack thereof) to withstand the adverse effects of climate change |
| Trans-boundary impacts | Any adverse effect on the environment resulting from human activity, the physical origin of which is situated wholly or in part within an area under the jurisdiction of another State |
| UKCP | The name given to the UK Climate Projections<br>NOTE 1: provides the future climate projections and observed (historical) climate data for UK regions.<br>NOTE 2: This will in turn be superseded by updates such as UK CP18 [Ref 3.N]. |
| Vulnerability | The degree to which a system/asset is exposed and resilient to adverse effects of climate change |

# 1. Scope

## Aspects covered

1.1 The requirements in this document shall be applied to the assessment, reporting and management of effects from projects on climate, along with the effects of climate on projects.

1.2 Environmental assessments must, as required by the EIA Directive 2011/92/EU [Ref 1.N], describe the likely significant effects of proposed projects on the environment resulting from the:

1) impact of the project on climate (GHG emissions); and,
2) vulnerability of the project to climate change (adaptation).

1.3 The assessment of effects on climate shall be informed by relevant information collated by other environmental factors, notably material assets and waste.

1.4 The assessment of effects on climate shall be used to inform other environmental factors where appropriate.

1.5 The assessment of climate effects on the project shall be used to inform the assessment of project vulnerability to major accidents and disasters where appropriate.

1.6 An overview of the vulnerability of a project to major accidents and disasters (man-made and natural) shall be reported in environmental assessments within the description of the project.

1.7 Consequential changes in the predicted effects of a project on the environment as a result of major accidents and disasters shall be reported in relevant environmental topics.

## Implementation

1.8 This document shall be implemented forthwith on all schemes requiring an assessment of climate on the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 6.N].

## Use of GG 101

1.9 The requirements contained in GG 101 [Ref 6.N] shall be followed in respect of activities covered by this document.

# 2. Principles and purpose

## Integration with consent procedures and planning policy

2.1 Projects shall use the assessment and design process to demonstrate their contribution to reduced GHG emissions in line with the EIA Directive 2011/92/EU [Ref 1.N] and the Climate Change Act 2008 SI No. 1056 CCA 2008 [Ref 10.N].

*NOTE 1 The Climate Change Act 2008 SI No. 1056 CCA 2008 [Ref 10.N], sets out a target to reduce by 100% the net UK carbon account by 2050 when compared to the 1990 baseline, or the baseline of the relevant transposing national regulations.*

*NOTE 2 The assessment of GHG emissions early in the life cycle of a project offers the greatest potential for the reduction of GHGs.*

## Assessment and consultation

2.2 The assessment and reporting shall identify the scale and nature of GHG emissions across the whole project life cycle, taking into account design and mitigation measures already incorporated into the project.

2.2.1 The assessment should report on construction and operational (maintenance and user) GHG emissions.

2.3 Decommissioning associated with a proposed project shall be excluded from assessment of climate (for both impacts on climate and vulnerability of projects to climate change) due to the length of the asset operational phase.

2.3.1 The assessment of climate should report on demolition where an existing asset requires removal prior to construction of a proposed asset.

2.4 Projects shall minimise their vulnerability against the negative effects of projected climate change through appropriate design and mitigation measures.

2.5 The assessment and reporting of the effects on climate shall be undertaken in accordance with the sustainability principles outlined in GG 103 [Ref 4.N].

2.6 The assessment and reporting of the effects on climate shall be undertaken in accordance with the requirements in the four over-arching environmental assessment documents:

1) LA 101 [Ref 5.N] Introduction to environmental assessment;
2) LA 102 [Ref 9.N] Screening projects for Environmental Impact Assessment;
3) LA 103 [Ref 8.N] Scoping projects for environmental assessment;
4) LA 104 [Ref 2.N] Environmental assessment & monitoring.

2.7 The principles of PAS 2080:2016 specification on infrastructure carbon management PAS 2080 2016 [Ref 1.I] (with the exception of setting project level carbon reduction targets) shall be used to inform the assessment of projects on climate and supplement the guidance contained herein.

2.8 Where potential trans-boundary impacts are predicted, projects shall consult with the relevant planning authorities likely to be concerned.

# 3. Assessment methodology

## Impact of projects on climate (GHG Emissions)

### Scoping

3.1 The scoping assessment shall report on the likely additional and avoided GHG emissions at each life cycle stage of the project, in comparison with current and future baseline GHG emissions.

3.2 The scoping assessment shall report on the nature and scale of GHG emissions (positive, neutral or negative) and the likelihood of significant effects.

3.3 The scoping assessment shall report on the following questions to gain an understanding of the need to undertake further assessment:

1) are construction GHG emissions (or GHG-emitting activity), compared to the baseline scenario (i.e. when compared to GHG emissions and energy use associated with existing maintenance activities), increasing by >1%?;
2) during operation, will roads meet or exceed any of the following criteria?
   a) a change of more than 10% in AADT;
   b) a change of more than 10% to the number of heavy duty vehicles; and
   c) a change in daily average speed of more than 20 km/hr.

3.4 Where the response to one or more of the scoping assessment questions is 'yes', further assessment shall be undertaken.

3.5 The scoping assessment shall report on life cycle stage or sub-stages for which the GHG emissions are not likely to be significant.

3.5.1 The scoping assessment should address the following:

1) is there (or is there likely to be, within the timescales of the assessment) sufficient certainty on the availability of quantitative GHG emissions information?;
2) will the availability of information allow the effects on climate resulting from GHG emissions to be assessed?

3.6 The scoping assessment shall identify the extent to which operational user GHG emissions are additional to the baseline in the absence of the project (do-minimum vs do-something), and the GHG emissions from traffic which are transferring from other roads in the surrounding area.

3.7 Where there is insufficient, reliable information for quantitative assessment for any life cycle stage of the project, a qualitative assessment of GHG emissions shall be completed in the early stages of project development.

### Study area

3.8 For construction and operational maintenance, the study area shall comprise GHG emissions associated with project construction related activities/materials and their associated transport.

3.9 For operational road user GHG emissions, the study area shall be consistent with the affected road network defined in a project's traffic model.

### Baseline scenario

3.10 The GHG emissions without the project shall be identified for the current and future baseline (do-minimum scenarios).

3.10.1 The boundary of the baseline GHG emissions should include current operational maintenance GHG emissions and operational user GHG emissions.

3.10.2 The baseline GHG emissions should be consistent with the study area outlined for the project.

**Data collection**

3.11 GHG emissions shall be calculated and reported for each of the project life cycle stages as required by the scope of the assessment to establish the 'do something' scenario.

3.11.1 Table 3.11.1 outlines the project life cycle stages and potential sources of GHG emission data that should be obtained to inform the assessment.

**Table 3.11.1 Sources and lifecycle stages for project GHG emissions**

| Main stage of project life cycle | Sub-stage of life cycle | Potential sources of GHG emissions (not exhaustive) | Examples of activity data |
|---|---|---|---|
| Construction stage | Product stage; including raw material supply, transport and manufacture. | Embodied GHG emissions associated with the required raw materials. | Materials quantities. |
| | Construction process stage; including transport to/from works site and construction /installation processes. | Activities for organisations conducting construction work. | Fuel/electricity consumption.<br>Construction activity type/duration.<br>Transportation of materials from point of purchase to site, mode/distance.<br>Area of land use change. |
| | Land use change. | GHG emissions mobilised from vegetation or soil loss during construction. | Type and area of land subject to change in usage. |
| Operation ('use-stage') (to extend 60yrs in line with appraisal period) | Use of the infrastructure by the end-user (road user). | Vehicles using highways infrastructure. | Traffic count/speed by vehicle type for highway links. |
| | Operation and maintenance (including repair, replacement and refurbishment). | Energy consumption for infrastructure operation and activities of organisations conducting routine maintenance. | Fuel/electricity consumption for vehicles, lighting and plant.<br>Raw material quantities and transport mode/distance.<br>Waste and arisings quantities,<br>transport mode/distance and disposal fate. |
| | Land use and forestry. | Ongoing land use GHG emissions/ sequestration each year. | Type and area of land subject to change in usage.<br>Net change in vegetation. |
| Opportunities for reduction | GHG emissions potential of recovery including reuse and recycling GHG emissions potential of benefits and loads of additional functions associated with the study system. | Avoided GHG emissions through substitution of virgin raw materials with those from recovered sources. | Waste and arisings material quantities and recycling/reuse fate. |

*NOTE 1 The first life cycle stage is 'construction', which includes GHG emissions from the construction process and the manufacture/transport of materials.*

*NOTE 2 The second life cycle stage is 'operation' which includes:*

1) *operation and maintenance, repair, replacement, refurbishment and land use changed (operational maintenance GHG emissions); and*
2) *emissions from end-users (operational user GHG emissions).*

*NOTE 3 The third life cycle stage comprises opportunities to minimise production/use of GHG emissions i.e. the potential for reduction of GHG emissions through reuse and recycling during the construction of the scheme.*

3.12 A proportionate approach shall be applied to calculating and reporting GHG emissions from changes in land use and forestry (i.e reporting only where there is likely to be a substantial change).

3.13 The GHG emissions calculation for the project life cycle shall be completed using an industry recognised carbon calculation tool(s) in accordance with the Overseeing Organisation requirements.

3.14 A proportionate approach shall be applied to capture the principal contributing factors associated with GHG emissions.

3.15 The assessment of projects on climate shall report the quantities of GHG emissions in metric tonnes of carbon dioxide equivalents (tCO2e).

3.16 An appropriate validated traffic model shall be used to estimate operational road user GHG emissions.

3.17 Emissions factor data for user GHG emissions shall enable assessment of the base year, opening year and design (future) year scenarios.

**Significance criteria**

3.18 An assessment of project GHG emissions against UK government or Overseeing Organisation carbon budgets shall be undertaken and presented as follows:

**Table 3.18 Project GHG emissions against relevant carbon budgets**

| Project stage | Estimated total carbon over carbon budget (tCO2e) ('Do something' Scenario) | Net CO2 project GHG emissions (tCO2e) (Do something - Do minimum) | Relevant carbon budget | | |
|---|---|---|---|---|---|
| Construction | | | | | |
| Operation | | | | | |
| Total | | | | | |

3.19 Where a project stage extends over multiple carbon budget periods, the projects GHG emissions shall be reported against each carbon budget for each project stage.

*NOTE 1 National policy states that "It is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets".*

*NOTE 2 In the context of NOTE 1, it is considered unlikely that projects will in isolation conclude significant effects on climate.*

3.20 The assessment of projects on climate shall only report significant effects where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets.

3.20.1 Where assessment conclusions indicate that there is likely to be a 'material impact' on the Government's carbon reduction targets, evidence to support this conclusion should be submitted to the Overseeing Organisation.

3.21 Bench marking of project performance shall be undertaken by comparing GHG emissions to other highway projects.

3.21.1 In comparing highways projects, GHG emissions should be normalised to take account of differences in size and scale.

**Design and mitigation**

3.22 Projects shall seek to minimise GHG emissions in all cases to contribute to the UK's target for net reduction in carbon emissions.

3.22.1 Projects should apply and develop the following options:

1) avoid / prevent:
   a) maximise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required, and/or explore alternative lower carbon options to deliver the project objectives (i.e. shorter route options with smaller construction footprints);
   b) identify through projects and delivery programmes opportunities to influence user GHG emissions;
2) reduce:
   a) apply low carbon and/or reduced resource consumption solutions (including technologies, materials and products) to minimise resource consumption during the construction, operation, and at end of life;
3) remediate:
   a) identify, assess and integrate measures to further reduce carbon through on or off-site offsetting or sequestration.

*NOTE 1 Minimising GHG emissions through design is a core principle of the Government's Infrastructure Carbon Review and the Specification on infrastructure carbon management PAS 2080 2016 [Ref 1.I].*

*NOTE 2 Offsetting and sequestering can include measures such as adoption of renewable energy technologies or the creation of new habitats or employment of technologies with the capacity to absorb carbon.*

3.23 Where carbon offsetting/sequestration is employed to reduce GHG emissions, projects shall agree the long term viability of the scheme with the Overseeing Organisation.

## Vulnerability of projects to climate change

**Scoping**

3.24 The scoping assessment shall identify whether anticipated changing climate conditions and weather events are likely to have significant adverse effects on the project (or elements of the project) during construction and operation.

*NOTE 1 Scoping will focus on identification of any likely significant climate changes and likely project exposure to these changes.*

*NOTE 2 Scoping will identify vulnerable elements of a project that require further assessment.*

**Study area**

3.25 The study area for assessing a project's vulnerability to climate change shall be based on the construction footprint/project boundary (including compounds and temporary land take).

**Baseline scenario**

3.26 The assessment of a project's vulnerability to climate change shall use published historical regional weather data to demonstrate the current climate impacts on a study area.

*NOTE The Met Office provides information on observed and future climate change relative to the baseline period of 1961-1990, based on the latest scientific understanding UK CP18 [Ref 3.N].*

3.26.1 Recent weather patterns and extreme weather events should be identified, to provide an indication of how the project will account for climate change in the immediate future i.e. during construction.

3.27 Historical events as a result of weather patterns and extreme weather events, i.e. landslides after heavy rainfall, shall be identified to provide an indication of past vulnerability.

3.28 To identify the future changes to the climate baseline, the following factors shall be identified and used in the assessment:

1) the life span of the project (including timescales for construction and operational life cycle stages);
2) climate trends associated with the UKCP high emissions scenario (50% probability) projection (using the latest available projections);
3) the environmental baseline under future projected climate conditions.

*NOTE* *UKCP provides probabilistic projections for the whole of the UK, at regional level and at local level UK Climate Projections.*

3.29 The relevant climate variables shall be identified and included in the assessment.

*NOTE* *UKCP includes a range of different climate variables (e.g. mean daily temperature for summer and winter, mean daily maximum temperatures for summer and mean daily minimum temperatures for winter).*

3.30 Assessments shall use the H++ climate scenarios to test the sensitivity of vulnerable safety critical features, to ensure that such features will not be affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections.

3.31 The assessment of a project's vulnerability to climate change shall take the life span of the project to be 60 years.

3.32 The life cycle stages being assessed shall determine the relevant period over which the projections are selected (e.g. short term 2030, medium term 2050, long term 2080), and the extent to which they will change in comparison to the baseline.

3.33 For projects which are expected to remain in operation beyond the last period of projections, the assessment shall continue to use the last available period for the remainder of the design life of the project.

**Data collection**

3.34 Following identification of the future climate scenarios, the project receptors within the study area which are vulnerable to climate change shall be identified as below:

1) the construction process (e.g. workforce, plant, machinery etc);
2) the assets and their operation, maintenance and refurbishment (e.g. pavements, structures, earthworks and drainage, technology assets, etc);
3) end-users (e.g. members of public, commercial operators etc).

3.35 The vulnerability of the project to future climate scenarios shall be identified and reported for each phase of the project life cycle.

*NOTE* *Examples of climate change events and associated impacts that can be assessed during construction and operation are presented in Table 3.35N (not exhaustive).*

**Table 3.35N Examples of potential climate impacts during construction and operation**

| Climate event | Impact |
|---|---|
| Construction | |
| Increased frequency of extreme weather. | 1) Damage, delay, health and safety impacts, increased costs. |
| Increased temperatures, prolonged periods of hot weather. | 1) Warm and dry conditions exacerbate dust generation and dispersion, health risks to construction workers. |
| Increased precipitation, and intense periods of rainfall. | 1) Flooding of works and soil erosion;<br>2) Increased risk of contamination of waterbodies;<br>3) Disruption to supply of materials and goods;<br>4) Landslides |
| Operation | |
| Increased precipitation, especially in Winter. | 1) Flooding;<br>2) Water scour causing structural damage;<br>3) Weakening or wash-out of structural soils;<br>4) Change in ground water level and soil moisture. |
| Gales. | 1) Damage from wind borne debris;<br>2) Additional or uneven loading of structures;<br>3) Disruption and potential danger to crossing users (including pedestrians and cyclists);<br>4) Damage to trees / landscaping. |
| Temperature extremes / dry periods. | 1) Stress on structures and technology;<br>2) Stress on surfaces e.g. difficulties with maintaining required texture depth during construction and operation;<br>3) Challenges for maintenance regimes. |

**Table 3.35N Examples of potential climate impacts during construction and operation** (continued)

| Climate event | Impact |
|---|---|
| Increased sea level rise and wave height. | 1) Flooding, increased corrosion potential/impact stress of structures supporting water crossings. |
| Increased frequency of extreme weather events. | 1) Increased requirement for maintenance and 0pt repair, danger to road users;<br>2) Increased costs. |

**Significance criteria**

3.36 Where the climate change impact on project receptors is potentially significant, a risk assessment shall be undertaken.

3.37 The risk assessment shall assess the likelihood and consequence of the impact occurring to each receptor, leading to evaluation of the significance of the effect.

3.38 The assessment of significance shall be carried out in accordance with the following steps:

1) the identification of hazards and benefits;
2) assessment of likelihood and consequences;
3) evaluation of significance.

3.39 Once the climate change impacts (hazards and opportunities) have been identified, a risk assessment of those impacts on the operational phase project shall be undertaken using the following framework in Table 3.39a (likelihood categories) and Table 3.39b (measure of consequence).

**Table 3.39a Likelihood categories**

| Likelihood category | Description (probability and frequency of occurrence) |
|---|---|
| Very high | The event occurs multiple times during the lifetime of the project (60 years) e.g. approximately annually, typically 60 events. |
| High | The event occurs several times during the lifetime of the project (60 years) e.g. approximately once every five years, typically 12 events. |
| Medium | The event occurs limited times during the lifetime of the project (60 years) e.g. approximately once every 15 years, typically 4 events. |
| Low | The event occurs during the lifetime of the project (60 years) e.g. once in 60 years. |
| Very low | The event can occur once during the lifetime of the project (60 years). |

**Table 3.39b Measure of consequence**

| Consequence of impact | Description |
|---|---|
| Very large adverse | Operation - national level (or greater) disruption to strategic route(s) lasting more than 1 week. |
| Large adverse | Operation - national level disruption to strategic route(s) lasting more than 1 day but less than 1 week or regional level disruption to strategic route(s) lasting more than 1 week. |
| Moderate adverse | Operation - regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week. |
| Minor adverse | Operation - regional level disruption to strategic route(s) lasting less than 1 day. |
| Negligible | Operation - disruption to an isolated section of a strategic route lasting less than 1 day. |

3.40 For the construction phase, a qualitative description of disruption risk shall be reported.

**Evaluation of significance**

3.41 The likelihood and consequence of each impact shall be combined in the form of a matrix to identify the significance of each impact as outlined in table 3.41.

**Table 3.41 Significance matrix**

| | | Measure of likelihood | | | | |
|---|---|---|---|---|---|---|
| | | Very low | Low | Medium | High | Very high |
| Measure of consequence | Very large | NS | S | S | S | S |
| | Large | NS | NS | S | S | S |
| | Moderate | NS | NS | S | S | S |
| | Minor | NS | NS | NS | NS | NS |
| | Negligible | NS | NS | NS | NS | NS |

*NOTE* *NS = Not significant; S = Significant.*

3.42 Significance conclusions for each impact shall be based on and incorporate confirmed design and mitigation measures.

**Design and mitigation**

3.43 The environmental assessment shall identify how the project can be adapted to protect it from future climate scenarios.

*NOTE* *Early engagement between design engineers and environmental assessment professionals is the most effective way of eliminating and reducing impacts on the project from climate, thereby reducing the need for additional / subsequent design and mitigation measures.*

3.44 Where an effect has been concluded to be significant, the design and mitigation hierarchy outlined within LA 104 [Ref 2.N] shall be re-assessed to reduce the significance of impacts to an acceptable level (not significant).

3.45 Where residual (non-significant) climate impacts have been identified in the environmental assessment, measures to manage the ongoing risks shall be identified.

# 4. Monitoring

### Impact of projects on climate

4.1 Quarterly GHG emission returns required on projects during the construction and operation stages shall be reported in accordance with the Overseeing Organisation's requirements.

4.2 Actual data provided for the GHG returns shall be evaluated to inform any ongoing monitoring of GHG emissions and also feed back into future assessment of projects during design development and planning approval.

### Vulnerability of projects to climate change

4.3 Once a project is operational, asset data shall be managed, maintained and monitored to ensure the project design is operating as intended.

*NOTE Asset management measures can evolve (adaptive management) once the asset is operational as an appropriate response to climate impacts.*

4.3.1 Where a design issue is identified, an assessment should be made to determine if corrective action is required, i.e. drainage amendments to rectify a flooding hotspot that was not anticipated at design stage.

# 5. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

| | |
|---|---|
| Ref 1.N | 2011/92/EU, 'Assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014' |
| Ref 2.N | Highways England. LA 104, 'Environmental assessment and monitoring' |
| Ref 3.N | UK Met Office. UK CP18 , 'https://www.metoffice.gov.uk' |
| Ref 4.N | Highways England. GG 103, 'Introduction and general requirements for sustainable development and design' |
| Ref 5.N | Highways England. LA 101, 'Introduction to environmental assessment' |
| Ref 6.N | Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges' |
| Ref 7.N | United Nations. United Nations Framework Convention on Climate Change. UNFCCC, 'Kyoto Protocol' |
| Ref 8.N | Highways England. LA 103, 'Scoping projects for environmental assessment' |
| Ref 9.N | Highways England. LA 102, 'Screening projects for Environmental Impact Assessment' |
| Ref 10.N | The National Archives. legislation.gov.uk. SI No. 1056 CCA 2008, 'The Climate Change Act 2008 (2050 Target Amendment) Order 2019' |

# 6. Informative references

The following documents are informative references for this document and provide supporting information.

| | |
|---|---|
| Ref 1.I | HM Treasury . Construction Leadership Council. PAS 2080, 'Carbon Management in Infrastructure' , 2016 |

Sustainability & Environment
Appraisal

# LA 114
# England National Application Annex to LA 114 Climate

Revision 0

**Summary**
There are no specific requirements for Highways England supplementary or alternative to those given in LA 114.

**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

**This is a controlled document.**

# Contents

## Release notes

| Version | Date | Details of amendments |
|---|---|---|
| 0 | Oct 2019 | Highways England National Application Annex to LA 114. |

Design Manual for Roads and Bridges

Sustainability & Environment
Appraisal

# LA 114
# Northern Ireland National Application Annex to LA 114 Climate

Revision 0

**Summary**
There are no specific requirements for Department for Infrastructure Northern Ireland supplementary or alternative to those given in LA 114.

**Application by Overseeing Organisations**
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

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# Contents

## Release notes

| Version | Date | Details of amendments |
|---|---|---|
| 0 | Oct 2019 | Department for Infrastructure, Northern Ireland National Application Annex to LA 114. |

Sustainability & Environment
Appraisal

# LA 114 SNAA
# Scotland National Application Annex to LA 114 Climate

(formerly New)

Version 1.0.0

**Summary**
This National Application Annex sets out Transport Scotland's specific requirements for the assessment and management of the impacts that road projects can have on, and experience from, climate change.

**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Transport Scotland team. The email address for all enquiries and feedback is: TSStandardsBranch@transport.gov.scot

**This is a controlled document.**

# Contents

# Latest release notes

| Document code | Version number | Date of publication of relevant change | Changes made to | Type of change |
|---|---|---|---|---|
| LA 114 SNAA | **1**.0.0 | June 2021 | Scotland NAA | Change to policy, major revision, new document development |
| (June 2021) Transport Scotland requirements for LA 114 created and published. | | | | |

# Previous versions

| Document code | Version number | Date of publication of relevant change | Changes made to | Type of change |
|---|---|---|---|---|

# Foreword

## Publishing information

This document is published by Highways England on behalf of Transport Scotland.

## Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

# Introduction

## Background

This National Application Annex outlines the Transport Scotland-specific requirements related to the assessment and management of the impacts that road projects can have on, and experience from, climate change in the context of Directive 2014/52/EU (hereafter referred to as the EIA Directive) 2014/52/EU [Ref 1.N].

## Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 5.N] apply to this document.

# Abbreviations

**Abbrreviations**

| Abbreviation | Definition |
|---|---|
| CAT | Carbon account for transport |
| CCRA | Climate Change Risk Assessment for Scotland |
| CMS | Carbon Management System |
| EIA | Environmental impact assessment |
| GHG | Greenhouse gas |
| UKCP | UK climate projections |

# Terms and definitions

**Terms**

| Term | Definition |
|---|---|
| Baseline scenario | The baseline is the level of GHG emissions against which future GHG emissions are compared. |
| Boundary | The boundary determines which GHG emissions are accounted for and reported in relation to the project. |
| Climate change adaptation | Adapting to current and future impacts of climate change to reduce the negative impacts and exploit opportunities. |
| Climate change mitigation | Reducing GHG emissions in order to slow or stop global climate change. |
| Direct GHG emissions | These are GHG emissions that originate from sources that are owned or controlled by the project. |
| Indirect GHG emissions | Indirect emissions are GHG emissions that are a consequence of the project, but that occur at sources owned or controlled by another entity. |
| GHG emissions | The six main anthropogenic GHGs are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. |
| Principles for sustainable land use | Reflect Scottish Government's policies on the priorities which should influence land use choices SG/2016/6 [Ref 8.N]. |
| Significant effect | A project is reported as having significant effects on climate where the assessment identifies increases in carbon emissions that will have a material impact on the ability of the Scottish Government to meet its carbon targets. |
| Tonne of carbon dioxide equivalent | This refers to one metric tonne of carbon dioxide or an amount of any other greenhouse gas with an equivalent global warming potential, as calculated in accordance with international carbon reporting practice. |

# S/1. The Roads (Scotland) Act 1984 (Environmental Impact Assessment) Regulations 2017 (additional to LA 114)

## Identification, description and assessment of climate impacts

S/1.1 The significant direct and indirect effects of the construction and operation of the proposed project on climate (for example the nature and magnitude of greenhouse gas (GHG) emissions) shall be identified.

### Data collection

S/1.2 A carbon management or measurement tool shall be agreed with Transport Scotland in advance of data collection.

S/1.2.1 Transport Scotland's Carbon Management System (CMS), which was created to support the use of data in Transport Scotland project appraisal and design decisions, should be used to ensure that GHG emissions across a project's life-cycle are assessed in a consistent manner.

*NOTE 1 The Transport Scotland Project Carbon Tool, a component of the CMS, can be used to support the assessment and reporting of GHG emissions across the whole project lifecycle and recommends:*

1) *a boundary for GHG emissions mapping for road projects, including with regard to embodied carbon (material resourcing, processing and manufacturing);*
2) *transport of materials to site, transport of waste; and*
3) *maintenance activities.*

*NOTE 2 The CMS:*

1) *supports the identification and categorisation of emissions in relation to the 'activities' that are responsible for generating them;*
2) *is based on established measurement protocols that allow for quantification of climate impacts using a carbon dioxide equivalent approach; and*
3) *lists dimensions and assumptions associated with specific elements of road projects.*

S/1.3 The climate change principles for sustainable land use introduced in the Land Use Strategy for Scotland SG/2016/6 [Ref 8.N] shall be applied in the assessment of projects that will have a significant effect on the use of land.

*NOTE 1 The Land Use Strategy SG/2016/6 [Ref 8.N], states that 'land-use decisions can be informed by an understanding of the opportunities and threats brought about by the changing climate.' Greenhouse gas emissions associated with land use can be reduced so that land can continue to contribute to delivering climate change adaptation and mitigation objectives.*

*NOTE 2 The climate change effects identified in assessments can reflect the potential for decisions that affect land-use to create an impact, including on natural systems, many miles away.*

### Significance criteria

S/1.4 Following the assessment of a project's GHG emissions using the criteria in LA 114 [Ref 2.I], the relevant carbon budget shall be assessed against the emissions envelope's within the Scottish Government's Climate Change Plan SG RPP3 [Ref 3.N].

*NOTE The Scottish Government's targets identified in the Climate Change Plan were established using the TIMES model with envelopes calibrated by Scottish specific data and sector intelligence.*

### Vulnerability of projects to climate change

S/1.5 The Climate Change Risk Assessment 2017 (CCRA) ASC (2016) [Ref 9.N] and The UK Climate Projections (UKCP) UK CP18 [Ref 4.N] shall inform the environmental assessment's assessment of project vulnerability to climate change in Scotland.

NOTE 1 *CCRA 2017 ASC (2016) [Ref 9.N] describes, and where possible quantifies over 130 impacts from climate change that Scotland will experience until 2100 and it is updated every five years.*

NOTE 2 *The UK Climate Projections (UKCP) UK CP18 [Ref 4.N] is an analysis tool designed to help decision makers assess the risk exposure of a project to climate. The projections are updated on a 9 year basis.*

NOTE 3 *The (CCRA) 2017 ASC (2016) [Ref 9.N], provides a robust basis for understanding the impacts of climate change and for adaptation planning.*

**Design and mitigation**

S/1.6 Impacts of climate change to a project shall take into account the Climate Ready Scotland: Scottish Climate Change Adaptation Programme 2019-2024 SG/2014/83 [Ref 7.N], which sets out policies and proposals to prepare Scotland for the challenges that we face as our climate continues to change in the decades ahead.

NOTE 1 *The Scottish Climate Change Adaptation Programme is a requirement of the Climate Change (Scotland) Act 2009 and addresses the risks set out in the CCRA 2017 ASC (2016) [Ref 9.N], published under section 56 of the UK Climate Change Act 2008 SI No. 1056 CCA 2008 [Ref 6.N].*

NOTE 2 *The Scottish Climate Change Adaptation Programme sets strategic principles that can underpin approaches to climate change adaptation and related measures, relating to direct and indirect effects of climate change impacts to road infrastructure .*

## S/2. Scottish Government climate change targets (additional to LA 114)

S/2.1 The assessment of projects on climate shall only report substantial effects where increases in GHG emissions will have a significant impact on the environment and the Scottish Government's ability to meet its carbon emission targets CCA(S) 2009 [Ref 2.N].

S/2.2 The GHG emission reduction targets set by Scottish Ministers, as mandated by The Climate Change (Scotland) Act 2009 CCA(S) 2009 [Ref 2.N] shall be taken into account with the respective contributions towards meeting the GHG reduction targets for the industry sector SG Climate policy [Ref 3.I].

*NOTE 1 The significance criteria set out in LA 114 [Ref 2.I] will be used to assess project GHG emissions, however this will be assessed against Scottish Government sector targets set in the updated Climate Change Plan SG RPP3 [Ref 3.N] (due to be published).*

*NOTE 2 The Climate Change (Scotland) Act 2009 CCA(S) 2009 [Ref 2.N], which is the statutory framework for addressing climate change in Scotland, details a target to reduce GHG emissions to net-zero by 2045 on the baseline (which is either 1990 or 1995 depending on the GHG) in line with that of the UK's Climate Change Act 2008 SI No. 1056 CCA 2008 [Ref 6.N].*

*NOTE 3 The Climate Change (Scotland) Act 2009 CCA(S) 2009 [Ref 2.N] employs the unit 'tonnes of carbon dioxide equivalent for measurement and calculation of GHG emissions, and reductions thereof, as calculated in accordance with international carbon reporting practice.*

*NOTE 4 The Carbon Account for Transport (CAT) TS CAT [Ref 1.I], which is published by Transport Scotland annually, outlines the contribution of Scotland's transport sector to achieving Scotland's GHG emission reduction target (it reports on the 'reducing emissions' strategic outcome for Scotland's National Transport Strategy) and can be used for comparative purposes.*

# S/3. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

| | |
|---|---|
| Ref 1.N | 2014/52/EU, 'Assessment of the effects of certain public and private projects on the environment' |
| Ref 2.N | CCA(S) 2009, 'Climate Change (Scotland) Act 2009' |
| Ref 3.N | Scottish Government. https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/. SG RPP3, 'Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3)' |
| Ref 4.N | UK Met Office. UK CP18 , 'https://www.metoffice.gov.uk' |
| Ref 5.N | Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges' |
| Ref 6.N | The National Archives. legislation.gov.uk. SI No. 1056 CCA 2008, 'The Climate Change Act 2008 (2050 Target Amendment) Order 2019' |
| Ref 7.N | SG/2014/83, 'The Scottish Government (2014) Climate Ready Scotland: Scottish Climate Change Adaptation Programme. SG/2014/83 [laid before the Scottish Parliament under Section 53 of the Climate Change (Scotland) Act 2009]' |
| Ref 8.N | SG/2016/6 , 'The Scottish Government (2016) Getting the best from our land. A Land Use Strategy for Scotland 2016 – 2021. SG/2016/6 [in pursuance of Section 57 of the Climate Change (Scotland) Act 2009].' |
| Ref 9.N | Committee on Climate Change, London. Adaptation Sub-Committee. ASC (2016), 'UK Climate Change Risk Assessment 2017, Evidence Report, Summary for Scotland' |

# S/4. Informative references

The following documents are informative references for this document and provide supporting information.

| | |
|---|---|
| Ref 1.I | Transport Scotland. https://www.transport.gov.scot/publication/carbon-account-for-transport-no-12-2020-edition/. TS CAT, 'Carbon Account for Transport (CAT)' |
| Ref 2.I | Highways England. LA 114, 'Climate' |
| Ref 3.I | Scottish Government. https://www.gov.scot/policies/climate-change/. SG Climate policy, 'Climate Change policy' |

Llywodraeth Cymru
Welsh Government

Sustainability & Environment
Appraisal

# LA 114
# Wales National Application Annex to LA 114 Climate

Revision 0

**Summary**
There are no specific requirements for Welsh Government supplementary or alternative to those given in LA 114.

**Feedback and Enquiries**
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Welsh Government team. The email address for all enquiries and feedback is: Standards_Feedback_and_Enquiries@gov.wales

**This is a controlled document.**

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# Release notes

| Version | Date | Details of amendments |
|---|---|---|
| 0 | Oct 2019 | Welsh Government National Application Annex to LA 114. |

## Appendix CL2.7

## European Commission Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment

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# Foreword

The need for action on climate change and biodiversity loss is recognised across Europe and around the world. To make progress towards combating and adapting to climate change, and halting the loss of biodiversity and the degradation of ecosystems, it is vital to fully integrate these issues in the plans, programmes and projects implemented across the EU.

It is widely recognised that climate change has enormous economic consequences. The evidence gathered in the *Stern Review on the Economics of Climate Change* (2006) shows that 'ignoring climate change will eventually damage economic growth.' The Review also points out that 'the benefits of strong and early action far outweigh the economic costs of not acting'. The Commission's *White Paper – Adapting to climate change: Towards a European framework for action* (2009) tackles this evidence and includes a commitment that '… the Commission will work with Member States and stakeholders setting guidelines and exchanging good practice, to ensure that account is taken of climate change impacts when implementing the Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Directives and spatial planning policies.' It also encourages Member States to adopt ecosystem-based approaches, including green infrastructure. The Commission's *EU Strategy on Adaptation to Climate Change*, to be adopted in 2013, will build on the White Paper.

The loss of biodiversity has become one of our main environmental challenges. Its impact on the delivery of ecosystem services, society and the economy as a whole is increasingly recognised, including in the international study by TEEB (2010) of The Economics of Ecosystems and Biodiversity — *Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations*. To address this challenge, Member States have committed themselves to halting the loss of biodiversity and ecosystems by 2020 and to restoring them in so far as feasible.

This *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment* is a response to the above commitments. Since climate change and biodiversity loss — like so many other environmental issues we face — are closely related, they are covered in the same guide.

It is clear that 'business as usual' will neither achieve our climate change nor our biodiversity objectives. The time has come to make sure that we employ all available tools to tackle these global threats. Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs) are legally-required and systematic tools, and as such are well suited to tackling these problems. The Commission's proposal for a revised EIA Directive adopted on 26 October 2012 also introduced amendments to adapt to these challenges (i.e. biodiversity and climate change, as well as disaster risks and availability of natural resources).

As José Manuel Barroso, President of the European Commission, said at the Athens Biodiversity Conference in 2009 – 'The success of our climate change policy will also be measured by the success of our efforts in stopping the loss of biodiversity.' Our aim is that this guide will help the impact assessment community to better integrate these issues into their work, stepping up global and EU action to combat biodiversity loss and climate change.

# Contents

# Acronyms and abbreviations

| | |
|---|---|
| **BAP** | Biodiversity Action Plan |
| **BISE** | Biodiversity Information System for Europe |
| **CBD** | Convention on Biological Diversity |
| **$CH_4$** | Methane |
| **$CO_2$** | Carbon dioxide |
| **EC** | European Commission |
| **ECCP** | European Climate Change Programme |
| **EEA** | European Environment Agency |
| **EIA** | Environmental Impact Assessment |
| **EIB** | European Investment Bank |
| **ETC/ACM** | European Topic Centre for Air Pollution and Climate Change Mitigation |
| **ETC-BD** | European Topic Centre for Biological Diversity |
| **EU ETS** | EU Emissions Trading System |
| **EU** | European Union |
| **GHG,GHGs** | Greenhouse gas, Greenhouse gases |
| **GIS** | Geographical Information System |
| **IAIA** | International Association for Impact Assessment |
| **IEMA** | Institute of Environmental Management and Assessment |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **JRC** | Joint Research Centre |
| **NBSAP** | National Biodiversity Strategy and Action Plan |
| **NGOs** | Non-governmental organisations |
| **$NO_x$** | Nitrogen oxides |
| **$N_2O$** | Nitrous oxide |
| **OECD** | Organisation for Economic Cooperation and Development |
| **PP, PPs** | Plan or Programme, Plans and/or Programmes |
| **SACs** | Special Areas of Conservation |
| **SEA** | Strategic Environmental Assessment |
| **SOER** | State of the Environment Report |
| **SPAs** | Special Protection Areas |
| **TEEB** | The Economics of Ecosystems and Biodiversity |
| **UN** | United Nations |
| **UNECE** | United Nations Economic Commission for Europe |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **VOCs** | Volatile organic compounds |

# Glossary

| Term | Definition |
|---|---|
| **Adaptation (climate change)** | The term used to describe responses to the effects of climate change. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.' Adaptation can also be thought of as learning how to live with the consequences of climate change. |
| **Adaptive capacity** | The ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities and to cope with the consequences. (CLIMATE-ADAPT Glossary) |
| **Adaptive management** | A systematic process for continually improving management policies and practices by learning from the outcomes of previously implemented policies and practices. |
| **Article 6(3) on appropriate assessment** | Article 6(3) of the Habitats Directive requires an appropriate assessment (also referred to as 'Habitats Directive assessment' or 'Natura 2000 assessment') to be carried out where any plans or projects that are not directly linked to the management of that site may have a significant effect on the conservation objectives and would ultimately affect the integrity of the site. Integrity can be defined as the ability of the site to fulfil its function to continue to support protected habitats or species. Annex I to the Habitats Directive includes a full list of protected habitats and Annex II of protected species. |
| **Baseline** | A description of the present and future state if the project is not implemented, taking into account changes resulting from natural events and other human activities. |
| **Biodiversity** | 'The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (Article 2 of the Convention on Biological Diversity). |
| **Biodiversity offsets** | Measurable project outcomes designed to compensate for significant residual adverse impacts of development plans or projects on biodiversity, after appropriate prevention and mitigation measures are taken. |
| **Birds Directive** | Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds [codified version], OJ L 20, 26.1.2010, p.7. |
| **Carbon sequestration** | The removal of carbon from the atmosphere and its storage in carbon sinks (such as oceans, forests or soil). Carbon sequestration is achieved through physical or biological processes, such as photosynthesis. |
| **Carbon sink** | An absorber of carbon (usually in the form of CO2). Natural carbon sinks include forests and other ecosystems that absorb carbon, thereby removing it from the atmosphere and offsetting CO2 emissions. (Modified from EEA Glossary) |
| **Climate** | Usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities of variables such as temperature, precipitation, and wind, over a period of time. The conventional period of time over which weather is averaged to calculate climate is 30 years, as defined by the World Meteorological Organisation (WMO). (Modified from IPCC Glossary) |
| **Climate change** | IPCC defines climate change as '... any change in climate over time, whether due to natural variability or as a result of human activity.' The United Nations Framework Convention on Climate Change (UNFCCC) defines it specifically in relation to human influence, as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. |
| **$CO_2$ equivalent** | A metric measure used to compare emissions of various greenhouse gases (GHGs) based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as 'million metric tonnes of carbon dioxide equivalents (MMTCDE)'. |
| **Cumulative effects** | The incremental effects of an action when added to the effects of past, present, and reasonably foreseeable future actions. Cumulative effects result from individually minor but collectively significant actions taking place over a period of time. |
| **Direct effects** | Environmental effects directly caused by the preparation, construction or operation of a project in a particular location. |
| **Disaster risk management plan** | A document that sets out goals and specific objectives for reducing disaster risks and includes a list of actions needed to accomplish them. It can be prepared by an authority, sector, organisation or enterprise. |

| | |
|---|---|
| **Ecosystem services** | Ecosystems serve a number of basic functions that are essential for using the Earth's resources sustainably. The Economics of Ecosystem Services and Biodiversity (TEEB) study defines ecosystem services as: 'the benefits people receive from ecosystems'. TEEB also sets out the basis of human dependence on the natural environment. The European-led study builds on the United Nations Millennium Ecosystem Assessment, which defined four categories of ecosystem services that contribute to human well-being:<br>• provisioning services e.g. wild foods, crops, fresh water and plant-derived medicines;<br>• regulating services e.g. filtration of pollutants by wetlands, climate regulation through carbon storage and water cycling, pollination and protection from disasters;<br>• cultural services e.g. recreation, spiritual and aesthetic values, education;<br>• supporting services e.g. soil formation, photosynthesis and nutrient cycling. (TEEB, 2010) |
| **Effort Sharing Decision** | A decision that sets annual binding greenhouse gas (GHG) emission targets for Member States for the 2013–2020 period. These targets concern emissions from sectors not included in the EU Emissions Trading System (ETS), such as transport, construction, agriculture and waste. |
| **EIA Directive** | Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment [codification], OJ L 26, 28.1.2012. The EIA Directive requires Member States to ensure that projects likely to have significant effects on the environment because of their nature, size or location are subject to an assessment of their environmental effects, before development consent is given. |
| **Emissions trading scheme** and **EU Emissions Trading System (EU ETS)** | A market mechanism that allows those bodies (such as countries, companies or manufacturing plants) that emit/release GHGs into the atmosphere to buy and sell these emissions (as allowances) amongst themselves. Emissions mean the release of GHGs and/or their precursors into the atmosphere over a set area and period of time. The European Union Emissions trading system (EU ETS) is based on the idea that creating a price for carbon offers the most cost-effective way to achieve the significant cuts in global GHG emissions that are needed to prevent climate change from reaching dangerous levels. |
| **Environmental limits** | Following the publication of the Millennium Ecosystem Assessment, it is widely accepted that ecosystems provide a range of benefits. External pressures (e.g. pollution) may impact ecosystems and diminish ecosystem services. In the long run, the system may reach a tipping/critical point beyond which the reduction in benefit is no longer acceptable or tolerable. Such a critical level can best be described as an **environmental limit**.<br>There are several frequently used terms that fall within the category of environmental limits, including:<br>• **Threshold** (also referred to as a biophysical threshold or a tipping point): a tolerance point at which the conditions necessary to maintain a prevailing ecosystem state are exceeded (e.g. pollutant levels may have a small effect until a critical point is reached and the impact becomes significant); and<br>• **Carrying capacity**: the concept that a particular system could indefinitely sustain a particular intensity of use providing it is at its capacity or use limit, but, beyond this, additional pressure would produce undesirable resource degradation. (SNIFFER, 2010) |
| **European Climate Change Programme** | A programme launched by the European Commission in June 2000. Its goal is to identify and develop all the necessary elements of the EU strategy for implementing the Kyoto Protocol. |
| **Fauna** | The animals of a particular region or habitat. |
| **Flora** | The plants of a particular region or habitat. |
| **Green infrastructure** | Green infrastructure serves the interests of both people and nature. It can be defined as a strategically planned and delivered network of high quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of benefits and services. Green infrastructure includes natural and semi-natural areas, features and green spaces in rural and urban, terrestrial, freshwater, coastal and marine areas. Areas protected as Natura 2000 sites are at the core of green infrastructure. |
| **Greenhouse gas (GHG)** | Any atmospheric gas (either natural or anthropogenic in origin) which absorbs thermal radiation emitted by the Earth's surface. This traps heat in the atmosphere and keeps the surface at a warmer temperature than would otherwise be possible. |
| **Habitats Directive** | Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, as amended, OJ L 206, 22.7.1992, p.7. |
| **Indirect effects/impacts** | Effects/impacts that occur away from the immediate location or timing of the proposed action, e.g. quarrying of aggregates elsewhere in the country as a result of a new road proposal, or as a consequence of the operation of the project (see also secondary effects). |
| **Kyoto Protocol** | The Kyoto Protocol was adopted at the Third Session of the Conference of the Parties (COP) to the UNFCCC in Kyoto (Japan) in 1997. It contains legally binding commitments. Countries included in Annex B of the Protocol (most OECD countries and Economies in Transition countries) agreed to reduce their anthropogenic emissions of GHGs ($CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, and $SF_6$) by at least 5 % below 1990 levels between 2008 and 2012. |
| **Maladaptation** | An action or process that increases vulnerability to climate-change-related hazards. Maladaptive actions and processes often include planned development policies and measures that deliver short-term gains or economic benefits, but increase vulnerability in the medium- to long-term. |

| | |
|---|---|
| **Maximum sustainable yield (MSY)** | Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. |
| **Mitigation (climate change)** | A term used to describe the process of reducing GHG emissions that are contributing to climate change. It includes strategies to reduce GHG emissions and enhance GHG sinks. |
| **Mitigation (EIA)** | Measures to 'prevent, reduce and where possible offset any significant adverse effects on the environment'. (EIA Directive) |
| **Natura 2000** | An EU-wide network of nature protection areas established under the Habitats Directive. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive and Special Protection Areas (SPAs) designated under the Birds Directive. |
| **No-regret measures** | 'No-regret' measures are activities that yield benefits even in the absence of climate change. In many locations, implementing these actions constitutes a very efficient first step in a long-term adaptation strategy. For example, controlling leakages in water pipes or maintaining drainage channels is almost always considered a very good investment from a cost–benefit analysis point-of-view, even in the absence of climate change. Improving building insulation norms and climate-proofing new buildings is another typical example of a no-regret strategy, since it increases climate robustness and any additional cost can be paid back within a few years.<br>Once no-regret measures have been identified, it is important to know why they are not yet implemented. Reasons can include: (i) financial and technological constraints; (ii) lack of information and transaction costs at the micro-level; and (iii) institutional and legal constraints. These obstacles can be addressed through adaptation planning, as a first step in a long-term adaptation strategy. (CLIMATE-ADAPT relevant webpage) |
| **Proxy indicator** | Indirect measure that approximates or represents a phenomenon in the absence of a direct measure. |
| **Public** | One or more natural or legal persons, and, in accordance with national legislation or practice, their associations, organisations or groups. (EIA Directive) |
| **Public concerned** | The public affected or likely to be affected by, or having an interest in, the environmental decision-making; for the purposes of this definition, non-governmental organisations promoting environmental protection and meeting any requirements under national law are included. |
| **Residual effects** | Effects that remain after mitigation action. |
| **Resilience** | The ability of a social or ecological system to absorb disturbances, while retaining the same basic structure and ways of functioning, as well as its capacity to self-organise and adapt to stress and change. There are different ways in which resilience can be framed; the Dutch Climate Changes Spatial Planning research programme provides a list. (Adapted from CLIMATE-ADAPT Glossary) |
| **Risk** | The probability that something will cause injury or harm. |
| **Scoping** | The process of determining the scope and level of detail of an EIA, including the environmental effects and alternatives which need to be considered, the assessment methods to be used, and the structure and contents of the environmental report. |
| **Screening** | The process of deciding whether a project requires an EIA. |
| **SEA Directive** | Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment, OJ L 197, 21.7.2001, p.30. The SEA Directive requires that the environmental effects of a broad range of plans and programmes (PPs) are assessed and taken into account while PPs are still being developed. The public must be consulted on the draft PP and environmental assessment, and their views must be taken into account. |
| **Secondary effects** | Effects that occur as a consequence of a primary effect or as a result of a complex pathway (see also indirect effects). |
| **Sensitivity** | The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g. a change in crop yield in response to a change in the temperature) or indirect (e.g. damages caused by more frequent coastal flooding due to rising sea levels). |
| **Short-term effects** | Effects that may occur during construction stage of a development, e.g. the increased traffic going to and from the site during the construction period. |
| **Significant effects** | Effects that are significant in the context of the project, i.e. a function not just of magnitude or size of effect, but of the nature, sensitivity and scale of the receptor. |
| **Synergistic effects** | Effects that interact to produce a total effect greater (or less than) than the sum of the individual effects. |
| **Vulnerability** | The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. |

# Summary

The *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment* aims to help Member States improve the way in which climate change and biodiversity are integrated in Environmental Impact Assessments (EIAs) carried out across the EU. This summary gives a brief overview of the guidelines and recommendations presented in the document.

Section 1 contains an introduction explaining the purpose, identifying the target audience and presenting an overview of the contents, to help readers decide when and how to use the guidance. Sections 2 and 3 explain why climate change and biodiversity are so important in EIA and present the relevant EU-level policy background. Section 4 provides advice on how to integrate climate change and biodiversity into selected stages of the EIA process. The annexes provide sources of further reading and links to other relevant information, data, and tools.

The boxes below summarise the main ways of incorporating climate change and biodiversity into EIA. The information has been organised according to four headings, which do not match the structure of the document, but reflect the key messages that appear throughout the guidance.

**HOW TO INCORPORATE CLIMATE CHANGE AND BIODIVERSITY INTO EIA:**

- **Build them into the assessment process at an early stage (screening and scoping):**
  - You will be more likely to include them in the rest of the EIA process;
  - They will be built into the mindset of all key parties involved, including authorities and policymakers, planners, EIA practitioners, etc.
- **Tailor how you incorporate biodiversity and climate change to the specific context of the project:**
  - It is not a matter of simply ticking off items on a checklist. Every EIA is different.

**HOW TO IDENTIFY CLIMATE CHANGE AND BIODIVERSITY ISSUES IN EIA:**

- **Bring together all the relevant stakeholders who need to be part of biodiversity/ecosystems-related and climate change-related decision-making:**
  - Let the stakeholders help identify the key climate change and biodiversity issues early in the process;
  - Design the engagement process and select the best tools for your particular situation. Consider the needs of the EIA and of climate change and biodiversity in particular.
- **Understand how both climate change and biodiversity interact with other issues to be assessed in the EIA, as well as with each other.**

**CRITICAL CHALLENGES FOR ADDRESSING CLIMATE CHANGE AND BIODIVERSITY IN EIA:**

- **Consider the impact that predicted changes in climate and biodiversity will have on the proposed project, potentially over a long timescale, and the project's resilience and capacity to cope.**
- **Consider long-term trends, with and without the proposed project, and avoid 'snapshot' analyses.**
- **Manage complexity.**
  - For example, introducing an element such as climate change mitigation would usually be positive, but it might have a negative impact on climate change adaptation and/or biodiversity.
- **Consider the complex nature of climate change and biodiversity and the potential of projects to cause cumulative effects.**
- **Be comfortable with uncertainty, because you can never be sure of the future.**
  - Use tools such as scenarios (for example, worst-case and best- case scenarios) to help handle the uncertainty inherent in complex systems and imperfect data. Think about risks when it is too difficult to predict impact.
- **Base your recommendations on the precautionary principle and acknowledge assumptions and the limitations of current knowledge.**
- **Be practical and use your common sense! When consulting stakeholders, avoid drawing out the EIA procedure and leave enough time to properly assess complex information.**

**HOW TO ASSESS EFFECTS RELATED TO CLIMATE CHANGE AND BIODIVERSITY IN EIA:**

- **Consider climate change scenarios at the outset:**
  - Include extreme climate situations and 'big surprises', which may either adversely affect the implementation and operation of a project or worsen its impact on biodiversity and other environmental aspects.
- **Analyse the evolving environmental baseline trends:**
  - Include trends in key issues over time, drivers for change, thresholds and limits, areas that may be particularly adversely affected and key distributional effects.
  - Use vulnerability assessment to help assess the evolution of the baseline environment and identify the most resilient alternative(s).
- **Take an integrated approach to planning and assessment, investigating relevant thresholds and limits.**
- **Seek to avoid biodiversity and climate change effects from the start, before considering mitigation or compensation. For biodiversity, EIA should focus on ensuring 'no-net-loss'.**
- **Assess alternatives that make a difference in terms of climate change and biodiversity.**
- **Use ecosystem-based approaches and green infrastructure as part of project design and/or mitigation measures.**
- **Assess climate change and biodiversity synergies and cumulative effects, which can be significant.**
  - Causal chains/network analysis may be helpful in understanding these interactions.

# 1. Introduction

## 1.1 Nature and purpose of this guidance

Climate change and biodiversity loss are among the most important environmental challenges we face today. Both are complex and cross-cutting issues, which affect nearly all human activity. The *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment* ('the guidance') aims to help Member States improve the way in which climate change and biodiversity issues are integrated in EIAs carried out across the EU, under Directive 2011/92/EU[1] (the 'EIA Directive').

EIAs are legally required. They are an opportunity to systematically integrate climate change and biodiversity into a wide range of public and private projects. However, despite climate change and biodiversity being set as priorities within environmental policy agendas (see Sections 3.1 and 3.2), experience[2] shows that they are not being systematically integrated into EIA. The main reason for this is that climate change and biodiversity are not yet explicitly included in the formal requirements of EIA procedures. In addition, they are multi-faceted issues that do not lend themselves to simple or quick analyses.

> **The EIA Directive**
>
> The EIA Directive requires Member States to ensure that projects likely to have significant effects on the environment because of their nature, size or location are subject to an assessment of their environmental effects. This assessment should take place before development consent is given, i.e. before the authority/ies decide(s) that the developer can go ahead with the project.
>
> The Directive harmonises EIA principles by introducing minimum requirements, in particular for the types of projects that should be assessed, the main obligations of developers, the assessment's content and provisions on the participation of competent authorities and the public.

This guidance is designed primarily for EIA practitioners and authorities, as well as other stakeholders across the EU. It is addressed to all Member States and their legislative and governance structures and applies to all project types that require either screening[3] (Annex II projects) or full EIA (Annex I and screened-in Annex II projects) under the EIA Directive. The guidelines and recommendations contained here are general and do not give tailored advice for the specific project types under Annex I and Annex II of the EIA Directive.

The guidance addresses the specific issues and challenges that climate change and biodiversity bring to EIA.[4] It is designed to encourage users to think about how important climate change and biodiversity issues are likely to be for their specific project and EIA. It also includes issues related to disaster risk management, mainly in the context of climate change adaptation. It is assumed that readers will be familiar with EIA, so it does not explain the basic process.

Since it is the first such type of guidance issued by the European Commission, and since the EIA Directive is currently under review (see Section 2.1 for more details) and the climate change and biodiversity scientific base, policies and EIA practices constantly evolve, it should be considered as a

[1] Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment [codification], OJ L 26, 28.1.2012, p.1. Directive 2011/92/EU codifies Directive 85/337/EEC and its three subsequent amendments (Directives 97/11/EC, 2003/35/EC and 2009/31/EC).

[2] Report from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on the application and effectiveness of the EIA Directive (Directive 85/337/EEC, as amended by Directives 97/11/EC and 2003/35/EC), COM(2009) 378 final.

[3] The process of deciding if a project requires EIA.

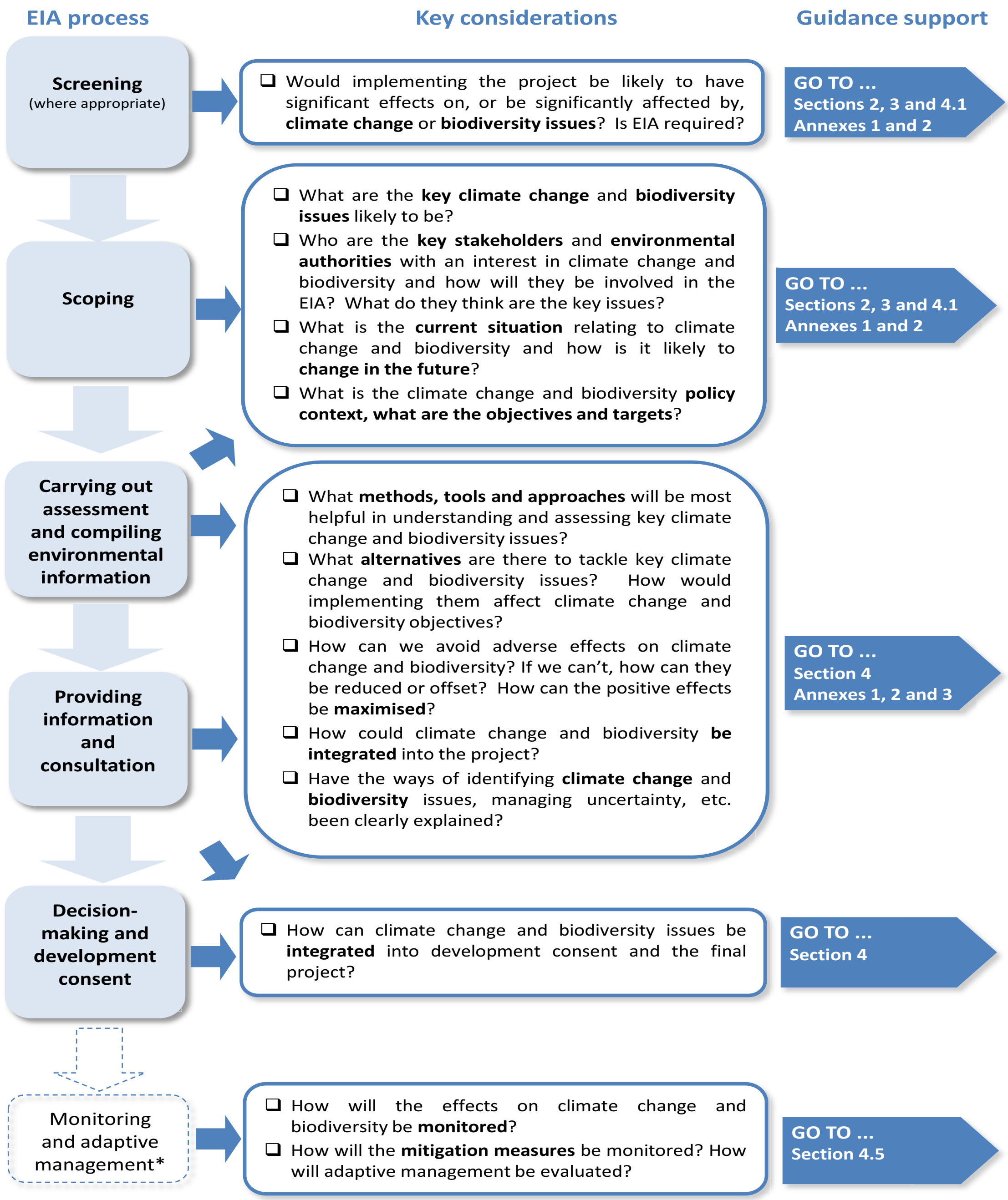
[4] A complementary *Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment* was prepared.

pilot guidance. Subsequent amended versions are expected as experience with the process is gained. These may include more specific guidance on integrating disaster risk management.

## 1.2 Overview of how to integrate climate change and biodiversity issues into the EIA process

Figure 1, below, gives an overview of how to integrate climate change and biodiversity issues into the EIA process, as well as where information on specific EIA stages can be found in this guidance.

**Figure 1: Overview of how to integrate climate change and biodiversity issues into key EIA stages**




*Monitoring is not obligatory under the EIA Directive, but is nevertheless used in some Member States.

# 2. Climate change and biodiversity in EIA

This section looks at how climate change and biodiversity are currently covered in EIA. It reviews the requirements of the EIA Directive and shows that not only are climate change and biodiversity clearly referenced in the legislation, but that they should be given more weight in light of the Directive's preventive intent or 'spirit'. It also discusses the benefits and challenges of integrating climate change and biodiversity into EIA.

## 2.1 The legal basis and the 'spirit' of the Directive

The EIA Directive contains a number of principles that provide the basis for considering climate change and biodiversity in EIA, even though it does not refer to either term explicitly (see Table 1). In line with Article 191 of the *Treaty on the Functioning of the European Union,*[5] the Directive clearly sets out to prevent damage to the environment rather than merely counteract it. Furthermore, The European Court of Justice has consistently confirmed that the EIA Directive has 'a wide scope and a broad purpose'[6] and therefore needs to be interpreted as such.

The 2012 Commission proposal for the revised EIA Directive[7] strengthened the provisions related to climate change and biodiversity.

As regards climate change, it introduced clear references to 'climate change' and 'greenhouse gases'. It provided a detailed description of climate change issues to be addressed as part of the screening criteria for Annex II projects — 'impacts of the project on climate change (in terms of greenhouse gas emissions, including from land use, land-use change and forestry), contribution of the project to an improved resilience, and the impacts of climate change on the project (e.g. if the project is coherent with a changing climate)'. Furthermore, it described climate change issues to be addressed in the EIA report in more detail — 'greenhouse gas emissions, including from land use, land-use change and forestry, mitigation potential, impacts relevant to adaptation, if the project takes into account risks associated with climate change'.

As regards biodiversity, the proposal introduced clear references to 'biodiversity' and 'species and habitats' protected under Council Directive 92/43/EEC[8] (the 'Habitats Directive') and Directive 2009/147/EC[9] (the 'Birds Directive). It introduced additional elements of biodiversity to be considered within the screening criteria for Annex II projects — 'population quality and quantity and ecosystem degradation and fragmentation'. It also proposed that the EIA report should cover 'biodiversity and the ecosystem services it provides'.

Lastly, the proposal introduced clear references to disaster risk management, mainly in Article 3 and Annexes III and IV.

[5] The Treaty on the Functioning of the European Union [consolidated version], OJ C 83, 30.3.2010, p.47.
[6] See Case C-72/95, Kraaijeveld and others, paragraph 31; Case C-227/01, Commission v Spain, paragraph 46.
[7] Proposal for a Directive of the European Parliament and of the Council amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, COM(2012) 628 final http://ec.europa.eu/environment/eia/pdf/com_628/1_EN_ACT_part1_v7.pdf.
[8] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, as amended, OJ L 206, 22.7.1992, p.7
[9] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009, on the conservation of wild birds [codified version], OJ L 20, 26.1.2010, p.7.

**Table 1: Direct and indirect references to climate change and biodiversity in the EIA Directive**

| Issue | Directive reference (direct) | Directive reference (indirect) |
|---|---|---|
| **Climate change** | • Climate/climatic factors' and interactions with other factors to be assessed within EIA (Article 3 and Annex IV(3)). | • The Directive refers to the precautionary principle and the need for preventive action and EIA in a transboundary context.<br>• Projects related to the transport, capture and storage of carbon dioxide (CO2) are included in Annex I and Annex II. |
| **Biodiversity** | • 'Fauna and flora' and interactions with other factors to be assessed (Article 3 and Annex IV(3)).<br>• Reference to the Habitats Directive and the Birds Directive (Annex III(2)(V)). | • Paragraph (14) of the recital acknowledges the value of ecosystems and highlights the need to take them into account when the effects of a project on the environment are assessed.<br>• Annex III (screening criteria) refers to the regenerative capacity of natural resources and the absorption capacity of the natural environment. |

## 2.2 Benefits of integrating climate change and biodiversity in EIA

For many types of project, EIA is the only legally-required tool for including environment issues at an early stage, when alternatives are still open and opportunities exist. Including climate change and biodiversity in EIA helps to, for example:

- achieve climate and biodiversity objectives;
- comply with EU and national legislation and policies;
- improve project reputation;
- increase a project's resilience to climate change;
- manage conflicts and potential synergies between climate change, biodiversity and other environmental issues;
- support the ecosystem services used by the project.

### 2.2.1 Achieving climate and biodiversity objectives

EIA provides a way of assessing key issues effectively and transparently and highlights opportunities to achieve wider environmental objectives, in particular those related to climate change (including disaster risk management) and biodiversity. For climate change this might include, for example, exploring the possible synergies and conflicts between climate change mitigation and adaptation and therefore avoiding maladaptation. For biodiversity, it might include, for example, assessing how the objectives and measures of the *EU 2020 Biodiversity Strategy*[10] can be integrated into the EIA process.

[10] Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of Regions, Our life insurance, our natural capital: an EU biodiversity strategy to 2020 (EC, COM(2011) 244 final).

### 2.2.2 Compliance with EU and national legislation and policies

Addressing climate change and biodiversity in EIA makes it easier to comply with the EIA Directive and relevant national laws. This is useful, since climate change and biodiversity are the subjects of many recent pieces of EU legislation, policies and strategies, including national binding targets.

Member States (see box right) are also likely to have a suite of legislative instruments relevant to climate change and biodiversity (e.g. building codes that promote energy efficiency, planning policies that avoid developing flood-prone areas, species and site protection).

**Climate and energy requirements in Austrian EIA procedures**

In Austria, a 2009 amendment to the EIA act requires project developers to provide information on how the proposed project has considered energy demand and flow, energy efficiency, GHG emissions and measures to reduce emissions and improve efficiency. This provision is accompanied by a guiding document to help project developers and EIA practitioners better understand and comply with the requirement.

### 2.2.3 Project reputation

Aside from meeting public policy requirements, projects also have to address pressure from developers, local authorities and the general public and show that the project has a positive effect on the environment, or only a minimal negative effect. Environmental impact affects a project's and project developer's reputation. This is particularly true for greenhouse gas (GHG) emissions, in part due to climate change concerns, but also because reducing GHGs can improve energy efficiency and reduce costs.

### 2.2.4 Resilience of projects to a changing climate

A number of recent studies on the vulnerability of the EU and specific sectors and territories to the changing climate (see Annex 1 for further reading on this subject) have shown that Europe's infrastructure needs to be adapted to better cope with natural phenomena caused by climate change. This means considering that the design parameters identified at a project's inception may no longer be valid at the end of its potentially long lifespan. It represents a shift in thinking, from the traditional assessment of environmental impact to taking possible long-term risks into account. Insurance firms, for instance, are already recognising the value of this way of thinking and including it in their risk assessments of natural hazards. EIA can help projects to adapt to this shift through the concept of resilience. A project needs to be assessed against an evolving environmental baseline. EIA should show an understanding of how the changing baseline can affect a project and how the project may respond over time. The EIA process is particularly important since it can help set the context for projects; taking potential climate change impact (including disaster risks) into consideration in EIA can make projects more resilient. More information on how resilience can be built into EIA is presented in Section 4.

### 2.2.5 Managing conflicts and potential synergies between climate change, biodiversity and other environmental issues

Considering climate change mitigation and adaptation, biodiversity and other environmental issues together has many benefits and is cost-effective. For example, it creates win-win situations when ecosystem-based approaches are applied to climate mitigation and adaptation and helps avoid mitigation actions that either don't have any adaptive capacity or reduce the resilience of other factors. Managing these conflicts and potential synergies is one of the roles of EIA.

### 2.2.6 Supporting ecosystem services

The ecosystem services provided by biodiversity also need to be considered as part of a project's development, as they can support its objectives and help in its implementation. For instance, a project could aim to reduce flood risk in a specific area and ensure the safety of and demand for local property; such a project may depend on a local wetland area to reduce flood risk or store water. Another example is a local green space that adds value to a residential development by providing a recreation area and temperatures cooler than in the local urban environment.

Acknowledging a project's reliance on ecosystem services, and hence on biodiversity, can make it more effective, as well as supporting biodiversity and biodiversity policy objectives. However, the degree to which a project can use these services depends on the local and wider environmental limits affected by it and by other projects, as well as by wider drivers for change. EIA can play an important role in helping to understand these relationships and the broader context.

## 2.3 Challenges of addressing climate change and biodiversity in EIA

It is the main characteristics of climate change and biodiversity that are most likely to pose significant challenges to addressing climate change and biodiversity in EIA. They are:

- the long-term and cumulative nature of effects;
- complexity of the issues and cause-effect relationships;
- uncertainty.

This section explains these aspects in more detail and tackles the question of how to deal with them more effectively throughout the EIA process. Table 2 (below) summarises ways of approaching them.

**Table 2: Tips on how to approach the challenges of integrating climate change and biodiversity into EIA**

| Key challenges | Tips on how to approach them |
|---|---|
| **Long-term and cumulative nature of effects** | • Avoid 'snapshot' analyses (i.e. at a single point in time) and consider trends, *with* and *without* the proposed project;<br>• Work with the notion of absorption capacity/environmental limits. |
| **Complexity of the issues and cause-effect relationships** | • Analyse the impact of proposed projects on key climate change and biodiversity trends and their drivers;<br>• Work with worst-case and best-case scenarios. |
| **Uncertainty** | • Acknowledge assumptions and the limitations of current knowledge;<br>• Base recommendations on the precautionary principle;<br>• Prepare for adaptive management. |

### 2.3.1 Long-term and cumulative nature of effects

The long-term nature of climate change − both mitigation and adaptation − makes it more difficult to consider within EIA, but doing so is crucial to the long-term viability of projects. Major long-term infrastructure projects are most likely to be vulnerable to progressively more significant climate change (including the increasing number of weather-related disasters). This influences the baseline environment against which projects should be assessed as part of EIA.

Effects on biodiversity are cumulative and once species or habitats are completely lost they cannot be replaced or recovered. This means that we need to avoid negative impact wherever possible and do more to enhance and better manage existing biodiversity and to help maximise ecosystem services.

EIA should therefore **avoid 'snapshot' analyses** (i.e. at a single point in time) and instead consider trends and scenarios with and without the proposed project (and its reasonable alternatives). It should also **work with the notion of environment limits,** which define an ecosystem's capacity to cope with change without losing its core attributes or functions.

### 2.3.2 Complexity of the issues and cause-effect relationships

Both climate change and biodiversity involve complex systems and interact with other environmental aspects and with people. Since we cannot fully understand all aspects of complex systems at the point in which we make decisions, we need to be able to use what we have. For example, we can **analyse trends** — the general direction in which things seem to move — based on available studies, reports and other sources of information.

### 2.3.3 Uncertainty

Uncertainty exists within any decision-making system, but it increases with complexity and timescale and is particularly likely to affect long-term projects. Uncertainty related to the long-term effects of a project on biodiversity and climate change, and to the effects of climate change on the project, is therefore very likely. Working with uncertainty requires **a qualitative approach**, as quantitative data are often either unavailable or unreliable in predicting impact.

# 3. Understanding climate change and biodiversity

This section provides background information on climate change and biodiversity in the EU. It starts by explaining the terms ‘climate change’ and ‘biodiversity’ and then provides an overview of the current status, trends, drivers and policy responses for climate change mitigation, adaptation and biodiversity.

The purpose of this section is to highlight the importance and complexity of climate change and biodiversity to those involved in EIA: authorities, project developers, EIA practitioners, regulators and other stakeholders. For those undertaking EIA, it also provides a starting point for identifying some of the key information sources and issues, policy objectives and targets that need to be considered to successfully integrate climate change and biodiversity into the process.

Depending on the scale of the project, an EIA may also need to consider the national, regional and local levels. However, for practical reasons, this document focuses on the international/EU context and should be considered a starting point. The information presented here will need to be supplemented with what is available in the Member States and from environmental authorities and other institutions.

## 3.1 Introduction to climate change

Responses to climate change can be divided into two aspects:

**Mitigation** — the term used to describe the process of reducing GHG emissions that contribute to climate change. It includes strategies to reduce GHG emissions and enhance GHG sinks.

**Adaptation** — is a process, or set of initiatives and measures, to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Adaptation can also be thought of as learning how to live with the consequences of climate change. The first consequences of climate change can already be seen in Europe and worldwide, and these impacts are predicted to intensify in the coming decades. Temperatures are rising, rainfall patterns are shifting, glaciers are melting, sea levels are getting higher and extreme weather resulting in hazards such as floods and droughts is becoming more common.

Climate change adaptation and mitigation are closely interrelated. While they are often considered as separate topics or policy fields, it is critical to consider the links between them. Certain adaptation responses have clear mitigation benefits, but some actions can result in ‘maladaptation’ — i.e. instead of reducing vulnerability to climate change, they actually increase it or reduce the adaptive capacity. Some actions can also distribute the benefits of adaptation unequally across society (for example, the prevention of climate-change-induced diseases only for affluent people).

One of the roles of EIA is to seek to manage these conflicts and potential synergies. This can be done by comprehensively assessing the synergies between climate change mitigation, adaptation and other environmental issues and policy concerns, in order to avoid negative synergies and missed opportunities for promoting positive synergies.

### 3.1.1 Climate change mitigation — overview of current status, trends and policy responses

#### *Current status, trends and key drivers*

Many studies have been carried out into how to assess the current status, trends and key drivers for GHG emissions, and they provide a useful background. See *Mitigating climate change — SOER 2010 thematic assessment* (EEA, 2010)[11] and other documents listed in Annex 1 of this guidance for an overview.

#### *Policy response*

In March 2007,[12] the EU Heads of State and Government endorsed an integrated approach to climate and energy policy that aims to combat climate change and increase the EU's energy security while strengthening its competitiveness. They set a series of demanding climate and energy targets to be met by 2020, known as the '20-20-20' targets (see box right).

**'20-20-20' climate and energy targets**

- A reduction in **EU GHG emissions** of at least **20%** below 1990 levels;
- **20%** of **EU energy consumption** to come from renewable resources;
- **20%** reduction in **primary energy use** compared with projected levels, to be achieved by improving energy efficiency.

With its Roadmap for moving to a competitive low-carbon economy in 2050, the European Commission has looked beyond these short-term objectives and set out a cost-effective pathway for reducing domestic emissions by 80 to 95 % by mid-century. The Roadmap identifies milestones and provides guidance on how to move to a climate-friendly, low carbon economy in the most efficient way.

The key aspects of international and EU climate change mitigation policy are summarised in Table 3 below.

**Table 3: Key aspects of climate change mitigation policy**

| Policy response | Objectives and targets |
|---|---|
| **United Nation Framework Convention on Climate Change (UNFCCC)** | • UNFCCC seeks to reduce international GHG emissions by setting national level targets based on the concept of 'common but differentiated responsibility'. This means that nations which have emitted the majority of GHGs up to now should seek to reduce GHGs at a greater rate. |
| **UNFCCC's Kyoto Protocol** | • Under the UNFCCC's Kyoto Protocol, 15 Member States of the EU ('EU-15') decided on a collective target of reducing GHG emissions by 8% relative to 1990 levels between 2008 and 2012 (Member State emission targets are differentiated under an EU burden-sharing decision). The other Member States have similar targets, with the exception of Cyprus and Malta.<br>• The EU-15 are well on track to meeting their target. Preliminary EEA estimates indicate that they reduced their emissions by 14.1% below base-year levels by 2011.[13] |

[11] http://www.eea.europa.eu/soer/europe/mitigating-climate-change.
[12] European Council, 8/9 March 2007.
[13] Approximated EU GHG inventory, http://www.eea.europa.eu/publications/approximated-eu-ghg-inventory-2011.

| | |
|---|---|
| **EU Climate and Energy Package** | • To meet the EU's obligation under international law and in line with European ambition. Member States are required to:<br>• Collectively reduce their combined GHG emissions in 2020 by at least 20% compared to 1990 levels. Note: the EU has offered to take on a 30% target for 2020 if other major emitters contribute adequately to global mitigation efforts.<br>• Produce 20% of their combined energy from renewable sources.<br>• Improve energy efficiency to reduce primary energy use by 20% compared with projected levels.<br>• The collective EU target of reducing emissions by 20% by 2020 is to be achieved by:<br>o The EU Emissions Trading System, the backbone of the EU mitigation effort, which sets a cap on emissions from the most polluting sectors, including over 11000 factories, power plants and other installations, including airlines. By 2020, the cap should result in a 21% reduction relative to 2005 levels. The EU ETS covers about 40% of all EU emissions.<br>o The 'effort sharing decision', which operates outside the EU ETS and establishes annual binding GHG emission targets for individual Member States for the 2013-2020 period. These concern emissions from sectors such as waste, agriculture, buildings, etc.<br>• The '20-20-20' targets are supported by the long-term target of 85-90% reduction in GHG emissions against 1990 levels by 2050. |
| **Roadmap for moving to a low-carbon economy in 2050** | • The Roadmap looks beyond the 2020 targets and sets out a plan to meet the long-term target of reducing EU emissions by 80-95% by 2050. The strategy takes a sectoral perspective, looking at how the heavy-emissions sectors such as power generation, transport, buildings and construction, industry and agriculture can make the transition to a low-carbon economy over the coming decades. |
| **Energy Roadmap 2050** | • In the *Energy Roadmap 2050*, the EU explores the challenges posed by delivering the EU's decarbonisation objective, while at the same time ensuring security of energy supply and competitiveness. |
| **Flagship initiative for a resource-efficient Europe** | • It supports the shift to a resource-efficient, low-carbon economy to achieve sustainable growth. It provides a long-term framework for action to factor in resource efficiency in a balanced manner in many policy areas, including climate change, energy, transport, industry, agriculture, biodiversity and regional development. |

### 3.1.2 Climate change adaptation — overview of current status, trends and policy responses

#### *Current status, trends and key drivers*

Regardless of the success of mitigation action, some degree of climate change is already 'locked in' and we are feeling the effects of our changing climate already. One of the most important consequences of climate change will be the increased frequency and magnitude of extreme events such as floods, droughts, windstorms and heat waves. Climate change may also trigger other hazards in which climate or weather conditions play a fundamental role, such as snow avalanches, landslides and forest fires.

Several studies have assessed the current status, trends and key drivers for climate change and provide a useful background. See *Adapting to climate change — SOER 2010 thematic assessment* (EEA, 2010)[14] and the *European Climate Adaptation Platform: CLIMATE-ADAPT,*[15] as well as other documents listed in Annex 1 to this Guidance.

#### *Policy response*

Adaptation involves adjusting our behaviour to limit harm and exploiting the beneficial opportunities arising from climate change. However, our level of preparedness, resilience and vulnerability are not

[14] http://www.eea.europa.eu/soer/europe/adapting-to-climate-change.
[15] http://climate-adapt.eea.europa.eu/

easily quantifiable, making it difficult to set hard and fast targets. But climate change mitigation targets are more tangible. In the EU, the focus is on integrating ('mainstreaming') adaptation into all relevant policies and instruments and facilitating effective, consistent adaptation actions at national, regional and local levels.

Many European countries, as well as some regions and cities, have adopted adaptation strategies. The European Environment Agency (EEA) keeps an overview of adaptation strategies in its 32 member countries.[16] It also hosts the European Climate Adaptation Platform: CLIMATE-ADAPT.

The key aspects of international and EU climate change adaptation policy are summarised in Table 4 below.

**Table 4: Key aspects of climate change adaptation policy**

| Policy response | Objectives and targets |
| --- | --- |
| **EU Strategy on Adaptation to Climate Change** | • The European Commission adopted a *White Paper on Adapting to Climate Change* in 2009, leading to an EU Adaptation Strategy in 2013.<br>• The *Adaptation Strategy* will:<br>○ recognise how important impact assessment is for climate proofing (this guidance supports the Strategy's key objectives and actions)<br>○ identify the key priorities for action and how EU policies can encourage effective adaptation action<br>○ highlight the issue of adapting infrastructure to climate change and include a separate document on this topic<br>○ encourage creating green infrastructure and applying ecosystem-based approaches.<br>• Guidance on how to mainstream adaptation into the Common Agricultural Policy and Cohesion Policy will be developed after the Adaptation Strategy is adopted. |
| **European Climate Adaptation Platform: CLIMATE-ADAPT** | • A publicly accessible, web-based platform designed to support policy-makers at EU, national, regional and local levels in the development of climate change adaptation measures and policies.<br>• It has been developed to help users to access, disseminate and integrate information on:<br>○ expected climate change in Europe<br>○ the vulnerability of regions, countries and sectors now and in the future<br>○ information on national, regional and transnational adaptation activities and strategies<br>○ case studies of adaptation and potential future adaptation options<br>○ online tools that support adaptation planning<br>○ adaptation-related research projects, guideline documents, reports information sources, links, news and events. |

## 3.2 Introduction to biodiversity

**Biodiversity** — or biological diversity — is one of the key terms in conservation, encompassing the richness of life and the diverse patterns it forms. The Convention on Biological Diversity (CBD) defines biological diversity as 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (Article 2).

The Natura 2000 network of protected areas, created on the basis of the Habitats and the Birds Directives, is the backbone of the EU's biodiversity policy. At present, the network covers almost 18 % of the EU's land surface and more than 145 000 km$^2$ of its seas. However, it is important to

[16] Available from: http://www.eea.europa.eu/themes/climate/national- adaptation-strategies.

remember that the concept of biodiversity is not limited to the Natura 2000 network, it is much broader:

- The Birds and Habitats Directives also cover species and habitats outside Natura 2000 sites.
- Under Article 6(3) of the Habitats Directive, an 'appropriate assessment' – is required for any plan or project likely to have a significant effect on Natura 2000 site, even if it is implemented outside these sites.
- Article 10 of the Habitats Directive recognises the importance of ensuring the ecological coherence of the Natura 2000 sites.
- Finally, the *EU 2020 Biodiversity Strategy* as endorsed by the Council and European Parliament covers the whole territory and emphasises the benefits that ecosystems give us. It provides a package of actions needed to halt the loss of biodiversity and the degradation of ecosystem services by 2020 and to restore them in so far as feasible.

It is recommended that an EIA takes into account all of these aspects of biodiversity.

### 3.2.1 Current status, trends and policy responses

#### *Current status, trends and key drivers*

Several studies have assessed the current status, trends and key drivers for biodiversity, and provide a useful background. See *Biodiversity — SOER 2012 thematic assessment* (EEA, 2010),[17] the *EU 2010 Biodiversity Baseline* (EEA, 2010),[18] and the other documents listed in Annex 1 to this guidance for an overview.

These studies have found that the rate of biodiversity loss is accelerating all over Europe. Although there are some positive signs, they recognise five main pressures and drivers of biodiversity loss: (i) habitat loss and fragmentation; (ii) overexploitation and unsustainable use of natural resources; (iii) pollution; (iv) invasive alien species, and (v) climate change.

The aim of the Natura 2000 network and the sites designated under it is to slow down the rate of biodiversity loss, by establishing a system to protect key species and habitats. However, many Natura 2000 sites remain in an unfavourable state and require improved management.

#### *Policy response*

Biodiversity has been a core part of EU policy for over 20 years. Nevertheless, the overall trends are still negative and recent policy has been considered ineffective. This is shown by the EU's failure to achieve the target of halting biodiversity loss by 2010.

In 2011, the European Commission adopted a new Biodiversity Strategy[19] with its 2020 headline target — 'Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss.'

[17] http://www.eea.europa.eu/soer/europe/biodiversity.
[18] http://www.eea.europa.eu/publications/eu-2010-biodiversity-baseline/.
[19] Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of Regions, Our life insurance, our natural capital: an EU biodiversity strategy to 2020 (EC, COM(2011) 244 final).

Target 2 of this Strategy is that 'by 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystem'. This target is broken down into accompanying actions, two of which seek to influence planning practices:

- set priorities to restore and promote the use of green infrastructure (Action 6); and
- ensure 'no-net-loss' of biodiversity and ecosystem services (Action 7).

These provide a good policy basis for preserving ecosystem services and using ecosystem-based approaches and green infrastructure within EIA. In the climate change context, ecosystem-based approaches can maintain existing carbon stocks, regulate water flow and storage, maintain and increase resilience, reduce vulnerability of ecosystems and people, help to adapt to climate change impacts, improve biodiversity conservation and livelihood opportunities and provide health and recreational benefits.[20]

The key aspects of international and EU biodiversity policy are summarised in Table 5 below.

**Table 5: Key aspects of biodiversity policy**

| Policy response | Objectives and targets |
|---|---|
| **The Habitats Directive and Birds Directive** | • The Habitats Directive and the Birds Directive seek to protect sites of particular importance for biodiversity— these sites form a network referred to as Natura 2000.<br>• Member States are required to designate and manage Natura 2000 network sites within their borders. This includes habitat and species conservation, and reducing the impact of building new infrastructure and of other human activities. This is achieved in part by applying Article 6(3) on 'appropriate assessments'.<br>• The two directives create provisions for the protection of certain species of flora and fauna when they occur in the wider natural environment.<br>• Article 10 of the Habitats Directive recognises the importance of ensuring the ecological coherence of Natura 2000 sites. |
| **The Convention on Biological Diversity (CBD)** | • The CBD is the main international agreement governing biodiversity policy. The EU and its Member States are all parties to the convention. Article 14 of the CBD, on Impact Assessment and Minimising Adverse Impacts, requires that a project's potential adverse impact on biodiversity be taken into account. |
| **Nagoya Protocol** | • The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation to the Convention on Biological Diversity* (adopted in Nagoya, October 2010) is a legally binding agreement that addresses two issues:<br>o How states provide access to genetic resources and/or associated traditional knowledge under their jurisdiction; and<br>o What measures they take to ensure that benefits of using such resources and/or knowledge are shared with provider countries, including indigenous and local communities? |
| **Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets** | • The *Strategic Plan for Biodiversity 2011-2020* (adopted in Nagoya, October 2010) aims to inspire action in support of biodiversity by all countries and stakeholders over the next decade.<br>• The *Strategic Plan* includes 20 headline targets, collectively known as the *Aichi Targets*. They are organised under five strategic goals that address the underlying causes of biodiversity loss, reduce the pressures on biodiversity, safeguard biodiversity at all levels, enhance its benefits, and provide for capacity-building. |
| **EU Biodiversity Strategy 2020** | • *Our life insurance, our natural capital: an EU biodiversity strategy to 2020* is in line with the two commitments made by EU Heads of State and Government in March 2010 — halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU |

[20] Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe (EC study, Ecologic Institute and Environmental Change Institute, 2011).

| | |
|---|---|
| | contribution to averting global biodiversity loss.<br>• The long-term goal states that 'by 2050, European Union biodiversity and the ecosystem services it provides — its natural capital — are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided.'<br>• The Strategy is also in line with the global commitments world leaders made in Nagoya in October 2010, when, in the context of the CBD, they adopted a package of measures addressing global biodiversity loss over the next decade (described above).<br>• The emphasis is on the essential contribution of biodiversity and ecosystem services to human wellbeing and economic prosperity, and avoiding catastrophic changes caused by the loss of biodiversity. This represents a significant change in approach for the impact assessment process, from reducing impact to actively improving (restoring) biodiversity as a whole and ensuring 'no-net-loss'.<br>• The main targets of the Strategy cover:<br>o full implementation of EU legislation on protecting biodiversity;<br>o better protection for ecosystems and more use of green infrastructure;<br>o more sustainable agriculture and forestry;<br>o better fish stock management;<br>o tighter controls on invasive alien species, including adopting new legislation to fill existing policy gaps;<br>o a more significant EU contribution to averting global biodiversity loss. |
| **Biodiversity Action Plans (BAPs)** | • BAPs provide details on how the Biodiversity Strategy is to be achieved. They are present at European level (for example, the 2006 BAP now superseded by the 2020 Biodiversity Strategy), but also exist across the EU and worldwide under the CBD (as National Biodiversity Strategy and Action Plans, NBSAPs). In Member States, they are sometimes aligned with the EU 2006 BAP.<br>• BAPs form the wider implementation framework for biodiversity, beyond Natura 2000. At Member State level, they list identified species and habitats, assess their status within the ecosystem, create conservation and restoration targets and establish the budgets and timelines needed to achieve said targets.<br>• BAPs can also require the protection of certain species where they occur outside of protected areas. |

## 3.3 Interactions between climate change and biodiversity

There are clear links between many environmental issues, just like there are connections in the natural environment. This section describes the link between climate change and biodiversity. It does not attempt to fully describe the relationship, but focuses on the key interactions directly relevant to EIA.

Examples of interactions between biodiversity and climate change are listed below:

- Supporting biodiversity delivers clear carbon benefits by enhancing the natural environment's ability to absorb and store carbon via soil and plant matter. Evidence suggests that healthy natural habitats such as soil, wetlands, and forests can sequester significant amounts of carbon. Damaging the biodiversity or physical environment of these areas can release the stored carbon, even indirectly, contributing to climate change, as well as reducing biodiversity.
- Biodiversity and the natural environment provide services that increase our resilience to the impacts of climate change and disasters. For example, well-functioning green spaces can regulate storm water flow, reducing the risk of flooding. Ecosystems and their services can be successfully used in many PPs as cost-effective alternatives to building infrastructure, or, for example, to manage flood risk (see box overleaf). Green spaces and vegetation also have a cooling effect and reduce the impact of heat waves in cities, lessening the urban heat island effect. Plants stabilise soil, reducing the risk of landslides and erosion (in fact, it is deforestation that can contribute to mudslides).

The relationship between biodiversity and climate change goes both ways — the effects of a changing climate are already having an impact on biodiversity and ecosystem service provision. It is predicted that, in the future, climate change will be the single biggest driver of biodiversity loss next to land-use change.[21] Climate change affects biodiversity because species tend to evolve to a specific range of environmental factors such as temperature, moisture, etc. As these factors alter due to climate change, species need to migrate to stay in their optimum environment. Some species are more adaptive, but, for others, a changing environment is a threat to their ability to survive and therefore increases extinction rates and reduces biodiversity.

The ability of species to respond to this climate-enforced migration is also limited by human activity, which has changed land-use and fragmented habitats. When roads, urban areas and agricultural land stand in their way, many species will find it almost impossible to migrate across the landscape. There is therefore a need to facilitate this natural adaptation process by, for example, creating migration corridors of natural habitats and reducing fragmentation.

**Using green infrastructure for flood risk management**

The EU Floods Directive establishes a framework for the management of flood risks. It gives the EU Member States the choice of measures to put in place to reduce the adverse consequences related to floods.

Article 7 requires Member States to set their own flood management objectives. These objectives should also, if appropriate, focus on 'non-structural' measures (ranging from early-warning to natural water retention measures) and/or on reducing the likelihood of flooding.

These are cost-effective alternatives to constructing or reinforcing dykes and dams. They also often have many additional benefits.

Examples include:

- restoring natural flows by realigning coastal areas or re-connecting rivers with their floodplain;
- restoring wetlands, which can store flood water and help slow down their flow;
- urban green infrastructure such as green spaces or green roofs.

**Source:** DG Environment relevant webpage

[21] Millennium Ecosystem Assessment (2005) Synthesis Report.

# 4. Integrating climate change and biodiversity into EIA

This section provides guidance on integrating climate change and biodiversity throughout the EIA process. It focuses on the EIA areas where climate change and biodiversity have the most impact.

It is divided into the following sub-sections:

- identifying climate change and biodiversity concerns in EIA (useful for screening and scoping);
- analysing evolving baseline trends;
- identifying alternatives and mitigation measures;
- assessing effects (cumulative effects and uncertainty);
- monitoring and adaptive management.

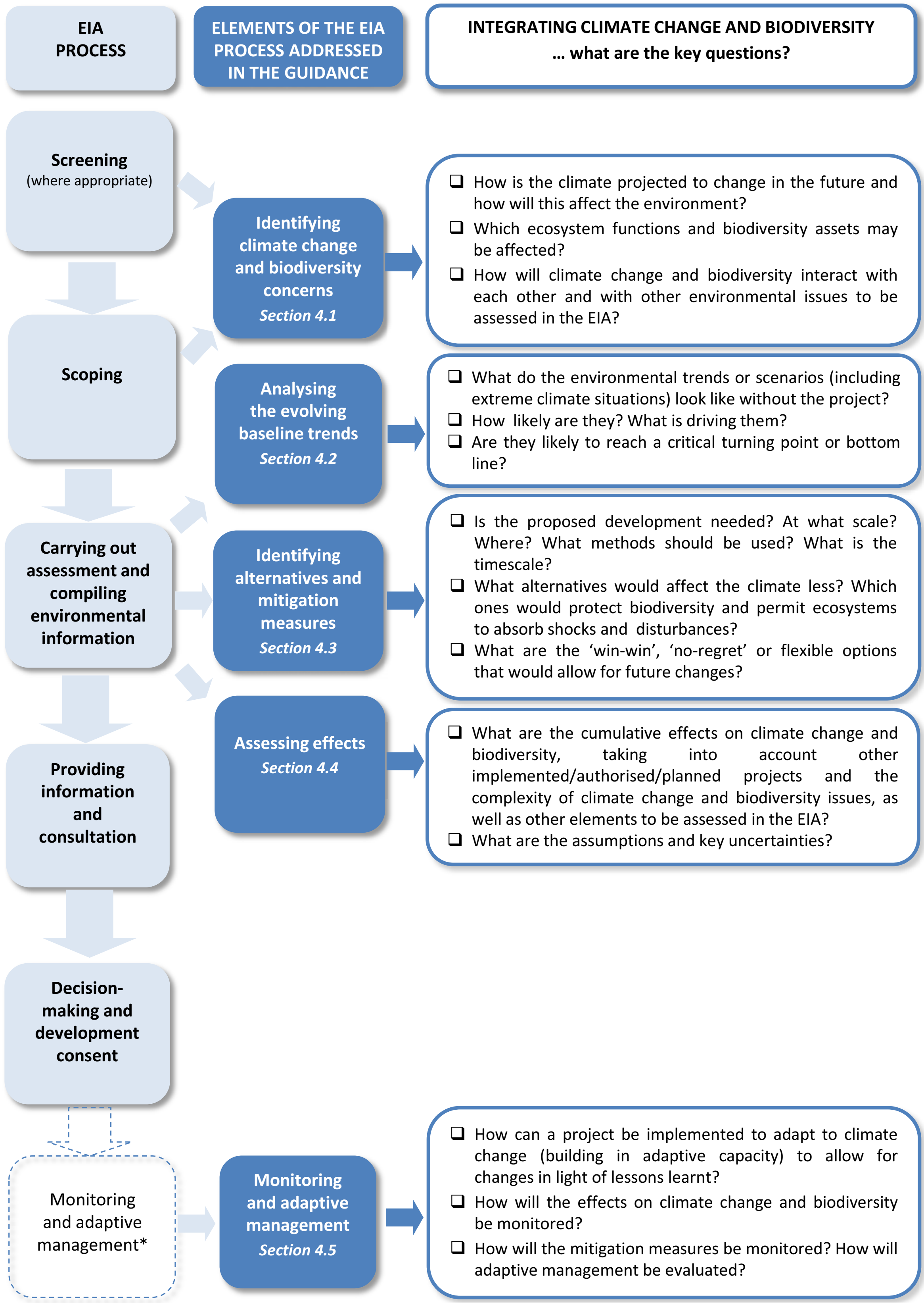
**Each sub-section looks at the EIA elements for which climate change (including disaster risks in the context of climate change adaptation) and biodiversity considerations are most relevant, and gives some examples. You can use these as a starting point for more in-depth work.**

This section pays particular attention to climate change adaptation, which is a relatively new issue in the context of EIA. The advice and examples provided could serve as a basis for developing tailored approaches to a wide range of infrastructure projects (e.g. power plants, motorways/roads, pipelines, industrial plants, overhead electrical power lines, installations for storage of petroleum, ports, waste disposal facilities, urban development projects, etc.) covered by the EIA Directive. Such tailored approaches fall outside the scope of this guidance, however.

Addressing climate change and biodiversity in the EIA process (see Section 2.3) brings new challenges for the EIA practitioner. There will be situations in which the EIA practitioner will have to make a judgement, preferably in consultation with stakeholders, to avoid unnecessarily extending the EIA procedure or to leave enough time to properly assess complex information. Taking a practical, common sense approach to EIA will sometimes be best.

Figure 2 (overleaf) shows the scope of this guidance and includes a set of questions related to specific topics addressed in it.

**Figure 2: Integrating climate change and biodiversity into EIA**




*Monitoring is not obligatory under the EIA Directive, but is nevertheless used in some Member States.

## 4.1 Identifying climate change and biodiversity concerns in EIA

This section looks at how climate change and biodiversity issues could be better factored into EIA. It can be useful in the screening and scoping stages of EIA. Of course, the issues and impacts relevant to a particular EIA will depend on the specific circumstances and context of each project (e.g. the sector concerned, location and scale, characteristics of the receiving environment, etc.).

The section is structured around four key recommendations:

- identifying **key issues early on**, with input from **relevant authorities and stakeholders**;
- determining whether the project may significantly change GHG emissions and defining the scope of any necessary GHG assessments (**climate mitigation concerns**);
- being clear about climate change scenarios used in the EIA and identifying the key **climate change adaptation concerns** and how they interact with the other issues to be assessed in EIA;
- identifying the key **biodiversity concerns** and how they interact with the other issues to be assessed in EIA.

### 4.1.1 Identifying key issues early on, with input from relevant authorities and stakeholders

Identifying key climate change and biodiversity issues early on ensures that they are recognised by all involved and followed-up throughout the EIA process. Involving relevant authorities and stakeholders at an early stage (at the latest at the scoping stage for Annex I projects or prior to the issuing of a screening decision for Annex II projects) will improve compliance with the EIA Directive. It will also make it possible to capture the most important issues and establish a consistent approach to assessing impact and looking for solutions. Making use of the knowledge and opinions of environmental authorities and stakeholders can help to:

- highlight potential areas of contention and areas of improvement in a timely and effective way;
- provide information on relevant forthcoming projects, policies and legislative or regulatory reforms, other types of assessments (including Article 6(3) of the Habitats Directive on 'appropriate assessment' — see box left) that should be considered when analysing evolving baseline trends (see Section 4.2);
- collect suggestions for building climate change mitigation and adaptation measures and/or biodiversity enhancement schemes into the proposed project from the very beginning.

**The relationship between EIA and Article 6(3) of the Habitats Directive**

Article 6(3) of the Habitats Directive requires an 'appropriate assessment' when any project, either individually or in combination with other plans and projects, is likely to have a significant effect on a Natura 2000 site (a Special Protection Area — SPA — under the Birds Directive, or Special Area of Conservation — SAC — under the Habitats Directive). There is therefore a clear link to EIA, but EIA has a wider environmental remit, as it should consider all biodiversity and not just impact related to Natura 2000 sites.

In some cases, the EIA and Article 6(3) assessments can be combined, or data and information from the Article 6(3) assessment of the Natura 2000 site can be used in the EIA and *vice-versa*. The extent of iteration between EIA and any Article 6(3) assessment will depend on the nature and scale of the project and site(s) concerned.

**The main climate change and biodiversity concerns are listed in Table 6, below.** They can help you define a set of questions on climate change mitigation, adaptation and biodiversity. These could then be asked in the screening and/or scoping stages of EIA.

**Table 6: Examples of main climate change and biodiversity concerns to consider as part of EIA**

| Climate change mitigation | Climate change adaptation | Biodiversity |
|---|---|---|
| • direct GHG emissions caused by the construction, operation, and possible decommissioning of the proposed project, including from land use, land-use change and forestry;<br>• indirect GHG emissions due to increased demand for energy;<br>indirect GHG emissions caused by any supporting activities or infrastructure which is directly linked to the implementation of the proposed project (e.g. transport, waste management). | • heat waves (including impact on human health, damage to crops, forest fires, etc.);<br>• droughts (including decreased water availability and quality and increased water demand);<br>• extreme rainfall, riverine flooding and flash floods;<br>• storms and high winds (including damage to infrastructure, buildings, crops and forests);<br>• landslides;<br>• rising sea levels, storm surges, coastal erosion and saline intrusion;<br>• cold spells;<br>• freeze-thaw damage[22]. | • degradation of ecosystem services;<br>• loss of habitats, fragmentation (including the extent or quality of the habitat, protected areas, including Natura 2000 sites, habitat fragmentation or isolation, as impact on processes important for the creation and/or maintenance of ecosystems)<br>• loss of species diversity (including species protected under the Habitats Directive and the Birds Directive)<br>• loss of genetic diversity. |

For climate change in particular, both the impact of the project on climate and climate change (i.e. mitigation aspects) and the impact of climate change on the project and its implementation (i.e. adaptation aspects) should be considered early on in the EIA process.

Note that this list is not comprehensive and should be adapted. The issues and impacts relevant to a particular EIA should be defined by the specific context of each project and by the concerns of the authorities and stakeholders involved. Flexibility is therefore needed. This table (and other tables in this section) should be used only as a starting point for discussion.

Annex 2 provides additional sources of information that can help you identify key issues and effects.

### 4.1.2 Understanding key climate mitigation concerns

When it comes to mitigation, the main concerns focus on GHG emissions. Implementing a project may lead to, for example:

- a direct increase in GHG emissions;
- an increase in energy demand leading to an indirect increase in GHG emissions;
- embedded GHG emissions, e.g. due to energy use in material production, transport, etc.;
- loss of habitats that provide carbon sequestration, (e.g. through land-use change).

This guidance does not include any specific methodologies for calculating GHG emissions as part of the EIA procedure. However, Annex 3 provides links to carbon calculators and other methodologies, including to the methodology for calculating absolute and relative GHG emissions piloted by the European Investment Bank (EIB).

[22] Freeze-thaw weathering is a form of physical weathering, common in mountains and glacial environments, caused by the expansion of water as it freezes. This process also applies to infrastructure materials, e.g. concrete. Climate change is projected to bring more unpredictable winter weather in some parts of the world, increasing the frequency of freeze-thaw cycles. As this happens, roads, railways, water networks, etc. will suffer problems and increased maintenance costs. (adapted from: Talk Talk, and Weathering of building Infrastructure and the changing climate: adaptation options (Auld H., Klaassen J., Comer N., 2007)

Table 7 (below) provides examples of basic questions that could be asked by EIA practitioners when identifying major climate change mitigation concerns.

**Table 7: Examples of key questions that could be asked when identifying key climate change mitigation concerns**

| Main concerns related to: | Key questions that could be asked at the screening and/or scoping stage of the EIA |
|---|---|
| **Direct GHG emissions** | • Will the proposed project emit carbon dioxide ($CO_2$), nitrous oxide ($N_2O$) or methane ($CH_4$) or any other greenhouse gases part of the UNFCCC?<br>• Does the proposed project entail any land use, land-use change or forestry activities (e.g. deforestation) that may lead to increased emissions? Does it entail other activities (e.g. afforestation) that may act as emission sinks? |
| **Indirect GHG emissions due to an increased demand for energy** | • Will the proposed project significantly influence demand for energy?<br>• Is it possible to use renewable energy sources? |
| **Indirect GHG caused by any supporting activities or infrastructure that is directly linked to the implementation of the proposed project (e.g. transport)** | • Will the proposed project significantly increase or decrease personal travel? Will the proposed project significantly increase or decrease freight transport? |

### 4.1.3 Understanding key climate change adaptation concerns

Both a project's impact on climate change (i.e. mitigation aspects) and the impact of climate change on the project and its implementation (i.e. adaptation aspects) should be considered early on in the EIA process. **How might implementing the project be affected by climate change? How might the project need to adapt to a changing climate and possible extreme events?**

When addressing climate change adaptation concerns as part of EIA, you should not only consider the historical data on climate, but also clearly identify and present the climate change scenario that should be considered in the assessment process. A clear description of the climate change scenario facilitates discussion on whether the expected climatic factors should be considered in the project design and how they may affect the project's environmental context. EIA practitioners, in particular, should outline extreme climate situations to be considered as part of the environmental baseline analysis.

You should also review any existing adaptation strategies, risk management plans and other national or sub-regional studies on the effects of climate variability and climate change, as well as proposed responses and available information on expected climate-related effects relevant to the project.

Table 8 provides examples of basic questions that you could ask when identifying major climate change adaptation concerns.

**Table 8: Examples of key questions that could be asked when identifying climate change adaptation concerns**

| Main concerns related to: | Key questions that could be asked at the screening and/or scoping stage of the EIA |
|---|---|
| **Heat waves**<br>(take into account that heat waves are usually associated with water scarcity — see also the suggestions for droughts) | • Will the proposed project restrain air circulation or reduce open spaces?<br>• Will it absorb or generate heat?<br>• Will it emit volatile organic compounds (VOCs) and nitrogen oxides ($NO_x$) and contribute to tropospheric ozone formation during sunny and warm days?<br>• Can it be affected by heat waves?<br>• Will it increase energy and water demand for cooling?<br>• Can the materials used during construction withstand higher temperatures (or will they experience, for example, material fatigue or surface degradation)? |
| **Droughts due to long-term changes in precipitation patterns**<br>(also consider possible synergistic effects with flood management actions that enhance water retention capacity in the watershed) | • Will the proposed project increase water demand?<br>• Will it adversely affect the aquifers?<br>• Is the proposed project vulnerable to low river flows or higher water temperatures?<br>• Will it worsen water pollution — especially during periods of drought with reduced dilution rates, increased temperatures and turbidity?<br>• Will it change the vulnerability of landscapes or woodlands to wild fires? Is the proposed project located in an area vulnerable to wildfires?<br>• Can the materials used during construction withstand higher temperatures? |
| **Extreme rainfall, riverine flooding and flash floods** | • Will the proposed project be at risk because it is located in a riverine flooding zone?<br>• Will it change the capacity of existing flood plains for natural flood management?<br>• Will it alter the water retention capacity in the watershed?<br>• Are embankments stable enough to withstand flooding? |
| **Storms and winds** | • Will the proposed project be at risk because of storms and strong winds?<br>• Can the project and its operation be affected by falling objects (e.g. trees) close to its location?<br>• Is the project's connectivity to energy, water, transport and ICT networks ensured during high storms? |
| **Landslides** | • Is the project located in an area that could be affected by extreme precipitation or landslides? |
| **Rising sea levels** | • Is the proposed project located in areas that may be affected by rising sea levels?<br>• Can seawater surges caused by storms affect the project?<br>• Is the proposed project located in an area at risk of coastal erosion? Will it reduce or enhance the risk of coastal erosion?<br>• Is it located in areas that may be affected by saline intrusion?<br>• Can seawater intrusion lead to leakage of polluting substances (e.g. waste)? |
| **Cold spells and snow** | • Can the proposed project be affected by short periods of unusually cold weather, blizzards or frost?<br>• Can the materials used during construction withstand lower temperatures?<br>• Can ice affect the functioning/operation of the project? Is the project's connectivity to energy, water, transport and ICT networks ensured during cold spells?<br>• Can high snow loads have an impact on the construction's stability? |
| **Freeze-thaw damage** | • Is the proposed project at risk of freeze-thaw damage (e.g. key infrastructure projects)?<br>• Can the project be affected by thawing permafrost? |

### 4.1.4 Understanding key biodiversity concerns

For biodiversity, key concerns should focus on ensuring 'no-net-loss' and should outline how EIA can support this goal. The project may result in, for example:

- changes in the provision of ecosystem services as a result of loss of species and habitats;
- habitat loss and degradation, e.g. the destruction of wetlands, grasslands and forests for housing, etc.;

- habitat fragmentation — ecosystems and their species need a certain amount of interconnectivity for processes to continue; breaking a natural area into smaller pieces, means that eventually species disappear and certain functions are lost;
- loss of species, e.g. the plants and animals endemic to a particular habitat will not be able to survive if that habitat is destroyed or altered by development;
- changes in natural environmental processes, such as continued river flow, water purification, coastal sediment transport, and erosion control, which can have long-term impact on habitats and species;
- direct impacts, for example birds colliding with power lines or wind turbines;
- the spread of invasive alien species that can transform natural habitats and disrupt native species;
- effects of pollution on ecosystems and species.

Table 9 (below) provides examples of basic questions you could ask when identifying major biodiversity concerns.

**Table 9: Examples of key questions that could be asked when identifying biodiversity concerns**

| Main concerns related to: | Key questions that could be asked at the screening and/or scoping stage of the EIA |
|---|---|
| **Degradation of ecosystem services**<br>(including impact on processes important for creating and / or maintaining ecosystems) | • Will the proposed project directly or indirectly lead to serious damage or total loss of ecosystem or land-use type, thus leading to a loss of ecosystem services? Will it affect the exploitation of ecosystems or land-use type so that the exploitation becomes destructive or unsustainable?<br>• Will the proposed project damage ecosystem processes and services, particularly those on which local communities rely?<br>• Is the project in any way dependent on ecosystem services?<br>• Can increased supply of ecosystem services contribute to the project's objective(s)?<br>• Will the proposed project result in emissions, effluents, and/or other means of chemical, radiation, thermal or noise emissions in areas providing key ecosystem services?<br>As regards processes important for creating and/or maintaining ecosystems:<br>• Will the proposed project change the food chain and interactions that shape the flow of energy and the distribution of biomass within the ecosystem?<br>• Will the proposed project result in significant changes to water level, quantity or quality?<br>• Will the proposed project result in significant changes to air quantity or pollution? |
| **Loss and degradation of habitats**<br>(including the Natura 2000 network, habitat fragmentation and isolation) | • If habitats are lost or altered, are there alternatives available to support the species populations concerned?<br>• Will the proposed project adversely affect any of the following: protected areas; threatened ecosystems outside protected areas; migration corridors identified as being important for ecological or evolutionary processes; areas known to provide important ecosystem services; or areas known to be habitats for threatened species?<br>• Will the proposed project involve creating linear infrastructure and lead to habitat fragmentation in areas providing key and other relevant ecosystem services?<br>• How seriously will this affect habitats and corridors, considering that they can also be adversely affected by climate change?<br>• Are there opportunities to establish or further develop green infrastructure as a part of the project to support the project's non-environmental and environmental goals (e.g. adaptation to climate change or increasing connectivity of protected sites)? |

| | |
|---|---|
| **Loss of species diversity**[23] (including species protected under the Habitats Directive and the Birds Directive) | • Will the proposed project have direct or indirect negative impact on the species of Community interest listed in Annex II and/or Annex IV or V, in particular, priority species from Annex II[24] of the Habitats Directive or on the species covered by the Birds Directive?<br>• Will the proposed project cause a direct or indirect loss of a population of a species identified as priority in National Biodiversity Strategies and Action Plans[25] (NBSAPs) and/or other sub-national biodiversity plans?<br>• Will the proposed project alter the species-richness or species-composition of habitats in the study area?<br>• Will the proposed project affect sustainable use of a population of a species?<br>• Will the proposed project surpass the maximum sustainable yield, the carrying capacity of a habitat/ecosystem or the maximum allowable disturbance level of populations, or ecosystem?<br>• Will the proposed project increase the risk of invasion by alien species? |
| **Loss of genetic diversity**[26] | • Will the proposed project result in the extinction of a population of a particularly rare species, declining species or a species identified as one of Community interest, in particular of priority species from Annex II of the Habitats Directive?<br>• Will the proposed project result in the extinction of a population of a particularly rare species, declining species or those identified as priorities in NBSAPs and/or sub-national biodiversity plans?<br>• Will the proposed project result in the fragmentation of an existing population leading to (genetic) isolation? |

## 4.2 Analysing the evolving baseline trends

The evolution of the baseline — how the current state of the environment is expected to change in the future — is critical to understanding how the proposed project might impact that changing environment.

The baseline environment is a moving baseline. This is especially true for large-scale projects, which might only become fully operational after many years. During this time, the biodiversity in the project's area may change and the area may be subject to different climatic conditions, such as storms, increased flooding, etc. For long-term projects or those with long-lasting effects (timescales exceeding 20 years), you should ideally use climate scenarios based on climate model results. Such projects may need to be designed to withstand very different environmental conditions from current ones. For short-term projects, scenarios need to represent only 'near future' or 'present-day' climates.[27]

Environmental outlooks and scenario studies that analyse trends and their likely future directions can provide useful information. If data are unavailable, it may be useful to use proxy indicators. For example, if air quality monitoring data are not readily available for an urban area, perhaps there are data outlining trends in traffic flow/volumes over time, or trends in emissions from stationary sources.

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[23] Definition: The number and variety of species found in a given area in a region http://www.cbd.int/cepa/toolkit/2008/doc/CBD-Toolkit-Glossaries.pdf

[24] Priority species are indicated by an asterisk (*) in Annex II of the Habitats Directive.

[25] National Biodiversity Strategies and Action Plans (NBSAPs) are the principal instruments for implementing the Convention at national level (Article 6). The Convention requires countries to prepare a national biodiversity strategy (or equivalent instrument) and to ensure that this strategy is mainstreamed into the planning and activities of all sectors whose activities can have an impact (positive or negative) on biodiversity.

[26] The potential loss of natural genetic diversity (genetic erosion) is extremely difficult to determine, and does not provide any practical clues for formal screening/scoping. The issue would probably only come up in dealing with highly-threatened, legally-protected species that are limited in numbers and/or have highly separated populations, or when complete ecosystems become separated and the risk of genetic erosion applies to many species (the reason for constructing so-called eco-ducts across major line infrastructure), COP 6 Decision VI/7, Annex: Guidelines for incorporating biodiversity-related issues into environmental impact assessment legislation and/or process and in strategic environmental impact assessment, http://www.cbd.int/decision/cop/?id=7181.

[27] Adapted from http://climate-adapt.eea.europa.eu.

Spatially explicit data and assessments, potentially using Geographical Information Systems (GIS), are likely to be important for analysing the evolving baseline trends and also to understand distributional effects. There are several such European sources of data, including data repositories and online digital datasets, for example the Biodiversity Information System for Europe (BISE) or the Climate change Data Centre. Annex 2 provides a comprehensive overview and links to sources of information on biodiversity and climate change.

When looking at the evolving baseline, you should consider:

- **Trends in key indicators over time,** for example GHG emissions, indices of vulnerability, frequency of extreme weather events, disaster risk, key species such as farmland birds and the status of habitats or protected areas. Are these trends continuing, changing, or levelling out? Are there environmental outlooks or scenario studies available that have looked at their likely future direction? If data are unavailable for certain indicators, can you use proxy indicators?

### Biodiversity considerations

**Designated sites**

- Are there any sites designated for nature conservation or the distribution of protected species that fall within the zone of influence?
- Does the project affect any sites likely to be designated in the foreseeable future?
- Is there any policy presumption in favour of habitat protection/creation/restoration in the area?

**General ecological considerations**

- What ecological features at or above the defined threshold level of value may occur within the zone of influence?
- What are their distribution and status elsewhere for comparison?
- What were their historical distributions, status and management compared with the present?
- What are their scales of variation, vulnerability and likely exposure to the project?
- What are the key ecological processes or species activity periods; are there seasonal variations in distribution, abundance and activity?
- Are there any species, the disappearance of which would have significant consequences for others?
- Are there any other projects planned within the same area or time-frame that may contribute to cumulative effects?

**Source:** Guidelines for Ecological Impact Assessment in the UK (IEEM, 2006)

- **Drivers of change** (both direct and indirect), which may cause a particular trend. Identifying drivers facilitates future projections, especially if some existing drivers are expected to change or new drivers are about to come into play and will significantly affect a given trend (e.g. already approved developments that have not been implemented yet; changes in economic incentives and market forces; changes in the regulatory or policy frameworks; etc.). Identifying drivers should not become a complex academic exercise — it is only important to recognise drivers that will significantly change the trend and take them into account when outlining the expected future state of the environment.

- **Thresholds/limits,** e.g. have thresholds already been breached or are limits expected to be reached? The EIA may determine whether the given trend is already approaching an established threshold or if it is coming close to certain tipping points that can trigger significant changes in the state or stability of the local ecosystem.[28]

- **Key areas that may be particularly adversely affected by the worsening environmental trends** including, in particular, protected areas, such as areas designated pursuant to the Birds Directive and the Habitats Directive. The Institute of Ecology and Environment Management (IEEM) in the UK recommends several considerations when establishing the baseline from the point of view of biodiversity (see box left).

[28] See examples of environmental limits relevant to climate change and biodiversity at http://www.resalliance.org/index.php/thresholds_database.

- **Critical interdependencies,** for example water supply and sewage treatment systems, flood defences, energy/electricity supply, communication networks, etc.
- **Benefits and losses brought by these trends and their distribution** may determine who benefits and who doesn't. Beneficial and adverse impacts are often not proportionally distributed within society — changes in ecosystems affect some population groups and economic sectors more seriously than others.
- **Climate change vulnerability** assessment needs to be built into any effective assessment of the evolution of the baseline environment, as well as of alternatives. Major infrastructure projects, in particular, are likely to be vulnerable (see box right).

When developing the baseline against which the project is to be evaluated it is also important to acknowledge uncertainty — depending on the timescale and spatial scale some uncertainty is inevitable and will increase for large-scale projects. Uncertainty can be communicated using terms such as 'strongly suspected', 'suspected', etc., used for instance by IPCC in their *Fourth Assessment report* (2007). More detailed guidance on expressing uncertainty is provided in Section 4.4.3.

**Climate change vulnerability of major infrastructure projects**

Major infrastructure projects may be particularly vulnerable to:

- increased flood risk to fossil fuel and nuclear power sites and electricity substations;
- reduced availability of cooling water for inland power stations;
- reduced quality of wireless service from increased temperatures and intense rainfall;
- increased flood risk to all transport sectors;
- increased scour of bridges from intense rainfall/flooding;
- reduced security of water supply from changing rainfall patterns;
- increased flood risk to wastewater infrastructure.

When assessing vulnerability, it is important to consider critical interdependencies, as they can lead to 'cascade failure', where the failure of one aspect, such as flood defences, can lead to other failures, e.g. flooded power stations leading to power cuts which in turn affect telecommunications networks.

**Source:** Climate Resilient Infrastructure: Preparing for a Changing Climate — Summary Document (HM Government, UK, 2011)

## 4.3 Identifying alternatives and mitigation measures

In the early stages of the process, alternatives are essentially different ways in which the developer can feasibly meet the project's objectives, for example by carrying out a different type of action, choosing a different location or adopting a different technology or design for the project. The zero option should also be considered, either as a specific alternative or to define the baseline. At the more detailed level of the process, alternatives may also merge into mitigating measures, where specific changes are made to the project design or to methods of construction or operation to 'prevent, reduce and where possible offset any significant adverse effects on the environment'.[29]

Note that many alternatives and mitigation measures important from the point of view of biodiversity and climate change should be addressed at strategic level, in a Strategic Environmental Assessment (SEA). For example, to avoid problems associated with flood risk, planners should prevent projects from being developed on flood plains or areas of flood risk, or promote land management to increase water retention capacity. To avoid or minimise effects on Natura 2000 sites located near motorway or railway projects, it is necessary to assess the siting of the whole corridor before leaving it to the level of individual sections, as this would limit the choice of alternative locations, etc.

[29] Annex IV of the EIA Directive.

### 4.3.1 Climate change mitigation

For **climate change mitigation,** it is important to investigate and use options to eliminate GHG emissions as a precautionary approach in the first place, rather than having to deal with mitigating their effects after they have been released. Mitigation measures identified and introduced as a result of an EIA, e.g. construction and operational activities that use energy and resources more efficiently, may contribute to climate change mitigation as well. However, this does not always mean that the project will have overall positive impacts as regards GHG emissions. Impact may be less negative in terms of quantity of emissions, but still have overall negative impact, unless the carbon used in development and transport is unequivocally equal to zero.

Bear in mind that some EIA mitigation measures that address climate change can themselves have significant environmental impact and may need to be taken into account (e.g. renewable energy generation or tree planting may have adverse impacts on biodiversity).

**Table 10: Examples of alternatives and mitigation measures related to climate change mitigation concerns**

| Main concerns related to: | Examples of alternatives and mitigation measures |
|---|---|
| **Direct GHG emissions** | • Consider different technologies, materials, supply modes, etc. to avoid or reduce emissions;<br>• Protect natural carbon sinks that could be endangered by the project, such as peat soils, woodlands, wetland areas, forests;<br>• Plan possible carbon off-set measures, available through existing off-set schemes or incorporated into the project (e.g. planting trees). |
| **GHG emissions related to energy** | • Use recycled/reclaimed and low-carbon construction materials;<br>• Build energy efficiency into the design of a project (e.g. include warmcel insulation, south facing windows for solar energy, passive ventilation and low-energy light bulbs);<br>• Use energy-efficient machinery;<br>• Make use of renewable energy sources. |
| **GHG emissions related to transport** | • Choose a site that is linked to a public transport system or put in place transport arrangements;<br>• Provide low-emission infrastructure for transport (e.g. electric charging bays, cycling facilities). |

### 4.3.2 Climate change adaptation

In terms of **climate change adaptation**, different types of EIA alternatives and mitigation measures (see box overleaf) are available for decision-makers to use in planning the adaptation of projects to climate change. The most appropriate mix of alternatives and/or mitigation measures will depend on the nature of the decision being made and the sensitivity of that decision to specific climate impacts and the level of tolerated risk. Key considerations include:[30]

- `no-regret’ or `low-regret` options that yield benefits under different scenarios;
- `win-win-win` options that have the desired impacts on climate change, biodiversity and ecosystem services, but also have other social, environmental or economic benefits;

[30] Adapted from http://climate-adapt.eea.europa.eu

- favouring reversible and flexible options that can be modified if significant impacts start to occur;
- adding 'safety margins' to new investments to ensure responses are resilient to a range of future climate impacts;
- promoting soft adaptation strategies, which could include building adaptive capacity to ensure a project is better able to cope with a range of possible impacts (e.g. through more effective forward planning);
- shortening project times;
- delaying projects that are risky or likely to cause significant effects.

If, based on an assessment of specific risks and constraints, alternatives and mitigation measures are considered impossible or too expensive, the project may have to be abandoned.

**Types of EIA mitigation measures for climate change adaptation and risk management**

- Measures that strengthen the project's capacity to adapt to increasing climate variability and climate change (e.g. building in early warning or emergency/disaster preparedness);
- Risk reduction mechanisms (e.g. insurance);
- Measures that control or manage certain identified risks (e.g. choice of project location to reduce exposure to natural disasters);
- Measures that improve the project's ability to operate under identified constraints (e.g. choice of most water-efficient or energy-efficient options);
- Measures that better exploit certain opportunities offered by the natural environment.

**Source:** Guidelines on the Integration of Environment and Climate Change in Development Cooperation, Guidelines No 4 (EuropeAid, 2009)

**Table 11: Examples of alternatives and mitigation measures related to climate change adaptation concerns**

| Main concerns related to: | Examples of alternatives and mitigation measures |
|---|---|
| **Heat waves** | • Ensure that the proposed project is protected from heat exhaustion;<br>• Encourage design optimal for environmental performance and reduce the need for cooling;<br>• Reduce thermal storage in a proposed project (e.g. by using different materials and colouring). |
| **Droughts** | • Ensure that the proposed project is protected from the effects of droughts (e.g. use water-efficient processes and materials that can withstand high temperatures);<br>• Install livestock watering ponds within animal-rearing systems;<br>• Introduce technologies and methods for capturing storm water;<br>• Put in place state-of-the-art wastewater treatment systems that make reusing water possible. |
| **Wildlife fires** | • Use fire-resistant construction materials;<br>• Create a fire-adapted space around the project (e.g. use fire-resistant plants). |
| **Extreme rainfall, riverine flooding and flash floods** | • Consider changes in construction design that allow for rising water levels and ground water levels (e.g. build on pillars, surround any flood-vulnerable or flood-critical infrastructure with flood barriers that use the lifting power of approaching floodwater to automatically rise, set up backwater valves in drainage-related systems to protect interiors from flooding caused by backflow of wastewater, etc.);<br>• Improve the project's drainage. |
| **Storms and winds** | • Ensure a design that can withstand increased high winds and storms. |
| **Landslides** | • Protect surfaces and control surface erosion (e.g. by quickly establishing vegetation — hydroseeding, turfing, trees);<br>• Put in place designs that control erosion (e.g. appropriate drainage channels and culverts). |
| **Rising sea levels** | • Consider changes in construction design to allow for rising sea levels (e.g. building on pillars, etc.). |
| **Cold spells and snow** | • Ensure that the project is protected from cold spells and snow (e.g. use construction materials that can withstand low temperatures and make sure the design can resist |

| | |
|---|---|
| | snow build-up). |
| **Freeze-thaw damage** | • Ensure that the project (e.g. key infrastructure) is able to resist winds and prevent moisture from entering the structure (e.g. by using different materials or engineering practices). |

### 4.3.3 Biodiversity

For **biodiversity**, EIA should focus on ensuring 'no-net-loss' (see box below) and avoiding effects from the start, before considering mitigation, with compensation being used as a last resort.

**Key messages for promoting 'no-net-loss' of biodiversity**

1. Avoid irreversible biodiversity loss, for example by improving the spatial arrangement of a project;
2. Seek alternative solutions that minimise biodiversity loss, in particular consider and prioritise maintaining habitats that are experiencing long-term decline;
3. Use mitigation to restore biodiversity resources where their loss is unavoidable;
4. Compensate for unavoidable loss by providing substitutes of at least similar biodiversity value;
5. Look for ways of optimising environmental benefits, for example by facilitating connection of fragmented environments or creating beneficial high biodiversity habitats.

**Source:** Biodiversity Impact Assessment (IAIA, 2005)

EIA mitigation measures for biodiversity can also help to mitigate and adapt to climate change. For example, creating new habitats, green spaces, green corridors, green and brown roofs (enhancement) can help maintain and enhance biodiversity, aid species in adapting to long-term climate change, and provide essential ecosystem services such as flood storage capacity, rainfall interception, shade and heat regulation and air quality regulation as part of adaptation to climate change.

As a last resort, biodiversity offsets can be used to compensate for significant negative impacts arising from a project, after appropriate prevention and mitigation measures have been taken. For example, Article 6(4) of the Habitats Directive provides a compensation system specifically for Natura 2000 sites. However, compensation will not always be possible: there are cases where a development proposal can be rejected on grounds of irreversible damage to, or irreplaceable loss of, biodiversity.

You should apply the precautionary principle when considering risks and adjust your proposal, rather than try to defend it against significant biodiversity effects.

**Table 12: Examples of alternatives and mitigation measures related to biodiversity concerns**

| Main concerns | Examples of alternatives and mitigation measures |
|---|---|
| **Degradation of ecosystem services** | • Restore degraded ecosystems on the site to enhance ecosystem services. |
| **Habitats,** (including Natura 2000 network, habitat fragmentation and isolation) | Use an ecosystem services approach, ecosystem-based approaches and green infrastructure:<br>• Green bridges and eco-ducts (elements of green infrastructure) re-connect natural areas divided by linear developments (e.g. roads or railway lines). They reduce accidents involving wild animals and cars, allow animals to move easily and safely from one area to another, and help plant species to spread. This gives animals more space to find food and shelter, and allows populations of the same species to interact, improving the overall resilience of the species. |
| **Species diversity** | • Introduce design alternatives to avoid adverse effects on bird species (e.g. size, height, spacing, lighting and visibility of wind turbines);<br>• Consider timing of construction, maintenance and decommissioning;<br>• Deliver 'smart conservation', e.g. by promoting well-designed parks, walking paths, green roofs and walls that can contribute to species diversity and to tackling climate change related to urban infrastructure projects. |

## 4.4 Assessing significant effects

Many assessment approaches used in the EIA process have the capacity to address biodiversity and climate change. Annex 3 lists several tools and approaches that are being used or piloted to support EIA assessment. There are, however, three fundamental issues that you should consider when addressing climate change and biodiversity: the **long-term and cumulative nature of effects**, **complexity of the issues and cause-effect relationships** and **uncertainty of projections**.

### 4.4.1 Long-term and cumulative nature of effects

As shown in Section 2, climate change and biodiversity are generally complex issues with long-term impacts and consequences. EIAs that aim to properly address biodiversity and climate should take this into account and assess the combined impact of any number of different effects. This requires an understanding of evolving baseline trends and an assessment of the cumulative effects of the project on the changing baseline.

There are a number of tips and approaches to be considered when assessing the cumulative effects of climate change and biodiversity in EIA:

- **Recognise cumulative effects early on in the EIA process,** in the scoping stage if possible. Talking to the right stakeholders as early as possible can give the wide overview needed to better understand how seemingly insignificant individual effects can have greater consequences when considered together.
- **Pay attention to the evolving baseline** when assessing the cumulative effects of climate change and biodiversity impacts. The current state of the environment will not necessarily be the future state of the environment, even if the proposed project does not go ahead. Moreover, both the climate and the species that make up the natural world are in a constant state of flux. A changing climate may mean that the design and operational management of a project meant for a certain climate scenario will no longer be relevant in 20 years' time. For instance, warmer summers may increase the susceptibility of materials to heat deformation or increase the risk of wildfires to a project. Considering potential impacts such as these is a unique challenge of climate change within EIA.
- **Distinguish between magnitude and significance and use significance criteria** — a large magnitude impact may not be significant if the species affected is common, widely distributed and readily able to recover, but a small magnitude impact may be very significant to a highly sensitive or rare species or habitat. Significance criteria can be developed from existing policy and guidance documents, such as: biodiversity strategies; biodiversity action plans for habitats and species; international, national and local designations: legislation; and/or using an ecosystem-based approach by identifying the valued ecosystem services and how these will be affected by drivers of change over time.
- **Where possible, use causal chains or network analysis** to understand the interactions and associated cumulative effects between specific elements of the project and aspects of the environment. The point is not to be comprehensive, but to understand which cumulative effects might be most significant. These can often be identified with stakeholders who can help work through potential pathways in causal chains.

### 4.4.2 Complexity of the issues and cause-effect relationships

Many of the recommendations regarding assessing a project's long-term and cumulative effects addressed in Section 4.4.1 will also help address the complexity of climate change and biodiversity and understand the cause-effect relationship they have with each other, as well as with other issues assessed within an EIA.

The complexity of climate change and biodiversity should not deter you from analysing direct and indirect impacts the proposed project could have on trends in key issues. At times, this will require simplified models that give best estimates of emissions and impacts, e.g. using best-case and worst-case scenarios to illustrate different future states under various assumptions.

Judging an impact's magnitude and significance must be context-specific. For an individual project — e.g. a road project — the contribution to GHGs may be insignificant on the global scale, but may well be significant on the local/regional scale, in terms of its contribution to set GHG-reduction targets.

**Communicating uncertainty**

Quantifying uncertainty can be very valuable in decision-making. It cannot eliminate uncertainty, but it can help to understand the levels of uncertainty we are dealing with. To do this well, uncertainty has to be well explained and communicated.

There are two types of probability, subjective and objective. Subjective or inductive probability gives an estimate based on the available information and strength of evidence. Objective or statistical probability presents information where all uncertainties are accounted for.

Irrespective of the type of probability, it is important to be consistent in how terms are used and how they relate to the probability they represent. The IPCC provides a guide, reproduced below:

| **Likelihood scale** | **Likelihood of the outcome** |
|---|---|
| **Term** | |
| Virtually certain | 99 – 100% probability |
| Very likely | 90 – 100% probability |
| Likely | 66 – 100% probability |
| About as likely as not | 33 – 66% probability |
| Unlikely | 0 – 33% probability |
| Very unlikely | 0 – 10% probability |
| Exceptionally unlikely | 0 – 1% probability |

**Source:** CLIMATE-ADAPT

Biodiversity impacts will also depend on geographical and temporal scales of impact and the sensitivity of the habitat or species concerned. For instance, a project's implementation could have possible negative effects on a species that is relatively common at global level, but is the only viable population of that species at local level.

As described in Section 4.4.1, using casual chains or network analysis should help to understand the complexity of the issues and cause-effect relationships.

### 4.4.3 Uncertainty

One of the tasks of describing expected impacts is to help audiences understand what is known with a high degree of confidence and what is relatively poorly understood.

Decision-makers and stakeholders are used to dealing with uncertainty all the time (e.g. economic growth, technological change) and they will able to use such information. It will be important to reassure them that considering a range of possible uncertain futures and understanding the uncertainties is part of good EIA practice and permits better and more flexible decisions.

The key principle in communicating uncertainty is avoiding complex or obscure language. Those undertaking EIA should describe the sources of uncertainty, characterise its nature and explain the meaning of phrases used. Using everyday language to describe uncertainty can makes the concept more accessible, but there is a risk of misunderstanding, as people may have personal and differing interpretations of terms like 'high confidence'. Using the IPCC terms (see box above) may help here.

The European Climate Adaptation Platform: CLIMATE-ADAPT offers Uncertainty Guidance which aims to help decision-makers to understand the sources of uncertainty in climate information that are most relevant for adaptation planning. It also provides further suggestions for dealing with uncertainty in adaptation planning and for communicating uncertainty.

## 4.5 Monitoring and adaptive management

Although monitoring is not required by the EIA Directive, it can be identified and implemented as a mitigation measure. For example, such monitoring measures could be linked to the environmental conditions set in development consent as a result of the EIA procedure (e.g. adherence to agreed flights schedules in order to avoid increasing noise or GHG emissions levels for airports). Moreover, generating recommendations for monitoring the impact of implementing a project, in order to identify any unforeseen adverse effects and take appropriate remedial action, is good EIA practice.

This guidance emphasises the importance of analysing long-term trends related to climate change and biodiversity, assessing direct and indirect impacts of proposed projects on these trends, acknowledging assumptions and uncertainty in the assessment process and ideally choosing a project design and implementation that allows for changes in light of lessons learnt. If project implementation does allow for changes to be made, EIA practitioners may find it useful to consider the principles of adaptive management.

A key feature of adaptive management is that decision-makers seek development strategies that can be modified once new insights are gained from experience and research. Learning, experimenting and evaluation are key elements of this approach. Adaptive management requires the flexibility to change decisions as new information becomes available. While this may not always be possible, project development designs and permits should increasingly allow for changes in project structure and operation, if changes in the environmental context make them necessary (e.g. increasing severity of flooding, droughts, heat waves, changes in habitats and migration corridors, need for changes in buffers of areas important for protection of biodiversity, etc.).

EIA may facilitate adaptive management by clearly acknowledging assumptions and uncertainty and proposing practical monitoring arrangements to verify the correctness of the predictions made and bring any new information to the attention of decision-makers. When designing such systems, EIA practitioners will need to expand project owners' and stakeholders' knowledge and awareness, ensure their commitment and propose approaches to project implementation that provide for flexibility.

# Annexes

## Annex 1: Further reading

The international, European, and Member State level policy documents, reports and guidelines described below include documents referred to within this guide and other sources of information potentially useful for integrating climate change and biodiversity into EIA. This section includes only reference documents publicly available on the internet. The table below provides the title, hyperlink (status as of November 2012) and short description of each source. The icons below are used to distinguish the different topics covered in the table.

**Key:**

Climate change    Mitigation    Adaptation    Biodiversity

EIA Environmental Impact Assessment    SEA Strategic Environmental Assessment

| Reference/further reading (links active as of March 2013) | Comments on relevance |
|---|---|
| **Climate change — general** | |
| Climate change, impacts and vulnerability in Europe 2012 (EEA, 2012) | • This report presents information on past and projected climate change and related impacts in Europe, based on a range of indicators. It also assesses the vulnerability of society, human health and ecosystems in Europe and identifies those regions most at risk from climate change. |
| Stern Review on the Economics of Climate Change (Cabinet Office - HM Treasury, 2006) | • This review contributes to assessing the evidence and building an understanding of the economics of climate change. It first examines the evidence on the economic impacts of climate change and explores the economics of stabilising GHGs in the atmosphere. The second half of the document considers the complex policy challenges involved in managing the transition to a low-carbon economy and in ensuring that societies can adapt to the unavoidable consequences of climate change. |
| Understanding climate change — SOER 2010 thematic assessment (EEA, 2010) | • This report provides an introduction to climate change, including scientific background, policy context, possible risks and impacts, policy actions and current targets and goals. |
| UN Framework Convention on Climate Change (UN FCCC) | • This website provides information on latest developments made through the United Nations Conference of Parties (COP) process.<br>• It includes links detailing international requirements (such as Kyoto, Bali Action Plan, Copenhagen Accord and Cancun Agreement), including likely developments.<br>• It is also a good source of supra-national GHG data. |
| **Climate change — mitigation** | |
| Mitigating climate change, SOER thematic assessment (EEA, 2010) | • This report summarises the EU's progress towards GHG reduction targets.<br>• It considers global and European GHG trends and associated challenges. |
| **Climate change — adaptation** | |
| Adapting to climate change — SOER 2010 thematic assessment (EEA, 2010) | • This report is a good source of European climate change impact analysis, with descriptions and analyses of current and possible future policy actions. |
| Climate Change: Working Group II: Impacts, Adaption and | • The IPPC Chapter on the impact of climate change across |

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| Vulnerability (IPCC, 2007) | Europe considers key vulnerabilities and possible policy responses. |
| Communication: the EU approach on the prevention of natural and manmade disasters (COM(2009) 82 final) | • The Communication sets out the EU's approach to preventing natural and man-made disasters and includes ways of mainstreaming prevention in existing legislative and financial instruments. |
| Forest, health and climate change: Urban green spaces, forests for cooler cities and healthier people (EEA, 2011) | • A leaflet describing the benefits of forests (parks and green spaces) in urban environments as an adaptation approach to climate change. |
| Fourth Assessment Report: Climate Change (IPCC, 2007) | • Information regarding global climate change science, split into a range of working groups and sectoral reports. |
| Guiding principles for adaptation to climate change in Europe ETC/ACC Technical Paper 2010/6 (ETC, 2010) | • This document considers the higher-level principles of adapting to climate change, with an introduction to the concept and supporting principles. |
| Managing the risks of extreme events and disasters to advance climate change adaptation (IPCC, 2012) | • Extreme weather and climate events, interacting with exposed and vulnerable human and natural systems, can lead to disasters. This report explores the challenge of understanding and managing the risks of climate extremes, to advance climate change adaptation. |
| Mapping the impacts of natural hazards and technological accidents in Europe (EEA, 2010) | • The report assesses the occurrence and impacts of disasters and the underlying hazards such as storms, extreme temperatures, forest fires, water scarcity and droughts, floods, snow avalanches, landslides, earthquakes, volcano eruptions and technological accidents in Europe in the 1998-2009 period. It is useful for assessing potential vulnerability. |
| Risk assessment and mapping guidelines for disaster management (SEC(2010) 1626 final) | • These EU guidelines focus on the processes and methods used in the prevention, preparedness and planning stages of national risk assessments and mapping, as carried out within the broader framework of disaster risk management. |
| White paper — Adapting to climate change: towards a European framework for action (EC, 2009) | • The White Paper setting out the EU's approach to adapting to climate change, based on the concept of mainstreaming.<br>• It refers to the resilience of biodiversity and natural systems. |
| **Biodiversity** | |
| **General** | |
| Assessing biodiversity in Europe — the 2010 report (EEA, 2010) | • The report provides information on the status of European biodiversity with a focus on designated areas and progress towards the EU's biodiversity targets. |
| Biodiversity Baseline Flyer (EEA, 2010) | • The report summarises the EEA's biodiversity assessments as part of the State of the Environment Report 2010. |
| Biodiversity — SOER 2010 thematic assessment (EEA, 2010) | • The report provides a comprehensive assessment of the state of and trends in Europe's biodiversity. |
| Biodiversity — 10 messages for 2010 (EEA, 2010) | • Provides a series of specific assessments based on Europe's bio-geographic regions and the relationship between climate change and biodiversity. |
| EU 2010 Biodiversity Baseline (EEA, 2010) | • The report provides an assessment of the status of and trends in Europe's biodiversity. |
| EU Biodiversity Strategy to 2020 (EC, COM(2011) 244 final) | • The new Biodiversity Strategy aims to halt the loss of biodiversity and ecosystem services in the EU by 2020. There are six main targets and 20 actions to help Europe reach its goal. |
| Landscape fragmentation in Europe (EEA, 2011) | • This report provides a foundation for environmental monitoring and protective measures for those landscapes that are not yet fragmented. It also makes it clear that fragmentation analysis must be integrated into transport and regional planning so that cumulative effects are considered more effectively in the future. |
| Millennium Ecosystem Assessment (2005) | • A report that considers the status of and trends in global biodiversity and the services it provides. |

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|---|---|
| PIANC — Working with Nature (PIANC, revised 2011 ) | • A document that sets out the World Association for Waterborne Transport (PIANC) management plans to integrate ecosystem services into its activities. It is based on the general principle of integrated planning. |
| Resource Paper: No Net Loss and Loss-Gain Calculations in Biodiversity Offsets (BBOP, 2012) | • This paper was prepared by the BBOP to help auditors, developers, conservation groups, communities, governments and financial institutions that wish to consider and develop best-practice related to biodiversity offsets. |
| The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB (TEEB, 2010) | • A report on the current provision of ecosystem services and the tools that can support their integration into policy and decision-making. |
| The use of environmental limits in regulating environmental systems - How could the concept be applied in environmental agencies? (SNIFFER, 2010) | • A report that considers the concept of environmental limits and how they may be usefully applied within environmental agencies. |
| **Green infrastructure** | |
| Green infrastructure implementation and efficiency (EC study, 2012) | • A study that assesses the effectiveness and efficiency of policy initiatives supporting green infrastructure across Europe.<br>• It identified the main existing policy measures that can help to support green infrastructure initiatives and their implementation, including seven in-depth case studies on thematic issues. |
| Green infrastructure and territorial cohesion (EEA, 2011) | • A report that explores the concept of green infrastructure, with illustrative examples of green infrastructure initiatives and analyses of integrating green infrastructure into policy sectors. |
| Green infrastructure — Sustainable investments for the benefit of both people and nature (SURF-nature project, 2011) | • A booklet that presents the basics of green infrastructure and explains a number of approaches. |
| **Article 6 of the Habitats Directive guidance documents** | |
| Commission Staff Working Document: Integrating biodiversity and nature protection into port development (EC, 2011) | • A document that describes the policy context for reconciling environmental requirements with port development. |
| EC Guidance: Non-mineral extraction and Natura 2000 (EU, 2011) | • This guidance document shows how the needs of extractive industries can be met while avoiding adverse effects on wildlife and nature.<br>• It examines how the potential impacts of extraction activities on nature and biodiversity can be minimised or avoided altogether. |
| EC Guidance: The implementation of the Birds and Habitats Directives in estuaries and coastal zones with particular attention to port developments and dredging (EU, 2011) | • This guidance document aims to explain the protection regime (defined under Article 6 of the Habitats Directive) that applies to Natura 2000 sites in the specific context of estuaries, fairway channels and coastal zones, with particular attention paid to port-related activities, including dredging and industry (e.g. shipyards). |
| EC Guidance: Wind energy development and Natura 2000 (EC, 2010) | • The purpose of this document is to provide guidance on how to best ensure that wind energy developments are compatible with the provisions of the Habitats Directive and the Birds Directive. |
| Guidance document on Article 6(4) of the Habitats Directive 92/43/EEC (EC, 2007/updated in 2012) | • This document clarifies the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, Opinion of the Commission. |
| Guidance document on the assessment of plans and projects significantly affecting Natura 2000 sites (EC, 2001) | • A methodological guidance document on the provisions of Articles 6(3) and (4) of the Habitats Directive. |
| Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC (EC, 2000) | • This document provides Member States with guidelines on how to interpret certain key concepts used in Article 6 of the Habitats Directive. |

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| **Biodiversity and climate change** | |
| Adapting through natural interventions (Climate North West, 2011) | • A detailed description and analysis of environment-based interventions that increase adaptive capacity with regard to climate change. |
| Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe (EC study, Ecologic Institute and Environmental Change Institute 2011) | • A study that addresses current knowledge gaps concerning the implementation of ecosystem-based approaches and aims to gain a better understanding of their role and potential in climate change adaptation and mitigation in Europe. |
| Biodiversity and Climate Change: Achieving the 2020 targets (CBD, 2010) | • A technical note on how the 2020 targets as set out in the CBD will be achieved, considering the problems caused by climate change and biodiversity loss. |
| Climate change and biodiversity — 10 messages for 2010 (EEA, 2010) | • A summary report exploring and describing the main issues surrounding climate change and biodiversity in Europe. |
| Climate change and biodiversity — The role of the European regions (ECNC, 2007) | • A report that discusses the role of European regions in responding to climate-change-related issues, including adaptation and mitigation. |
| Impacts of climate change and selected renewable energy infrastructures on EU biodiversity and the Natura 2000 network: Summary report (EC study, 2011) | • A summary report that provides an overview of the likely impact of climate change on biodiversity in the EU and includes indications as to how the design and implementation of current policy might need to be adapted in order to ensure that the EU respects its commitment to reducing biodiversity loss. |
| Nature's role in climate change (EC, 2009) | • A report on the potential role of nature and ecosystem services in mitigating and responding to climate change. |
| **EIA** | |
| Environmental impact assessment of projects, Rulings of the Court of Justice (EU, 2010) | • A collection of the most important rulings of the European Court of Justice related to key articles of the EIA Directive. |
| Report on the application and effectiveness of the EIA Directive (COM (2009) 378 final) | • A report that reviews the application and effectiveness of the EIA Directive in the EU.<br>• It gives an overview of the link between EIA and other legislation and includes a section on the link between EIA, biodiversity and climate change. |
| **EIA and biodiversity** | |
| Biodiversity, Ecology, and Ecosystem Services - Impact assessment considerations/approaches (IAIA, updated 2010) | • An IAIA Wiki webpage that provides a range of overarching principles, case studies, possible tools, links, etc. on biodiversity, ecology and ecosystem services in the context of impact assessment considerations/approaches. |
| Biodiversity in impact assessment (IAIA, 2005) | • A publication that reviews key strategic and operational issues linked to integrating biodiversity-related considerations into impact assessment practices. |
| Biodiversity in impact assessment: Voluntary guidelines on biodiversity-inclusive impact assessment (Secretariat of CBD, the Netherlands Commission on Environmental Assessment, 2006) | • Assessment guidelines that seek to incorporate the requirements of the CBD into PPs (via SEA) and projects (via EIA).<br>• They deal with high-level principles and provide relevant case studies. |
| Guidelines for ecological impact assessment in the United Kingdom (IEEM, 2006) | • Guidelines that include examples of how biodiversity could be included in assessment methodologies (although not directly applicable to EIA). |
| Position paper on environmental assessment in the European Union (Birdlife, 2010) | • No-net-loss of biodiversity (and net-gain wherever possible) is a principle that must be applied in the environmental assessment system that is used in the wider countryside.<br>• This paper considers how this can be achieved through EIA, SEA and impact assessment of the European Commission's own policies and other initiatives. It proposes reforms to |

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| | each of these forms of environmental assessment as a means of achieving the EU's biodiversity goals. |
| Promoting biodiversity-inclusive EIA: best practice guide for publishing primary biodiversity data (IAIA, GBIF, 2011) | • A report that promotes standards and data publishing tools that can be used to collect and publish primary biodiversity data on the internet. |
| Resolution X.17 - Environmental impact assessment and strategic environmental assessment: updated scientific and technical guidance (RAMSAR Convention, 2010) | • A technical guidance document based on the CBD guidelines described above. It contains RAMSAR-specific additions that seek to include wetlands. |
| TEEB for local and regional policy makers (TEEB, 2010) | • This report considers how EIA and SEA could include ecosystem services. |
| Working with nature, PIANC position paper (PIANC, revised 2011) | • This paper calls for an important shift in our approach, towards navigation development projects that help deliver mutually beneficial 'win-win' solutions.<br>• It focuses on achieving the project objectives in an ecosystem context rather than assessing the consequences of a predefined project design. It also identifies win-win solutions rather than simply minimising ecological harm. |
| **EIA and climate change** | |
| Climate change adaptation & EIA (IEMA, 2010) | • A guidance document that sets out overarching principles related to assessment, reporting and follow-up. |
| Guidelines on the Integration of Environment and Climate Change in Development Cooperation, Guidelines No. 4 (EuropeAid, 2009) | • Guidelines covering EIA and SEA, with specific reference to climate change, adaptation and risk management in international development funding and projects. |
| Incorporating climate change considerations in environmental assessment: General guidance for practitioners (The Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment, 2003) | • A document that sets out principles, and provides checklists and examples to help include climate change adaptation in EIA. |
| Incorporating climate change impacts and adaptation in environmental impact assessments: opportunities and challenges (OECD, 2010) | • A guidance document that assesses the current state of including adaptation in EIA, with examples of current approaches. |
| Symposium on impact assessment and climate change, Washington, 17-18.11.2010 (IAIA, 2010) | • A document with links to presentations on various aspects of climate change. |
| Symposium on climate change and impact assessment, Aalborg, 25-27 October 2010 (IAIA, 2010) | • A document with links to presentations on various aspects of climate change. |

## Annex 2: Sources of information on climate change and biodiversity

This annex outlines the different types and sources of information that are available and can be used to support the integration of climate change and biodiversity into EIA. Additional sources of information are listed in Annex I. This information will be particularly useful in the EIA screening, scoping and assessment stages, as well as for monitoring/follow-up.

### *Types of information*

Examples of the types of quantitative datasets relevant to climate change and biodiversity include:

- species distribution;
- trend data, e.g. loss of species/habitats;
- protected area status: e.g. Natura 2000 sites, national designations;
- GHG emission inventories, etc.;
- climate projections: IPCC, etc.;
- future climate and socio-economic scenarios.

These datasets may already exist, depending on the location and scale required.

### *Sources of information*

The strategic documents that provide the context in which a project must be considered will serve as the starting point for sources of information on climate change and biodiversity. These may include, for example, municipal/local authority spatial plans and policies/strategies on biodiversity protection (e.g. biodiversity action plans for species and habitats) and climate change mitigation and adaptation plans, strategies, risk assessment or risk management plans, or vulnerability assessment studies.

Other assessments may also be relevant, such as SEAs carried out for higher-level plans and programmes under the SEA Directive, or assessments carried out under the Habitats Directive.

For biodiversity, specialist sources include:

- environmental authorities with responsibility for nature conservation;
- environmental NGOs;
- stakeholders dependent on or influencing biodiversity-derived ecosystem services, e.g. foresters, fisheries, water companies/authorities.

For climate change, specialist sources include:

- species distribution;
- trend data, e.g. loss of species/habitats;
- protected area status: Natura 2000 sites, national designations, etc.;
- GHG emission inventories etc.;
- climate projections: IPCC , etc.;
- future climate and socio-economic scenarios.

### *Key European sources of data*

The table below summarises some of the key sources of data available at European level, including data repositories and datasets, online tools and key reports and documents. The table is organised by different topics and types of data, using the icons below.

**Key:**

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| Climate change | Biodiversity | Mitigation | Adaptation |
| Databases, data repositories and online tools | Organisations and research projects | Reports and other documents | |

**Table: Key European sources of data, including data repositories and online digital datasets**

| | Source | Description | Links (March 2013) |
|---|---|---|---|
| | **Climate change** | | |
| | **Climate Change Data Centre (EEA)** | Repository of a wide range of climate change relevant data and information. It includes all the latest climate change relevant developments within the EEA. It is a good meta-source of developments across European climate policy and reporting. | http://www.eea.europa.eu/themes/climate/dc |
| | **Climate Change Knowledge Portal, CCKP (the World Bank Group)** | The portal provides online access to comprehensive global, regional, and country data related to climate change and development. The portal provides development practitioners with a resource that helps them explore, evaluate, synthesise, and learn about climate-related vulnerabilities and risks, in various levels of detail. | http://sdwebx.worldbank.org/climateportal/index.cfm |
| | **Intergovernmental Panel on Climate Change (IPPC)** | The IPCC is the leading international body for the assessment of climate change. Its website includes the fourth assessment report on climate change (2007) and other global climate change science findings, split by working groups and sectors. | http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml |
| | **Climate change — mitigation** | | |
| | **European Topic Centre for Air Pollution and Climate Change Mitigation, ETC/ACM (EEA)** | The ETC/ACM assists the EEA in supporting EU policy in the fields of air pollution and climate change mitigation. The ETC/ACM provides reports and databases relevant to climate change mitigation. | http://acm.eionet.europa.eu/ |
| | **Greenhouse Gas Emission Viewer (EEA)** | The EEA GHG viewer provides easy access and analysis of the data contained in the Annual EU GHG inventories. The EEA GHG data viewer shows emission trends for the main sectors and allows for comparisons of emissions between different countries and activities. | http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer |
| | **Climate change — adaptation** | | |
| | **CLIMATE-ADAPT: European Climate Adaptation Platform (EEA)** | CLIMATE-ADAPT is an interactive, publicly accessible web-based tool on adaptation to climate change. It is designed to support policy-makers at EU, national, regional and local levels in the development of climate change adaptation measures and policies. | http://climate-adapt.eea.europa.eu/ |
| | **CLIMSAVE** | CLIMSAVE is a research project that is developing a user-friendly, interactive web-based tool that will allow stakeholders to assess climate change impacts and vulnerabilities for a range of sectors, including agriculture, forestry, biodiversity, coasts, water resources and urban development. Linking models relating to different sectors will enable stakeholders to see how interactions could affect the European landscape. | http://www.climsave.eu/climsave/index.html |

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| | **EmDAT** | International disaster database that provides information helpful for natural disaster preparation and decision-making. It can be useful for scoping vulnerability to climate change. | http://www.emdat.be/ |
| | **ERA-NET ROAD — Coordination and Implementation of Road Research in Europe** | ERA-NET ROAD was a Coordination Action funded by the EU Sixth Framework Programme for European Research and Technological Development. Eleven National Road Administrations participated. A call entitled Road owners getting to grips with climate change was launched as part of this Coordinated Action. Four projects relevant to climate change adaptation were funded within the call: IRWIN — Improved local winter index to assess maintenance needs and adaptation costs in climate change scenarios; P2R2C2 — Pavement Performance and Remediation Requirements following Climate Change; RIMAROCC — Risk Management for Roads in a Changing Climate; SWAMP — Storm Water prevention — Methods to predict damage from water stream in and near road pavements in lowland areas. The project is being continued as ERA-NET Road II within an enlarged consortium and with funding from the EU Seventh Framework Programme for Research and Technological Development. | http://www.eranetroad.org/ |
| | **European Severe Weather Database** | Database of severe weather events across Europe. It can be useful for indicating general vulnerability of projects. | http://www.essl.org/ESWD/ |
| | **NatCatSERVICE** | Insurance-based database analysing approximately 1 000 events per year. The information collated can be used to document and perform risk and trend analyses on the extent and intensity of individual natural hazard events in various parts of the world. | http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx |
| | **National Adaptation Strategies (EEA)** | Up-to-date database of EU Member State progress on the EU's Adaptation White Paper. It is a good source of country-specific actions. | http://www.eea.europa.eu/themes/climate/national-adaptation-strategies |
| | **National Climate Research The Netherlands** | The joint website of the Dutch Climate Changes Spatial Planning Programme and the Knowledge for Climate Research Programme. The Climate Changes Spatial Planning Programme enhances joint-learning between communities and people in practice within spatial planning, on several themes: climate scenarios, mitigation, adaptation, integration and communication. The Knowledge for Climate Research Programme develops knowledge and services and focuses on eight hotspots, enabling the climate proofing of the Netherlands. | http://www.climateresearchnetherlands.nl/ |
| | **Urban adaptation to climate change in Europe and Interactive maps from the Report on Eye on Earth (EEA)** | This Report provides information on challenges and opportunities specific to cities and related national and European policies. It is accompanied by a range of interactive maps from the Eye on Earth report, including on the heat wave risk to European cities; coastal flooding; and the share of green and blue areas. | http://www.eea.europa.eu/publications/urban-adaptation-to-climate-change<br>http://eea.maps.arcgis.com/apps/PublicGallery/index.html?appid=1573f2f083824a34a5640bd04e098248&group=b9052eb339264f64b1eb75f6244eccdf |
| | **Biodiversity** | | |
| | **ALARM** | ALARM (**A**ssessing **LA**rge Scale **R**isks for Biodiversity with Tested **M**ethods) is a research project that developed and tested methods and protocols for the assessment of large-scale environmental risks, in order to minimise negative direct and indirect human impacts. | http://www.alarmproject.net/alarm/ |
| | **Biodiversity Data Centre (EEA)** | Repository of a wide range of biodiversity-relevant data and information. It includes all the latest biodiversity-relevant developments within the EEA and is a good meta-source of | http://www.eea.europa.eu/themes/biodiversity/dc |

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| | | developments across European biodiversity policy and reporting. | |
| | **Birdlife Datazone** | Updated site that provides species- and habitat-specific information for sites across the EU (and beyond). | http://www.birdlife.org/datazone/ |
| | **Biodiversity Information System for Europe, BISE (EEA)** | Database of all relevant European biodiversity data sources. It is a good source of indicators and maps collated from across European institutions. | http://biodiversity.europa.eu/data |
| | **European Topic Centre on Biological Diversity, ETC/BC (EEA)** | The ETC/BD is an international consortium working with the EEA under a framework partnership agreement. It presents expert knowledge and reporting in a series of reports and databases. | http://bd.eionet.europa.eu/ |
| | **Global Biodiversity Information Service** | Publicly accessible biodiversity data, including species occurrence and taxonomic information. It is a very detailed species-specific data source and a good indicator of potential species presence across Europe for use in scoping. It is likely to require site investigation to confirm occurrences. | http://data.gbif.org/welcome.htm |
| | **Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)** | The IPBES goal is to be an interface between the scientific community and policy makers and to build capacity for and strengthen the use of science in policy making. IPBES set up a mechanism to address the gaps in the science policy interface on biodiversity and ecosystem services. | http://www.ipbes.net/ |
| | **MACIS** | MACIS (**M**inimisation of and **A**daptation to **Cl**imate Change **I**mpacts on BiodiverSity) is a research project that summarises what is already known about the impacts of climate change on biodiversity and developed methods to assess potential impacts in the future. | http://macis-project.net/index.html |
| | **Natura2000 Viewer (EEA)** | Information on the Natura2000 network across EU Member States. | http://natura2000.eea.europa.eu/# |
| | **RESPONSES** | The objective of the RESPONSES research project is to identify and assess integrated EU climate-change policy responses that achieve ambitious mitigation and environmental targets and, at the same time, reduce the EU's vulnerability to inevitable climate change impacts. | http://www.responsesproject.eu/ |
| **General** | | | |
| | **Data and Maps (European Environment Agency)** | Access to the EEA's maps, indicators, databases and graphs. | http://www.eea.europa.eu/data-and-maps |
| | **EUROSTAT** | Database with a huge range of environmental, economic and social data. | http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home |
| | **EUROSTAT Country profiles** | Country-specific data on a range of issues including climate change emissions and sectoral activity. | http://epp.eurostat.ec.europa.eu/guip/introAction.do |
| | **EUROSTAT Sustainable development indicators** | The Sustainable Development Indicators are used to monitor the EU Sustainable Development Strategy in a report published by Eurostat every two years. They are organised into ten themes, including climate change and natural resources, and include Member State-level information. | http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators |
| | **Group on Earth Observatories (GEO)** | Database of global data components on a range of environmental aspects, including climate change and biodiversity. | http://geossregistries.info/holdings.htm |
| | **Indicators (EEA)** | Indicators and factsheets about Europe's environment. | http://www.eea.europa.eu/data-and-maps/indicators#c7=all&c5=&c0=10&b_start=0 |

## Annex 3: Tools for integrating climate change and biodiversity in EIA

This annex provides an overview of some of the tools and approaches that are available to support the assessment of climate change and biodiversity within EIA. This is not an exhaustive list and many other tools may also be relevant.[31] Some of the tools and approaches listed are used to support the assessment of specific aspects of climate change and biodiversity (e.g. GHG emission calculators and ecological surveys), whilst others can be more generally applicable. Some apply to specific stages of EIA and others to the whole EIA process.

The tools and approaches that will be relevant and useful for your EIA will depend on the specific circumstances of the project (e.g. the type of project, its location, the characteristics of the receiving environment, etc.) and therefore its potential effects. These circumstances will define the type, level of detail and nature of analysis that is appropriate to a particular EIA and therefore which tools may be relevant. The decision about whether to use any of these tools for the EIA should be taken early in the process, most likely at the scoping stage.

| Name | Description | Application Comments | Source of further information |
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| **Biodiversity offsetting** | Biodiversity offsetting is an approach that seeks to compensate for unavoidable loss of habitats and species due to development. Though not formalised in every Member State, there are specific provisions for offsetting within the Environmental Liability Directive and Habitats Directive — Article 6.4. | The practice is developing across Europe. Recent examples include the 2011 Biodiversity Strategy, which makes reference to the Commission acting in line with previous studies. It is likely that, within the context of European policy, Member States will develop this area as they see fit. | Business-led offsetting programme: http://bbop.forest-trends.org/index.php<br>BirdLife International position on offsetting: http://www.birdlife.org/eu/pdfs/2010_BHDTF_position_Biodiversity_offsets.pdf<br>European Commission feasibility study: http://ec.europa.eu/environment/enveco/pdf/eftec_habitat_technical_report.pdf<br>A source of news, data, and analytics on markets and payments for ecosystem services: http://www.ecosystemmarketplace.com/ |
| **Biodiversity screening map** | Screening maps are a form of spatial analysis that requires the identification of the habitats sited around a particular project. Based on these, habitats are assessed on their relative worth, considering wider trends and likely impacts of the project. Information on potentially significant effects needing consideration should be part of the screening decision. | Screening maps are useful during the screening and scoping stages, for identifying potential areas of higher-value biodiversity that may be used as alternatives. | Some of the information sources presented in Annex 2 could be useful, but expert judgment and the experience of other stakeholders are more relevant here. |

[31] The IAIA wiki is a useful resource for more general tools and concepts for the practice of EIA: http://www.iaia.org/iaiawiki/ .

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| **(Pilot) Carbon footprint exercise (EIB)** | The European Investment Bank (EIB) developed a sector-specific methodology to assess the carbon footprint of projects it finances. Most EIB projects emit GHGs into the atmosphere, either directly (e.g. fuel combustion or production-process emissions) or indirectly through purchased electricity and/or heat. In addition, many projects result in emission reductions or increases when compared to what would have happened if the project didn't exist, referred to as the baseline.<br>The objective of the draft methodology is twofold:<br>• to assess the absolute GHG emissions of the projects financed by the EIB; and<br>• to assess any emission variations compared to a baseline, referred to as the relative emission. | A comprehensive practical guide for EIB staff working on the pilot footprint calculations. | EIB |
| **Confidence levels** | Confidence levels are an effective approach to communicating uncertainty and may be useful when considering potential climate change impacts. | Increasingly, climate change impacts are being shown in probabilistic scenarios that can be presented in terms of confidence levels. | Confidence levels vary between different climate scenarios — e.g. the IPPC provides information as to specific confidence levels within different assessments. |
| **Disaster risk management** | The systematic process of using administrative directives, organisations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster. | This term is an extension of the more general term 'risk management' and addresses the specific issue of disaster risks. Disaster risk management aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures that focus on prevention, mitigation and preparedness | |
| **Ecological surveys** | Undertaken by expert ecologists, site surveys can identify and describe the ecosystems, habitats and species present on site. This enables the identification of protected species or habitats and informs project designers of the need to reduce avoidable damage to higher-value areas of biodiversity and to look for areas of potential enhancement. | The scale and type of expertise required will vary hugely between projects and should be defined based on local circumstances. An early ecological survey can save time and effort at later stages of the project by allowing the early identification of certain species and habitats that require particular protection or mitigation measures. There is also the need to consider Member States' legal requirements based on the Birds Directive and Habitats Directive. | There is a wide range of consultants available to undertake ecological surveys. |

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| **Ecosystem-based approaches** | Managing, restoring and protecting biodiversity and ecosystem services provide multiple benefits to human society. These ecosystem-based approaches contribute to protecting and restoring natural ecosystems by conserving or enhancing carbon stocks, reducing emissions caused by ecosystem degradation and loss, and providing cost-effective protection against some of the threats that result from climate change. | Ecosystem-based approaches can be used as cost-effective alternatives to infrastructure projects or their elements. | Relevant information from the DG Environment website, including the following reports:<br>• Towards a Strategy on Climate Change, Ecosystem Services and Biodiversity<br>http://ec.europa.eu/environment/nature/pdf/discussion_paper_climate_change.pdf<br>• Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe<br>http://ec.europa.eu/environment/nature/climatechange/pdf/EbA_EBM_CC_FinalReport.pdf<br>Relevant information from the CBD website:<br>http://www.cbd.int/climate/ |
| **Ecosystem services approach** | Ecosystem services potentially offer a new tool to use in EIA, using the concepts developed by the Millennium Ecosystem Assessment. | Ecosystem services could be used in particular when considering alternatives and mitigation measures in EIA. | Millennium Ecosystem Assessment (MEA) (2005) Ecosystems and Human Well-Being: Synthesis. Island Press, Washington. http://www.maweb.org/en/index.aspx<br>World Resources Institute (2008) Ecosystem Services: A Guide for Decision Makers http://www.wri.org/publication/ecosystem-services-a-guide-for-decision-makers<br>Sheate W, Eales R, Daly E, Murdoch A, and Hill C (2008), Case study on developing tools and methodologies to deliver an ecosystem-based approach: Thames Gateway Green Grids, Project report NR0109, London, Defra, 2008, available at<br>http://randd.defra.gov.uk/Document.aspx?Document=NR0109_7429_FRP.pdf |

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| **Ecosystem services valuation** | The economic valuation of ecosystem services has significantly developed as a potential tool within impact assessment. Recent analysis within the TEEB and various Member States indicates that this approach has the potential to make the economic value of biodiversity clear. In theory, this would allow a more informed understanding of the societal impact of a project.<br>Valuation is a useful tool but the most efficient use of the concept of ecosystem services within impact assessment may be demonstrating that the environment is important to us rather than quantifying the cost equivalence of this importance. | The time and resource requirements for ecosystem valuation are significant and may undermine its potential to support impact assessment practice where resources are limited. It is possible to relate existing valuation studies to a different project but this is difficult and the results are generally for illustrative purposes only, due to the contextual nature of the environment of different projects. However certain ecosystem services (i.e. provisioning services) can be relatively simply valued and may add value to certain assessments. | Chapter 6 of TEEB for Local and Regional Policy makers considers economic valuation as part of EIA (and SEA) practice:<br>http://www.teebweb.org/local-and-regional-policy-makers-report/<br>Guide to valuing ecosystem services (UK):<br>http://www.defra.gov.uk/environment/natural/ecosystems-services/valuing-ecosystem-services/ |
| **GHG conversion factors** | Managed by the UK Department for Food, Environment and Rural Affairs (Defra), this resource provides a useful excel-based tool for considering the total GHG emissions of a range of materials and activities.<br>Activities include fuel, electricity, processes, transport and refrigeration. | The tool was developed for the UK but is useful elsewhere because of its wide range of parameters that can be populated with whatever data are available.<br>It is useful for scoping and when considering alternatives. | Sheet available from here: http://archive.defra.gov.uk/environment/business/reporting/pdf/110807-guidelines-ghg-conversion-factors.xls |
| **GHG emission calculators** | Emission calculators quantify the total GHG (or often carbon alone) emissions from an activity or project as a whole. Emissions can be calculated for operation or the construction of a project. Various calculators exist and are generally based on GHG equivalents for certain indicators, such as energy consumption. | Depending on the scale of your project, it may be appropriate to hire consultants; online tools can be used for smaller projects. Note that some of these focus on transport emissions and may not always be relevant for all projects. | A number of consultancies operate or provide GHG emissions calculators that can be used for individual projects. Examples include:<br>http://www.carbonindependent.org/<br>http://www.oneplanetliving.net/?s=carbon+calculator<br>The World Resource Institute and World Business Council for Sustainable Development have developed and maintain the http://www.ghgprotocol.org/ website, which includes a wide range of sectoral GHG calculators and related tools/case studies. |
| **GIS and spatial analysis** | Geographic Information Systems (GIS) and their use as a form of spatial analysis have proven to be valueable in communicating and identifying environmental impacts of projects. There is a huge spectrum of possible GIS methods and uses and these can be tailored depending on individual project scales and resources. | The nature of the GIS required will vary depending on the scale of the project and its intended purpose. GIS is a broad technique and can be used to undertake analysis of various morphological or technical factors or only to support consultation exercises. | GIS is largely dependent on available data; potentially useful sources of pan-European information and data are presented in Annex 2. |

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| **GRaBS Adaptation Action Planning Tool** | GRaBS (Green and blue space adaptation for urban areas and eco towns) is an online toolkit (developed within the INTERREG IV C programme) that presents spatially various aspects of climate change risk and vulnerability. It has relatively low data resolution but may be useful to understand broader regional vulnerabilities. | It is a useful tool for the scoping stage and for identifying regional trends for certain climate hazards. However, its current scope covers only a limited number of locations (GRaBS partners). | http://www.ppgis.manchester.ac.uk/grabs/start.html |
| **Green infrastructure** | 'Green infrastructure' refers to ecosystem-based approaches in a spatial context.<br>It can be defined as a strategically planned and delivered network of high- quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of benefits and services. Green Infrastructure includes natural and semi-natural areas, features and green spaces in rural and urban, terrestrial, freshwater, coastal and marine areas. Areas protected as Natura 2000 sites are at the core of green Infrastructure.<br><br>The underlying principle of Green Infrastructure is that the same area of land can frequently offer multiple benefits. By enhancing Green Infrastructure, valuable landscape features can be maintained or created, which is valuable not only for biodiversity, climate change mitigation and adaptation, but also contributes to ecosystem services such as clean water, productive soil and attractive recreational areas. In addition, Green Infrastructure can sometimes be a cost-effective alternative or be complementary to grey infrastructure and intensive land use change. | It is useful when considering alternatives and mitigation measures. | http://ec.europa.eu/environment/nature/ecosystems/index_en.htm |
| **Integrated Biodiversity Assessment Tool (IBAT) for Business** | The tool offers up-to-date biodiversity information to support impact assessment. | For business use, subscription required. | https://www.ibatforbusiness.org/login |

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| **Integrated Biodiversity Assessment Tool (IBAT) for Research and Conservation Planning** | IBAT for Research and Conservation Planning is an innovative tool designed to facilitate access to a range of global and national data layers, such as protected area boundaries, biological information about habitat and species diversity indices, and key areas for biodiversity, which can be useful for research and conservation planning purposes. | To be used by the academic and conservation research communities. | https://www.ibat-alliance.org/ibat-conservation/ |
| **Life Cycle Assessment (LCA)** | LCA is a technique that seeks to consider all the environmental impacts of particular actions over their lifetimes. This is particularly relevant to climate change as GHG emissions are often released during the construction stage.<br>LCA can include a full assessment of all impacts in detail or be a less quantitative and detailed consideration of the materials in use and their probable environmental impacts. For example, responsibly-sourced wood has a lower carbon footprint than steel and a generally lower impact on biodiversity than un-certified wood. LCAs can be undertaken by consultants or in-house. | Undertaking full LCA can be a very costly and timely process, but certain elements of a project may already be subject to LCA so the information can be used by EIA where available.<br>It may also be possible to undertake a qualitative assessment of possible LCA impacts based on readily available information such as material types.<br>LCA is particularly useful during the impact assessment stage of the EIA and can inform the consideration of alternatives buy identify the most significant elements of a project in terms of biodiversity and climate change. | Online repository of LCA tools:<br>http://www.dantes.info/Tools&Methods/Software/enviro_soft_SW.html<br>Introduction on LCA and the LCA Resource Centre are available through the European Commission's Joint Research Centre:<br>http://lca.jrc.ec.europa.eu/lcainfohub/introduction.vm |
| **Network analysis** | Network analysis is an effective way to consider complex systems by linking causes and impacts via a chain of causation. The concept is based on the idea that there are links and impact pathways between elements of a project and environmental outcomes, and that these can be identified. This enables the identification of actions that may achieve desired objectives, such as reduced impact or enhancement. | This approach can be used to ascertain the probable impacts and benefits on climate change and biodiversity of various elements of a project by identifying their outcomes via the development of a chain of causation. It is best undertaken during the scoping stage, but may be extended into the later stages of assessment. | Network analysis is generally dependent on the use of expert knowledge and judgment and the accurate identification and linking of drivers and impacts. |

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|---|---|---|---|
| **Risk management** | When considering climate change, it is particularly useful to frame potential impacts in terms of their probability and magnitude. These two components make up risk.<br><br>Such framing can be achieved for example by considering the probability of impact (how likely is it that rising sea levels will affect a project) in relation to the magnitude of the impact (what would be the likely impact of rising sea levels on a project). Understanding these two elements is essential to reducing vulnerability and increasing resilience. | Thinking in terms of probability and magnitude within an EIA can inform stakeholders about a project's vulnerability and the need for adaptation measures — what alternatives are available and what monitoring is required. | Vulnerability and climate change (Vancouver sewerage area infrastructure): http://www.metrovancouver.org/planning/ClimateChange/ClimateChangeDocs/Vulnerability_climate_change.pdf<br><br>IAIA's risk management advice: http://www.iaia.org/iaiawiki/ra.ashx |
| **Robust Decision Making (RDM)** | RDM is a decision-making concept that seeks to consider the vulnerability and adaptability of a project rather that solely predicting the impact of that project. An example of RDM could be looking at a road system and considering what climate circumstances would cause the road to cease to operate (for instance floods, temperature changes, etc.). Having identified the vulnerability, the project supported by EIA can then consider potential alternatives that may reduce this vulnerability. This will include an assessment of other elements such as cost and the potential impacts on other EIA issues, including biodiversity. | RDM is particularly useful when considering the impacts of climate change on a project and should be integrated into the alternative stage of project design and EIA.<br><br>RDM approaches are commonly used within project design but EIA offers the potential to make this link to climate change more explicit and effective. | RDM and climate change:<br><br>http://www.rdcep.org/<br><br>Related publications: http://www.rand.org/international_programs/pardee/pubs/futures_method/exploratory.html |
| **Scenarios** | Scenarios relate to climate change (e.g. IPCC scenarios) and socio-economic/alternative futures scenarios and assess the resilience of projects and the environment in the long term. The use of scenarios is a response to uncertainty. | Scenarios are effective for considering the evolution of the baseline — both in terms of the potential impacts of the climate on a project and the changes to wider socio-economic context that the project operates in. Scenarios can also support assessing alternatives. | Potential European resources include the information on the EEA's website:<br><br>http://www.eea.europa.eu/themes/scenarios/scenarios-and-forward-studies-eea-activities<br><br>http://www.eea.europa.eu/themes/scenarios/intro<br><br>http://scenarios.ew.eea.europa.eu/ |

| | | | |
|---|---|---|---|
| **Spheres of influence and ecosystem chains** | Spheres of influence are based on using spatial tools to assess the potential effects of a project beyond the specific project boundaries. These concepts use tools such as network analysis but apply them spatially. This entails looking at the indirect impact on downstream or related ecosystems, for instance at how changing water abstraction will impact downstream systems; how increased dust will affect the turbidity of downstream environments; how removing one habitat type will affect neighbouring habitats. | This concept is particularly useful for the screening and scoping stages and for identifying indirect and secondary effects. It requires an understanding of possible impacts and causal chains. Network analysis is a related tool.<br>It may also be useful when considering alternatives and their impacts. | Some information sources presented in Annex 2 may be helpful, but expert judgment and the experience of other stakeholders are more relevant. |
| **Technical data** | Technical data and parameters provided by equipment manufacturers may include information on emissions per production unit; energy use/demand, etc. | Data from process and equipment suppliers could be used to assess the magnitude and significance of a project's overall GHG emissions and how GHG emissions can be mitigated. | Many potential sources of such data and comparative data exist for different types of common equipment, see for example:<br>http://www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/pages/office-equipment.aspx |
| **Vulnerability assessment** | A vulnerability assessment is the process of identifying, quantifying, and prioritising (or ranking) the vulnerabilities in a system. Vulnerability assessment has many things in common with risk assessment. Assessments are typically performed according to the following steps:<br>• cataloguing assets and capabilities (resources) in a system<br>• assigning quantifiable value (or at least rank order) and importance to those resources<br>• identifying the vulnerabilities or potential threats to each resource<br>• mitigating or eliminating the most serious vulnerabilities for the most valuable resources. | Vulnerability assessment is helpful when taking a resilience approach to climate change. It needs to be built into any effective assessment of the evolution of the baseline environment and of alternatives to investigate how the environment will change if the plan or programme is not implemented, and in relation to different alternatives. It can therefore be used to evaluate alternatives and to help identify and select the most resilient one(s). | Climate change Clearing House. Technical Briefings on Climate Vulnerability Assessment:<br>http://www.theclimatechangeclearinghouse.org/Resources/TechBrief/default.aspx<br><br>Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment (National Wildlife Federation, Washington, D.C., 2011):<br>www.nwf.org/vulnerabilityguide |

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**Appendix CL2.8**

**European Commission Guidance for the Calculation of Land Carbon Stocks provides a methodology for calculating carbon stocks from land use**

# COMMISSION DECISION

## of 10 June 2010

## on guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC

*(notified under document C(2010) 3751)*

(2010/335/EU)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC [1], and in particular Annex V, part C, point 10 thereof,

Whereas:

(1) Directive 2009/28/EC lays down rules for calculating the greenhouse gas impact of biofuels, bioliquids and their fossil fuel comparators, which take into account emissions from carbon stock changes caused by land use change. Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC [2] includes corresponding rules as far as biofuels are concerned.

(2) The Commission should draw its guidelines for the calculation of land carbon stocks on the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. Those Guidelines were intended for national greenhouse gas inventories and are not expressed in a form that is readily applicable by economic operators. It is therefore appropriate, where IPCC Guidelines for National Greenhouse Gas Inventories lack the necessary information for purposes of biofuel and bioliquid production or where such information is not accessible, to draw on other scientific sources of data.

(3) For the calculation of the carbon stocks in soil organic matter it is appropriate to take into account climate, soil type, land cover, land management and input. For mineral soils, the IPCC Tier 1 methodology for soil organic carbon is an appropriate method to use for this purpose as it covers the global level. For organic soils, the IPCC methodology addresses in particular carbon loss following soil drainage and does this only through annual losses. As soil drainage normally results in high carbon stock loss that cannot be compensated by the greenhouse gas saving of biofuels or bioliquids and as drainage of peatland soil is prohibited by the sustainability criteria laid down by Directive 2009/28/EC, it suffices to lay down general rules for determining soil organic carbon or carbon losses in organic soils.

(4) For the calculation of carbon stock in living biomass and dead organic matter a low complexity approach corresponding to IPCC Tier 1 methodology for vegetation should be an appropriate method. In accordance with that methodology it is reasonable to assume that all carbon stock in living biomass and dead organic matter is lost from the land upon conversion. Dead organic matter is usually of low significance in land conversion for the establishment of crops for the production of biofuels and bioliquids, but should be taken into account at least for closed forests.

(5) In calculating the greenhouse gas impact of land conversion, economic operators should be able to use actual values for the carbon stocks associated with the reference land use and the land use after conversion. They should also be able to use standard values and it is appropriate for these guidelines to provide them. It is not necessary, however, to provide standard values for improbable combinations of climate and soil type.

(6) Annex V to Directive 2009/28/EC sets out the method for calculating greenhouse gas impacts and contains rules for the calculation of annualised emissions of carbon stock changes from land use changes. The guidelines annexed to this Decision establish rules for the calculation of land carbon stocks, completing the rules laid down in the Annex V,

[1] OJ L 140, 5.6.2009, p. 16.
[2] OJ L 350, 28.12.1998, p. 58.

where:

$C_{DOM}$ = above and below ground carbon stock in dead organic matter (measured as mass of carbon per hectare);

$C_{DW}$ = carbon stock in dead wood pool (measured as mass of carbon per hectare), calculated in accordance with point 5.2.1;

$C_{LI}$ = carbon stock in litter (measured as mass of carbon per hectare), calculated in accordance with point 5.2.2.

5.2.1. *Carbon stock in dead wood pool*

For the calculation of $C_{DW}$ the following rule shall apply:

$C_{DW} = DOM_{DW} \times CF_{DW}$

where:

$C_{DW}$ = carbon stock in dead wood pool (measured as mass of carbon per hectare);

$DOM_{DW}$ = weight of dead wood pool (measured as mass of dry matter per hectare);

$CF_{DW}$ = carbon fraction of dry matter in dead wood pool (measured as mass of carbon per mass of dry matter).

For $CF_{DW}$ the value of 0,5 may be used.

5.2.2. *Carbon stock in litter*

For the calculation of $C_{LI}$ the following rule shall apply:

$C_{LI} = DOM_{LI} \times CF_{LI}$

where:

$C_{LI}$ = carbon stock in litter (measured as mass of carbon per hectare);

$DOM_{LI}$ = weight of litter (measured as mass of dry matter per hectare);

$CF_{LI}$ = carbon fraction of dry matter in litter (measured as mass of carbon per mass of dry matter).

For $CF_{LI}$ the value of 0,4 may be used.

6. STANDARD SOIL CARBON STOCK IN MINERAL SOILS

A value for $SOC_{ST}$ shall be selected from table 1, based on the appropriate climate region and soil type of the area concerned as set out in points 6.1 and 6.2.

*Table 1*

**$SOC_{ST}$, standard soil organic carbon in the 0-30 centimetre topsoil layer**

*(tonnes of carbon per hectare)*

| Climate Region | Soil type | | | | | |
|---|---|---|---|---|---|---|
| | High activity clay soils | Low activity clay soils | Sandy soils | Spodic soils | Volcanic soils | Wetland soils |
| Boreal | 68 | — | 10 | 117 | 20 | 146 |
| Cold temperate, dry | 50 | 33 | 34 | — | 20 | 87 |
| Cold temperate, moist | 95 | 85 | 71 | 115 | 130 | 87 |
| Warm temperate, dry | 38 | 24 | 19 | — | 70 | 88 |
| Warm temperate, moist | 88 | 63 | 34 | — | 80 | 88 |
| Tropical, dry | 38 | 35 | 31 | — | 50 | 86 |
| Tropical, moist | 65 | 47 | 39 | — | 70 | 86 |
| Tropical, wet | 44 | 60 | 66 | — | 130 | 86 |
| Tropical, montane | 88 | 63 | 34 | — | 80 | 86 |

6.1. **Climate region**

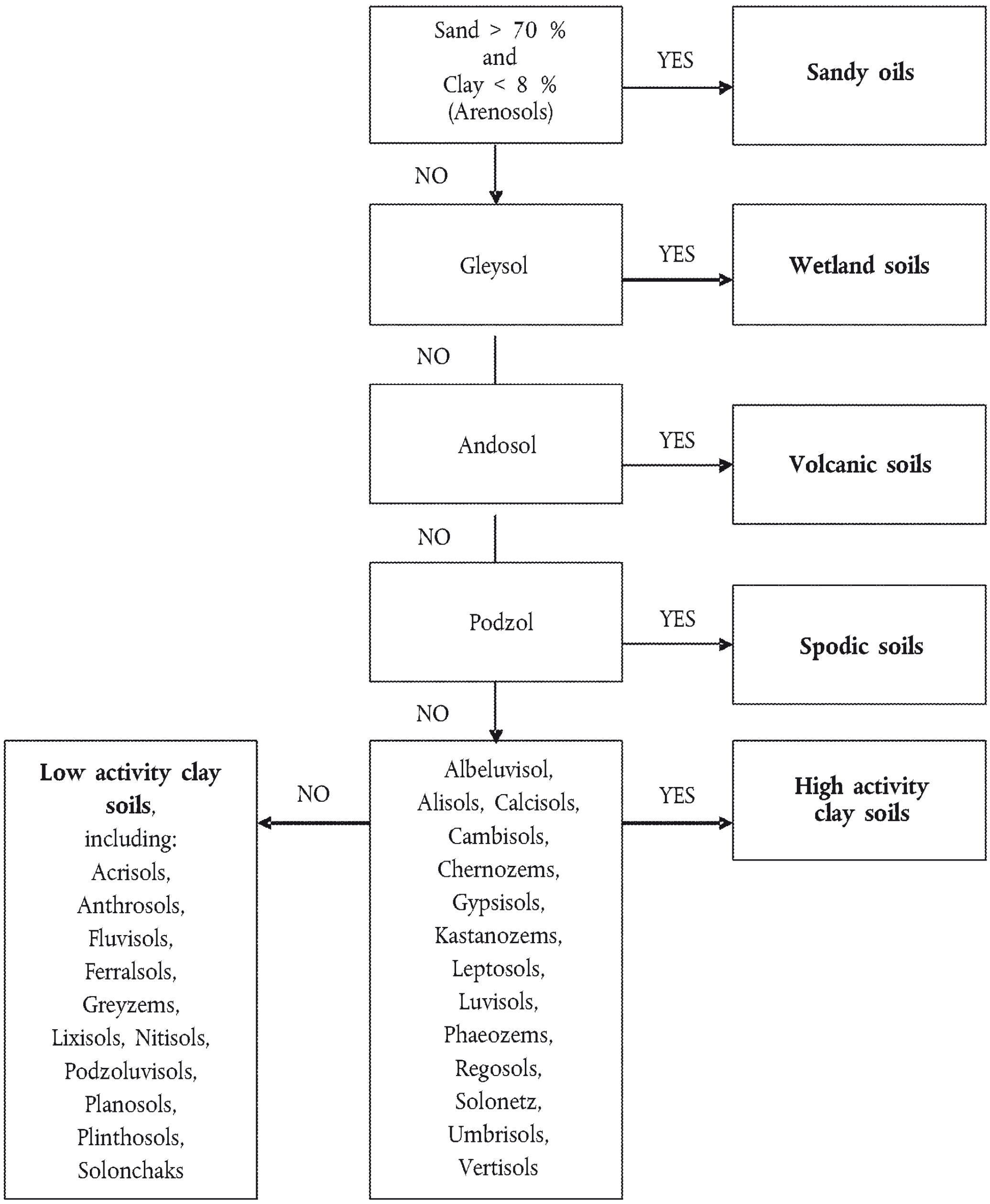
The appropriate climate region for the selection of the appropriate value for $SOC_{ST}$ shall be determined from the climate region data layers available through the Transparency platform established by Article 24 of Directive 2009/28/EC.

6.2. **Soil type**

The appropriate soil type shall be determined according to figure 3. The soil type data layers available through the Transparency platform established by Article 24 of Directive 2009/28/EC may be used as guidance to determine the appropriate soil type.

*Figure 3*

**Classification of soil types**




7. FACTORS REFLECTING THE DIFFERENCE IN SOIL ORGANIC CARBON COMPARED TO THE STANDARD SOIL ORGANIC CARBON

Appropriate values for $F_{LU}$, $F_{MG}$ and $F_I$ shall be selected from tables in this point. For the calculation of $CS_R$ the appropriate management and input factors are those that were applied in January 2008. For the calculation of $CS_A$ the appropriate management and input factors are those that are being applied and will lead to the equilibrium carbon stock concerned.

7.1. **Cropland**

*Table 2*

**Factors for cropland**

| Climate region | Land use ($F_{LU}$) | Management ($F_{MG}$) | Input ($F_I$) | $F_{LU}$ | $F_{MG}$ | $F_I$ |
|---|---|---|---|---|---|---|
| Temperate/Boreal, dry | Cultivated | Full-tillage | Low | 0,8 | 1 | 0,95 |
| | | | Medium | 0,8 | 1 | 1 |
| | | | High with manure | 0,8 | 1 | 1,37 |
| | | | High without manure | 0,8 | 1 | 1,04 |
| | | Reduced tillage | Low | 0,8 | 1,02 | 0,95 |
| | | | Medium | 0,8 | 1,02 | 1 |
| | | | High with manure | 0,8 | 1,02 | 1,37 |
| | | | High without manure | 0,8 | 1,02 | 1,04 |
| | | No till | Low | 0,8 | 1,1 | 0,95 |
| | | | Medium | 0,8 | 1,1 | 1 |
| | | | High with manure | 0,8 | 1,1 | 1,37 |
| | | | High without manure | 0,8 | 1,1 | 1,04 |
| Temperate/Boreal, moist/wet | Cultivated | Full-tillage | Low | 0,69 | 1 | 0,92 |
| | | | Medium | 0,69 | 1 | 1 |
| | | | High with manure | 0,69 | 1 | 1,44 |
| | | | High without manure | 0,69 | 1 | 1,11 |
| | | Reduced tillage | Low | 0,69 | 1,08 | 0,92 |
| | | | Medium | 0,69 | 1,08 | 1 |
| | | | High with manure | 0,69 | 1,08 | 1,44 |
| | | | High without manure | 0,69 | 1,08 | 1,11 |
| | | No till | Low | 0,69 | 1,15 | 0,92 |
| | | | Medium | 0,69 | 1,15 | 1 |
| | | | High with manure | 0,69 | 1,15 | 1,44 |
| | | | High without manure | 0,69 | 1,15 | 1,11 |
| Tropical, dry | Cultivated | Full-tillage | Low | 0,58 | 1 | 0,95 |
| | | | Medium | 0,58 | 1 | 1 |
| | | | High with manure | 0,58 | 1 | 1,37 |
| | | | High without manure | 0,58 | 1 | 1,04 |

| Climate region | Land use ($F_{LU}$) | Management ($F_{MG}$) | Input ($F_I$) | $F_{LU}$ | $F_{MG}$ | $F_I$ |
|---|---|---|---|---|---|---|
| | | Reduced tillage | Low | 0,58 | 1,09 | 0,95 |
| | | | Medium | 0,58 | 1,09 | 1 |
| | | | High with manure | 0,58 | 1,09 | 1,37 |
| | | | High without manure | 0,58 | 1,09 | 1,04 |
| | | No till | Low | 0,58 | 1,17 | 0,95 |
| | | | Medium | 0,58 | 1,17 | 1 |
| | | | High with manure | 0,58 | 1,17 | 1,37 |
| | | | High without manure | 0,58 | 1,17 | 1,04 |
| Tropical, moist/wet | Cultivated | Full-tillage | Low | 0,48 | 1 | 0,92 |
| | | | Medium | 0,48 | 1 | 1 |
| | | | High with manure | 0,48 | 1 | 1,44 |
| | | | High without manure | 0,48 | 1 | 1,11 |
| | | Reduced tillage | Low | 0,48 | 1,15 | 0,92 |
| | | | Medium | 0,48 | 1,15 | 1 |
| | | | High with manure | 0,48 | 1,15 | 1,44 |
| | | | High without manure | 0,48 | 1,15 | 1,11 |
| | | No till | Low | 0,48 | 1,22 | 0,92 |
| | | | Medium | 0,48 | 1,22 | 1 |
| | | | High with manure | 0,48 | 1,22 | 1,44 |
| | | | High without manure | 0,48 | 1,22 | 1,11 |
| Tropical Montane | Cultivated | Full-tillage | Low | 0,64 | 1 | 0,94 |
| | | | Medium | 0,64 | 1 | 1 |
| | | | High with manure | 0,64 | 1 | 1,41 |
| | | | High without manure | 0,64 | 1 | 1,08 |
| | | Reduced tillage | Low | 0,64 | 1,09 | 0,94 |
| | | | Medium | 0,64 | 1,09 | 1 |
| | | | High with manure | 0,64 | 1,09 | 1,41 |
| | | | High without manure | 0,64 | 1,09 | 1,08 |
| | | No till | Low | 0,64 | 1,16 | 0,94 |
| | | | Medium | 0,64 | 1,16 | 1 |
| | | | High with manure | 0,64 | 1,16 | 1,41 |
| | | | High without manure | 0,64 | 1,16 | 1,08 |

Table 3 provides guidance for selecting appropriate values from Tables 2 and 4.

*Table 3*

**Guidance on management and input for cropland and perennial crops**

| Management/ Input | Guidance |
|---|---|
| Full-tillage | Substantial soil disturbance with full inversion and/or frequent (within year) tillage operations. At planting time, little (e.g. < 30 %) of the surface is covered by residues. |
| Reduced tillage | Primary and/or secondary tillage but with reduced soil disturbance (usually shallow and without full soil inversion) and normally leaves surface with > 30 % coverage by residues at planting. |
| No till | Direct seeding without primary tillage, with only minimal soil disturbance in the seeding zone. Herbicides are typically used for weed control. |
| Low | Low residue return occurs when there is due to removal of residues (via collection or burning), frequent bare-fallowing, production of crops yielding low residues (e.g. vegetables, tobacco, cotton), no mineral fertilisation or nitrogen-fixing crops. |
| Medium | Representative for annual cropping with cereals where all crop residues are returned to the field. If residues are removed then supplemental organic matter (e.g. manure) is added. Also requires mineral fertilisation or nitrogen-fixing crop in rotation. |
| High with manure | Represents significantly higher carbon input over medium carbon input cropping systems due to an additional practice of regular addition of animal manure. |
| High without manure | Represents significantly greater crop residue inputs over medium carbon input cropping systems due to additional practices, such as production of high residue yielding crops, use of green manures, cover crops, improved vegetated fallows, irrigation, frequent use of perennial grasses in annual crop rotations, but without manure applied (see row above). |

7.2. **Perennial crops**

*Table 4*

**Factors for perennial crops, namely multi-annual crops whose stem is usually not annually harvested such as short rotation coppice and oil palm**

| Climate region | Land use ($F_{LU}$) | Management ($F_{MG}$) | Input ($F_I$) | $F_{LU}$ | $F_{MG}$ | $F_I$ |
|---|---|---|---|---|---|---|
| Temperate/Boreal, dry | Perennial crop | Full-tillage | Low | 1 | 1 | 0,95 |
| | | | Medium | 1 | 1 | 1 |
| | | | High with manure | 1 | 1 | 1,37 |
| | | | High without manure | 1 | 1 | 1,04 |
| | | Reduced tillage | Low | 1 | 1,02 | 0,95 |
| | | | Medium | 1 | 1,02 | 1 |
| | | | High with manure | 1 | 1,02 | 1,37 |
| | | | High without manure | 1 | 1,02 | 1,04 |
| | | No till | Low | 1 | 1,1 | 0,95 |
| | | | Medium | 1 | 1,1 | 1 |
| | | | High with manure | 1 | 1,1 | 1,37 |
| | | | High without manure | 1 | 1,1 | 1,04 |

| Climate region | Land use ($F_{LU}$) | Management ($F_{MG}$) | Input ($F_I$) | $F_{LU}$ | $F_{MG}$ | $F_I$ |
|---|---|---|---|---|---|---|
| Temperate/Boreal, moist/wet | Perennial crop | Full-tillage | Low | 1 | 1 | 0,92 |
| | | | Medium | 1 | 1 | 1 |
| | | | High with manure | 1 | 1 | 1,44 |
| | | | High without manure | 1 | 1 | 1,11 |
| | | Reduced tillage | Low | 1 | 1,08 | 0,92 |
| | | | Medium | 1 | 1,08 | 1 |
| | | | High with manure | 1 | 1,08 | 1,44 |
| | | | High without manure | 1 | 1,08 | 1,11 |
| | | No till | Low | 1 | 1,15 | 0,92 |
| | | | Medium | 1 | 1,15 | 1 |
| | | | High with manure | 1 | 1,15 | 1,44 |
| | | | High without manure | 1 | 1,15 | 1,11 |
| Tropical, dry | Perennial crop | Full-tillage | Low | 1 | 1 | 0,95 |
| | | | Medium | 1 | 1 | 1 |
| | | | High with manure | 1 | 1 | 1,37 |
| | | | High without manure | 1 | 1 | 1,04 |
| | | Reduced tillage | Low | 1 | 1,09 | 0,95 |
| | | | Medium | 1 | 1,09 | 1 |
| | | | High with manure | 1 | 1,09 | 1,37 |
| | | | High without manure | 1 | 1,09 | 1,04 |
| | | No till | Low | 1 | 1,17 | 0,95 |
| | | | Medium | 1 | 1,17 | 1 |
| | | | High with manure | 1 | 1,17 | 1,37 |
| | | | High without manure | 1 | 1,17 | 1,04 |
| Tropical, moist/wet | Perennial crop | Full-tillage | Low | 1 | 1 | 0,92 |
| | | | Medium | 1 | 1 | 1 |
| | | | High with manure | 1 | 1 | 1,44 |
| | | | High without manure | 1 | 1 | 1,11 |
| | | Reduced tillage | Low | 1 | 1,15 | 0,92 |
| | | | Medium | 1 | 1,15 | 1 |
| | | | High with manure | 1 | 1,15 | 1,44 |
| | | | High without manure | 1 | 1,15 | 1,11 |
| | | No till | Low | 1 | 1,22 | 0,92 |
| | | | Medium | 1 | 1,22 | 1 |
| | | | High with manure | 1 | 1,22 | 1,44 |
| | | | High without manure | 1 | 1,22 | 1,11 |
| Tropical Montane | Perennial crop | Full-tillage | Low | 1 | 1 | 0,94 |
| | | | Medium | 1 | 1 | 1 |
| | | | High with manure | 1 | 1 | 1,41 |
| | | | High without manure | 1 | 1 | 1,08 |

| Climate region | Land use ($F_{LU}$) | Management ($F_{MG}$) | Input ($F_I$) | $F_{LU}$ | $F_{MG}$ | $F_I$ |
|---|---|---|---|---|---|---|
| | | Reduced tillage | Low | 1 | 1,09 | 0,94 |
| | | | Medium | 1 | 1,09 | 1 |
| | | | High with manure | 1 | 1,09 | 1,41 |
| | | | High without manure | 1 | 1,09 | 1,08 |
| | | No till | Low | 1 | 1,16 | 0,94 |
| | | | Medium | 1 | 1,16 | 1 |
| | | | High with manure | 1 | 1,16 | 1,41 |
| | | | High without manure | 1 | 1,16 | 1,08 |

Table 3 in point 7.1 provides guidance for selecting appropriate values from Table 4.

## 7.3. **Grassland**

*Table 5*

**Factors for grassland, including savannahs**

| Climate region | Land Use ($F_{LU}$) | Management ($F_{MG}$) | Input ($F_I$) | $F_{LU}$ | $F_{MG}$ | $F_I$ |
|---|---|---|---|---|---|---|
| Temperate/Boreal, dry | Grassland | Improved | Medium | 1 | 1,14 | 1 |
| | | | High | 1 | 1,14 | 1,11 |
| | | Nominally managed | Medium | 1 | 1 | 1 |
| | | Moderately degraded | Medium | 1 | 0,95 | 1 |
| | | Severely degraded | Medium | 1 | 0,7 | 1 |
| Temperate/Boreal, moist/wet | Grassland | Improved | Medium | 1 | 1,14 | 1 |
| | | | High | 1 | 1,14 | 1,11 |
| | | Nominally managed | Medium | 1 | 1 | 1 |
| | | Moderately degraded | Medium | 1 | 0,95 | 1 |
| | | Severely degraded | Medium | 1 | 0,7 | 1 |
| Tropical, dry | Grassland | Improved | Medium | 1 | 1,17 | 1 |
| | | | High | 1 | 1,17 | 1,11 |
| | | Nominally managed | Medium | 1 | 1 | 1 |
| | | Moderately degraded | Medium | 1 | 0,97 | 1 |
| | | Severely degraded | Medium | 1 | 0,7 | 1 |
| Tropical, moist/wet | Savannah | Improved | Medium | 1 | 1,17 | 1 |
| | | | High | 1 | 1,17 | 1,11 |
| | | Nominally managed | Medium | 1 | 1 | 1 |
| | | Moderately degraded | Medium | 1 | 0,97 | 1 |
| | | Severely degraded | Medium | 1 | 0,7 | 1 |
| Tropical Montane, dry | Grassland | Improved | Medium | 1 | 1,16 | 1 |
| | | | High | 1 | 1,16 | 1,11 |

| Climate region | Land Use ($F_{LU}$) | Management ($F_{MG}$) | Input ($F_I$) | $F_{LU}$ | $F_{MG}$ | $F_I$ |
|---|---|---|---|---|---|---|
| | | Nominally managed | Medium | 1 | 1 | 1 |
| | | Moderately degraded | Medium | 1 | 0,96 | 1 |
| | | Severely degraded | Medium | 1 | 0,7 | 1 |

Table 6 provides guidance for selecting appropriate values from Table 5.

*Table 6*

**Guidance on management and input for grassland**

| Management/ Input | Guidance |
|---|---|
| Improved | Represents grassland which is sustainably managed with moderate grazing pressure and that receive at least one improvement (e.g. fertilisation, species improvement, irrigation). |
| Nominally managed | Represents non-degraded and sustainably managed grassland, but without significant management improvements. |
| Moderately degraded | Represents overgrazed or moderately degraded grassland, with somewhat reduced productivity (relative to the native or nominally managed grassland) and receiving no management inputs. |
| Severely degraded | Implies major long-term loss of productivity and vegetation cover, due to severe mechanical damage to the vegetation and/or severe soil erosion. |
| Medium | Applies where no additional management inputs have been used. |
| High | Applies to improved grassland where one or more additional management inputs/improvements have been used (beyond that is required to be classified as improved grassland). |

7.4. **Forest land**

*Table 7*

**Factors for forest land having at least 10 % canopy cover**

| Climate region | Land use ($F_{LU}$) | Management ($F_{MG}$) | Input ($F_I$) | $F_{LU}$ | $F_{MG}$ | $F_I$ |
|---|---|---|---|---|---|---|
| All | Native forest (non-degraded) | n/a (*) | n/a | 1 | | |
| All | Managed forest | All | All | 1 | 1 | 1 |
| Tropical, moist/dry | Shifting cultivation-shortened fallow | n/a | n/a | 0,64 | | |
| | Shifting cultivation-mature fallow | n/a | n/a | 0,8 | | |
| Temperate/Boreal, moist/dry | Shifting cultivation-shortened fallow | n/a | n/a | 1 | | |
| | Shifting cultivation-mature fallow | n/a | n/a | 1 | | |

(*) n/a = not applicable; in these cases $F_{MG}$ and $F_I$ shall not apply and for the calculation of *SOC* the following rule may be used: $SOC = SOC_{ST} \times F_{LU}$.

Table 8 provides guidance for selecting appropriate values from Table 7.

*Table 8*

**Guidance on land use for forest land**

| Land use | Guidance |
|---|---|
| Native forest (non-degraded) | Represents native or long-term, non-degraded and sustainably managed forest. |
| Shifting cultivation | Permanent shifting cultivation, where tropical forest or woodland is cleared for planting of annual crops for a short time (e.g. 3-5 years) period and then abandoned to regrowth. |
| Mature fallow | Represents situations where the forest vegetation recovers to a mature or near mature state prior to being cleared again for cropland use. |
| Shortened fallow | Represents situations where the forest vegetation recovery is not attained prior to reclearing. |

8. CARBON STOCK VALUES FOR ABOVE AND BELOW GROUND VEGETATION CARBON STOCK

For $C_{VEG}$ or $R$ the appropriate values laid down in this point may be used.

8.1. **Cropland**

*Table 9*

**Vegetation values for cropland (general)**

| Climate region | $C_{VEG}$ (tonnes carbon/hectare) |
|---|---|
| All | 0 |

*Table 10*

**Vegetation values for sugar cane (specific)**

| Domain | Climate region | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) |
|---|---|---|---|---|
| Tropical | Tropical dry | Tropical dry forest | Africa | 4,2 |
| | | | Asia (continental, insular) | 4 |
| | | Tropical scrubland | Asia (continental, insular) | 4 |
| | Tropical moist | Tropical moist deciduous forest | Africa | 4,2 |
| | | | Central and South America | 5 |
| | Tropical wet | Tropical rain forest | Asia (continental, insular) | 4 |
| | | | Central and South America | 5 |
| Subtropical | Warm temperate dry | Subtropical steppe | North America | 4,8 |
| | Warm temperate moist | Subtropical humid forest | Central and South America | 5 |
| | | | North America | 4,8 |

8.2. **Perennial crops, namely multi-annual crops whose stem is usually not annually harvested such as short rotation coppice and oil palm**

*Table 11*

**Vegetation values for perennial crops (general)**

| Climate region | $C_{VEG}$ (tonnes carbon per hectare) |
|---|---|
| Temperate (all moisture regimes) | 43,2 |
| Tropical, dry | 6,2 |
| Tropical, moist | 14,4 |
| Tropical, wet | 34,3 |

*Table 12*

**Vegetation values for specific perennial crops**

| Climate region | Crop type | $C_{VEG}$ (tonnes carbon per hectare) |
|---|---|---|
| All | Coconuts | 75 |
| | Jatropha | 17,5 |
| | Jojoba | 2,4 |
| | Oil palm | 60 |

8.3. **Grassland**

*Table 13*

**Vegetation values for grassland — excluding scrubland (general)**

| Climate region | $C_{VEG}$ (tonnes carbon per hectare) |
|---|---|
| Boreal — Dry & Wet | 4,3 |
| Cool Temperate — Dry | 3,3 |
| Cool Temperate — Wet | 6,8 |
| Warm Temperate — Dry | 3,1 |
| Warm Temperate — Wet | 6,8 |
| Tropical — Dry | 4,4 |
| Tropical — Moist & Wet | 8,1 |

*Table 14*

**Vegetation values for Miscanthus (specific)**

| Domain | Climate region | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) |
|---|---|---|---|---|
| Subtropical | Warm temperate dry | Subtropical dry forest | Europe | 10 |
| | | | North America | 14,9 |
| | | Subtropical steppe | North America | 14,9 |

*Table 15*

**Vegetation values for scrubland, namely land with vegetation composed largely of woody plants lower than 5 meter not having clear physiognomic aspects of trees**

| Domain | Continent | $C_{VEG}$ (tonnes carbon per hectare) |
|---|---|---|
| Tropical | Africa | 46 |
| | North and South America | 53 |
| | Asia (continental) | 39 |
| | Asia (insular) | 46 |
| | Australia | 46 |
| Subtropical | Africa | 43 |
| | North and South America | 50 |
| | Asia (continental) | 37 |
| | Europe | 37 |
| | Asia (insular) | 43 |
| Temperate | Global | 7,4 |

8.4. **Forest land**

*Table 16*

**Vegetation values for forest land — excluding forest plantations — having between 10 % and 30 % canopy cover**

| Domain | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) | *R* |
|---|---|---|---|---|
| Tropical | Tropical rain forest | Africa | 40 | 0,37 |
| | | North and South America | 39 | 0,37 |
| | | Asia (continental) | 36 | 0,37 |
| | | Asia (insular) | 45 | 0,37 |
| | Tropical moist forest | Africa | 30 | 0,24 |
| | | North and South America | 26 | 0,24 |
| | | Asia (continental) | 21 | 0,24 |
| | | Asia (insular) | 34 | 0,24 |
| | Tropical dry forest | Africa | 14 | 0,28 |
| | | North and South America | 25 | 0,28 |
| | | Asia (continental) | 16 | 0,28 |
| | | Asia (insular) | 19 | 0,28 |
| | Tropical mountain systems | Africa | 13 | 0,24 |
| | | North and South America | 17 | 0,24 |
| | | Asia (continental) | 16 | 0,24 |
| | | Asia (insular) | 26 | 0,28 |

| Domain | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) | *R* |
|---|---|---|---|---|
| Subtropical | Subtropical humid forest | North and South America | 26 | 0,28 |
| | | Asia (continental) | 22 | 0,28 |
| | | Asia (insular) | 35 | 0,28 |
| | Subtropical dry forest | Africa | 17 | 0,28 |
| | | North and South America | 26 | 0,32 |
| | | Asia (continental) | 16 | 0,32 |
| | | Asia (insular) | 20 | 0,32 |
| | Subtropical steppe | Africa | 9 | 0,32 |
| | | North and South America | 10 | 0,32 |
| | | Asia (continental) | 7 | 0,32 |
| | | Asia (insular) | 9 | 0,32 |
| Temperate | Temperate oceanic forest | Europe | 14 | 0,27 |
| | | North America | 79 | 0,27 |
| | | New Zealand | 43 | 0,27 |
| | | South America | 21 | 0,27 |
| | Temperate continental forest | Asia, Europe (≤ 20 y) | 2 | 0,27 |
| | | Asia, Europe (> 20 y) | 14 | 0,27 |
| | | North and South America (≤ 20 y) | 7 | 0,27 |
| | | North and South America (> 20 y) | 16 | 0,27 |
| | Temperate mountain systems | Asia, Europe (≤ 20 y) | 12 | 0,27 |
| | | Asia, Europe (> 20 y) | 16 | 0,27 |
| | | North and South America (≤ 20 y) | 6 | 0,27 |
| | | North and South America (> 20 y) | 6 | 0,27 |
| Boreal | Boreal coniferous forest | Asia, Europe, North America | 12 | 0,24 |
| | Boreal tundra woodland | Asia, Europe, North America (≤ 20 y) | 0 | 0,24 |
| | | Asia, Europe, North America (> 20 y) | 2 | 0,24 |
| | Boreal mountain systems | Asia, Europe, North America (≤ 20 y) | 2 | 0,24 |
| | | Asia, Europe, North America (> 20 y) | 6 | 0,24 |

*Table 17*

**Vegetation values for forest land — excluding forest plantations — having more than 30 % canopy cover**

| Domain | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) |
|---|---|---|---|
| Tropical | Tropical rain forest | Africa | 204 |
| | | North and South America | 198 |
| | | Asia (continental) | 185 |
| | | Asia (insular) | 230 |
| | Tropical moist deciduous forest | Africa | 156 |
| | | North and South America | 133 |
| | | Asia (continental) | 110 |
| | | Asia (insular) | 174 |
| | Tropical dry forest | Africa | 77 |
| | | North and South America | 131 |
| | | Asia (continental) | 83 |
| | | Asia (insular) | 101 |
| | Tropical mountain systems | Africa | 77 |
| | | North and South America | 94 |
| | | Asia (continental) | 88 |
| | | Asia (insular) | 130 |
| Subtropical | Subtropical humid forest | North and South America | 132 |
| | | Asia (continental) | 109 |
| | | Asia (insular) | 173 |
| | Subtropical dry forest | Africa | 88 |
| | | North and South America | 130 |
| | | Asia (continental) | 82 |
| | | Asia (insular) | 100 |
| | Subtropical steppe | Africa | 46 |
| | | North and South America | 53 |
| | | Asia (continental) | 41 |
| | | Asia (insular) | 47 |
| Temperate | Temperate oceanic forest | Europe | 84 |
| | | North America | 406 |
| | | New Zealand | 227 |
| | | South America | 120 |
| | Temperate continental forest | Asia, Europe (≤ 20 y) | 27 |
| | | Asia, Europe (> 20 y) | 87 |
| | | North and South America (≤ 20 y) | 51 |
| | | North and South America (> 20 y) | 93 |

| Domain | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) |
|---|---|---|---|
| | Temperate mountain systems | Asia, Europe (≤ 20 y) | 75 |
| | | Asia, Europe (> 20 y) | 93 |
| | | North and South America (≤ 20 y) | 45 |
| | | North and South America (> 20 y) | 93 |
| Boreal | Boreal coniferous forest | Asia, Europe, North America | 53 |
| | Boreal tundra woodland | Asia, Europe, North America (≤ 20 y) | 26 |
| | | Asia, Europe, North America (> 20 y) | 35 |
| | Boreal mountain systems | Asia, Europe, North America (≤ 20 y) | 32 |
| | | Asia, Europe, North America (> 20 y) | 53 |

*Table 18*

**Vegetation values for forest plantations**

| Domain | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) | *R* |
|---|---|---|---|---|
| Tropical | Tropical rain forest | Africa broadleaf > 20 y | 87 | 0,24 |
| | | Africa broadleaf ≤ 20 y | 29 | 0,24 |
| | | Africa *Pinus* sp. > 20 y | 58 | 0,24 |
| | | Africa *Pinus* sp. ≤ 20 y | 17 | 0,24 |
| | | Americas *Eucalyptus* sp. | 58 | 0,24 |
| | | Americas *Pinus* sp. | 87 | 0,24 |
| | | Americas *Tectona grandis* | 70 | 0,24 |
| | | Americas other broadleaf | 44 | 0,24 |
| | | Asia broadleaf | 64 | 0,24 |
| | | Asia other | 38 | 0,24 |
| | Tropical moist deciduous forest | Africa broadleaf > 20 y | 44 | 0,24 |
| | | Africa broadleaf ≤ 20 y | 23 | 0,24 |
| | | Africa *Pinus* sp. > 20 y | 35 | 0,24 |
| | | Africa *Pinus* sp. ≤ 20 y | 12 | 0,24 |
| | | Americas *Eucalyptus* sp. | 26 | 0,24 |
| | | Americas *Pinus* sp. | 79 | 0,24 |
| | | Americas *Tectona grandis* | 35 | 0,24 |
| | | Americas other broadleaf | 29 | 0,24 |
| | | Asia broadleaf | 52 | 0,24 |
| | | Asia other | 29 | 0,24 |

| Domain | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) | *R* |
|---|---|---|---|---|
| | Tropical dry forest | Africa broadleaf > 20 y | 21 | 0,28 |
| | | Africa broadleaf ≤ 20 y | 9 | 0,28 |
| | | Africa *Pinus* sp. > 20 y | 18 | 0,28 |
| | | Africa *Pinus* sp. ≤ 20 y | 6 | 0,28 |
| | | Americas *Eucalyptus* sp. | 27 | 0,28 |
| | | Americas *Pinus* sp. | 33 | 0,28 |
| | | Americas *Tectona grandis* | 27 | 0,28 |
| | | Americas other broadleaf | 18 | 0,28 |
| | | Asia broadleaf | 27 | 0,28 |
| | | Asia other | 18 | 0,28 |
| | Tropical shrubland | Africa broadleaf | 6 | 0,27 |
| | | Africa *Pinus* sp. > 20 y | 6 | 0,27 |
| | | Africa *Pinus* sp. ≤ 20 y | 4 | 0,27 |
| | | Americas *Eucalyptus* sp. | 18 | 0,27 |
| | | Americas *Pinus* sp. | 18 | 0,27 |
| | | Americas *Tectona grandis* | 15 | 0,27 |
| | | Americas other broadleaf | 9 | 0,27 |
| | | Asia broadleaf | 12 | 0,27 |
| | | Asia other | 9 | 0,27 |
| | Tropical mountain systems | Africa broadleaf > 20 y | 31 | 0,24 |
| | | Africa broadleaf ≤ 20 y | 20 | 0,24 |
| | | Africa *Pinus* sp. > 20 y | 19 | 0,24 |
| | | Africa *Pinus* sp. ≤ 20 y | 7 | 0,24 |
| | | Americas *Eucalyptus* sp. | 22 | 0,24 |
| | | Americas *Pinus* sp. | 29 | 0,24 |
| | | Americas *Tectona grandis* | 23 | 0,24 |
| | | Americas other broadleaf | 16 | 0,24 |
| | | Asia broadleaf | 28 | 0,24 |
| | | Asia other | 15 | 0,24 |
| Subtropical | Subtropical humid forest | Americas *Eucalyptus* sp. | 42 | 0,28 |
| | | Americas *Pinus* sp. | 81 | 0,28 |
| | | Americas *Tectona grandis* | 36 | 0,28 |
| | | Americas other broadleaf | 30 | 0,28 |
| | | Asia broadleaf | 54 | 0,28 |
| | | Asia other | 30 | 0,28 |

| Domain | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) | *R* |
|---|---|---|---|---|
| | Subtropical dry forest | Africa broadleaf > 20 y | 21 | 0,28 |
| | | Africa broadleaf ≤ 20 y | 9 | 0,32 |
| | | Africa *Pinus* sp. > 20 y | 19 | 0,32 |
| | | Africa *Pinus* sp. ≤ 20 y | 6 | 0,32 |
| | | Americas *Eucalyptus* sp. | 34 | 0,32 |
| | | Americas *Pinus* sp. | 34 | 0,32 |
| | | Americas *Tectona grandis* | 28 | 0,32 |
| | | Americas other broadleaf | 19 | 0,32 |
| | | Asia broadleaf | 28 | 0,32 |
| | | Asia other | 19 | 0,32 |
| | Subtropical steppe | Africa broadleaf | 6 | 0,32 |
| | | Africa *Pinus* sp. > 20 y | 6 | 0,32 |
| | | Africa *Pinus* sp. ≤ 20 y | 5 | 0,32 |
| | | Americas *Eucalyptus* sp. | 19 | 0,32 |
| | | Americas *Pinus* sp. | 19 | 0,32 |
| | | Americas *Tectona grandis* | 16 | 0,32 |
| | | Americas other broadleaf | 9 | 0,32 |
| | | Asia broadleaf > 20 y | 25 | 0,32 |
| | | Asia broadleaf ≤ 20 y | 3 | 0,32 |
| | | Asia coniferous > 20 y | 6 | 0,32 |
| | | Asia coniferous ≤ 20 y | 34 | 0,32 |
| | Subtropical mountain systems | Africa broadleaf > 20 y | 31 | 0,24 |
| | | Africa broadleaf ≤ 20 y | 20 | 0,24 |
| | | Africa *Pinus* sp. > 20 y | 19 | 0,24 |
| | | Africa *Pinus* sp. ≤ 20 y | 7 | 0,24 |
| | | Americas *Eucalyptus* sp. | 22 | 0,24 |
| | | Americas *Pinus* sp. | 34 | 0,24 |
| | | Americas *Tectona grandis* | 23 | 0,24 |
| | | Americas other broadleaf | 16 | 0,24 |
| | | Asia broadleaf | 28 | 0,24 |
| | | Asia other | 15 | 0,24 |
| Temperate | Temperate oceanic forest | Asia, Europe, broadleaf > 20 y | 60 | 0,27 |
| | | Asia, Europe, broadleaf ≤ 20 y | 9 | 0,27 |
| | | Asia, Europe, coniferous > 20 y | 60 | 0,27 |
| | | Asia, Europe, coniferous ≤ 20 y | 12 | 0,27 |
| | | North America | 52 | 0,27 |
| | | New Zealand | 75 | 0,27 |
| | | South America | 31 | 0,27 |

| Domain | Ecological zone | Continent | $C_{VEG}$ (tonnes carbon per hectare) | $R$ |
|---|---|---|---|---|
| | Temperate continental forest and mountain systems | Asia, Europe, broadleaf > 20 y | 60 | 0,27 |
| | | Asia, Europe, broadleaf ≤ 20 y | 4 | 0,27 |
| | | Asia, Europe, coniferous > 20 y | 52 | 0,27 |
| | | Asia, Europe, coniferous ≤ 20 y | 7 | 0,27 |
| | | North America | 52 | 0,27 |
| | | South America | 31 | 0,27 |
| Boreal | Boreal coniferous forest and mountain systems | Asia, Europe > 20 y | 12 | 0,24 |
| | | Asia, Europe ≤ 20 y | 1 | 0,24 |
| | | North America | 13 | 0,24 |
| | Boreal tundra woodland | Asia, Europe > 20 y | 7 | 0,24 |
| | | Asia, Europe ≤ 20 y | 1 | 0,24 |
| | | North America | 7 | 0,24 |

**Appendix CL2.9**

**The Department for Business, Energy and Industrial Strategy (BEIS) provides GHG emission factors for UK-based organisations**

Department for
Business, Energy
& Industrial Strategy

# 2020 Government greenhouse gas conversion factors for company reporting

## Methodology Paper for Conversion factors Final Report

July 2020

Any enquiries regarding this publication should be sent to Climatechange.Statistics@beis.gov.uk.

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# Tables

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# Glossary

| Abbreviation | Definition |
|---|---|
| ANPR | Automatic Number Plate Recognition |
| BEV | Battery electric vehicle |
| CAA | Civil Aviation Authority |
| CBS | National Bureau for Statistics in the Netherlands |
| CEF | Carbon emission factor |
| $CH_4$ | Methane |
| CHP | Combined Heat and Power |
| CHPQA | Combined Heat and Power Quality Assurance |
| CNG | Compressed natural gas |
| $CO_2$ | Carbon dioxide |
| DfT | Department for Transport |
| DUKES | Digest of UK Energy Statistics |
| EEA | European Environment Agency |
| EF | Emission factor |
| ETS | Emissions Trading System |
| FAME | Fatty Acid Methyl Ester |
| GCV | Gross calorific value |
| GHG | Greenhouse gas |
| GVW | Gross vehicle weight |
| GWP | Global Warming Potential |
| HGVs | Heavy goods vehicles |
| IPCC | Intergovernmental Panel on Climate Change |
| LCA | Life cycle assessment |

| | |
|---|---|
| LGVs | Light goods vehicles |
| LPG | Liquefied petroleum gas |
| MTBE | Methyl tert-butyl ether |
| NAEI | National Atmospheric Emissions Inventory |
| NCV | Net calorific value |
| NEDC | New European Driving Cycle |
| $N_2O$ | Nitrous oxide |
| ORR | Office of Rail and Road |
| PHEV | Plug-in hybrid electric vehicle |
| RoPax | Roll on/roll off a passenger |
| RTE | French transmission system operator |
| RTFO | Renewable Transport Fuel Obligation |
| RW | Real-world |
| SEAI | Sustainable Energy Authority of Ireland |
| SECR | Streamlined Energy and Carbon Reporting |
| SMMT | Society of Motor Manufacturers and Traders |
| T&D | Transmission & Distribution |
| TfL | Transport for London |
| TTW | Tank-To-Wheel (i.e. direct emissions at the point of use) |
| UK GHGI | UK's Greenhouse Gas Inventory |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WLTP | Worldwide Harmonised Light Vehicle Test Procedure |
| WTT | Well-To-Tank (i.e. upstream emissions from the production of fuel or electricity) |
| WTW | Well-To-Wheel (= Well-To-Tank + Tank-To-Wheel) |
| xEV | Generic term for battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV), range-extended electric vehicles (REEV) and fuel cell electric vehicles (FCEV) |

# 1. General Introduction

1.1. Greenhouse gases (GHG) can be measured by recording emissions at source, by continuous emissions monitoring or by estimating the amount emitted using activity data (such as the amount of fuel used) and applying relevant conversion factors (e.g. calorific values, emission factors, etc.).

1.2. These conversion factors allow organisations and individuals to calculate GHG emissions from a range of activities, including energy use, water consumption, waste disposal and recycling, and transport activities. For instance, a conversion factor can be used to calculate the amount of GHG emitted as a result of burning a particular quantity of oil in a heating boiler.

1.3. Chapters 2 to 14 present the conversion factors for a single type of emissions-releasing activity (for example, using electricity or driving a passenger vehicle). These emissions-releasing activities are categorised into three groups known as scopes. Each activity is listed as either Scope 1, Scope 2 or Scope 3.

a) Scope 1 (direct) emissions are those from activities owned or controlled by your organisation. Examples of Scope 1 emissions include emissions from combustion in owned or controlled boilers, furnaces and vehicles; and emissions from chemical production in owned or controlled process equipment.
b) Scope 2 (energy indirect) emissions are those released into the atmosphere that is associated with the consumption of purchased electricity, heat, steam and cooling. These indirect emissions are a consequence of an organisation's energy use but occur at sources the organisation does not own or control.
c) Scope 3 (other indirect) emissions are a consequence of your actions that occur at sources an organisation does not own or control and are not classed as Scope 2 emissions. Examples of Scope 3 emissions are business travel by means not owned or controlled by an organisation, waste disposal, materials or fuels that an organisation purchases. Deciding if emissions from a vehicle, office or factory that you use are Scope 1 or Scope 3 may depend on how organisations define their operational boundaries. Scope 3 emissions can be from activities that are upstream or downstream of an organisation. More information on Scope 3 and other aspects of reporting can be found in the Greenhouse Gas Protocol Corporate Standard.

1.4. The 2020 UK Government Greenhouse Gas Conversion factors for Company Reporting[1] (hereafter the 2020 UK GHG Conversion factors) represent the current official set of UK government conversion factors. These factors are also used in a number of different policies.

1.5. The UK GHG Conversion Factors have been developed as part of the NAEI (National Atmospheric Emissions Inventory) contract, managed by Ricardo Energy & Environment, which includes the:

a) UK Air Quality Pollutant Inventory (AQPI)
b) UK Greenhouse Gas Inventory (GHGI)

[1] Previously known as the 'Guidelines to Defra/DECC's GHG Conversion factors for Company Reporting'.

1.6. The UK GHGI for 2018 (Ricardo Energy & Environment, 2020) is available at: https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2004231028_ukghgi-90-18_Main_v02-00.pdf.

1.7. Values for the non-carbon dioxide ($CO_2$) GHGs, methane ($CH_4$) and nitrous oxide ($N_2O$), are presented as $CO_2$ equivalents ($CO_2e$), using Global Warming Potential (GWP) factors from the Intergovernmental Panel on Climate Change (IPCC)'s fourth assessment report (GWP for $CH_4$ = 25, GWP for $N_2O$ = 298). This is consistent with reporting under the United Nations Framework Convention on Climate Change (UNFCCC) and consistent with the UK GHGI, upon which the 2020 GHG Conversion Factors are based. Although the IPCC has prepared a newer version, the methods have not yet been officially accepted for use under the UNFCCC.

1.8. The 2020 GHG Conversion Factors are for use with activity data that falls entirely or mostly within 2020. The factors will continue to be improved and updated on an annual basis with the next publication in June 2021. Further information about the 2020 GHG Conversion factors together with previous methodology papers is available at: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting.

1.9. It is important to note that the primary aim of this methodology paper is to provide information on the methodology used in creating the UK Government GHG Conversion factors for Company Reporting. This report provides the methodological approach, the key data sources and the assumptions used to define the conversion factors provided in the 2020 GHG Conversion factors. The report aims to expand and complement the information already provided in the data tables themselves. However, it is not intended to be an exhaustively detailed explanation of every calculation performed (this is not practical/possible), nor is it intended to provide guidance on the practicalities of reporting for organisations. Rather, the intention is to provide an overview with key information so that the basis of the conversion factors provided can be better understood and assessed.

1.10. Detailed guidance on how the conversion factors provided should be used is contained in the "Introduction" worksheet of the 2020 GHG Conversion factors set. This guidance must be referred to before using the conversion factors and provides important context for the description of the methodologies presented in this report and in the table footnotes.

## Overview of changes since the previous update

1.11. Major changes and updates in terms of methodological approach from the 2019 update are summarised below. All other updates are essentially revisions of the previous year's data based on new/improved data whilst using existing calculation methodologies (i.e. using a similar methodological approach as for the 2019 update):

a) The biodiesel factors have been aligned to the UK Greenhouse Gas Inventory (UK GHGI) methodologies (on which these factors are based) which assume that the methanol reagent in the synthesis of biodiesel (Fatty acid methyl esters, FAME) is derived from fossil feedstock and so this is now accounted for within the "Biodiesel" worksheet.

b) There have been amendments to the methodology for the calculation of car emission factors, relating to the real-world uplift applied to regulatory testing values. The car emission factors are based upon data from Society of Motor Manufacturers and Traders (SMMT) for regulatory testing average carbon dioxide per kilometre ($CO_2$/km) and corresponding registrations in the UK by vehicle size (or market segment) and fuel type. An uplift factor is then applied to convert the mean $CO_2$/km data to account for the real-world impacts not fully captured by regulatory testing. Due to the type-approval transition from the previous New European Driving Cycle (NEDC) to Worldwide Harmonised Light Vehicle Test Procedure (WLTP) protocol, we have sourced new data for the real-world uplift factor to apply to new vehicle registrations with $CO_2$ emissions data based on tests under WLTP.

c) Similar to above on the real-world uplift factor used for new cars; some changes to the methodology have been necessary for xEVs due to the transition to a new regulatory $CO_2$ emissions testing protocol. Additionally, the factors for the electric operation of plug-in hybrid electric vehicles (PHEVs) have been revised downwards, to reflect the average proportion of time that vehicles are in the electric operation mode (for consistency also with the direct emissions due to combustion of petrol or diesel when operating in charge-sustaining mode). This change was due to new information showing that this is not already implemented in the EEA $CO_2$ monitoring database source for this dataset.

d) New additional factors have been added in the 2020 update as one of the requirements of the new Streamlined Energy and Carbon Reporting (SECR)[2] is to report emissions from activities for which companies are responsible including the combustion of fuel (and transport fuel) and the operation of any facility, together with the annual emissions from purchasing electricity, heat, steam or cooling by companies for their own use. The factors are presented in kWh units to help companies calculate the kWh from transport where only mileage or km data is available.

e) Major changes have been implemented in the “Material use” and “Waste disposal” worksheets of the 2020 GHG Conversion Factors set. Composting factors have been completely revised based on a more comprehensive, peer reviewed life cycle analysis (LCA) that takes account of a wider range of emissions. Additionally, factors for re-use have been removed. Re-use is not a waste management process and does not fall under the Scope 3 emissions factors for waste disposal. While preparation for re-use is a waste management route, no published data source enables a robust estimate of transport distances (and hence impact) to be made. Finally, the conversion factors for ‘Books’ have been removed to avoid duplication as these factors are identical to the ‘Paper and board: paper’ factors in both tabs.

f) The fuel tables have GHG emission factors for waste oils and lubricants. However, these fuel properties were not provided within the “Fuel properties” worksheet. We have now added in the waste oils and lubricants properties to the “Fuel properties” worksheet for completeness.

[2] For Streamlined Energy and Carbon Reporting guidance, please see link: https://www.gov.uk/government/publications/environmental-reporting-guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance

# 2. Fuel Emission Factors

## Section summary

2.1. The fuels conversion factors should be used for primary fuel sources combusted at a site or in an asset owned or controlled by the reporting organisation. Well-to-tank (WTT) factors should be used to account for the upstream Scope 3 emissions associated with extraction, refining and transportation of the raw fuel sources to an organisation's site (or asset), prior to their combustion.

2.2. The fuel properties can be used to determine the typical calorific values/densities of the most common fuels. The fuel properties should be utilised to change units of energy, mass, volume, etc. into alternative units; this is particularly useful where an organisation is collecting data in units of measure that do not have a fuel conversion factor that can be directly used to determine a carbon emission total.

2.3. Table 1 shows where the related worksheets to fuel conversion factors are available in the online spreadsheets of the UK GHG Conversion factors.

**Table 1: Related worksheets to the fuel conversion factors**

| Worksheet name | Full set | Condensed set |
|---|---|---|
| Fuels | Y | Y |
| WTT – fuels | Y | N |
| Fuel properties | Y | Y |
| Conversions | Y | Y |

## Summary of changes since the previous update

2.4. In the 2020 update, waste oils and lubricants fuel properties have been added to the fuel properties table. Conversion factors for these fuels were available within the fuel emissions factors sheet but where previously not included in the fuel properties table. We have now added in the waste oils and lubricants properties to the fuel properties table for completeness.

2.5. The fuel properties of waste oils were previously assumed to be similar to fuel oil. However, in the 2020 update, this assumption has been revised, from using the fuel oil density and calorific values to gas oil, to be more in line with the GHGI, as indications are that waste oils included in the GHGI are more similar to gas oil than fuel oil.

2.6. Continued fleet turnover in road transport and off-road machinery of engines meeting more recent emissions standards has caused significant changes to the $CH_4$ conversion factors for diesel consumption in the 2020 update. The $CH_4$ conversion factors have reduced by 17% compared to 2019 update.

# Direct Emissions

2.7. All the fuel conversion factors for direct emissions presented in the 2020 GHG Conversion factors are based on the conversion factors used in the UK GHGI for 2018 (managed by Ricardo Energy & Environment) (Ricardo Energy & Environment, 2020).

2.8. The $CO_2$ emissions factors are based on the same factors used in the UK GHGI and are essentially independent of application as they assume that all fuel is fully oxidised and combusted. However, emissions of $CH_4$ and $N_2O$ can vary to some degree for the same fuel depending on the use (e.g. conversion factors for gas oil used in rail, shipping, non-road mobile machinery or different scales/types of stationary combustion plants can all be different). The figures for fuels in the 2020 GHG Conversion factors are based on an activity-weighted average of all the different $CH_4$ and $N_2O$ conversion factors from the GHGI.

2.9. The majority of conversion factors from the GHGI are on a net energy basis (t/TJ), and have been converted into different energy, volume and mass based units using the information on Gross and Net Calorific Values (CV) (see definition of Gross CV and Net CV in the footnote below[3]) from the GHGI and for some fuels, BEIS's Digest of UK Energy Statistics (DUKES) (BEIS, 2019b).

2.10. There are three tables in the 2020 GHG Conversion factors, the first of which provides conversion factors for gaseous fuels, the second for liquid fuels and the final table provides the conversion factors for solid fuels.

2.11. When making calculations based on energy use, it is important to check (e.g. with your fuel supplier) whether these values were calculated on a Gross CV or Net CV basis and use the appropriate factor. Natural gas consumption figures quoted in kilowatt hours (kWh) by suppliers in the UK are generally calculated (from the volume of gas used) on a Gross CV basis (National Grid, 2020). Therefore, the emission factor for energy consumption on a Gross CV basis should be used by default for calculation of emissions from natural gas in kWh, unless your supplier specifically states they have used Net CV basis in their calculations instead.

# Indirect/WTT Emissions from Fuels

2.12. These fuel lifecycle emissions (also sometimes referred to as 'Well-To-Tank', or simply WTT, emissions usually in the context of transport fuels) are the emissions 'upstream' from the point of use of the fuel. They result from the extraction, transport, refining, purification or conversion of primary fuels to fuels for direct use by end-users and the distribution of these fuels. They are classed as Scope 3 according to the GHG Protocol.

2.13. For the upstream conversion factors relating to diesel, petrol, kerosene, natural gas, CNG, and LNG, data are taken from a study by Exergia (Exergia et al., 2015); please refer to Table 4 for definitions of acronyms. However, since this report does not estimate upstream emissions for coal, naphtha, and LPG, the JRC Well-To-

[3] Gross CV or higher heating value (HHV) is the CV under laboratory conditions. Net CV or lower heating value (LHV) is the useful calorific value in typical real-world conditions (e.g. boiler plant). The difference is essentially the latent heat of the water vapour produced (which can be recovered in laboratory conditions).

Wheels (JEC WTW, 2014) study is used for these fuels (being the most recent update to this source).

2.14. For fuels covered by the 2020 GHG Conversion factors where no fuel lifecycle emission factor was available in either source, these were estimated based on similar fuels, according to the assumptions in Table 4.

2.15. WTT emissions for petrol, diesel and kerosene in the Exergia study (Exergia et al., 2015), used within the 2020 GHG Conversion factors set, are based on:

- Detailed modelling of upstream emissions associated with 35 crude oils used in EU refining, which accounted for 88% of imported oil in 2012.
- Estimates of the emissions associated with the transport of these crude oils to EU refineries by sea and pipeline, based on the location of ports and refineries.
- Emissions from refining, modelled on a country by country basis, based on the specific refinery types in each country. An EU average is then calculated based on the proportion of each crude oil going to each refinery type.
- An estimate of emissions associated with imported finished products from Russia and the US.

2.16. Conversion factors are also calculated for diesel as supplied at public and commercial refuelling stations, by factoring in the WTT component due to biodiesel supplied in the UK as a proportion of the total supply of diesel and biodiesel (4.71% by unit volume, 4.35% by unit energy – see Table 2). These estimates have been made based on the Department for Transport Renewable Fuel Statistics (DfT, 2020b).

2.17. Conversion factors are also calculated for petrol as supplied at public and commercial refuelling stations, by factoring in the bioethanol supplied in the UK as a proportion of the total supply of petrol and bioethanol (4.51% by unit volume, 2.97% by unit energy – see Table 2). These estimates have also been made based on Department for Transport Renewable Fuel Statistics (DfT, 2020b).

**Table 2: Liquid biofuels for transport consumption**

| | Total Sales, millions of litres | | Biofuel % Total Sales | | |
|---|---|---|---|---|---|
| | Biofuel | Conventional Fuel | per unit mass | per unit volume | per unit of energy |
| Diesel/Biodiesel | 1,415 | 28,628 | 4.98% | 4.71% | 4.35% |
| Petrol/Bioethanol | 751 | 15,915 | 4.85% | 4.51% | 2.97% |

Source: Department for Transport, Table RTFO 01. Data used here is from the Renewable fuel statistics 2018, April to December: Final report (2020) and Renewable fuel statistics 2019: Third provisional report (2020)

2.18. Emissions for natural gas, LNG and CNG, used within the 2020 GHG Conversion factors, are based on (Exergia et al., 2015):

a) Estimates of emissions associated with supply in major gas producing countries supplying the EU. These include both countries supplying piped gas and countries supplying LNG.

b) The pattern of gas supply for each Member State (based on IEA data for natural gas supply in 2012).

c) Combining the information on emissions associated with sources of gas, with the data on the pattern of gas supply for each Member State, including the proportion of LNG that is imported.

2.19. The methodology developed allows for the value calculated for gas supply in the UK to be updated annually This allows changes in the sources of imported gas, particularly LNG, to be reflected in the emissions value.

2.20. Information on quantities and source of imported gas are available annually from DUKES[4] (BEIS, 2019a) and can be used to calculate the proportion of gas in UK supply coming from each source. These can then be combined with the emissions factors for gas from each source from the EU study (Exergia et al., 2015), to calculate a weighted emissions factor for UK supply.

2.21. The methodology for calculating the WTT conversion factors for natural gas and CNG is different to the other fuels as it considers the increasing share of UK gas supplied via imports of LNG (which have a higher WTT emission factor than conventionally sourced natural gas) in recent years. Table 3 provides a summary of the information on UK imports of LNG and their significance compared to other sources of natural gas used in the UK grid. Small quantities of imported LNG are now re-exported, so a value for net imports is used in the methodology. The figures in Table 3 have been used to calculate the revised figures for Natural Gas and CNG WTT conversion factors provided in Table 4 below.

**Table 3: Imports of LNG into the UK as a share of imports and net total natural gas supply**

| Year | LNG % of total natural gas imports (2) | Net Imports as % total UK supply of natural gas (1) | LNG Imports as % total UK supply of natural gas |
|---|---|---|---|
| 2010 | 34.1% | 41.3% | 19.1% |
| 2011 | 46.0% | 43.7% | 29.5% |
| 2012 | 27.1% | 49.2% | 17.5% |
| 2013 | 19.1% | 51.7% | 12.1% |
| 2014 | 26.0% | 46.3% | 15.9% |
| 2015 | 30.2% | 43.4% | 18.8% |
| 2016 | 21.4% | 48.2% | 12.7% |
| 2017 | 13.5% | 46.7% | 8.0% |
| 2018 | 14.8% | 48.8% | 8.6% |

Source: DUKES 2019, (1) Table 4.1 - Commodity balances and (2) Table 4.5 - Natural gas imports and exports; (BEIS, 2019b).

2.22. The final combined conversion factors, presented as kilograms of carbon dioxide equivalents per gigajoule on a net calorific value basis ($kgCO_2e/GJ$, Net CV basis),

[4] From Table 4.1 Commodity balances for natural gas and Table 4.5 Natural gas imports and exports, DUKES 2019

are listed in Table 4. These include WTT emissions of $CO_2$, $N_2O$ and $CH_4$. These are converted into other units of energy (e.g. kWh, Therms) and to units of volume and mass using the default Fuel Properties and Unit Conversion factors also provided in the 2020 GHG Conversion factors alongside the emission factor data tables.

**Table 4: Basis of the indirect/WTT emissions factors for different fuels**

| Fuel | Indirect/WTT EF ($kgCO_2e$/GJ, Net CV basis) | Source of Indirect/WTT Emission Factor | Assumptions |
|---|---|---|---|
| Aviation Spirit | 18.20 | Estimate | Similar to petrol |
| Aviation turbine fuel | 15.00 | Exergia, EM Lab and COWI, 2015 | Emission factor for kerosene |
| Burning oil[1] | 15.00 | Estimate | Same as Kerosene, as above |
| Compressed natural gas (CNG)[2] | 10.87 | Exergia, EM Lab and COWI, 2015 | Factors in UK % share LNG imports |
| Coal (domestic) | 15.08 | JEC WTW (2014) | Emission factor for coal |
| Coal (electricity generation) | 15.08 | JEC WTW (2014) | Emission factor for coal |
| Coal (industrial) | 15.08 | JEC WTW (2014) | Emission factor for coal |
| Coal (electricity generation - home produced coal only) | 15.08 | JEC WTW (2014) | Emission factor for coal |
| Coking coal | 15.08 | Estimate | Assume same as factor for coal |
| Diesel (100% mineral diesel) | 17.40 | Exergia, EM Lab and COWI, 2015 | |
| Fuel oil[3] | 15.00 | Estimate | Assume same as factor for kerosene |
| Gas oil[4] | 17.40 | Estimate | Assume same as factor for diesel |
| Liquefied petroleum gas (LPG) | 7.82 | JEC WTW (2014) | |
| Liquefied natural gas (LNG)[5] | 19.60 | Exergia, EM Lab and COWI, 2015 | |
| Lubricants | 9.54 | Estimate | Based on LPG figure, scaled relative to direct emissions ratio |
| Marine fuel oil | 15.00 | Estimate | Assume same as factor for fuel oil |

| | | | |
|---|---|---|---|
| Marine gas oil | 17.40 | Estimate | Assume same as factor for gas oil |
| Naphtha | 14.10 | JEC WTW (2014) | |
| Natural gas | 7.36 | Exergia, EM Lab and COWI, 2015 | Factors in UK % share LNG imports |
| Other petroleum gas | 6.83 | Estimate | Based on LPG figure, scaled relative to direct emissions ratio |
| Petrol (100% mineral petrol) | 18.20 | Exergia, EM Lab and COWI, 2015 | |
| Petroleum coke | 12.21 | Estimate | Based on LPG figure, scaled relative to direct emissions ratio |
| Processed fuel oils - distillate oil | 9.18 | Estimate | Based on LPG figure, scaled relative to direct emissions ratio |
| Processed fuel oils - residual oil | 9.65 | Estimate | Based on LPG figure, scaled relative to direct emissions ratio |
| Refinery miscellaneous | 8.80 | Estimate | Based on LPG figure, scaled relative to direct emissions ratio |
| Waste oils | 9.20 | Estimate | Based on LPG figure, scaled relative to direct emissions ratio |

Notes:

(1) Burning oil is also known as kerosene or paraffin used for heating systems. Aviation Turbine fuel is a similar kerosene fuel specifically refined to a higher quality for aviation.
(2) CNG = Compressed Natural Gas is usually stored at 200 bar in the UK for use as an alternative transport fuel.
(3) Fuel oil is used for stationary power generation. Also, use this emission factor for similar marine fuel oils.
(4) Gas oil is used for stationary power generation and 'diesel' rail in the UK. Also, use this emission factor for similar marine diesel oil and marine gas oil fuels.
(5) LNG = Liquefied Natural Gas, usually shipped into the UK by tankers. LNG is usually used within the UK gas grid; however, it can also be used as an alternative transport fuel.

# 3. UK Electricity, Heat and Steam Emission Factors

## Section summary

3.1. UK electricity conversion factors should be used to report on electricity used by an organisation at sites owned or controlled by them. This is reported as a Scope 2 (indirect) emission. The conversion factors for electricity are for the electricity supplied to the grid that organisations purchase – i.e. not including the emissions associated with the transmission and distribution of electricity. Conversion factors for transmission and distribution losses (the energy loss that occurs in getting the electricity from the power plant to the organisations that purchase it) are available separately and should be used to report the Scope 3 emissions associated with grid losses. WTT conversion factors for the UK and overseas electricity should be used to report the Scope 3 emissions of extraction, refining and transportation of primary fuels before their use in the generation of electricity.

3.2. Heat and steam conversion factors should be used to report emissions within organisations that purchase heat or steam energy for heating purposes or for the use in specific industrial processes. District heat and steam factors are also available. WTT heat and steam conversion factors should be used to report emissions from the extraction, refinement and transportation of primary fuels that generate the heat and steam organisations purchase.

3.3. Table 5 shows where the related worksheets to UK electricity and heat & steam conversion factors are available in the online spreadsheets of the UK GHG Conversion factors set.

**Table 5: Related worksheets to UK electricity and heat & steam emission factors**

| Worksheet name | Full set | Condensed set |
|---|---|---|
| UK electricity | Y | Y |
| Transmission and distribution | Y | Y |
| WTT – UK & overseas Electricity | Y | N |
| Heat and steam | Y | N |
| WTT – heat and steam | Y | N |

## Summary of changes since the previous update

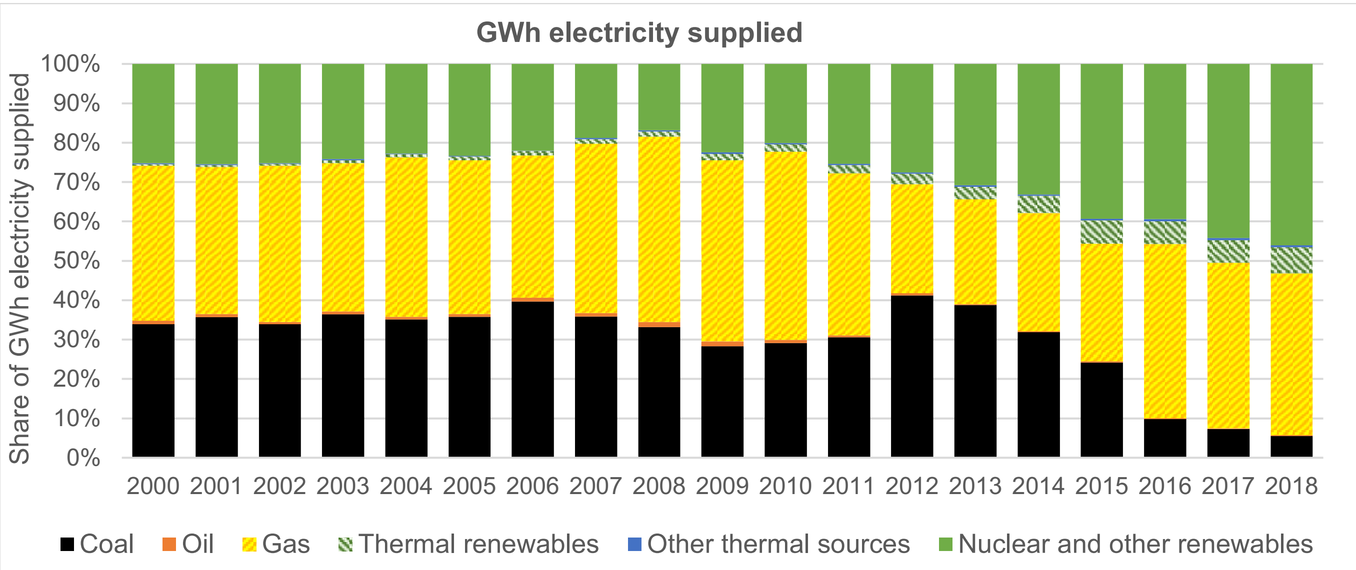
3.4. The Combined Heat and Power (CHP) methodologies depend upon the DUKES CHP fuel mix, which varies from year to year, and $CH_4$ and $N_2O$ emission factor data from the UK GHGI, which are also subject to inter-annual variations or revisions to assumptions (see Section 2 of this report). There have not been any method changes for conversion factors described in this chapter.

## Direct Emissions from UK Grid Electricity

3.5. The electricity conversion factors given represent the average $CO_2$ emission from the UK national grid per kWh of electricity generated, classed as Scope 2 of the GHG Protocol and separately for electricity transmission and distribution losses, classed as Scope 3. The calculations also factor in net imports of electricity via the interconnectors with Ireland, the Netherlands and France. These factors include only direct $CO_2$, $CH_4$ and $N_2O$ emissions at UK power stations and from autogenerators, plus those from the proportion of imported electricity. They do not include emissions resulting from production and delivery of fuel to these power stations (i.e. from gas rigs, refineries and collieries, etc.).

3.6. The UK grid electricity factor changes from year to year as the fuel mix consumed in UK power stations (and autogenerators) changes, and as the proportion of net imported electricity also changes. These annual changes can be large as they depend very heavily on the relative prices of coal and natural gas as well as fluctuations in peak demand and renewables. There has been a sustained decline in the amount of coal used for electricity generation over the past few years, largely driven by the increase in the carbon floor price from £9 per tonne of $CO_2$ to £15 in 2015 (BEIS, 2019b). The annual variability, and the recent trends in coal use, in UK electricity generation mix is illustrated in Figure 1 below.

**Figure 1: Time series of the mix of UK electricity generation by type**




Notes: The chart presents data for actual years; the emissions factors for a given GHG Conversion Factor update year correspond to the data for the actual year 2 years behind, i.e. the 2020 conversion factors are based on 2018 data.

3.7. The UK electricity conversion factors provided in the 2020 GHG Conversion factors are based on emissions from sector 1A1ai (power stations) and 1A2b/1A2gviii (autogenerators) in the UK Greenhouse Gas Inventory (GHGI) for 2018 (Ricardo Energy & Environment, 2020). These emissions from the GHGI only include autogeneration from coal and natural gas, and do not include emissions for electricity generated and supplied by autogenerators using oil or other thermal non-renewable fuels[5]. Estimates of the emissions arising from other fuels used for autogeneration have been made using standard GHGI emission factors, information from DUKES (BEIS, 2019b) Table 5.6, and BEIS's DUKES team on the total fuel use (and shares by fuel type). The method also accounts for the share of autogeneration electricity that is exported to the grid (~10.5% for the 2018 data year), which varies significantly from year-to-year.

3.8. The UK is a net importer of electricity from the interconnectors with France and Netherlands, and a net exporter of electricity to Ireland according to DUKES (BEIS, 2019b). For the 2020 GHG Conversion factors the total net electricity imports were calculated from DUKES Table 5.1.2 (Electricity supply, availability and consumption 1970 to 2018). The net shares of imported electricity over the interconnectors are calculated from data from DUKES Table 5A (Net Imports via interconnectors, GWh).

3.9. An average imported electricity emission factor is calculated from the individual factors for the relevant countries (CBS, 2020), (RTE, 2020), (SEAI, 2020) weighted by their respective share of net imports. This average electricity emission factor – including losses – is used to account for the net import of electricity, as it will also have gone through the relevant countries' distribution systems. Note that this method effectively reduces the UK's electricity conversion factors as the resulting average net imported electricity emission factor is lower than that for the UK. This is largely because France's electricity generation is much less carbon-intensive than that of the UK, and accounts for the largest share of the net imports.

3.10. The source data and calculated emissions factors are summarised in Table 6, Table 7 and Table 8. Time series source data and conversion factors are fixed/locked from the 2019 GHG Conversion Factor update and for earlier years and have been highlighted in light grey. The tables provide the data and conversion factors against the relevant data year. Table 6 also provides a comparison of how the data year reads across to the GHG conversion factors update / reporting year to which the data and conversion factors are applied, which is two years ahead of the data year. For example, the most recent emission factor for the 2020 GHG Conversion factors is based on the data year 2018.

3.11. Earlier years (those prior to the current update) are based on data reported in previous versions of DUKES and following the convention set from 2016 data year, historic time series factors/data have not been updated. Time series data in light grey is locked/fixed for the purposes of company reporting and has not been updated in the database in the 2020 GHG Conversion factors update.

3.12. A full-time series of data using the most recently available GHGI and DUKES datasets for all years is provided in Appendix 2 of this report. This is provided for purposes other than company reporting, where a fully consistent data time series is desirable, e.g. for policy impact analysis. This dataset also reflects the changes in the methodological approach implemented for the 2016 update and is applied across the whole time series.

[5] Other thermal non-renewable fuels include the following (with ~2018 update % share): blast furnace gas (~30%), chemical waste (~13%), coke oven gas (~6%) and municipal solid waste (MSW, ~50%)

**Table 6: Base electricity generation emissions data**

| Data Year | Applied to Reporting Year* | Electricity Generation [1] GWh | Total Grid Losses [2] % | UK electricity generation emissions [3], ktonne | | |
|---|---|---|---|---|---|---|
| | | | | $CO_2$ | $CH_4$ | $N_2O$ |
| **1990** | 1992 | 290,666 | 8.08% | 204,614 | 2.671 | 5.409 |
| **1991** | 1993 | 293,743 | 8.27% | 201,213 | 2.499 | 5.342 |
| **1992** | 1994 | 291,692 | 7.55% | 189,327 | 2.426 | 5.024 |
| **1993** | 1995 | 294,935 | 7.17% | 172,927 | 2.496 | 4.265 |
| **1994** | 1996 | 299,889 | 9.57% | 168,551 | 2.658 | 4.061 |
| **1995** | 1997 | 310,333 | 9.07% | 165,700 | 2.781 | 3.902 |
| **1996** | 1998 | 324,724 | 8.40% | 164,875 | 2.812 | 3.612 |
| **1997** | 1999 | 324,412 | 7.79% | 152,439 | 2.754 | 3.103 |
| **1998** | 2000 | 335,035 | 8.40% | 157,171 | 2.978 | 3.199 |
| **1999** | 2001 | 340,218 | 8.25% | 149,036 | 3.037 | 2.772 |
| **2000** | 2002 | 349,263 | 8.38% | 160,927 | 3.254 | 3.108 |
| **2001** | 2003 | 358,185 | 8.56% | 171,470 | 3.504 | 3.422 |
| **2002** | 2004 | 360,496 | 8.26% | 166,751 | 3.490 | 3.223 |
| **2003** | 2005 | 370,639 | 8.47% | 177,044 | 3.686 | 3.536 |
| **2004** | 2006 | 367,883 | 8.71% | 175,963 | 3.654 | 3.414 |
| **2005** | 2007 | 370,977 | 7.25% | 175,086 | 3.904 | 3.550 |
| **2006** | 2008 | 368,314 | 7.21% | 184,517 | 4.003 | 3.893 |
| **2007** | 2009 | 365,252 | 7.34% | 181,256 | 4.150 | 3.614 |
| **2008** | 2010 | 356,887 | 7.45% | 176,418 | 4.444 | 3.380 |
| **2009** | 2011 | 343,418 | 7.87% | 155,261 | 4.450 | 2.913 |
| **2010** | 2012 | 348,812 | 7.32% | 160,385 | 4.647 | 3.028 |
| **2011** | 2013 | 330,128 | 7.88% | 148,153 | 4.611 | 3.039 |
| **2012** | 2014 | 320,470 | 8.04% | 161,903 | 5.258 | 3.934 |
| **2013** | 2015 | 308,955 | 7.63% | 146,852 | 4.468 | 3.595 |
| **2014*** | 2016 | 297,897 | 8.30% | 126,358 | 4.769 | 2.166 |
| **2015** | 2017 | 296,959 | 8.55% | 106,209 | 7.567 | 2.136 |
| **2016** | 2018 | 297,203 | 7.85% | 84,007 | 7.856 | 1.532 |
| **2017** | 2019 | 294,086 | 7.83% | 74,386 | 7.588 | 1.353 |

| Data Year | Applied to Reporting Year* | Electricity Generation (1) GWh | Total Grid Losses (2) % | UK electricity generation emissions (3), ktonne | | |
|---|---|---|---|---|---|---|
| | | | | $CO_2$ | $CH_4$ | $N_2O$ |
| **2018** | 2020 | 289,120 | 7.92% | 68,046 | 8.443 | 1.368 |

Notes:

(1) **From 1990-2013**: Based upon calculated total for centralised electricity generation (GWh supplied) from DUKES Table 5.5 Electricity fuel use, generation and supply for the year 1990 to 2014. The total is consistent with UNFCCC emissions reporting categories 1A1ai+1A2d includes (according to Table 5.5 categories) GWh supplied (gross) from all 'Major power producers'; plus, GWh supplied from thermal renewables + coal and gas thermal sources, hydro-natural flow and other non-thermal sources from 'Other generators'.

* **From 2014 onwards**: based on the **total** for **all** electricity generation (GWh supplied) from DUKES Table 5.6, with a reduction of the total for autogenerators based on unpublished data from the BEIS DUKES team on the share of this that is actually exported to the grid (~11% in 2018).

(2) Based upon calculated net grid losses from data in DUKES Table 5.1.2 (long term trends, only available online).

(3) **From 1990-2013**: Emissions from UK centralised power generation (including Crown Dependencies only) listed under UNFCC reporting category 1A1a and autogeneration - exported to the grid (UK Only) listed under UNFCC reporting category 1A2f from the UK Greenhouse Gas Inventory for 2012 (Ricardo-AEA, 2014) for data years 1990-2012, and for 2013 (Ricardo Energy & Environment, 2015) for the 2013 data year.

* **From 2014 onwards**: Excludes emissions from Crown Dependencies and also includes an accounting (estimate) for autogeneration emissions not specifically split out in the UK GHGI, consistent with the inclusion of the GWh supply for these elements also from 2014 onwards. Data is from the GHGI (Ricardo Energy & Environment, 2020) for the 2018 data year.

**Table 7: Base electricity generation conversion factors (excluding imported electricity)**

| Data Year | Emission Factor, $kgCO_2e$ / kWh | | | | | | | | | | | | % Net Electricity Imports |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | For electricity GENERATED (supplied to the grid) | | | | Due to grid transmission /distribution LOSSES | | | | For electricity CONSUMED (includes grid losses) | | | | |
| | $CO_2$ | $CH_4$ | $N_2O$ | Total | $CO_2$ | $CH_4$ | $N_2O$ | Total | $CO_2$ | $CH_4$ | $N_2O$ | Total | TOTAL |
| **1990** | 0.70395 | 0.00019 | 0.00577 | 0.70991 | 0.05061 | 0.00001 | 0.00042 | 0.05104 | 0.7658 | 0.00021 | 0.00628 | 0.77229 | **3.85%** |
| **1991** | 0.685 | 0.00018 | 0.00564 | 0.69081 | 0.04318 | 0.00001 | 0.00033 | 0.04352 | 0.74675 | 0.00019 | 0.00615 | 0.75309 | **5.18%** |
| **1992** | 0.64907 | 0.00017 | 0.00534 | 0.65458 | 0.05678 | 0.00002 | 0.00042 | 0.05722 | 0.70205 | 0.00019 | 0.00578 | 0.70801 | **5.29%** |
| **1993** | 0.58632 | 0.00018 | 0.00448 | 0.59098 | 0.05101 | 0.00002 | 0.00037 | 0.0514 | 0.6316 | 0.00019 | 0.00483 | 0.63662 | **5.25%** |
| **1994** | 0.56204 | 0.00019 | 0.0042 | 0.56643 | 0.04471 | 0.00002 | 0.0003 | 0.04502 | 0.62154 | 0.00021 | 0.00464 | 0.62639 | **5.22%** |
| **1995** | 0.53394 | 0.00019 | 0.0039 | 0.53803 | 0.03813 | 0.00001 | 0.00024 | 0.03839 | 0.58721 | 0.00021 | 0.00429 | 0.5917 | **4.97%** |
| **1996** | 0.50774 | 0.00018 | 0.00345 | 0.51137 | 0.04182 | 0.00002 | 0.00026 | 0.0421 | 0.55432 | 0.0002 | 0.00376 | 0.55828 | **4.80%** |
| **1997** | 0.46989 | 0.00018 | 0.00297 | 0.47304 | 0.03816 | 0.00002 | 0.00022 | 0.0384 | 0.50961 | 0.00019 | 0.00322 | 0.51302 | **4.76%** |
| **1998** | 0.46912 | 0.00019 | 0.00296 | 0.47226 | 0.04084 | 0.00002 | 0.00024 | 0.04111 | 0.51211 | 0.0002 | 0.00323 | 0.51555 | **3.51%** |
| **1999** | 0.43806 | 0.00019 | 0.00253 | 0.44077 | 0.04375 | 0.00002 | 0.00027 | 0.04404 | 0.47745 | 0.00020 | 0.00275 | 0.48041 | **3.94%** |
| **2000** | 0.46076 | 0.0002 | 0.00276 | 0.46372 | 0.04083 | 0.00002 | 0.00024 | 0.04109 | 0.50293 | 0.00021 | 0.00301 | 0.50616 | **3.82%** |
| **2001** | 0.47872 | 0.00021 | 0.00296 | 0.48189 | 0.04398 | 0.00002 | 0.00027 | 0.04427 | 0.52354 | 0.00022 | 0.00324 | 0.52701 | **2.78%** |
| **2002** | 0.46256 | 0.0002 | 0.00277 | 0.46554 | 0.04487 | 0.00002 | 0.00027 | 0.04516 | 0.50418 | 0.00022 | 0.00302 | 0.50742 | **2.24%** |
| **2003** | 0.47767 | 0.00021 | 0.00296 | 0.48084 | 0.03621 | 0.00002 | 0.00023 | 0.03646 | 0.52187 | 0.00023 | 0.00323 | 0.52533 | **0.57%** |
| **2004** | 0.47831 | 0.00021 | 0.00288 | 0.4814 | 0.03831 | 0.00002 | 0.00025 | 0.03857 | 0.52395 | 0.00023 | 0.00315 | 0.52733 | **1.97%** |
| **2005** | 0.47196 | 0.00022 | 0.00297 | 0.47515 | 0.03884 | 0.00002 | 0.00024 | 0.0391 | 0.50883 | 0.00024 | 0.0032 | 0.51226 | **2.16%** |
| **2006** | 0.50098 | 0.00023 | 0.00328 | 0.50448 | 0.03883 | 0.00002 | 0.00023 | 0.03908 | 0.53993 | 0.00025 | 0.00353 | 0.54371 | **1.97%** |
| **2007** | 0.49625 | 0.00024 | 0.00307 | 0.49956 | 0.03838 | 0.00002 | 0.00022 | 0.03863 | 0.53555 | 0.00026 | 0.00331 | 0.53911 | **1.37%** |
| **2008** | 0.49433 | 0.00026 | 0.00294 | 0.49752 | 0.03611 | 0.00002 | 0.00021 | 0.03634 | 0.53414 | 0.00028 | 0.00317 | 0.53759 | **2.91%** |

| Data Year | Emission Factor, $kgCO_2e$ / kWh | | | | | | | | | | | | % Net Electricity Imports |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | For electricity GENERATED (supplied to the grid) | | | | Due to grid transmission /distribution LOSSES | | | | For electricity CONSUMED (includes grid losses) | | | | |
| | $CO_2$ | $CH_4$ | $N_2O$ | Total | $CO_2$ | $CH_4$ | $N_2O$ | Total | $CO_2$ | $CH_4$ | $N_2O$ | Total | TOTAL |
| **2009** | 0.45211 | 0.00027 | 0.00263 | 0.45501 | 0.03783 | 0.00002 | 0.00024 | 0.03809 | 0.49074 | 0.0003 | 0.00285 | 0.49389 | **0.80%** |
| **2010** | 0.4598 | 0.00028 | 0.00269 | 0.46277 | 0.05061 | 0.00001 | 0.00042 | 0.05104 | 0.49613 | 0.0003 | 0.0029 | 0.49933 | **0.73%** |
| **2011** | 0.44877 | 0.00029 | 0.00285 | 0.45192 | 0.04318 | 0.00001 | 0.00033 | 0.04352 | 0.48715 | 0.00032 | 0.0031 | 0.49056 | **1.76%** |
| **2012** | 0.5052 | 0.00034 | 0.00381 | 0.50935 | 0.04418 | 0.00003 | 0.00033 | 0.04454 | 0.54938 | 0.00037 | 0.00414 | 0.55389 | **3.40%** |
| **2013** | 0.47532 | 0.00036 | 0.00347 | 0.47915 | 0.03925 | 0.00003 | 0.00029 | 0.03956 | 0.51457 | 0.00039 | 0.00375 | 0.51871 | **4.10%** |
| **2014** | 0.42417 | 0.00040 | 0.00217 | 0.42673 | 0.03837 | 0.00004 | 0.00020 | 0.03860 | 0.46254 | 0.00044 | 0.00236 | 0.46534 | **6.44%** |
| **2015** | 0.35766 | 0.00064 | 0.00214 | 0.36044 | 0.03343 | 0.00006 | 0.00020 | 0.03369 | 0.39108 | 0.00070 | 0.00234 | 0.39412 | **6.59%** |
| **2016** | 0.28266 | 0.00066 | 0.00154 | 0.28486 | 0.02409 | 0.00006 | 0.00013 | 0.02428 | 0.30675 | 0.00072 | 0.00167 | 0.30913 | **5.57%** |
| **2017** | 0.25294 | 0.00065 | 0.00137 | 0.25496 | 0.02148 | 0.00005 | 0.00012 | 0.02165 | 0.27442 | 0.00070 | 0.00149 | 0.27660 | **4.78%** |
| **2018** | 0.23536 | 0.00073 | 0.00141 | 0.23750 | 0.02024 | 0.00006 | 0.00012 | 0.02042 | 0.25559 | 0.00079 | 0.00153 | 0.25792 | **6.20%** |

Notes: * From 1990-2013 the emission factor used was for French electricity only, and is as published in previous methodology papers. The methodology was updated from 2014 onwards with new data on the contribution of electricity from the other interconnects, hence these figures are based on a weighted average emission factor of the conversion factors for France, the Netherlands and Ireland, based on the % share supplied.

Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) / (1 - %Electricity Total Grid LOSSES)

Emission Factor (Electricity LOSSES) = Emission Factor (Electricity CONSUMED) - Emission Factor (Electricity GENERATED)

⇒ Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) + Emission Factor (Electricity LOSSES),

**Table 8: Base electricity generation emissions factors (including imported electricity)**

| Data Year | Emission Factor, $kgCO_2e$ / kWh | | | | | | | | | | | | % Net Elec Imports |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | For electricity GENERATED (supplied to the grid, plus imports) | | | | Due to grid transmission /distribution LOSSES | | | | For electricity CONSUMED (includes grid losses) | | | | |
| | $CO_2$ | $CH_4$ | $N_2O$ | Total | $CO_2$ | $CH_4$ | $N_2O$ | Total | $CO_2$ | $CH_4$ | $N_2O$ | Total | TOTAL |
| **1990** | 0.6812 | 0.00019 | 0.00558 | 0.68697 | 0.05985 | 0.00002 | 0.00049 | 0.06036 | 0.74106 | 0.0002 | 0.00607 | 0.74733 | **3.85%** |
| **1991** | 0.65616 | 0.00017 | 0.0054 | 0.66174 | 0.05915 | 0.00002 | 0.00049 | 0.05966 | 0.71532 | 0.00019 | 0.00589 | 0.72139 | **5.18%** |
| **1992** | 0.62005 | 0.00017 | 0.0051 | 0.62532 | 0.05061 | 0.00001 | 0.00042 | 0.05104 | 0.67066 | 0.00018 | 0.00552 | 0.67636 | **5.29%** |
| **1993** | 0.55913 | 0.00017 | 0.00428 | 0.56358 | 0.04318 | 0.00001 | 0.00033 | 0.04352 | 0.60232 | 0.00018 | 0.00461 | 0.6071 | **5.25%** |
| **1994** | 0.53633 | 0.00018 | 0.00401 | 0.54051 | 0.05678 | 0.00002 | 0.00042 | 0.05722 | 0.59311 | 0.0002 | 0.00443 | 0.59773 | **5.22%** |
| **1995** | 0.5113 | 0.00018 | 0.00373 | 0.51521 | 0.05101 | 0.00002 | 0.00037 | 0.0514 | 0.56231 | 0.0002 | 0.0041 | 0.56661 | **4.97%** |
| **1996** | 0.48731 | 0.00017 | 0.00331 | 0.4908 | 0.04471 | 0.00002 | 0.0003 | 0.04502 | 0.53202 | 0.00019 | 0.00361 | 0.53582 | **4.80%** |
| **1997** | 0.45112 | 0.00017 | 0.00285 | 0.45414 | 0.03813 | 0.00001 | 0.00024 | 0.03839 | 0.48925 | 0.00019 | 0.00309 | 0.49253 | **4.76%** |
| **1998** | 0.45633 | 0.00018 | 0.00288 | 0.45939 | 0.04182 | 0.00002 | 0.00026 | 0.0421 | 0.49816 | 0.0002 | 0.00314 | 0.5015 | **3.51%** |
| **1999** | 0.42438 | 0.00018 | 0.00245 | 0.427 | 0.03816 | 0.00002 | 0.00022 | 0.0384 | 0.46254 | 0.0002 | 0.00267 | 0.46541 | **3.94%** |
| **2000** | 0.44628 | 0.00019 | 0.00267 | 0.44914 | 0.04084 | 0.00002 | 0.00024 | 0.04111 | 0.48712 | 0.00021 | 0.00292 | 0.49024 | **3.82%** |
| **2001** | 0.46725 | 0.0002 | 0.00289 | 0.47034 | 0.04375 | 0.00002 | 0.00027 | 0.04404 | 0.511 | 0.00022 | 0.00316 | 0.51438 | **2.78%** |
| **2002** | 0.45378 | 0.0002 | 0.00272 | 0.4567 | 0.04083 | 0.00002 | 0.00024 | 0.04109 | 0.49461 | 0.00022 | 0.00296 | 0.49779 | **2.24%** |
| **2003** | 0.47537 | 0.00021 | 0.00294 | 0.47853 | 0.04398 | 0.00002 | 0.00027 | 0.04427 | 0.51936 | 0.00023 | 0.00322 | 0.5228 | **0.57%** |
| **2004** | 0.47033 | 0.00021 | 0.00283 | 0.47337 | 0.04487 | 0.00002 | 0.00027 | 0.04516 | 0.51521 | 0.00022 | 0.0031 | 0.51853 | **1.97%** |
| **2005** | 0.46359 | 0.00022 | 0.00291 | 0.46673 | 0.03621 | 0.00002 | 0.00023 | 0.03646 | 0.49981 | 0.00023 | 0.00314 | 0.50318 | **2.16%** |
| **2006** | 0.49263 | 0.00022 | 0.00322 | 0.49608 | 0.03831 | 0.00002 | 0.00025 | 0.03857 | 0.53094 | 0.00024 | 0.00347 | 0.53465 | **1.97%** |
| **2007** | 0.49054 | 0.00024 | 0.00303 | 0.49381 | 0.03884 | 0.00002 | 0.00024 | 0.0391 | 0.52939 | 0.00025 | 0.00327 | 0.53291 | **1.37%** |
| **2008** | 0.48219 | 0.00026 | 0.00286 | 0.48531 | 0.03883 | 0.00002 | 0.00023 | 0.03908 | 0.52102 | 0.00028 | 0.00309 | 0.52439 | **2.91%** |
| **2009** | 0.44917 | 0.00027 | 0.00261 | 0.45205 | 0.03838 | 0.00002 | 0.00022 | 0.03863 | 0.48755 | 0.00029 | 0.00284 | 0.49068 | **0.80%** |

| Data Year | Emission Factor, $kgCO_2e$ / kWh | | | | | | | | | | | | % Net Elec Imports |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | For electricity GENERATED (supplied to the grid, plus imports) | | | | Due to grid transmission /distribution LOSSES | | | | For electricity CONSUMED (includes grid losses) | | | | |
| | $CO_2$ | $CH_4$ | $N_2O$ | Total | $CO_2$ | $CH_4$ | $N_2O$ | Total | $CO_2$ | $CH_4$ | $N_2O$ | Total | TOTAL |
| **2010** | 0.45706 | 0.00028 | 0.00267 | 0.46002 | 0.03611 | 0.00002 | 0.00021 | 0.03634 | 0.49317 | 0.0003 | 0.00289 | 0.49636 | **0.73%** |
| **2011** | 0.44238 | 0.00029 | 0.00281 | 0.44548 | 0.03783 | 0.00002 | 0.00024 | 0.03809 | 0.4802 | 0.00031 | 0.00305 | 0.48357 | **1.76%** |
| **2012** | 0.49023 | 0.00033 | 0.00369 | 0.49426 | 0.04287 | 0.00003 | 0.00032 | 0.04322 | 0.5331 | 0.00036 | 0.00402 | 0.53748 | **3.40%** |
| **2013** | 0.4585 | 0.00035 | 0.00334 | 0.46219 | 0.03786 | 0.00003 | 0.00028 | 0.03816 | 0.49636 | 0.00038 | 0.00362 | 0.50035 | **4.10%** |
| **2014** | 0.40957 | 0.00039 | 0.00209 | 0.41205 | 0.03705 | 0.00003 | 0.00019 | 0.03727 | 0.44662 | 0.00042 | 0.00228 | 0.44932 | **6.44%** |
| **2015** | 0.34885 | 0.00062 | 0.00209 | 0.35156 | 0.03261 | 0.00006 | 0.00020 | 0.03287 | 0.38146 | 0.00068 | 0.00229 | 0.38443 | **6.59%** |
| **2016** | 0.28088 | 0.00066 | 0.00153 | 0.28307 | 0.02394 | 0.00006 | 0.00013 | 0.02413 | 0.30482 | 0.00072 | 0.00166 | 0.3072 | **5.57%** |
| **2017** | 0.25358 | 0.00065 | 0.00137 | 0.2556 | 0.02153 | 0.00005 | 0.00012 | 0.0217 | 0.27511 | 0.0007 | 0.00149 | 0.2773 | **4.78%** |
| **2018** | 0.23104 | 0.00072 | 0.00138 | 0.23314 | 0.01987 | 0.00006 | 0.00012 | 0.02005 | 0.25091 | 0.00078 | 0.00150 | 0.25319 | **6.20%** |

Notes: * From 1990-2013 the emission factor used was for French electricity only. The methodology was updated from 2014 onwards with new data on the contribution of electricity from the other interconnects, hence these figures are based on a weighted average emission factor of the conversion factors for France, the Netherlands and Ireland, based on the % share supplied.

Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) / (1 - %Electricity Total Grid LOSSES)

Emission Factor (Electricity LOSSES) = Emission Factor (Electricity CONSUMED) - Emission Factor (Electricity GENERATED)

⇒ Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) + Emission Factor (Electricity LOSSES)

## Indirect/WTT Emissions from UK Grid Electricity

3.13. In addition to the GHG emissions resulting directly from the generation of electricity, there are also indirect/WTT emissions resulting from the production, transport and distribution of the fuels used in electricity generation (i.e. indirect/WTT/-fuel lifecycle emissions as included in the Fuels WTT tables). The average fuel lifecycle emissions per unit of electricity generated will be a result of the mix of different sources of fuel/primary energy used in electricity generation.

3.14. Average WTT conversion factors for electricity have been calculated using the corresponding fuels WTT conversion factors and data on the total fuel consumption by type of generation from Table 5.6, DUKES 2018 (BEIS, 2019b). The data used in these calculations are presented in Table 9, Table 10 and Table 11 with the final WTT conversion factors for electricity.

**Table 9: Fuel Consumed in electricity generation (GWh), by year**

| Data Year | Fuel Consumed in Electricity Generation, GWh | | | | | |
|---|---|---|---|---|---|---|
| | Coal | Fuel Oil | Natural Gas | Other thermal (excl. renewables) | Other generation | Total |
| **1996** | 390,938 | 45,955 | 201,929 | 16,066 | 243,574 | 898,462 |
| **1997** | 336,614 | 25,253 | 251,787 | 16,066 | 257,272 | 886,992 |
| **1998** | 347,696 | 17,793 | 267,731 | 16,046 | 268,184 | 917,450 |
| **1999** | 296,706 | 17,920 | 315,548 | 16,187 | 256,159 | 902,520 |
| **2000** | 333,429 | 18,023 | 324,560 | 15,743 | 228,045 | 919,800 |
| **2001** | 367,569 | 16,545 | 312,518 | 12,053 | 249,422 | 958,107 |
| **2002** | 344,552 | 14,977 | 329,442 | 12,343 | 244,609 | 945,923 |
| **2003** | 378,463 | 13,867 | 323,926 | 17,703 | 241,638 | 975,597 |
| **2004** | 364,158 | 12,792 | 340,228 | 16,132 | 228,000 | 961,309 |
| **2005** | 378,846 | 15,171 | 331,658 | 21,877 | 233,705 | 981,257 |
| **2006** | 418,018 | 16,665 | 311,408 | 18,038 | 224,863 | 988,991 |
| **2007** | 382,857 | 13,491 | 355,878 | 14,613 | 189,813 | 956,652 |
| **2008** | 348,450 | 18,393 | 376,810 | 13,074 | 167,638 | 924,366 |
| **2009** | 286,820 | 17,597 | 359,303 | 11,551 | 213,450 | 888,721 |
| **2010** | 297,290 | 13,705 | 373,586 | 9,322 | 202,893 | 896,796 |
| **2011** | 302,729 | 10,514 | 307,265 | 8,913 | 232,146 | 861,567 |
| **2012** | 399,253 | 9,076 | 214,146 | 12,926 | 230,227 | 865,628 |
| **2013** | 365,697 | 6,849 | 202,325 | 15,198 | 239,526 | 829,594 |
| **2014** | 280,452 | 6,167 | 218,395 | 19,934 | 275,426 | 800,374 |
| **2015** | 212,336 | 7,192 | 212,976 | 23,050 | 323,693 | 779,248 |
| **2016** | 87,669 | 6,790 | 298,077 | 25,319 | 325,774 | 743,630 |
| **2017** | 64,597 | 6,324 | 286,031 | 24,882 | 339,012 | 720,846 |
| **2018** | 49,318 | 5,699 | 273,397 | 26,557 | 343,480 | 698,450 |

Source: For the latest 2018 data year, Table 5.6, Digest of UK Energy Statistics (DUKES) (BEIS, 2019b) is used. Earlier years are based on data reported in previous versions of DUKES and following the new convention set from 2016 update (2014 data year), historic time series factors/data (i.e. prior to the very latest year) have not been updated. No data is available from DUKES on fuel consumed prior to 1996, so it is assumed the shares prior to this were the same as 1996.

### Table 10: Fuel consumed in electricity generation as a % of the Total, by year

| Data Year | Fuel Consumed in Electricity Generation, % Total | | | | | |
|---|---|---|---|---|---|---|
| | Coal | Fuel Oil | Natural Gas | Other thermal (excl. renewables) | Other generation | Total |
| **1990** | 43.50% | 5.10% | 22.50% | 1.80% | 27.10% | 100.00% |
| **1991** | 38.00% | 2.80% | 28.40% | 1.80% | 29.00% | 100.00% |
| **1992** | 37.90% | 1.90% | 29.20% | 1.70% | 29.20% | 100.00% |
| **1993** | 32.90% | 2.00% | 35.00% | 1.80% | 28.40% | 100.00% |
| **1994** | 36.30% | 2.00% | 35.30% | 1.70% | 24.80% | 100.00% |
| **1995** | 38.40% | 1.70% | 32.60% | 1.30% | 26.00% | 100.00% |
| **1996** | 36.40% | 1.60% | 34.80% | 1.30% | 25.90% | 100.00% |
| **1997** | 38.80% | 1.40% | 33.20% | 1.80% | 24.80% | 100.00% |
| **1998** | 37.90% | 1.30% | 35.40% | 1.70% | 23.70% | 100.00% |
| **1999** | 38.60% | 1.50% | 33.80% | 2.20% | 23.80% | 100.00% |
| **2000** | 42.30% | 1.70% | 31.50% | 1.80% | 22.70% | 100.00% |
| **2001** | 40.00% | 1.40% | 37.20% | 1.50% | 19.80% | 100.00% |
| **2002** | 37.70% | 2.00% | 40.80% | 1.40% | 18.10% | 100.00% |
| **2003** | 32.30% | 2.00% | 40.40% | 1.30% | 24.00% | 100.00% |
| **2004** | 33.20% | 1.50% | 41.70% | 1.00% | 22.60% | 100.00% |
| **2005** | 35.10% | 1.20% | 35.70% | 1.00% | 26.90% | 100.00% |
| **2006** | 46.10% | 1.00% | 24.70% | 1.50% | 26.60% | 100.00% |
| **2007** | 43.50% | 5.10% | 22.50% | 1.80% | 27.10% | 100.00% |
| **2008** | 38.00% | 2.80% | 28.40% | 1.80% | 29.00% | 100.00% |
| **2009** | 37.90% | 1.90% | 29.20% | 1.70% | 29.20% | 100.00% |
| **2010** | 32.90% | 2.00% | 35.00% | 1.80% | 28.40% | 100.00% |
| **2011** | 36.30% | 2.00% | 35.30% | 1.70% | 24.80% | 100.00% |
| **2012** | 46.12% | 1.05% | 24.74% | 1.49% | 26.60% | 100.00% |
| **2013** | 44.08% | 0.83% | 24.39% | 1.83% | 28.87% | 100.00% |
| **2014** | 35.04% | 0.77% | 27.29% | 2.49% | 34.41% | 100.00% |
| **2015** | 27.25% | 0.92% | 27.33% | 2.96% | 41.54% | 100.00% |
| **2016** | 11.79% | 0.91% | 40.08% | 3.40% | 43.81% | 100.00% |
| **2017** | 8.96% | 0.88% | 39.68% | 3.45% | 47.03% | 100.00% |
| **2018** | 7.06% | 0.82% | 39.14% | 3.80% | 49.18% | 100.00% |

Notes: Calculated from figures in Table 9

**Table 11: Indirect/WTT emissions share for fuels used for electricity generation and the calculated average indirect/WTT emission factor, by year**

| Data Year | Indirect/WTT Emissions as % Direct $CO_2$ Emissions, by fuel | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Coal | Fuel Oil | Natural Gas | Other thermal (excl. renewables) | Other generation | Weighted Average | Direct $CO_2$ ( (kg $CO_2$/ kWh) | Calc Indirect /WTT (kg $CO_2$e/ kWh |
| **1990** | 16.50% | 18.90% | 10.40% | 12.50% | 14.70% | **14.70%** | 0.6812 | 0.10012 |
| **1991** | 16.50% | 18.90% | 10.40% | 12.50% | 14.70% | **14.70%** | 0.65616 | 0.09644 |
| **1992** | 16.50% | 18.90% | 10.40% | 12.50% | 14.70% | **14.70%** | 0.62005 | 0.09113 |
| **1993** | 16.50% | 18.90% | 10.40% | 12.50% | 14.70% | **14.70%** | 0.55913 | 0.08218 |
| **1994** | 16.50% | 18.90% | 10.40% | 12.50% | 14.70% | **14.70%** | 0.53633 | 0.07883 |
| **1995** | 16.50% | 18.90% | 10.40% | 12.50% | 14.70% | **14.70%** | 0.5113 | 0.07515 |
| **1996** | 16.50% | 18.90% | 10.40% | 12.50% | 14.70% | **14.70%** | 0.48731 | 0.07162 |
| **1997** | 16.50% | 18.90% | 10.40% | 12.50% | 14.10% | **14.10%** | 0.45112 | 0.06345 |
| **1998** | 16.50% | 18.90% | 10.40% | 12.50% | 14.00% | **14.00%** | 0.45633 | 0.06372 |
| **1999** | 16.50% | 18.90% | 10.40% | 12.50% | 13.50% | **13.50%** | 0.42438 | 0.0573 |
| **2000** | 16.50% | 18.90% | 10.40% | 12.50% | 13.60% | **13.60%** | 0.44628 | 0.06079 |
| **2001** | 16.50% | 18.90% | 10.40% | 12.50% | 13.80% | **13.80%** | 0.46725 | 0.06452 |
| **2002** | 16.50% | 18.90% | 10.40% | 12.50% | 13.60% | **13.60%** | 0.45378 | 0.06184 |
| **2003** | 16.50% | 18.90% | 10.40% | 12.50% | 13.80% | **13.80%** | 0.47537 | 0.06545 |
| **2004** | 16.50% | 18.90% | 10.40% | 12.50% | 13.60% | **13.60%** | 0.47033 | 0.06413 |
| **2005** | 16.50% | 18.90% | 10.40% | 12.50% | 13.70% | **13.70%** | 0.46359 | 0.06368 |
| **2006** | 16.50% | 18.90% | 10.40% | 12.50% | 14.00% | **14.00%** | 0.49263 | 0.06888 |
| **2007** | 16.50% | 18.90% | 10.40% | 12.50% | 13.60% | **13.60%** | 0.49054 | 0.06694 |
| **2008** | 16.50% | 18.90% | 10.40% | 12.50% | 13.50% | **13.50%** | 0.48219 | 0.06492 |
| **2009** | 16.50% | 18.90% | 12.40% | 12.50% | 14.30% | **14.30%** | 0.44917 | 0.06423 |
| **2010** | 16.50% | 18.90% | 13.90% | 12.50% | 15.10% | **15.10%** | 0.45706 | 0.069 |
| **2011** | 16.50% | 18.90% | 15.30% | 12.50% | 15.90% | **15.90%** | 0.44238 | 0.07033 |
| **2012** | 16.40% | 18.80% | 13.45% | 12.59% | 15.35% | **15.35%** | 0.49023 | 0.07527 |
| **2013** | 16.38% | 18.92% | 12.62% | 12.59% | 15.02% | **15.02%** | 0.4585 | 0.0689 |
| **2014** | 16.38% | 18.45% | 13.61% | 12.59% | 15.11% | **15.11%** | 0.40957 | 0.06188 |
| **2015** | 16.38% | 19.01% | 16.03% | 12.59% | 16.07% | **16.07%** | 0.34885 | 0.05605 |
| **2016** | 16.38% | 18.99% | 14.63% | 12.59% | 14.95% | **14.95%** | 0.28088 | 0.04198 |
| **2017** | 16.38% | 19.02% | 13.55% | 12.59% | 14.06% | **14.06%** | 0.25358 | 0.03565 |
| **2018** | 16.38% | 19.03% | 13.54% | 12.24% | 13.93% | **13.93%** | 0.23104 | 0.03217 |

Notes: Indirect/WTT emissions as % direct $CO_2$ emissions is based on information for specific fuels. The weighted average is calculated from the figures for fuels from both Table 10 and Table 11.

# 5. Passenger Land Transport Emission Factors

## Section summary

5.1. Conversion factors for passenger land transport are included in this section of the methodology paper. This section includes vehicles owned by the reporting organisation (Scope 1), business travel in other vehicles (e.g. employee own car for business use, hire car, public transport (Scope 3)), and electric vehicles (EVs) (Scope 2). Other Scope 3 conversion factors included here are for transmission and distribution losses for electricity used for electric vehicles, WTT for passenger transport (vehicles owned by reporting organisation) and other business travel.

5.2. Table 14 shows where the related worksheets to the passenger land transport conversion factors are available in the online spreadsheets of the UK GHG Conversion factors.

**Table 14: Related worksheets to passenger land transport emission factors**

| Worksheet name | Full set | Condensed set |
|---|---|---|
| Passenger vehicles | Y | Y |
| UK Electricity for Electric Vehicles (EVs) | Y | Y |
| UK Electricity T&D for EVs | Y | Y |
| Business travel – land* | Y | Y |
| WTT – pass vehicles & travel – land* | Y | N |

* cars and motorbikes only

## Summary of changes since the previous update

5.3. In the 2020 update, there have been amendments to the methodology for calculating conversion factors for cars, relating the type-approval transition from the previous New European Driving Cycle (NEDC) to Worldwide Harmonised Light Vehicle Test Procedure (WLTP) protocol, and the real-world (RW) uplift factor applied to regulatory testing values. The car conversion factors are based on data from the Society of Motor Manufacturers and Traders (SMMT) for regulatory testing of average carbon dioxide per kilometre ($CO_2$/km) and corresponding registrations in the UK by vehicle size (or market segment) and fuel type. An uplift factor is then applied to convert the mean $CO_2$/km data to real-world (RW) estimates, which are not fully captured by the regulatory testing. Due to the type-approval transition, we have sourced new data for the RW uplift factor to apply to new vehicle registrations with $CO_2$ emissions data based on tests under WLTP; this change is expected to be implemented in the 2021 update. This year the data received from SMMT was a mixture of NEDC and NEDC-equivalent values which despite their names, are not equivalent values and a factor was applied to convert the NEDCe values back to NEDC values. Thus, the RW/NEDC uplift factor was taken from the (ICCT, 2017) report.

5.4. The new uplift factor is significantly lower than previous years' factors which is expected as the regulatory testing WLTP $CO_2$ levels are closer to the real-world driving $CO_2$ levels. The impact on the final conversion factors in the 2021 update would be a combination of new cars' registrations and the much lower value of the new-RW uplift factor. The result should show a general continuation of the year-to-year trends in the improvements in the calculated fleet-wide real-world $CO_2$ conversion factors for cars.

5.5. Similar to above on the upcoming changes in the RW uplift factor used for new cars; some changes to the methodology for electric cars will be necessary due to the transition to a new regulatory $CO_2$ emissions testing protocol. Additionally, the factors for the electric operation of plug-in hybrid electric cars, have been revised in the 2020 update to reflect the average proportion of time that vehicles are in the electric operation (which is not already implemented in the EEA $CO_2$ monitoring source database (EEA, 2020a)).

5.6. The impacts will be relatively minor in the final resulting $CO_2$ conversion factors due to the uplift factor changes. However, for PHEVs only, the emissions due to average electricity consumption/km data have been decreased significantly compared to previous year. Smaller reductions for battery electric vehicles (BEVs) compared to previous year are due to a decrease in the $CO_2$ conversion factors for UK electricity.

5.7. Whilst there have been no methodological changes to the calculation of conversion factors relating to motorcycle use, emissions are reducing as more stringent Euro standards (with lower emission factors) penetrate into the fleet and the higher polluting (earlier Euro standards) vehicles are now reducing (in terms of share of vehicle km).

5.8. Rail passenger-km conversion factors have declined significantly for international travel in particular (17% for $CO_2e$), due to decarbonisation in the grid electricity used for the different route sections.

5.9. As with cars and motorcycles, increased penetration of buses satisfying the latest Euro standards causes a decline in $CH_4$ conversion factors in particular, similar to increased bus occupancy rates according to DfT statistics.

# Direct Emissions from Passenger Cars

## Conversion factors for Petrol and Diesel Passenger Cars by Engine Size

5.10. The methodology for calculating average conversion factors for passenger cars is based upon a combination of datasets on the average new vehicle regulatory emissions for vehicles registered in the UK, and an uplift to account for differences between these and real-world driving performance emissions. As mentioned above, the regulatory test cycle/procedures are currently under transition from the previous NEDC to the new WLTP[9] which will apply to new vehicle registrations with $CO_2$ emissions data based on tests under WLTP. The key objective of the change is to bring the results of tests under regulatory testing conditions closer to those observed in the real-world. From 2020, all new light duty vehicles (cars and vans) registered in the EU have WLTP-based regulatory $CO_2$ emissions values. For the reasons mentioned in Section 5.3, this change in RW uplift factors will be implemented in the 2021 update.

5.11. SMMT[10] provides numbers of registrations and averages of the NEDC (or NEDCe) $gCO_2$/km figures for new vehicles registered from 1997 to 2019[11]. The new regulatory testing protocol (WLTP) provides $gCO_2$/km data for new vehicles registered after September 2018. The SMMT dataset represents a good indication of the relative $gCO_2$/km by size and market segment category. Table 15 presents the 2002-2019 average $CO_2$ conversion factors and the number of vehicle registrations.

**Table 15: Average $CO_2$ conversion factors and total registrations by engine size for 2003 to 2019 (based on data sourced from SMMT)**

| Vehicle Type | Engine size | Size label | NEDC* $gCO_2$ per km | Total no. of registrations | % Total |
|---|---|---|---|---|---|
| **Petrol car** | < 1.4 l | Small | 122.9 | 13,123,642 | 58% |
| | 1.4 - 2.0 l | Medium | 160.2 | 8,226,310 | 36% |
| | > 2.0 l | Large | 245.5 | 1,206,127 | 5% |
| **Average petrol car** | | **All** | **147.8** | **22,556,079** | **100%** |
| **Diesel car** | <1.7 l | Small | 108.7 | 5,671,331 | 35% |
| | 1.7 - 2.0 l | Medium | 136.4 | 7,271,673 | 44% |
| | > 2.0 l | Large | 166.9 | 3,440,073 | 21% |
| **Average diesel car** | | **All** | **136.8** | **16,383,077** | **100%** |

* For 2019 and 2018, NEDCe reported data is converted to NEDC, based on an estimated 9% correlation factor from SMMT based on analysis of vehicle models where both NEDC and NEDCe values exist. NEDCe (NEDC equivalent) data are officially reported figures that have been calculated using an official regulatory correlation tool from $CO_2$ emissions data that has been generated based on regulatory testing using WLTP. They are used to check compliance of new vehicle registrations with the EU-wide regulatory $CO_2$ targets set on NEDC basis.

[9] NEDC = New European Driving Cycle, which has been the standard cycle used in the type approval of all new passenger cars and vans historically. From 2017 there has been a phased transition in vehicle testing using the new WLTP (Worldwide Harmonised Light Vehicle Test Procedure); from September 2018 onwards all new cars and vans must have been tested/reported values under WLTP. More information is available on the VCA website: https://www.vehicle-certification-agency.gov.uk/fcb/wltp.asp

[10] SMMT is the Society of Motor Manufacturers and Traders that represents the UK auto industry. http://www.smmt.co.uk/

[11] The SMMT $gCO_2$/km dataset for 1997 represented around 70% of total registrations, which rose to about 99% by 2000 and essentially all vehicles thereafter.

5.12. For the 2020 GHG Conversion factors update, the SMMT data has been used in conjunction with DfT's ANPR (Automatic Number Plate Recognition) data to weight the conversion factors to account for the age and activity distribution of the UK vehicle fleet in 2015. Although ANPR data was received for 2017, it did not provide sufficient disaggregation (on the engine size of the vehicles) and so could not be used in the model without altering the calculations significantly.

5.13. The ANPR data has been collected annually (since 2007) over 256 sites in the UK on different road types (urban and rural major/minor roads, and motorways) and regions. Measurements are made at each site on one weekday (8 am-2 pm and 3 pm-9 pm) and one-half weekend day (either 8 am-2 pm or 3 pm-9 pm) each year in June and are currently available for 2007 - 2011, 2013 - 2015 and 2017. There are approximately 1.4 -1.7 million observations recorded from all the sites each year, and they cover various vehicle and road characteristics such as fuel type, age of the vehicle, engine sizes, vehicle weight and road types.

5.14. Data for the UK car fleet were extracted from the 2015 ANPR dataset and categorised according to their engine size, fuel type and year of registration. The 2020 GHG conversion factors for petrol and diesel passenger cars were subsequently calculated based upon the equation below:

$$2020\ \text{update}\ \text{gCO}_2/\text{km} = \Sigma\left(\text{gCO}_2/\text{km}_{\text{yr reg}} \times \frac{\text{ANPR}_{\text{yr reg}}}{\text{ANPR}_{\text{total 2015}}}\right)$$

5.15. A limitation of the NEDC is that it takes no account of further ‘real-world’ effects that can have a significant impact on fuel consumption. These include use of accessories (air conditioning, lights, heaters etc.), vehicle payload (only driver +25kg is considered in tests, no passengers or further luggage), poor maintenance (tyre under inflation, maladjusted tracking, etc.), gradients (tests effectively assume a level road), weather, more aggressive driving style, etc. It is therefore desirable to uplift NEDC based data to bring it closer to anticipated ‘real-world’ vehicle performance.

5.16. An uplift factor over NEDC based $gCO_2$/km factors is applied to account for the combined ‘real-world’ effects on fuel consumption. The uplift applied varies over time and is based on work performed by (ICCT, 2017); this study used data on almost 1.1 million vehicles from fourteen data sources and eight countries, covering the fuel consumption/$CO_2$ from actual real-world use and the corresponding type-approval values. The values used are based on average data from the two UK-based sources analysed in the ICCT study, as summarised in Table 16 below, and illustrated in Figure 2 alongside the source data/chart reproduced from the ICCT (2017) report. This is an update to the previous report used for the 2019 update to the GHG Conversion factors.  The methodology will need to be further revised for future updates when WLTP-based dataset will become the norm for all new light duty vehicles (cars and vans).

**Table 16: Average GCF 'real-world' uplift for the UK, applied to the NEDC-based $gCO_2/km$ data**

| Data year | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|
| RW uplift % | 9.70% | 10.80% | 11.90% | 13.00% | 15.65% | 18.30% | 20.95% | 23.60% |
| Data year | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** |
| RW uplift % | 26.25% | 27.63% | 29.00% | 33.33% | 41.50% | 38.00% | 31.50% | 31.50% |

5.17. The above uplifts have been applied to the ANPR weighted SMMT $gCO_2/km$ to give the new 'Real-World' 2020 GHG Conversion factors, to take into account the 'real-world' impacts on fuel consumption not captured by drive cycles such as the NEDC in type-approval. The final average equivalent uplift averaged across all vehicles was 22.9% on top of NEDC $gCO_2/km$.

5.18. Figures for the aggregated average conversion factors by engine type and fuel type (as well as the overall average) were calculated based on weighting by the relative mileage of the different categories. This calculation utilised data from the UK GHG Inventory on the relative % total mileage by petrol and diesel cars. Overall, for petrol and diesel, this split in total annual mileage was 50.5% petrol and 49.5% diesel, and can be compared to the respective total registrations of the different vehicle types for 2003-2019, which were 57.9% petrol and 42.1% diesel.

5.19. Conversion factors for $CH_4$ and $N_2O$ have been updated for all vehicle classes and are based on the emission factors from the UK GHGI. The emission factors used in the UK GHGI are based on COPERT 4 version 11 (EMISIA, 2019).

5.20. The final 2020 conversion factors for petrol and diesel passenger cars by engine size are presented in the 'Passenger vehicles' and 'Business travel- land' worksheets of the 2020 GHG Conversion factors set.

**Figure 2: Updated GCF 'Real world' uplift values for the UK based on (ICCT, 2017)**

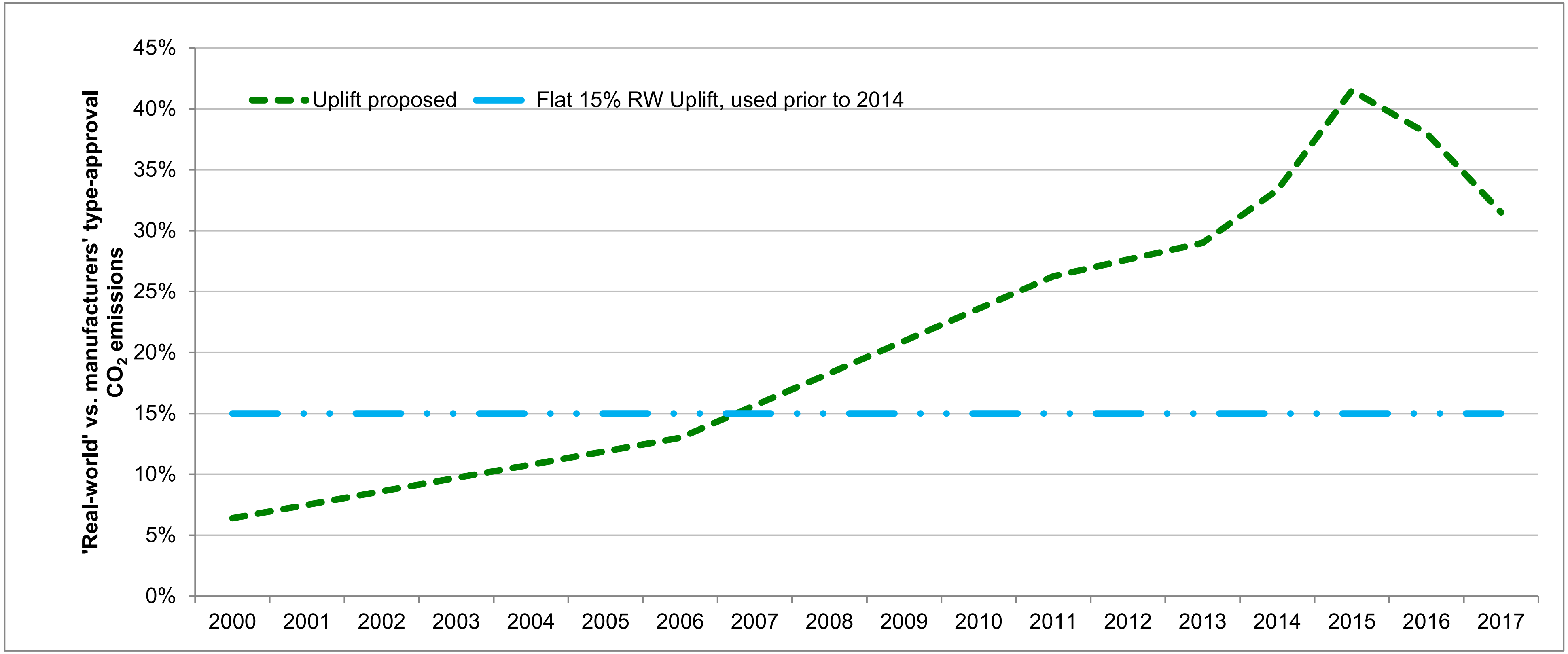
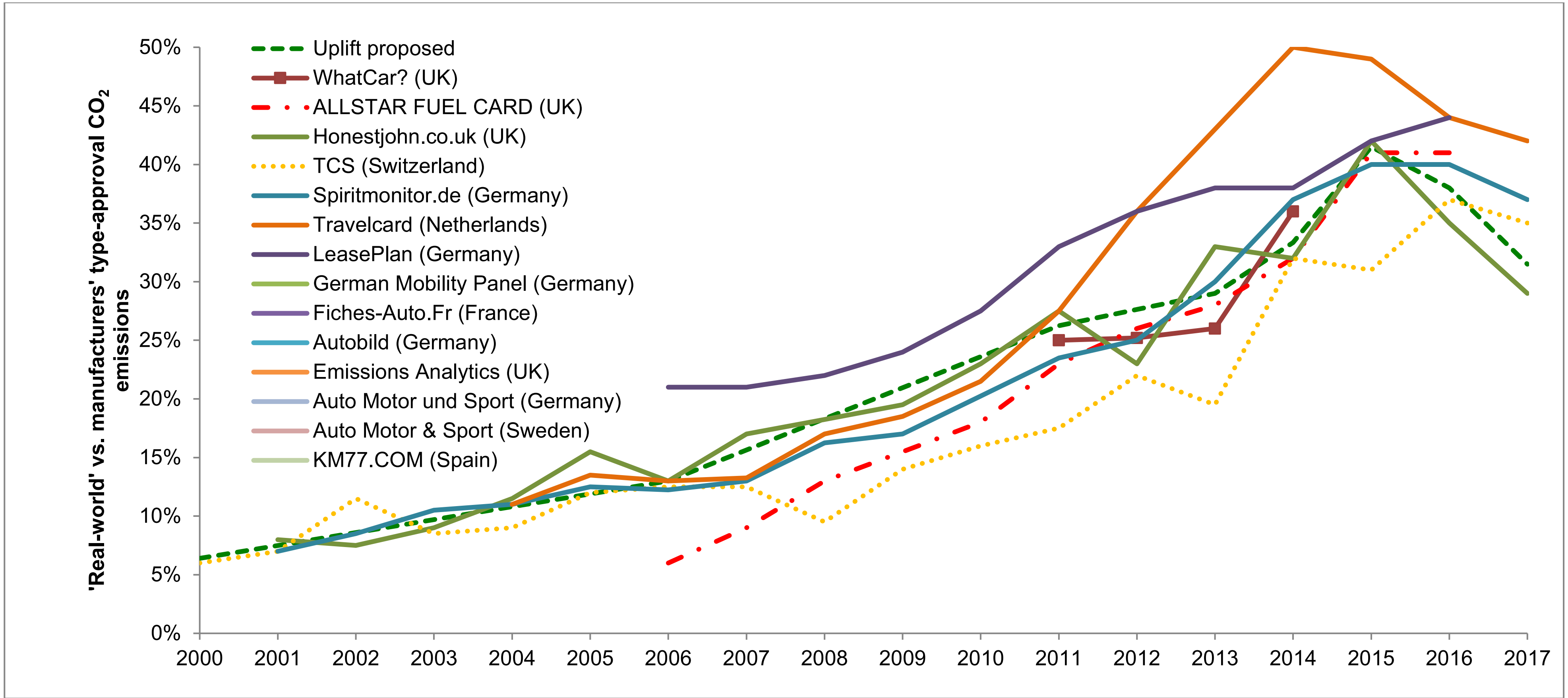


**Figure 3: Comparison of 'Real world' uplift values from various sources (ICCT, 2017)**




Notes: In the above charts a y-axis value of 0% would mean no difference between the $CO_2$ emissions per km experienced in 'real-world' driving conditions and those from official type-approval testing protocol.

## Hybrid, LPG and CNG Passenger Cars

5.21. The methodology used in the 2020 update for small, medium and large hybrid petrol/diesel electric cars is similar to that used previously and is calculated in a similar way to conventional petrol and diesel vehicles. The conversion factors are based on datasets with numbers of registrations and averages of the NEDC $gCO_2/km$ figures from SMMT for new hybrid vehicles registered between 2012 and 2019. The SMMT source dataset used in the derivation of passenger car conversion factors included plug-in hybrid cars within the hybrid category, which have not been used in this cars model.

5.22. Due to the significant size and weight of the LPG and CNG fuel tanks, it is assumed only medium and large sized vehicles are available. In the 2020 GHG Conversion factors, $CO_2$ conversion factors for CNG and LPG medium and large cars are derived by multiplying the equivalent petrol EF by the ratio of CNG (and LPG) to petrol conversion factors on a unit energy (Net CV) basis. For example, for a Medium car run on CNG:

$$\mathrm{gCO_2/km_{CNG\ Medium\ car}} = \mathrm{gCO_2/km_{Petrol\ Medium\ car}} \times \frac{\mathrm{gCO_2/kWh_{CNG}}}{\mathrm{gCO_2/kWh_{Petrol}}}$$

5.23. For the 2020 GHG Conversion factors, the conversion factors for $CH_4$ and $N_2O$ were updated for all vehicle classes, but the methodology remains unchanged. These are based on the emission factors from the UK GHGI (Ricardo Energy & Environment, 2020).

## Plug-in Hybrid Electric and Battery Electric Passenger Cars (xEVs)

5.24. Since the number of electric vehicles (xEVs[12]) in the UK fleet is rapidly increasing (and will continue to increase in the future), at least for passenger cars and vans, there is a need for specific conversion factors for such vehicles to complement conversion factors for vehicles fuelled primarily by petrol, diesel, natural gas or LPG.

5.25. These conversion factors are currently presented in a number of data tables in the GHG Conversion factors workbook, according to the type / ‘Scope’ of the emission component. The following tables / worksheets, shown in Table 17, are required for BEVs (battery electric vehicles) and PHEVs (plug-in hybrid electric vehicles), and related REEVs (range-extended electric vehicles). Since there are still relatively few models available on the market, all PHEVs and REEVs are grouped into a single category. There are not yet meaningful numbers of fuel cell electric vehicles (FCEVs) in use, so these are not included at this time.

5.26. Table 17 provides an overview of the GHG Conversion Factor tables that have been developed for the reporting of emissions from electric vehicles, which aligns with current reporting.

[12] xEVs is a generic term used to refer collectively to battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), range-extended electric vehicles (REEVs, or ER-EVs, or REX) and fuel cell electric vehicles (FCEVs).

**Table 17: Summary of emissions reporting and tables for new electric vehicle emission factors**

| Emission component | Emissions Scope and Reporting Worksheet | Plug-in hybrid electric vehicles (PHEVs) | Battery electric vehicles (BEVs) |
|---|---|---|---|
| Direct emissions from the use of petrol or diesel | **Scope 1:**<br>• Passenger vehicles<br>• Delivery vehicles | Yes | (Zero emissions) |
| Emissions resulting from electricity use:<br>(a) Electricity Generation<br>(b) Electricity Transmission & Distribution losses | **(a) Scope 2:**<br>• UK electricity for EVs<br>**(b) Scope 3:**<br>• UK electricity T&D for EVs | Yes | Yes |
| Upstream emissions from the use of liquid fuels and electricity | **Scope 3:**<br>• WTT- passenger vehicles & travel- land<br>• WTT- delivery vehicles & freight | Yes | Yes |
| Total GHG emissions for all components for not directly owned /controlled assets | **Scope 3:**<br>• Business travel- land<br>• Freighting goods<br>• Managed assets- vehicles | Yes | Yes |

## Data inputs, sources and key assumptions

5.27. A number of data inputs and assumptions were needed to calculate the final GHG conversion factors for electric cars and vans. Table 18 provides a summary of the key data inputs, the key data sources and other assumptions used for the calculation of the final xEV conversion factors.

5.28. The calculation of UK fleet average conversion factors for electric vehicles is based upon data obtained from the EEA $CO_2$ monitoring databases for cars and vans, which are publicly available (EEA, 2020a), (EEA, 2020b). These databases provide details by manufacturer and vehicle type (and by EU member state) on the annual number of registrations and test cycle performance for average $CO_2$ emissions ($gCO_2$/km) and electrical energy consumption (Wh/km, for plug-in vehicles). This allows for the classification of vehicles into market segments and the calculation of registrations weighted average performance figures. The xEV models included in the current databases (which cover registrations up to the end of 2018) and their allocation to different market segments, are presented in Table 18. To calculate the corresponding conversion factors for the tables split by car 'size' category, it is assumed segments A and B are 'Small' cars, segments C and D are 'Medium' cars and all other segments are 'Large' cars.

**Table 18: xEV car models and their allocation to different market segments**

| Make | Model | Segment | Segment Name | BEV | PHEV |
|---|---|---|---|---|---|
| Audi | A3 | C | Lower Medium | - | Yes |
| Audi | Q7 | H | Dual Purpose | - | Yes |
| BMW | I3 | B | Supermini | Yes | - |
| BMW | I3 REEV | B | Supermini | - | Yes |
| BMW | I8 | G | Specialist Sports | - | Yes |
| BMW | Series 2 | C | Lower Medium | - | Yes |
| BMW | Series 3 | D | Upper Medium | - | Yes |
| BMW | Series 5 | E | Executive | - | Yes |
| BMW | Series 7 | F | Luxury Saloon | - | Yes |
| BMW | X5 | H | Dual Purpose | - | Yes |
| BYD | E6Y | C | Lower Medium | Yes | - |
| Chevrolet | Volt | C | Lower Medium | - | Yes |
| Citroen | C-Zero | A | Mini | Yes | - |
| Ford | Focus | C | Lower Medium | Yes | - |
| Ford | Mondeo | D | Upper Medium | - | Yes |
| Hyundai | Ioniq | C | Lower Medium | Yes | Yes |
| Hyundai | Kona | H | Dual Purpose | Yes | - |
| Jaguar | I-Pace | H | Dual Purpose | Yes | - |
| Kia | Niro | H | Dual Purpose | - | Yes |
| Kia | Optima | D | Upper Medium | - | Yes |
| Kia | Soul | C | Lower Medium | Yes | - |
| Land rover | Range Rover | H | Dual Purpose | - | Yes |
| Mahindra | E20PLUS | C | Lower Medium | Yes | - |
| Mclaren | P1 | G | Specialist Sports | - | Yes |
| Mercedes-Benz | B Class | C | Lower Medium | Yes | - |
| Mercedes-Benz | C Class | D | Upper Medium | - | Yes |
| Mercedes-Benz | E Class | E | Executive | - | Yes |
| Mercedes-Benz | GL | H | Dual Purpose | - | Yes |
| Mercedes-Benz | S Class | F | Luxury Saloon | - | Yes |
| Mia | MIA | A | Mini | Yes | - |
| Mini | Countryman | C | Lower Medium | - | Yes |
| Mitsubishi | I-MIEV | A | Mini | Yes | - |
| Mitsubishi | Outlander | H | Dual Purpose | - | Yes |
| Nissan | E-NV200 | I | Multi-Purpose Vehicle | Yes | - |
| Nissan | Leaf | C | Lower Medium | Yes | - |
| Opel | Ampera | D | Upper Medium | - | Yes |
| Peugeot | ION | A | Mini | Yes | - |
| Porsche | 918 | G | Specialist Sports | - | Yes |

| | | | | | |
|---|---|---|---|---|---|
| Porsche | Cayenne | H | Dual Purpose | - | Yes |
| Porsche | Panamera | F | Luxury Saloon | - | Yes |
| Renault | Fluence Z.E. | D | Upper Medium | Yes | - |
| Renault | Kangoo | I | Multi-Purpose Vehicle | Yes | - |
| Renault | Zoe | C | Lower Medium | Yes | - |
| Smart | ForFour | B | Supermini | Yes | - |
| Smart | ForTwo | A | Mini | Yes | - |
| Tesla | Model S | F | Luxury Saloon | Yes | - |
| Tesla | Model X | H | Dual Purpose | Yes | - |
| Tesla | Roadster | G | Specialist Sports | Yes | - |
| Think | Thinkcity | A | Mini | Yes | - |
| Toyota | Prius | C | Lower Medium | - | Yes |
| Volkswagen | E-Golf | C | Lower Medium | Yes | - |
| Volkswagen | E-Up | A | Mini | Yes | - |
| Volkswagen | Golf | C | Lower Medium | - | Yes |
| Volkswagen | Passat | D | Upper Medium | - | Yes |
| Volvo | S90 | E | Executive | - | Yes |
| Volvo | V60 | D | Upper Medium | - | Yes |

Notes: Only includes models with registrations in the UK fleet up to the end of 2018 (EEA, 2020a).

5.29. During the derivation of the conversion factors, many discrepancies were found in the EEA $CO_2$ monitoring databases for the $gCO_2$/km and Wh/km data for certain models, which were then updated based on other sources of official regulatory type-approval data, for example from manufacturer's websites and the Green Car Guide (Green Car Guide, 2018).

5.30. Consistent with the approach used for the calculation of conversion factors for conventionally fuelled passenger cars, the $gCO_2$/km and Wh/km figures from type approval with NEDC need adjusting to account for real-world performance (charging losses are already accounted for under the type approval methodology (VDA, 2014)). Several assumptions are therefore made in order to calculate adjusted 'Real-World' energy consumption and emission factors, consistent with the approach for conventionally fuelled passenger cars. These assumptions were discussed and agreed with DfT.

5.31. As for conventional vehicles (see earlier section for petrol and diesel cars), there has been a transition to the new regulatory test – WLTP, however NEDCe values are still reported (for checking compliance with EU $CO_2$ targets for new cars and vans for 2021/2020 respectively). In addition, reported electricity consumption for BEVs and PHEVs up to the end of 2019 has still been based on the previous NEDC testing regime, and data on the new WLTP basis will not be reported until the 2020 year. Therefore, the GHG CF calculations for xEVs are unchanged for the 2020 update but will be amended from the 2021 update to reflect the change in the data for new vehicle registrations from 2020.

5.32. A further complication for PHEVs is that the real-world electric range is lower than that calculated on the standard regulatory testing protocol, which also needs to be accounted for in the assumption of the average share of total km running on electricity. Figure 4 illustrates the utility function used to calculate the share of electric km based on the electric range of a PHEV. Real-World factors for average $gCO_2$/km and Wh/km for PHEVs are therefore further adjusted based on the ratio of calculated electric shares of total km under Test-Cycle and Real-World conditions.

5.33. The key assumptions used in the calculation of adjusted Real-World $gCO_2$/km and Wh/km figures are summarised in Table 19. The calculated real-world figures for individual vehicle models are used to calculate the final registrations-weighted average factors for different vehicle segments/sizes. These are then combined with other GHG Conversion factors to calculate the final set of conversion factors for different Scopes/reporting tables (i.e. as summarised in earlier Table 17).

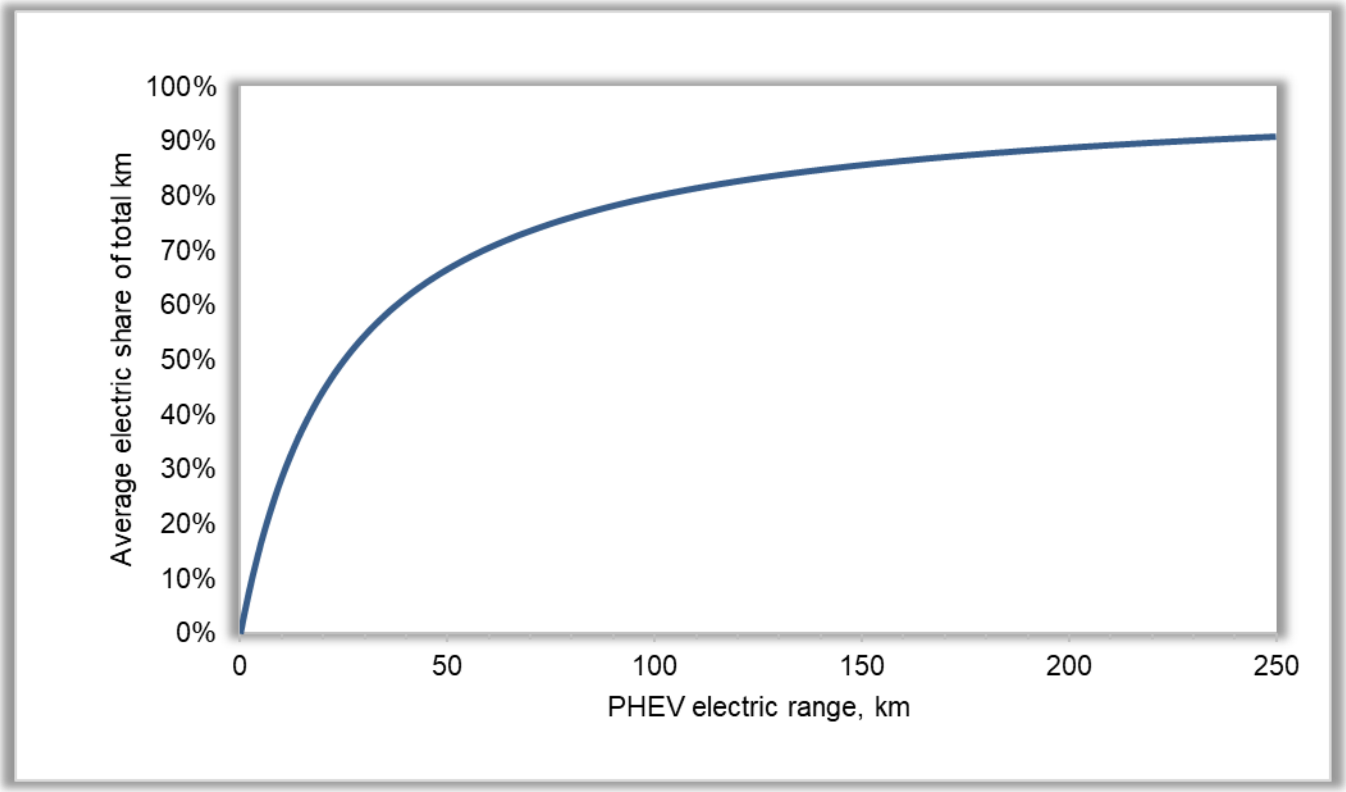
**Table 19: Summary of key data elements, sources and key assumptions used in the calculation of GHG conversion factors for electric cars and vans**

| Data type | Raw data source | Other notes |
|---|---|---|
| Numbers of registrations of different vehicle types/models | Reported for GB by vehicle make/model in EEA $CO_2$ monitoring databases:<br>• Data for 2010-2018 for cars<br>• Data for 2012-2018 for vans | This data is used in conjunction with $CO_2$/km and Wh/km data to calculate registrations-weighted average figures by market segment or vehicle size category. |
| $CO_2$ emissions from petrol or diesel fuel use per km (test-cycle) | As for registrations | Zero for BEVs. For PHEVs, the conversion factors are for the average share of km driven in charge-sustaining mode / average liquid fuel consumption per km. |
| Wh electricity consumption per km (test-cycle) | As for registrations | Average electricity consumption per average km (i.e. factoring in for PHEVs that only a fraction of total km will be in electric mode). |
| Test-Cycle to Real-World conversion for $gCO_2$ / km | Assumption based on literature, consistent with the source used for the car EFs for conventional powertrains. | An uplift of **35%** is applied to the test-cycle emission component. |
| Test-Cycle to Real-World conversion for Wh per km | Assumption based on best available information on the average difference between test-cycle and real-world performance | An uplift of **40%** is applied to the test-cycle electrical energy consumption component. This is consistent with the uplift currently being used in the analysis for the EC DG CLIMA, developed/agreed with the EC's JRC. |

| | | |
|---|---|---|
| Electric range for PHEVs under Test-Cycle conditions | Available from various public sources for specific models | Values representative of the models currently available on the market are used, i.e. generally between 30-50km. The notable exception is the BMW i3 REX, which was 200km up to 2015. |
| Electric range for PHEVs under Real-World conditions | Calculated based on Test-Cycle electric range and Test-Cycle to Real-World conversion for Wh per km | Calculated based on Test-Cycle electric range and Test-Cycle to Real-World conversion for Wh/km |
| Share of electric km on Test-Cycle | Calculated using the standard formula used in type-approval*: **Electric km %** = 1 – (25 / (25 + Electric km range)) | Uses Test-Cycle electric range in km |
| Share of electric km in Real-World conditions | Calculated using standard formula*: **Electric km %** = 1 – (25 / (25 + Electric km range)) | Uses Real-World electric range in km |
| Loss factor for electric charging | N/A | Charging losses are already accounted for under the type approval testing protocol in the Wh/km dataset. |
| GHG conversion factors for electricity consumption | UK electricity conversion factors (kg$CO_2$e / kWh):<br>• Electricity generated<br>• Electricity T&D<br>• WTT electricity generated<br>• WTT electricity T&D | From the UK GHG Conversion factors model outputs for UK Electricity |
| $CH_4$, $N_2O$ and WTT $CO_2$e emissions from petrol /diesel use | Calculated based on derived Real-World g/km for petrol /diesel. | Calculation uses GHG Conversion factors for petrol/diesel: uses the ratio of direct $CO_2$ emission component to $CH_4$, $N_2O$ or WTT $CO_2$e component for petrol/diesel. |

Notes: * the result of this formula is illustrated in Figure 4 below.

**Figure 4: Illustration of the relationship of electric range to average electric share of total km for PHEVs assumed in the calculations**




Notes: Calculated by Ricardo based on the standard formula used for NEDC: Electric km % = 1 – (25 / (25 + Electric km range))

## Conversion factors by Passenger Car Market Segments

5.34. For the 2020 GHG Conversion factors, the market classification split (according to SMMT classifications) was derived using detailed SMMT data on new car registrations between 2011 and 2019 split by fuel, presented in Table 20, and again combining this with information extracted from the 2015 ANPR dataset. These data were then uplifted to take into account ‘real-world’ impacts, consistent with the methodology used to derive the car engine size emission factors. The supplementary market segment based conversion factors for passenger cars are presented in the ‘Passenger vehicles’ and ‘Business travel- land’ worksheets of the 2020 GHG Conversion factors set.

5.35. Conversion factors for $CH_4$ and $N_2O$ were also updated for all car classes. These figures are based on the conversion factors from the UK GHG Inventory (Ricardo Energy & Environment, 2020). The emission factors used in the UK GHGI are now based on COPERT 4 version 11 (EMISIA, 2019). The factors are presented together with the overall total conversion factors in the tables of the 2020 GHG Conversion factors set.

5.36. As a final additional step, an accounting for biofuel use has been included in the calculation of the final passenger car emission factors.

**Table 20: Average car $CO_2$ conversion factors and total registrations by market segment for 2003 to 2019 (based on data sourced from SMMT)**

| Fuel Type | Market Segment | Example Model | 2003 to 2019 | | |
|---|---|---|---|---|---|
| | | | $gCO_2$/km | # registrations | % Total |
| Diesel | A. Mini | Smart Fortwo | 90.7 | 7,809 | 0.0% |
| | B. Super Mini | VW Polo | 104.8 | 1,838,553 | 11.22% |
| | C. Lower Medium | Ford Focus | 114.8 | 4,799,232 | 29.29% |
| | D. Upper Medium | Toyota Avensis | 133.4 | 3,460,106 | 21.12% |
| | E. Executive | BMW 5-Series | 135.8 | 1,406,074 | 8.58% |
| | F. Luxury Saloon | Bentley Continental GT | 164.9 | 83,936 | 0.51% |
| | G. Specialist Sports | Mercedes SLK | 136.3 | 119,736 | 0.73% |
| | H. Dual Purpose | Land Rover Discovery | 153.5 | 3,334,546 | 20.35% |
| | I. Multi Purpose | Renault Espace | 144.3 | 1,333,086 | 8.14% |
| | **All** | **Total** | **136.8** | **16,383,078** | **100%** |
| Petrol | A. Mini | Smart Fortwo | 110.6 | 870,648 | 3.85% |
| | B. Super Mini | VW Polo | 125.4 | 11,338,480 | 50.14% |
| | C. Lower Medium | Ford Focus | 146.7 | 5,939,356 | 26.27% |
| | D. Upper Medium | Toyota Avensis | 177.0 | 1,487,403 | 6.58% |
| | E. Executive | BMW 5-Series | 199.4 | 432,915 | 1.91% |
| | F. Luxury Saloon | Bentley Continental GT | 287.9 | 79,342 | 0.35% |
| | G. Specialist Sports | Mercedes SLK | 209.4 | 728,242 | 3.22% |
| | H. Dual Purpose | Land Rover Discovery | 185.5 | 1,032,868 | 4.57% |
| | I. Multi Purpose | Renault Espace | 164.9 | 702,606 | 3.11% |
| | **All** | **Total** | **147.8** | **22,611,860** | **100%** |
| Unknown Fuel (Diesel + Petrol) | A. Mini | Smart Fortwo | 109.3 | 878,457 | 2.25% |
| | B. Super Mini | VW Polo | 120.8 | 13,177,033 | 33.79% |
| | C. Lower Medium | Ford Focus | 131.7 | 10,738,588 | 27.54% |
| | D. Upper Medium | Toyota Avensis | 145.5 | 4,947,509 | 12.69% |
| | E. Executive | BMW 5-Series | 148.8 | 1,838,989 | 4.72% |
| | F. Luxury Saloon | Bentley Continental GT | 213.1 | 163,278 | 0.42% |
| | G. Specialist Sports | Mercedes SLK | 190.1 | 847,978 | 2.17% |
| | H. Dual Purpose | Land Rover Discovery | 158.3 | 4,367,414 | 11.20% |
| | I. Multi Purpose | Renault Espace | 151.6 | 2,035,692 | 5.22% |
| | **All** | **Total** | **141.9** | **38,994,938** | **100%** |

# Direct Emissions from Taxis

5.37. The conversion factors for black cabs are based on data provided by Transport for London (TfL)[13] on the testing of emissions from black cabs using real-world London Taxi cycles, and an average passenger occupancy of 1.5 (average 2.5 people per cab, including the driver) from LTI, 2007 – a more recent source has not yet been identified. This methodology accounts for the significantly different operational cycle of black cabs/taxis in the real world when compared to the NEDC (official vehicle type-approval) values, which significantly increases the emission factor (by ~40% vs NEDC).

5.38. The conversion factors (per passenger km) for regular taxis were estimated based on the average type-approval $CO_2$ factors for medium and large cars, uplifted by the same factor as for black cabs (i.e. 40%, based on TfL data) to reflect the difference between the type-approval figures and those operating a real-world taxi cycle (i.e. based on different driving conditions to average car use), plus an assumed average passenger occupancy of 1.4 (L.E.K. Consulting, 2002).

5.39. Conversion factors per passenger km for taxis and black cabs are presented in the 'Business travel- land' worksheet of the 2020 GHG Conversion factors set. The base conversion factors per vehicle km are also presented in the 'Business travel-land' worksheet of the 2020 GHG Conversion factors set.

5.40. Conversion factors for $CH_4$ and $N_2O$ have been updated for all taxis for the 2020 update. These figures are based on the conversion factors for diesel cars from the latest UK GHG Inventory (Ricardo Energy & Environment, 2020) and are presented together with the overall total conversion factors in the 'Business travel-land' worksheet of the 2020 GHG Conversion factors set.

5.41. It should be noted that the current conversion factors for taxis still do not take into account emissions spent from "cruising" for fares. Currently, robust data sources do not exist that could inform such an "empty running" factor. If suitably robust sources are identified in the future, the methodology for taxis may be revisited and revised in a future update to account for this.

[13] The data was provided by TfL in a personal communication and is not available in a public TfL source.

# Direct Emissions from Vans/Light Goods Vehicles (LGVs)

5.42. Average conversion factors by fuel, for vans/light good vehicles (LGVs: N1 vehicles, vans up to 3.5 tonnes gross vehicle weight - GVW) and by size (Class I, II or III) are presented in Table 21 and in the "Delivery vehicles" worksheet of the 2020 GHG Conversion factors set. The methodology for calculating the $CO_2$ conversion factors for different LGV size classes (from the average LGV values based on the UK GHGI) has been amended, also for consistency with changes made to the dataset on payload capacity (see later section of this report on the freight emissions factors for vans/LGVs). In previous years (up to the 2018 update), older data from the UK GHGI (now no longer available) was used to estimate the relative performance of vans of different size classes.

5.43. Conversion factors for petrol and diesel vans/LGVs are based upon emission factors and vehicle km for average sized LGVs from the UK GHGI for 2018. $CO_2$ emissions factors for different size classes are estimated relative to quantitative analysis of (EEA, 2020b) dataset, as outlined below in more detail. These conversion factors are further uplifted by 15% to represent 'real-world' emissions (i.e. also factoring in typical vehicle loading versus unloaded test-cycle based results), consistent with the previous approach used for cars, and agreed with DfT in the absence of a similar time-series dataset of 'real-world' vs type-approval emissions from vans (see earlier section on passenger cars). In a future update, it is envisaged this uplift will be further reviewed.

5.44. The dataset used to allocate different vehicles to each van class is based on a reference weight (approximately equivalent to kerb weight plus 60kg). Previously (up to the 2018 update) this was based on an extraction for a single year from the SMMT MVRIS (Motor Vehicle Registration Information System) database. From the 2019 update, this has been updated to be based on the same dataset as the updated payload assumptions - i.e. information from EEA new van $CO_2$ monitoring database (EEA, 2020b). The new dataset used has now been updated to be based on data from 2012 (the first year for which data was available) to the most recent year available (currently up to the end of 2018). The assumed split of petrol and diesel van stock between size classes uses the split of registrations from this dataset. The relative $CO_2$ emissions performance of different petrol/diesel van size categories is based on a registrations-weighted average from this dataset. This change in dataset/methodology has resulted in significant changes in the absolute $CO_2$ emissions, and relative differences, by van size class. However, the new data are based on a more recent and extensive dataset, so should be much more representative of the current UK fleet. Importantly, this dataset is consistent with the new data used to calculate the average van loading capacity from 2020 (see later section on van freight emission factors), and will be updatable in future years as new data becomes available from the EEA $CO_2$ monitoring database (EEA, 2020b).

5.45. In the 2020 update, $CO_2$ conversion factors for CNG and LPG vans are calculated from the conversion factors for conventionally fuelled vans using the same methodology as for passenger cars. The average van conversion factor is calculated based on the relative UK GHGI vehicle km for petrol and diesel vans for 2018, as presented in Table 21.

5.46. Conversion factors for $CH_4$ and $N_2O$ were also updated for all van classes, based on the conversion factors from the UK GHG Inventory (Ricardo Energy & Environment, 2020).

5.47. As a final additional step, an accounting for biofuel use has been included in the calculation of the final vans/LGVs emission factors.

**Table 21: New conversion factors for vans for the 2020 GHG Conversion factors**

| Van fuel | Van size | Direct $gCO_2e$ per km | | | | vkm | Payload Capacity |
|---|---|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | Total | % split | Tonnes |
| Petrol (Class I) | Up to 1.305 tonne | 210.0 | 0.2 | 0.6 | 210.8 | 15.4% | 0.52 |
| Petrol (Class II) | 1.305 to 1.740 tonne | 207.1 | 0.2 | 0.6 | 207.9 | 75.5% | 0.76 |
| Petrol (Class III) | Over 1.740 tonne | 331.9 | 0.2 | 0.6 | 332.8 | 9.0% | 1.01 |
| **Petrol (average)** | **Up to 3.5 tonne** | **218.8** | **0.2** | **0.6** | **219.6** | **100.0%** | **0.75** |
| Diesel (Class I) | Up to 1.305 tonne | 146.7 | 0.0 | 1.8 | 148.5 | 3.9% | 0.49 |
| Diesel (Class II) | 1.305 to 1.740 tonne | 187.2 | 0.0 | 1.8 | 189.0 | 23.9% | 0.79 |
| Diesel (Class III) | Over 1.740 tonne | 269.9 | 0.0 | 1.8 | 271.7 | 72.2% | 1.09 |
| **Diesel (average)** | **Up to 3.5 tonne** | **245.3** | **0.0** | **1.8** | **247.1** | **100.0%** | **1.00** |
| LPG | Up to 3.5 tonne | 271.0 | 0.0 | 0.7 | 271.7 | **100.0%** | 0.99 |
| CNG | Up to 3.5 tonne | 245.2 | 1.2 | 0.7 | 247.1 | **100.0%** | 0.99 |
| **Average** | | **244.4** | **0.0** | **1.8** | **246.2** | **100.0%** | **0.99** |

## Plug-in Hybrid Electric and Battery Electric Vans (xEVs)

5.48. As outlined earlier for cars, since the number of electric cars and vans (xEVs[14]) in the UK fleet is rapidly increasing, there is now a need to include specific conversion factors for such vehicles to complement the existing conversion factors for other vehicle types.

5.49. The methodology, data sources and key assumptions utilised in the development of the conversion factors for xEVs are the same for vans as outlined earlier for cars. These were discussed and agreed with DfT.

[14] xEVs is a generic term used to refer collectively to battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), range-extended electric vehicles (REEVs, or ER-EVs, or REX) and fuel cell electric vehicles (FCEVs).

5.50. It should be noted that only models with registrations in the UK fleet up to the end of 2018 are included in the model.

5.51. Table 22 provides a summary of the vans models registered into the UK market by the end of 2018 (the most recent data year for the source EEA $CO_2$ monitoring database at the time of the development of the 2020 GHG Conversion factors). At this point, there are only battery electric vehicle (BEV) models available in the vans' marketplace.

**Table 22: xEV van models and their allocation to different size categories**

| Make | Model | Van Segment | BEV | PHEV |
|---|---|---|---|---|
| CITROEN | BERLINGO | Class II | Yes | - |
| FORD | TRANSIT CONNECT | Class III | Yes | - |
| GOUPIL | G4 | Class I | Yes | - |
| IVECO | DAILY | Class III | Yes | - |
| MERCEDES | VITO | Class III | Yes | - |
| MIA | MIA | Class I | Yes | - |
| NISSAN | E-NV200 | Class II | Yes | - |
| PEUGEOT | PARTNER | Class II | Yes | - |
| RENAULT | KANGOO | Class II | Yes | - |
| TATA | ACE | Class I | Yes | - |

Notes: Only includes models with registrations in the UK fleet up to the end of 2018

5.52. All other methodological details are as already outlined for xEV passenger cars.

## Direct Emissions from Buses

5.53. The 2015 and earlier updates used data from DfT from the Bus Service Operators Grant (BSOG) in combination with DfT bus activity statistics (vehicle km, passenger km, average passenger occupancy) to estimate conversion factors for local buses. DfT holds very accurate data on the total amount of money provided to bus service operators under the scheme, which provides a fixed amount of financial support per unit of fuel consumed. Therefore, the total amount of fuel consumed (and hence $CO_2$ emissions) could be calculated from this, which when combined with DfT statistics on total vehicle km, bus occupancy and passenger km allow the calculation of emission factors[15].

5.54. From the 2016 update onwards, it was necessary to make some methodological changes to the calculations due to changes in the Scope/coverage of the underlying DfT datasets, which include:

a) BSOG data are now only available for commercial services, and not also for local authority supported services.
b) BSOG data are now only available for England, outside of London: i.e. data are no longer available for London, due to a difference in how funding for the city is managed/provided, nor for other parts of the UK.

5.55. The conversion factors for buses account for additional direct $CO_2$ emissions from the use of selective catalytic reduction (SCR). This technology uses a urea solution (also known as 'AdBlue') to effectively remove $NO_x$ and $NO_2$ from diesel engines' exhaust gases; this process occurs over a specially formulated catalyst. The urea solution is injected into the vehicles' exhaust system before harmful $NO_x$ emissions are generated from the tail pipe. When the fuel is burnt, urea solution is injected into the SCR catalyst to convert the $NO_x$ into a less harmful mixture of nitrogen and water vapour; small amounts of carbon dioxide are also produced as a result of this reaction. Emissions from the consumption of urea in buses have been included in the estimates for overall $CO_2$ conversion factors for buses. A summary of the key assumptions used in the calculation of emissions from urea is provided in the following Table 23. These are based on assumptions in the EMEP/EEA Emissions Inventory Guidebook (EEA, 2019).

**Table 23: Key assumptions used in the calculation of $CO_2$ emissions from Urea (aka 'AdBlue') use**

| | $CO_2$ EF for urea consumption ($kgCO_2$ /kg urea solution)[1] | Percentage of vehicles using urea | Urea consumption rate as a percentage of fuel consumed by vehicles using urea |
|---|---|---|---|
| Euro IV | 0.238 | 75% | 4% |
| Euro V | 0.238 | 75% | 6% |
| Euro VI | 0.238 | 100% | 3.5% |

[15] The robustness of the BSOG data has reduced over the years because of the changes to the way BSOG is paid to operators and local authorities. Approximations have been made in recent update years where data was not available (based on previous year data) and a revised methodology has commenced from 2016.

Notes: [1]Assumes 32.5% (by mass) aqueous solution of urea

5.56. Briefly, the main calculation for local buses can be summarised as follows:

a) Total fuel consumption (Million litres) = Total BSOG (£million) / BSOG fuel rate (p/litre) x 100
b) Total bus passenger-km (Million pkm) = Total activity (Million vkm) x Average bus occupancy (#)
c) Average fuel consumption (litres/pkm) = Total fuel consumption / Total bus passenger-km
d) Average bus emission factor = Average fuel consumption x Fuel Emission Factor ($kgCO_2e$/litre) + Average Emission Factor from Urea Use

5.57. As a final additional step, biofuel use is accounted for in the final bus emission factors.

5.58. Conversion factors for coach services were estimated based on figures from National Express, who provide the majority of scheduled coach services in the UK.

5.59. Conversion factors for $CH_4$ and $N_2O$ are based on the conversion factors from the UK GHG Inventory (Ricardo Energy & Environment, 2020). These factors are also presented together with an overall total factor in Table 24.

5.60. Table 24 gives a summary of the 2020 GHG Conversion factors and average passenger occupancy. It should also be noted that fuel consumption and conversion factors for individual operators and services will vary significantly depending on the local conditions, the specific vehicles used and on the typical occupancy achieved.

**Table 24: Conversion factors for buses for the 2020 GHG Conversion factors**

| Bus type | Average passenger occupancy | $gCO_2e$ per passenger km | | | |
|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | Total |
| Local bus (not London) | 10.04 | 118.48 | 0.02 | 1.00 | 119.50 |
| Local London bus | 20.02 | 78.08 | 0.01 | 0.47 | 78.56 |
| **Average local bus** | **12.54** | **102.31** | **0.02** | **0.79** | **103.12** |
| Coach* | 17.56 | 26.79 | 0.01 | 0.52 | 27.32 |

Notes: Average load factors/passenger occupancy mainly taken from DfT Bus statistics, Table BUS0304 "Average bus occupancy on local bus services by metropolitan area status and country: Great Britain, annual from 2004/05". * Combined figure based on data from DfT for non-local buses and coaches combined calculated based on an average of the last 5 years for which this was available (up to 2007). Actual occupancy for coaches alone is likely to be significantly higher.

## Direct Emissions from Motorcycles

5.61. Data from type approval is not currently readily available for motorbikes and $CO_2$ emission measurements were only mandatory in motorcycle type approval from 2005.

5.62. Conversion factors for motorcycles are split into 3 categories:

a) Small motorbikes (mopeds/scooters up to 125cc);

b) Medium motorbikes (125-500cc); and
c) Large motorbikes (over 500cc).

5.63. The conversion factors are calculated based on a large dataset kindly provided by (Clear, 2008)[16], based on a mix of magazine road test reports and user reported data. A summary is presented in Table 25, with the corresponding complete conversion factors developed for motorcycles presented in the 'Passenger vehicles' worksheet of the 2020 GHG Conversion factors set. The total average has been calculated weighted by the relative number of registrations of each category according to DfT licencing statistics for 2018 (DVLA, 2019).

5.64. These conversion factors are based predominantly on data derived from real-world riding conditions (rather than test-cycle based data) and are therefore likely to be more representative of typical in-use performance. The average difference between the factors based on real-world observed fuel consumption and other figures based upon test-cycle data from the European Motorcycle Manufacturers Association (ACEM) (+9%) is smaller than the corresponding differential previously used to uplift cars and vans test cycle data to real-world equivalents (+15%).

5.65. Conversion factors for $CH_4$ and $N_2O$ were updated based on the conversion factors from the latest UK GHG Inventory (Ricardo Energy & Environment, 2020). These factors are also presented together with overall total conversion factors in the "Passenger vehicles", "Business travel -land", and "Managed assets- vehicles" worksheets of the 2020 GHG Conversion factors set.

**Table 25: Summary dataset on $CO_2$ emissions from motorcycles based on detailed data provided by Clear (2008)**

| CC Range | Model Count | Number | Av. $gCO_2$/km | Av. MPG* |
|---|---|---|---|---|
| Up to 125cc | 24 | 58 | 85.0 | 76.5 |
| 125cc to 200cc | 3 | 13 | 77.8 | 83.5 |
| 200cc to 300cc | 16 | 57 | 93.1 | 69.8 |
| 300cc to 400cc | 8 | 22 | 112.5 | 57.8 |
| 400cc to 500cc | 9 | 37 | 122.0 | 53.3 |
| 500cc to 600cc | 24 | 105 | 139.2 | 46.7 |
| 600cc to 700cc | 19 | 72 | 125.9 | 51.6 |
| 700cc to 800cc | 21 | 86 | 133.4 | 48.8 |
| 800cc to 900cc | 21 | 83 | 127.1 | 51.1 |
| 900cc to 1000cc | 35 | 138 | 154.1 | 42.2 |
| 1000cc to 1100cc | 14 | 57 | 135.6 | 48.0 |
| 1100cc to 1200cc | 23 | 96 | 136.9 | 47.5 |
| 1200cc to 1300cc | 9 | 32 | 136.6 | 47.6 |
| 1300cc to 1400cc | 3 | 13 | 128.7 | 50.5 |
| 1400cc to 1500cc | 61 | 256 | 132.2 | 49.2 |

[16] Dataset of motorcycle fuel consumption compiled by Clear (http://www.clear-offset.com/) for the development of its motorcycle $CO_2$ model used in its carbon offsetting products.

| CC Range | Model Count | Number | Av. $gCO_2$/km | Av. MPG* |
|---|---|---|---|---|
| 1500cc to 1600cc | 4 | 13 | 170.7 | 38.1 |
| 1600cc to 1700cc | 5 | 21 | 145.7 | 44.6 |
| 1700cc to 1800cc | 3 | 15 | 161.0 | 40.4 |
| 1800cc to 1900cc | 0 | 0 | | 0.0 |
| 1900cc to 2000cc | 0 | 0 | | 0.0 |
| 2000cc to 2100cc | 1 | 5 | 140.9 | 46.2 |
| **<125cc** | **24** | **58** | **85.0** | **76.5** |
| **126-500cc** | **36** | **129** | **103.2** | **63.0** |
| **>500cc** | **243** | **992** | **137.2** | **47.4** |
| Total | 303 | 1179 | 116.8 | 55.7 |

Note: Summary data based on data provided by Clear (www.clear-offset.com) from a mix of magazine road test reports and user reported data. * MPG has been calculated from the supplied $gCO_2$/km dataset, using the fuel properties for petrol from the latest conversion factors dataset.

# Direct Emissions from Passenger Rail

5.66. Conversion factors for passenger rail services have been updated and provided in the “Business travel – land” worksheet of the 2020 GHG Conversion factors set. These include updates to the national rail, international rail (Eurostar), light rail schemes and the London Underground. Conversion factors for $CH_4$ and $N_2O$ emissions were also updated in the 2020 update. These factors are based on the assumptions outlined in the following paragraphs.

## International Rail (Eurostar)

5.67. The international rail factor is based on a passenger-km weighted average of the conversion factors for the following Eurostar routes: London-Brussels, London-Paris, London-Marne Le Vallee (Disney), London-Avignon, London-Amsterdam and the ski train from London to Bourg St Maurice[17]. The conversion factors were provided by Eurostar for the 2020 update, together with information on the basis of the electricity figures used in their calculation.

5.68. The methodology used to calculate the Eurostar conversion factors currently uses 3 key pieces of information:

a) Total electricity use by Eurostar trains on the UK and France/Belgium track sections;
b) Total passenger numbers (and therefore calculated passenger km) on all Eurostar services;
c) Conversion factors for electricity (in $kgCO_2$ per kWh) for the UK and France/Belgium journey sections. These are based on the UK grid average electricity from the GHG Conversion factors and the France/Belgium grid averages from the last freely available version of the IEA $CO_2$ Emissions from Fuel Combustion highlights dataset (from 2013).

[17] Although there are now also direct Eurostar routes to Lyon and Marseille, information relating to these routes has not been provided in 2019.

5.69. The new figure from Eurostar is 4.917 $gCO_2$/pkm.

5.70. $CH_4$ and $N_2O$ conversion factors have been estimated from the corresponding conversion factors for electricity generation, proportional to the $CO_2$ emission factors.

## National Rail

5.71. The national rail factor refers to an average emission per passenger kilometre for diesel and electric trains in 2018-19. The factor is sourced from information from the Office of the Rail Regulator's National rail trends for 2017-18 (ORR, 2019). This has been calculated based on total electricity and diesel consumed by the railway for the year sourced from the Association of Train Operating Companies (ATOC), and the total number of passenger kilometres (from National Rail Trends).

5.72. $CH_4$ and $N_2O$ conversion factors have been estimated from the corresponding emissions factors for electricity generation and diesel rail from the UK GHG Inventory (Ricardo Energy & Environment, 2020), proportional to the $CO_2$ emission factors. The conversion factors were calculated based on the relative passenger km proportions of diesel and electric rail provided by DfT for 2006-2007 (since no newer datasets are available from DfT).

## Light Rail

5.73. The light rail factors were based on an average of factors for a range of UK tram and light rail systems, as detailed in Table 26.

5.74. Figures for the London Overground, London Tramlink and Docklands Light Railway (DLR) for 2018/19 are based on figures kindly provided by TfL, adjusted to the new 2020 grid electricity $CO_2$ emission factor.

5.75. The factors for Midland Metro, Tyne and Wear Metro, Manchester Metrolink and Sheffield Supertram were calculated based on annual passenger km data from DfT's Light rail and tram statistics (DfT, 2019a) and the new 2020 grid electricity $CO_2$ emission factor.

5.76. The factor for the Glasgow Underground was calculated based on the annual passenger km data from DfT's Glasgow Underground statistics, and the new 2020 grid electricity $CO_2$ emission factor.

5.77. The average emission factor for light rail and tram was estimated based on the relative passenger km of the eight different rail systems (see Table 26).

5.78. $CH_4$ and $N_2O$ conversion factors have been estimated from the corresponding emissions factors for electricity generation, proportional to the $CO_2$ emission factors.

**Table 26: GHG emission factors, electricity consumption and passenger km for different tram and light rail services**

| | Type | Electricity use | gCO₂e per passenger km | | | | Million pkm |
|---|---|---|---|---|---|---|---|
| | | kWh/pkm | $CO_2$ | $CH_4$ | $N_2O$ | Total | |
| DLR (Docklands Light Rail) | Light Rail | 0.098 | 24.66 | 0.08 | 0.15 | 24.88 | **653.60** |
| Glasgow Underground | Light Rail | 0.164 | 41.22 | 0.13 | 0.25 | 41.60 | **41.90** |
| Midland Metro | Light Rail | 0.135 | 33.95 | 0.11 | 0.20 | 34.25 | **77.40** |
| Tyne and Wear Metro | Light Rail | 0.233 | 58.44 | 0.18 | 0.35 | 58.97 | **318.60** |
| London Overground | Light Rail | 0.099 | 24.76 | 0.08 | 0.15 | 24.98 | **1,285.05** |
| London Tramlink | Tram | 0.107 | 26.94 | 0.08 | 0.16 | 27.19 | **149.19** |
| Manchester Metrolink | Tram | 0.078 | 19.68 | 0.06 | 0.12 | 19.86 | **457.30** |
| Supertram | Tram | 0.350 | 87.82 | 0.27 | 0.53 | 88.62 | **77.40** |
| **Average*** | | **0.118** | **29.64** | **0.09** | **0.18** | **29.91** | **Total: 3060** |

Notes: * Weighted by relative passenger km

### London Underground

5.79. The London Underground rail factor was provided from DfT, which was based on the 2018 UK electricity emission factor, so was therefore adjusted to be consistent with the 2020 grid electricity $CO_2$ emission factor.

5.80. $CH_4$ and $N_2O$ conversion factors have been estimated from the corresponding emissions factors for electricity generation, proportional to the $CO_2$ emission factors.

## Indirect/WTT Emissions from Passenger Land Transport

### Cars, Vans, Motorcycles, Taxis, Buses and Ferries

5.81. Indirect/WTT conversion factors for cars, vans, motorcycles, taxis, buses and ferries include only emissions resulting from the fuel lifecycle (i.e. production and distribution of the relevant transport fuel). These indirect/WTT conversion factors were derived using simple ratios of the direct $CO_2$ conversion factors and the indirect/WTT conversion factors for the relevant fuels from the “Fuels” worksheet and the corresponding direct $CO_2$ conversion factors for vehicle types using these fuels in the “Passenger vehicles”, “Business travel – land” and “Business travel – air” worksheets in the 2020 GHG Conversion factors set.

## Rail

5.82. Indirect/WTT conversion factors for international rail (Eurostar), light rail and the London Underground were derived using a simple ratio of the direct $CO_2$ conversion factors and the indirect/WTT conversion factors for grid electricity from the “UK Electricity” worksheet and the corresponding direct $CO_2$ conversion factors for vehicle types in the “Passenger vehicles”, “Business travel – land” and “Business travel – air” worksheets in the GHG Conversion factors set.

5.83. The conversion factors for National rail services are based on a mixture of emissions from diesel and electric rail. Indirect/WTT conversion factors were therefore calculated from corresponding estimates for diesel and electric rail combined using relative passenger km proportions of diesel and electric rail provided by DfT for 2006-7 (no newer similar dataset is available).

# 6. Freight Land Transport Emission Factors

## Section summary

6.1. This section describes the calculation of the conversion factors for the transport of freight on land (road and rail). Scope 1 factors included are for delivery vehicles owned or controlled by the reporting organisation. Scope 3 factors are described for freighting goods over land through a third-party company, including factors for both the whole vehicle's load of goods, or per tonne of goods shipped. WTT factors for both delivery vehicles owned by the reporting organisation and for freighting goods via a third party. Factors for managed assets (vans/LGVs, HGVs) are also detailed in this section.

6.2. Table 27 shows where the related worksheets to the freight land transport conversion factors are available in the online spreadsheets of the UK GHG Conversion factors set.

**Table 27 Related worksheets to freight land transport emission factors**

| Worksheet name | Full set | Condensed set |
|---|---|---|
| Delivery vehicles | Y | N |
| Freighting goods* | Y | Y |
| WTT – delivery vehicles & freight* | Y | N |
| Managed assets – vehicles** | Y | Y |

*Notes*: * vans, HGVs and rail only; ** vans and HGVs only

## Summary of changes since the previous update

6.3. Provisional changes to the HGVs methodology have been implemented in the 2020 update to accommodate the discontinuation of DfT's fuel consumption statistics back in 2016 (the last year for which data was available) and the need to project changes in HGVs fuel consumption forwards. Therefore, the 2016 rigid and artic HGVs $CO_2$ factors were scaled using the calculated % change of the UK GHGI $CO_2$ factors for rigid and artic HGVs between 2018 (update year) and 2016 (last year DfT's data was available).

## Direct Emissions from Heavy Goods Vehicles (HGVs)

6.4. The HGV factors are based on road freight statistics from the Department for Transport (DfT, 2019c) for Great Britain (GB), from a survey on different sizes of rigid and articulated HGVs in the fleet in 2019. The statistics on fuel consumption figures (in miles per gallon) have been estimated by DfT from the survey data. For the 2020 update, these are combined with test data from the European

ARTEMIS[18] project showing how fuel efficiency, and therefore the $CO_2$ emissions, varies with vehicle load.

6.5. The miles per gallon (MPG) figures in Table RFS0141 (DfT, 2017) are converted to $gCO_2$ per km factors using the standard fuel conversion factor for diesel in the 2020 GHG Conversion factors. Table RFS0125 (DfT, 2019c) shows the percent loading factors are on average between 33-64% in the UK HGV fleet. Figures from the ARTEMIS project show that the effect of the load becomes proportionately greater for heavier classes of HGVs. In other words, the relative difference in fuel consumption between running an HGV completely empty or fully laden is greater for a large >33t HGV than it is for a small <7.5t HGV. From the analysis of the ARTEMIS data, it was possible to derive the figures in Table 28 showing the change in $CO_2$ emissions for a vehicle completely empty (0% load) or fully laden (100% load) on a weight basis compared with the emissions at half-load (50% load). The data show the effect of the load is symmetrical and largely independent of the HGVs Euro emission classification and type of drive cycle. So, for example, a >17t rigid HGV emits 18% more $CO_2$ per kilometre when fully laden and 18% less $CO_2$ per kilometre when empty relative to emissions at half-load.

6.6. The refrigerated/temperature-controlled HGVs included a 19.3% and 16.0% uplift which is applied to rigid and arctic refrigerated/temperature-controlled HGVs respectively. The refrigerated/temperature-controlled average factors have a 17.5% uplift applied. This is based on average data for different sizes of refrigerated HGV from (Tassou, S.A., et al., 2009). This accounts for the typical additional energy needed to power refrigeration equipment in such vehicles over similar non-refrigerated alternatives (AEA/Ricardo, 2011).

**Table 28: Change in $CO_2$ emissions caused by +/- 50% change in load from the average loading factor of 50%**

| | Gross Vehicle Weight (GVW) | % change in $CO_2$ emissions |
|---|---|---|
| **Rigid** | <7.5t | ± 8% |
| | 7.5-17t | ± 12.5% |
| | >17 t | ± 18% |
| **Articulated** | <33t | ± 20% |
| | >33t | ± 25% |

Source: EU-ARTEMIS project

6.7. Using these loading factors, the $CO_2$ factors derived from the DfT survey's MPG data, each corresponding to different average states of HGV loading, were corrected to derive the 50% laden $CO_2$ factor shown for each class of HGV. These are shown in the final factors presented in the "Delivery vehicles" and "Freighting goods" worksheets of the 2020 GHG Conversion factors set.

[18] Artemis (Advanced Research & Technology for EMbedded Intelligent Systems) is the association for actors in Embedded Intelligent Systems within Europe, https://artemis-ia.eu/

6.8. The loading factors in Table 28 were then used to derive corresponding $CO_2$ factors for 0% and 100% loadings in the above sections. Because the effect of vehicle loading on $CO_2$ emissions is linear with load (according to the ARTEMIS data), then these factors can be linearly interpolated if a more precise figure on vehicle load is known. For example, an HGV running at 75% load would have a $CO_2$ factor halfway between the values for 50% and 100% laden factors.

6.9. It might be surprising to see that the $CO_2$ factor for a >17t rigid HGV is greater than for a >33t articulated HGV. However, these factors merely reflect the estimated MPG figures from DfT statistics that consistently show worse MPG fuel efficiency, on average, for large rigid HGVs than large articulated HGVs once the relative degree of loading is accounted for. This is likely to be a result of the usage pattern for different types of HGVs where large rigid HGVs may spend more time travelling at lower, more congested urban speeds, operating at lower fuel efficiency than articulated HGVs which spend more time travelling under higher speed, free-flowing traffic conditions on motorways where fuel efficiency is closer to optimum. Under the drive cycle conditions more typically experienced by large articulated HGVs, the $CO_2$ factors for large rigid HGVs may be lower than indicated in “Delivery vehicles” and “Freighting goods” worksheets of the 2020 GHG Conversion factors set. Thus, the factors in “Delivery vehicles” and “Freighting goods” worksheets, linked to the DfT statistics (DfT, 2017) on MPG (estimated by DfT from the survey data), reflect each HGV class’s typical usage pattern on the GB road network.

6.10. UK average factors for all rigid and articulated classes of HGVs are also provided in the “Delivery vehicles” and “Freighting goods” worksheets of the 2020 GHG Conversion factors set, if the user requires aggregate factors for these main classes of HGVs, perhaps in case the weight class of the HGV is not known. Again, these factors represent averages for the GB HGV fleet in 2018. These are derived directly from the mpg values for rigid and articulated HGVs in Table RFS0141 (DfT, 2017) as explained in Section 6.3.

6.11. At a more aggregated level, factors for all HGVs are still representing the average MPG for all rigid and articulated HGV classes in Table RFS0141 (DfT, 2017). This factor should be used if the user has no knowledge of or requirement for different classes of HGVs and may be suitable for analysis of HGV $CO_2$ emissions in, for example, inter-modal freight transport comparisons.

6.12. The conversion factors included in the “Delivery vehicles” worksheet of the 2020 GHG Conversion factors set are provided in distance units to enable $CO_2$ emissions to be calculated from the distance travelled by the HGV in km multiplied by the appropriate conversion factor for the type of HGV and, if known, the extent of loading.

6.13. For comparison with other freight transport modes (e.g. road vs. rail), the user may require $CO_2$ factors in tonne km (tkm) units. The “Freighting goods” worksheet of the 2020 GHG Conversion factors set also provides such factors for each weight class of rigid and articulated HGVs, for all rigid and for all articulated, and aggregated for all HGVs. These are derived from the fleet average $gCO_2$ per vehicle km factors in the “Delivery vehicles” worksheet. The average tonnes of freight lifted figures are derived from the tkm and vehicle km (vkm) figures given for each class of HGVs in Tables RFS0113 and RFS0110, respectively (DfT, 2019c). Dividing the tkm by the vkm figures gives the average tonnes of freight lifted by each HGV class. For example, a rigid HGV >3.5 - 7.5t has an average load of 44%. The 2020 GHG Conversion factors include factors in tonne km (tkm) for all loads (0%, 50%, 100% and average).

6.14. A tkm is the distance travelled multiplied by the weight of freight carried by the HGV. So, for example, an HGV carrying 5 tonnes freight over 100 km has a tkm value of 500 tkm. The $CO_2$ emissions are calculated from these factors by multiplying the number of tkm the user has for the distance and weight of the goods being moved by the $CO_2$ conversion factor in the “Freighting goods” worksheet of the 2020 GHG Conversion factors for the relevant HGV class.

6.15. Conversion factors for $CH_4$ and $N_2O$ have been updated for all HGV classes. These are based on the conversion factors from the UK GHG Inventory (Ricardo Energy & Environment, 2020). $CH_4$ and $N_2O$ emissions are assumed to scale relative to vehicle class/$CO_2$ emissions for HGVs. These factors are presented with an overall total factor in the “Delivery vehicles” and “Freighting goods” worksheets of the 2020 GHG Conversion factors set.

6.16. Emissions from the consumption of urea to control $NO_x$ exhaust emissions (in SCR systems) in HGVs are included in the estimates for overall $CO_2$ emission factors. The method for this is the same as for buses, as described in the “Direct Emissions from Buses” section.

## Direct Emissions from Vans/Light Goods Vehicles (LGVs)

6.17. Conversion factors for light good vehicles (LGVs, vans up to 3.5 tonnes gross vehicle weight - GVW), were calculated based on the conversion factors per vehicle-km in the earlier section on “Direct Emissions from Vans/Light Goods Vehicles (LGVs)”.

6.18. The typical / average capacities and average payloads that are used in the calculation of van conversion factors per tonne km are presented in Table 29. The average payload capacity values are based on the quantitative (registrations-weighted) assessment of the EEA new van $CO_2$ monitoring databases for 2012-2018 registrations in the UK (EEA, 2020b). These databases provide information on the number of registrations for different vehicle makes and models with specifications including also the unloaded (reference) mass of the vehicle and maximum permitted weight rating (i.e. Gross Vehicle Weight, GVW).

**Table 29: Typical van freight capacities and estimated average payload**

| Van fuel | Van size, Gross Vehicle Weight | Vkm % split | Av. Payload Capacity, tonnes | Av. Payload, tonnes |
|---|---|---|---|---|
| Petrol (Class I) | Up to 1.305 tonne | 15.45% | 0.52 | 0.19 |
| Petrol (Class II) | 1.305 to 1.740 tonne | 75.53% | 0.76 | 0.28 |
| Petrol (Class III) | Over 1.740 tonne | 9.02% | 1.01 | 0.42 |
| **Petrol (average)** | **Up to 3.5 tonne** | **100.00%** | **0.75** | **0.30** |
| Diesel (Class I) | Up to 1.305 tonne | 3.92% | 0.49 | 0.18 |
| Diesel (Class II) | 1.305 to 1.740 tonne | 23.91% | 0.79 | 0.29 |

| Van fuel | Van size, Gross Vehicle Weight | Vkm % split | Av. Payload Capacity, tonnes | Av. Payload, tonnes |
|---|---|---|---|---|
| Diesel (Class III) | Over 1.740 tonne | 72.17% | 1.09 | 0.45 |
| **Diesel (average)** | **Up to 3.5 tonne** | **100.00%** | **1.00** | **0.40** |
| LPG (average) | Up to 3.5 tonne | 100.00% | 0.99 | 0.40 |
| CNG (average) | Up to 3.5 tonne | 100.00% | 0.99 | 0.40 |
| **Average** | **Up to 3.5 tonne** | **100.00%** | **0.99** | **0.40** |

6.19. The average load factors assumed for different vehicle types used to calculate the average payloads in Table 29 are summarised in Table 30, on the basis of DfT statistics from a survey of company owned vans. No new/more recent datasets have been identified for the average % loading of vans/LGVs for the 2020 update.

**Table 30: Utilisation of vehicle capacity by company-owned LGVs: annual average 2003 – 2005 (proportion of total vehicle kilometres travelled)**

| Average van loading | Utilisation of vehicle volume capacity | | | | |
|---|---|---|---|---|---|
| | 0-25% | 26-50% | 51-75% | 76-100% | Total |
| Mid-point for van loading ranges | 12.5% | 37.5% | 62.5% | 87.5% | |
| **Proportion of vehicles in the loading range** | | | | | |
| Up to 1.8 tonnes | 45% | 25% | 18% | 12% | **100%** |
| 1.8 – 3.5 tonnes | 36% | 28% | 21% | 15% | **100%** |
| **All LGVs** | 38% | 27% | 21% | 14% | **100%** |
| **Estimated weighted average % loading** | | | | | |
| Up to 1.8 tonnes | | | | | **36.8%** |
| 1.8 – 3.5 tonnes | | | | | **41.3%** |
| **All LGVs** | | | | | **40.3%** |

Notes: Based on information from Table 24 from (Allen, J. and Browne, M., 2008)

6.20. Conversion factors for $CH_4$ and $N_2O$ have been updated for all van classes in the 2020 GHG Conversion factors set. These are based on the conversion factors from the UK GHG Inventory (Ricardo Energy & Environment, 2020). $N_2O$ emissions are assumed to scale relative to vehicle class/$CO_2$ emissions for diesel vans.

6.21. Conversion factors per tonne km are calculated from the average load factors for the different weight classes in combination with the average freight capacities of the different vans in Table 29 and the earlier conversion factors per vehicle-km in the “Delivery vehicles” and “Freighting goods” worksheets of the 2020 GHG Conversion factors set.

# Direct Emissions from Rail Freight

6.22. The data used to update the rail freight conversion factors for the 2020 GHG Conversion factors set, was provided by the Office of the Rail Regulator’s (ORR, 2019a). This factor is presented in “Freighting goods” worksheet of the 2020 GHG Conversion factors set.

6.23. The factor can be expected to vary with rail traffic route, speed and train weight. Freight trains are hauled by electric and diesel locomotives, but the vast majority of freight is carried by diesel rail and correspondingly $CO_2$ emissions from diesel rail freight are over 96% of the total $CO_2$ from rail freight for 2018-19 (ORR, 2019a).

6.24. Traffic-, route- and freight-specific factors are not currently available, though these would present a more appropriate means of comparing modes (e.g. for bulk aggregates, intermodal, other types of freight). The rail freight $CO_2$ factor will be reviewed and updated if data become available relevant to rail freight movement in the UK.

6.25. $CH_4$ and $N_2O$ conversion factors have been estimated from the corresponding emissions for diesel rail from the UK GHG Inventory (Ricardo Energy & Environment, 2020), proportional to the $CO_2$ emissions. The conversion factors were calculated based on the relative passenger km proportions of diesel and electric rail provided by DfT for 2006-7 in the absence of more suitable tonne km data for freight.

# Indirect/WTT Emissions from Freight Land Transport

## Vans and HGVs

6.26. Indirect/WTT conversion factors for Vans and HGVs include only emissions resulting from the fuel lifecycle (i.e. production and distribution of the relevant transport fuel). These indirect/WTT conversion factors were derived using simple ratios of the direct $CO_2$ conversion factors and the indirect/WTT conversion factors for the relevant fuels and the corresponding direct $CO_2$ conversion factors for vehicle types using these fuels.

## Rail

6.27. The conversion factors for freight rail services are based on a mixture of emissions from diesel and electric rail. Indirect/WTT conversion factors were therefore calculated in a similar way to the other freight transport modes, except for combining indirect/WTT conversion factors for diesel and electricity into a weighted average for freight rail using relative $CO_2$ emissions from traction energy for diesel and electric freight rail provided from ORR in “Table 2.100 Estimates of passenger and freight energy consumption and $CO_2e$ emissions” (ORR, 2019a).

# 12. Material Consumption/Use and Waste Disposal

## Section summary

12.1. This section describes conversion factors for material use and waste disposal. Material use conversion factors should be used **only** to report on consumption of procured materials based on their origin (that is, comprised of primary material or recycled materials). For primary materials, these factors cover the extraction, primary processing, manufacture and transportation of materials to the point of sale, not the materials in use. For secondary materials, the factors cover sorting, processing, manufacture and transportation to the point of sale, not the materials in use. These factors are useful for reporting efficiencies gained through reduced procurement of material or the benefit of procuring items that are the product of a previous recycling process. The factors are **not** suitable for quantifying the benefits of collecting products or materials for recycling.

12.2. Waste-disposal figures should be used for Greenhouse Gas Protocol reporting of Scope 3 emissions associated with end-of-life disposal of different materials. **These figures do not quantify the environmental impact of different waste management options**. They are suitable **only** for Scope 3 reporting of emissions impacts under the Greenhouse Gas Protocol accounting standard.

12.3. These factors appear in the “Material use” and “Waste disposal” worksheets, available in both the full and condensed sets of the UK GHG Conversion factors.

## Summary of changes since the previous update

The following changes have been made since the 2019 update.

12.4. Open-loop recycling factors for average construction and demolition waste and batteries have been removed, as they do not relate to a specific product that a company would procure.

12.5. The conversion factors for ‘Books’ have been removed to avoid duplication as these factors are identical to the ‘Paper and board: paper’ factors in the “Material use” and “Waste disposal” worksheets.

12.6. Changes to Paper and board:

a) Board manufacture and recycling have been updated to incorporate a new (2019) life cycle assessment report by Fefco, while carton board has also been updated (RISE, 2019).
b) A new factor for open-loop recycling has been adopted, based on the footprint of recycled pulp at mill gate (Environ 2012).
c) Imports and exports from China have been removed from the model, pending availability of more up-to-date information on the carbon intensity of the Chinese energy supply and more granular data on the sources and destinations of East Asian imports and exports – the current model is therefore built based on European emissions. Data from the Confederation of Paper Industries (CPI)

suggest that around 80% of all paper imported to the UK originates in Europe, while only around 8% is imported from Asia (CPI, 2019).

12.7. Changes to Aluminium:

a) Factors now exclude the can manufacture (forming) emission and cover manufacture of aluminium sheet, in line with the stated scope of the emission factor.
b) Onward transport of material and product has been included for closed-loop recycling. Previously, this element had been quantified for virgin aluminium only but it is not offset by recycling and should be included in both calculations.

12.8. Changes to Wood:

a) Raw material factors have been changed to values from the Ecoinvent lifecycle inventory database to improve transparency and internal consistency.

12.9. Changes to Compost:

a) Raw material factors have been updated based on peer-reviewed sources (Boldrin, Alessio, Karin R. Hartling, Maria Laugen, and Thomas H. Christensen., 2010) that take full account of processing emissions and nitrous oxide production.

12.10. Factors related to reuse have been removed from the “Waste disposal” worksheet. Reuse is not a waste management activity. While preparation for reuse is a waste management activity, there is no data source on which to base the average transport distance, and hence emissions.

# Emissions from Material Use and Waste Disposal

12.11. Since 2012 the greenhouse gas conversion factors for material consumption / use and waste disposal have been aligned with the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (‘the Scope 3 Standard’)[26]. This sets down rules on accounting for emissions associated with material consumption and waste management.

12.12. The company sending waste for recycling **does not receive any benefit to its carbon account** from recycling as the figures for waste disposal no longer include the potential benefits where primary resource extraction is replaced by recycled material. Under this accounting methodology, the organisation using recycled materials will see a reduction in their account where this use is in place of higher impact primary materials.

12.13. Whilst the factors are appropriate for accounting, they are therefore **not appropriate for informing decision making on alternative waste management options** (i.e. they do not show the impact of waste management options).

12.14. All figures expressed are kilograms of carbon dioxide equivalent ($CO_2e$) per tonne of material. This includes the Kyoto protocol basket of greenhouse gases. Please note that biogenic[27] $CO_2$ has been excluded from these figures.

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[26] http://www.ghgprotocol.org/standards/Scope-3-standard

[27] Biogenic $CO_2$ is the $CO_2$ absorbed and released by living organisms during and at the end of their life. By convention, this is assumed to be in balance in sustainably managed systems.

12.15. The information for material consumption presented in the conversion factors spreadsheet has been separated from the emissions associated with waste disposal to allow separate reporting of these emission sources, in compliance with the Scope 3 Standard.

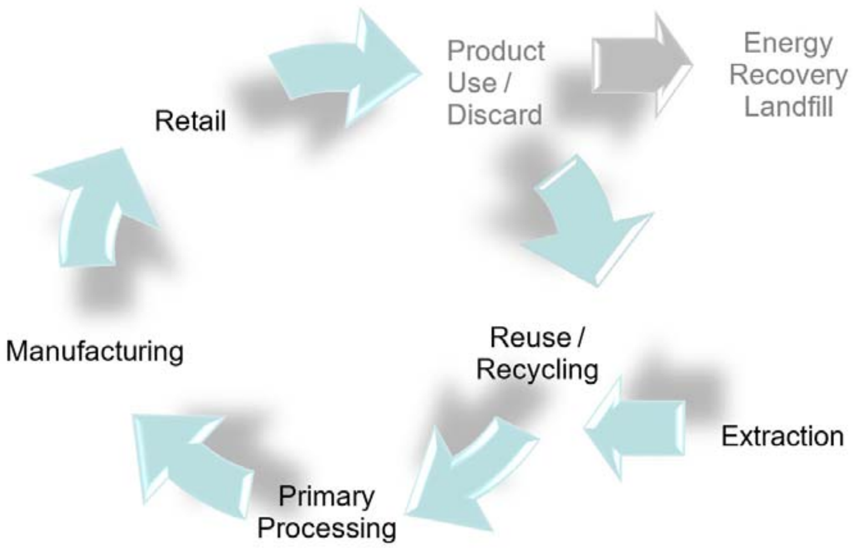
12.16. Businesses must quantify emissions associated with both material use and waste management in their Scope 3 accounting, to fully capture changes due to activities such as waste reduction.

12.17. The following subsections provide a summary of the methodology, key data sources and assumptions used to define the emission factors.

## Material Consumption/Use

12.18. Figure 5 shows the boundary of greenhouse gas emissions summarised in the material consumption table.

**Figure 5: Boundary of material consumption data sets**




Notes: Arrows represent transportation stages; greyed items are excluded.

12.19. The conversion factors presented for material consumption cover all greenhouse gas emissions from the point of raw material extraction through to the point at which a finished good is manufactured and provided for sale. Commercial enterprises may, therefore, use these factors to estimate the impact of goods they procure. Organisations involved in the manufacture of goods using these materials should note that if they separately report emissions associated with their energy use in forming products with these materials, there is potential for double counting. As many of the data sources used in preparing the tables are confidential, we are unable to publish a more detailed breakdown. However, the standard assumptions made are described below.

12.20. Conversion factors are provided for both recycled and primary materials. To identify the appropriate carbon factor, an organisation should seek to identify the level of recycled content in materials and goods purchased. Under this accounting methodology, the organisation using recycled materials in place of primary materials receives the benefit of recycling in terms of reduced Scope 3 emissions.

12.21. These factors are estimates to be used in the absence of data specific to your goods and services. If you have more accurate information for your products, then please refer to the more accurate data for reporting your emissions.

12.22. Information on the extraction of raw materials and manufacturing impacts are commonly sourced from the same reports, typically life cycle inventories published by trade associations. The sources utilised in this study are listed in Appendix 1 to this report. The stages covered include mining activities for non-renewable resources, agriculture and forestry for renewable materials, production of materials used to make the primary material (e.g. soda ash used in glass production) and primary production activities such as casting metals and producing board. Intermediate transport stages are also included. Full details are available in the referenced reports.

12.23. Conversion factors provided include emissions associated with product forming.

12.24. Table 51 identifies the transportation distances and vehicle types which have been assumed as part of the conversion factors provided. The impact of transporting the raw material (e.g. forestry products, granules, glass raw materials) is already included in the manufacturing profile for all products. The transportation tables and Greenhouse Gas Protocol guidelines on vehicle emissions have been used for most vehicle emission factors.

**Table 51: Distances and transportation types used in EF calculations**

| Destination / Intermediate Destination | One Way Distance | Mode of transport | Source |
|---|---|---|---|
| Transport of raw materials to the factory | 122km | Average, all HGVs | (DfT, 2010) Based on average haulage distance for all commodities, not specific to the materials in the first column. |
| Distribution to Retail Distribution Centre & to retailer | 96km | | (McKinnon, 2007), (IGD, 2018) |

12.25. Transport of goods by consumers is excluded from the factors presented, as is the use of the product.

## Waste Disposal

12.26. As defined under the Scope 3 standard, emissions associated with recycling and energy recovery are attributed to the organisation which uses the recycled material or which uses the waste to generate energy. The emissions attributed to the company which generates the waste cover only the collection of waste from their site. This does not mean that emissions from waste management or recycling are zero, or are not important; it simply means that, in accounting terms, these emissions are for another organisation to report.

12.27. The final emissions factor data summarised in the tables have been revised to be in line with the company reporting requirements in the Scope 3 Standard. Under this standard, to avoid double-counting, the emissions associated with recycling are attributed to the user of the recycled materials, and the same attribution approach has also been applied to the emissions from energy generation from waste. Only transportation and minimal preparation emissions are attributed to the entity disposing of the waste.

12.28. Landfill emissions remain within the accounting Scope of the organisation producing waste materials. Factors for landfill are provided within the waste disposal sheet in the 2020 GHG Conversion Factors. these factors are now drawn directly from MELMod, which contains information on landfill waste composition and material properties, with the addition of collection and transport emissions.

12.29. Figures for Refuse Collection Vehicles have been taken from the Environment Agency's Waste and Resource Assessment Tool for the Environment (WRATE) (Environment Agency, 2010).

12.30. Transport distances for waste were estimated using a range of sources, principally data supplied by the Environment Agency for use in the WRATE (2005) tool (Environment Agency, 2010). The distances adopted are shown in Table 52.

**Table 52: Distances used in the calculation of emission factors**

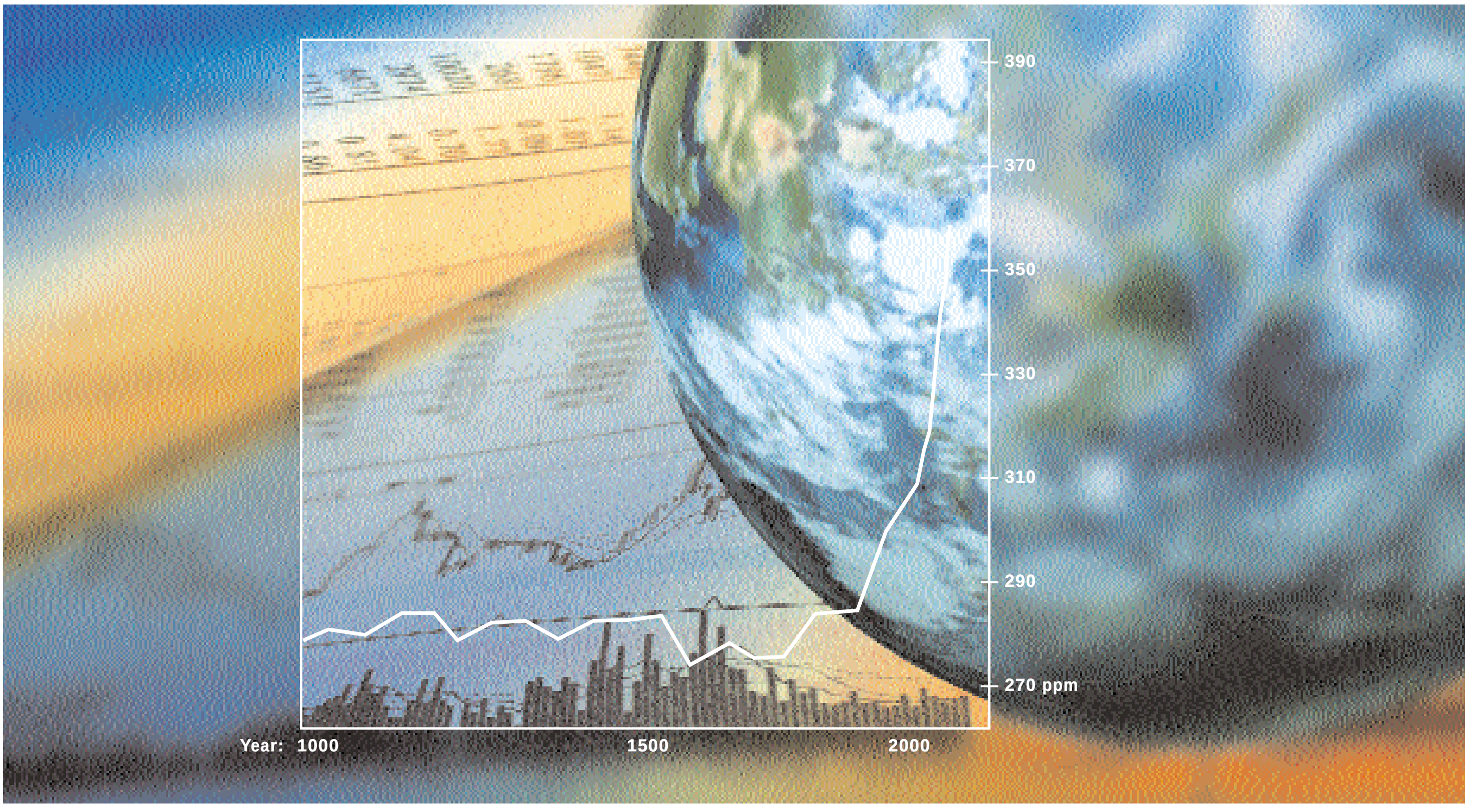
| Destination / Intermediate Destination | One Way Distance | Mode of transport | Source |
|---|---|---|---|
| Household, commercial and industrial landfill | 25km by Road | 26 Tonne GVW Refuse Collection Vehicle, maximum waste capacity 12 tonnes | Environment Agency (2010) |
| Inert landfill | 10km by Road | | Environment Agency (2010) |
| Transfer station / CA site | 10km by Road | | |
| MRF | 25km by Road | | |
| MSW incinerator | 50km by Road | | |
| Cement kiln | 50km by Road | | |
| Recyclate | 50km by Road | Average, all HGVs | Environment Agency (2010) |
| Inert recycling | 10km by Road | | Environment Agency (2010) |

12.31. Road vehicles are volume-limited rather than weight limited. For all HGVs, an average loading factor (including return journeys) is used based on the HGV factors provided in the 2020 Conversion factors. Waste vehicles leave a depot empty and return fully laden. A 50% loading assumption reflects the change in load over a collection round which could be expected.

**Appendix CL2.10**

**The World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol provides overarching guidance on developing GHG inventories and reporting standards**

# The Greenhouse Gas Protocol




## A Corporate Accounting and Reporting Standard

REVISED EDITION

World Business Council for Sustainable Development

WORLD RESOURCES INSTITUTE

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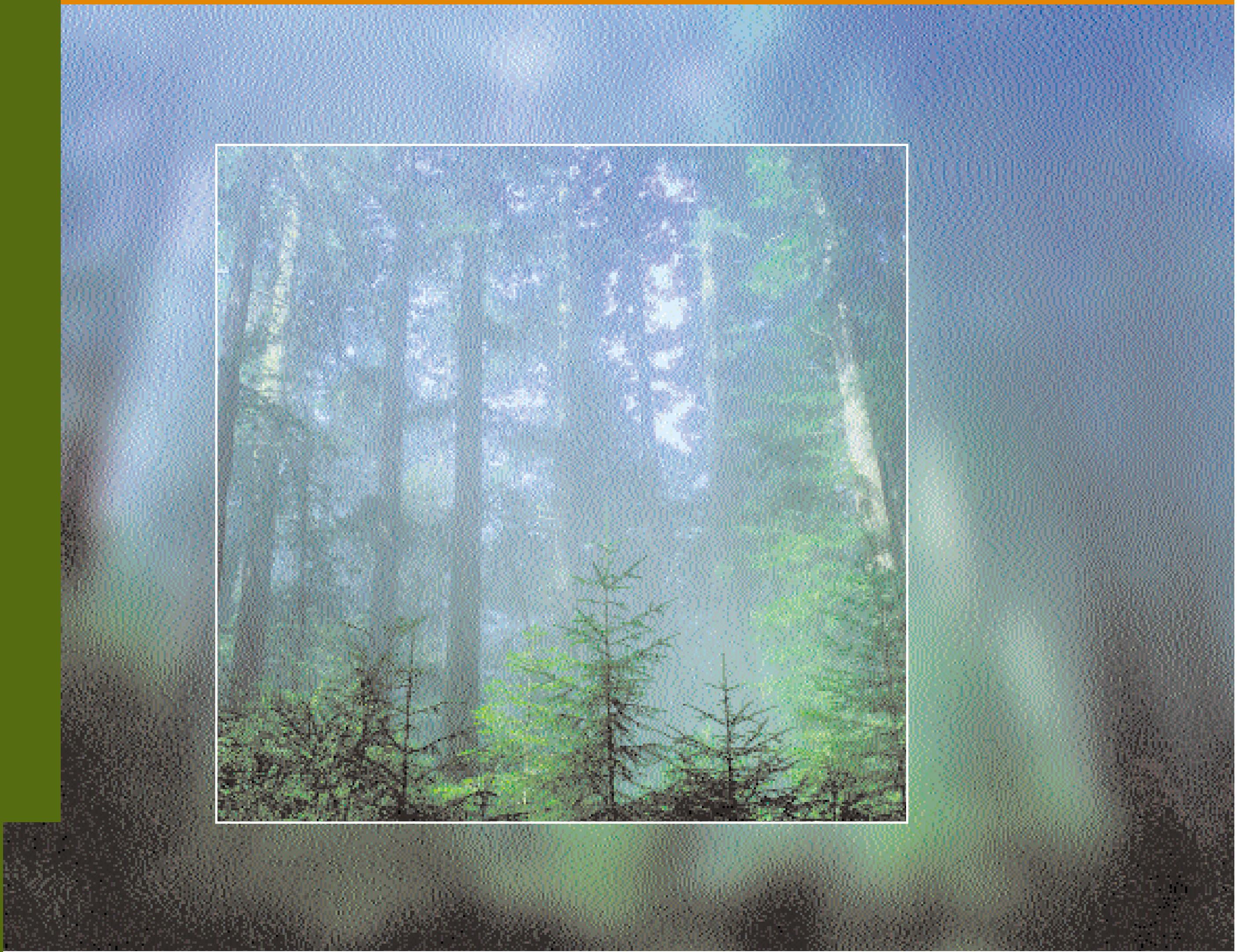
# Introduction



The Greenhouse Gas Protocol Initiative is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards for business and to promote their broad adoption.

The GHG Protocol Initiative comprises two separate but linked standards:

- *GHG Protocol Corporate Accounting and Reporting Standard* (this document, which provides a step-by-step guide for companies to use in quantifying and reporting their GHG emissions)
- *GHG Protocol Project Quantification Standard* (forthcoming; a guide for quantifying reductions from GHG mitigation projects)

The first edition of the *GHG Protocol Corporate Accounting and Reporting Standard (GHG Protocol Corporate Standard),* published in September 2001, enjoyed broad adoption and acceptance around the globe by businesses, NGOs, and governments. Many industry, NGO, and government GHG programs[1] used the standard as a basis for their accounting and reporting systems. Industry groups, such as the International Aluminum Institute, the International Council of Forest and Paper Associations, and the WBCSD Cement Sustainability Initiative, partnered with the GHG Protocol Initiative to develop complementary industry-specific calculation tools. Widespread adoption of the standard can be attributed to the inclusion of many stakeholders in its development and to the fact that it is robust, practical, and builds on the experience and expertise of numerous experts and practitioners.

This revised edition of the *GHG Protocol Corporate Standard* is the culmination of a two-year multi-stakeholder dialogue, designed to build on experience gained from using the first edition. It includes additional guidance, case studies, appendices, and a new chapter on setting a GHG target. For the most part, however, the first edition of the Corporate Standard has stood the test of time, and the changes in this revised edition will not affect the results of most GHG inventories.

This *GHG Protocol Corporate Standard* provides standards and guidance for companies and other types of organizations[2] preparing a GHG emissions inventory. It covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol — carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride ($SF_6$). The standard and guidance were designed with the following objectives in mind:

- To help companies prepare a GHG inventory that represents a true and fair account of their emissions, through the use of standardized approaches and principles
- To simplify and reduce the costs of compiling a GHG inventory
- To provide business with information that can be used to build an effective strategy to manage and reduce GHG emissions
- To provide information that facilitates participation in voluntary and mandatory GHG programs
- To increase consistency and transparency in GHG accounting and reporting among various companies and GHG programs.

Both business and other stakeholders benefit from converging on a common standard. For business, it reduces costs if their GHG inventory is capable of meeting different internal and external information requirements. For others, it improves the consistency, transparency, and understandability of reported information, making it easier to track and compare progress over time.

## The business value of a GHG inventory

Global warming and climate change have come to the fore as a key sustainable development issue. Many governments are taking steps to reduce GHG emissions through national policies that include the introduction of emissions trading programs, voluntary programs, carbon or energy taxes, and regulations and standards on energy efficiency and emissions. As a result, companies must be able to understand and manage their GHG risks if they are to ensure long-term success in a competitive business environment, and to be prepared for future national or regional climate policies.

A well-designed and maintained corporate GHG inventory can serve several business goals, including:

- Managing GHG risks and identifying reduction opportunities
- Public reporting and participation in voluntary GHG programs
- Participating in mandatory reporting programs
- Participating in GHG markets
- Recognition for early voluntary action.

## Who should use this standard?

This standard is written primarily from the perspective of a business developing a GHG inventory. However, it applies equally to other types of organizations with operations that give rise to GHG emissions, e.g., NGOs, government agencies, and universities.[3] It should not be used to quantify the reductions associated with GHG mitigation projects for use as offsets or credits—the forthcoming *GHG Protocol Project Quantification Standard* will provide standards and guidance for this purpose.

Policy makers and architects of GHG programs can also use relevant parts of this standard as a basis for their own accounting and reporting requirements.

# Introduction

## Relationship to other GHG programs

It is important to distinguish between the GHG Protocol Initiative and other GHG programs. The *GHG Protocol Corporate Standard* focuses only on the accounting and reporting of emissions. It does not require emissions information to be reported to WRI or WBCSD. In addition, while this standard is designed to develop a verifiable inventory, it does not provide a standard for how the verification process should be conducted.

The *GHG Protocol Corporate Standard* has been designed to be program or policy neutral. However, many existing GHG programs use it for their own accounting and reporting requirements and it is compatible with most of them, including:

- Voluntary GHG reduction programs, e.g., the World Wildlife Fund (WWF) Climate Savers, the U.S. Environmental Protection Agency (EPA) Climate Leaders, the Climate Neutral Network, and the Business Leaders Initiative on Climate Change (BLICC)
- GHG registries, e.g., California Climate Action Registry (CCAR), World Economic Forum Global GHG Registry
- National and regional industry initiatives, e.g., New Zealand Business Council for Sustainable Development, Taiwan Business Council for Sustainable Development, Association des entreprises pour la réduction des gaz à effet de serre (AERES)
- GHG trading programs,[4] e.g., UK Emissions Trading Scheme (UK ETS), Chicago Climate Exchange (CCX), and the European Union Greenhouse Gas Emissions Allowance Trading Scheme (EU ETS)
- Sector-specific protocols developed by a number of industry associations, e.g., International Aluminum Institute, International Council of Forest and Paper Associations, International Iron and Steel Institute, the WBCSD Cement Sustainability Initiative, and the International Petroleum Industry Environmental Conservation Association (IPIECA).

Since GHG programs often have specific accounting and reporting requirements, companies should always check with any relevant programs for any additional requirements before developing their inventory.

## GHG calculation tools

To complement the standard and guidance provided here, a number of cross-sector and sector-specific calculation tools are available on the GHG Protocol Initiative website (www.ghgprotocol.org), including a guide for small office-based organizations (see chapter 6 for full list). These tools provide step-by-step guidance and electronic worksheets to help users calculate GHG emissions from specific sources or industries. The tools are consistent with those proposed by the Intergovernmental Panel on Climate Change (IPCC) for compilation of emissions at the national level (IPCC, 1996). They have been refined to be user-friendly for non-technical company staff and to increase the accuracy of emissions data at a company level. Thanks to help from many companies, organizations, and individual experts through an intensive review of the tools, they are believed to represent current "best practice."

## Reporting in accordance with the *GHG Protocol Corporate Standard*

The GHG Protocol Initiative encourages the use of the *GHG Protocol Corporate Standard* by all companies regardless of their experience in preparing a GHG inventory. The term "shall" is used in the chapters containing standards to clarify what is required to prepare and report a GHG inventory in accordance with the *GHG Protocol Corporate Standard.* This is intended to improve the consistency with which the standard is applied and the resulting information that is publicly reported, without departing from the initial intent of the first edition. It also has the advantage of providing a verifiable standard for companies interested in taking this additional step.

## Overview of main changes to the first edition

This revised edition contains additional guidance, case studies, and annexes. A new guidance chapter on setting GHG targets has been added in response to many requests from companies that, having developed an inventory, wanted to take the next step of setting a target. Appendices have been added on accounting for indirect emissions from electricity and on accounting for sequestered atmospheric carbon.

Changes to specific chapters include:

- CHAPTER 1: Minor rewording of principles.
- CHAPTER 2: Goal-related information on operational boundaries has been updated and consolidated.
- CHAPTER 3: Although still encouraged to account for emissions using both the equity and control approaches, companies may now report using one approach. This change reflects the fact that not all companies need both types of information to achieve their business goals. New guidance has been provided on establishing control. The minimum equity threshold for reporting purposes has been removed to enable emissions to be reported when significant.
- CHAPTER 4: The definition of scope 2 has been revised to exclude emissions from electricity purchased for resale—these are now included in scope 3. This prevents two or more companies from double counting the same emissions in the same scope. New guidance has been added on accounting for GHG emissions associated with electricity transmission and distribution losses. Additional guidance provided on Scope 3 categories and leasing.
- CHAPTER 5: The recommendation of pro-rata adjustments was deleted to avoid the need for two adjustments. More guidance has been added on adjusting base year emissions for changes in calculation methodologies.
- CHAPTER 6: The guidance on choosing emission factors has been improved.
- CHAPTER 7: The guidance on establishing an inventory quality management system and on the applications and limitations of uncertainty assessment has been expanded.
- CHAPTER 8: Guidance has been added on accounting for and reporting project reductions and offsets in order to clarify the relationship between the *GHG Protocol Corporate* and *Project Standards*.
- CHAPTER 9: The required and optional reporting categories have been clarified.
- CHAPTER 10: Guidance on the concepts of materiality and material discrepancy has been expanded.
- CHAPTER 11: New chapter added on steps in setting a target and tracking and reporting progress.

## Frequently asked questions

Below is a list of frequently asked questions, with directions to the relevant chapters.

- What should I consider when setting out to account for and report emissions? CHAPTER 2
- How do I deal with complex company structures and shared ownership? CHAPTER 3
- What is the difference between direct and indirect emissions and what is their relevance? CHAPTER 4
- Which indirect emissions should I report? CHAPTER 4
- How do I account for and report outsourced and leased operations? CHAPTER 4
- What is a base year and why do I need one? CHAPTER 5
- My emissions change with acquisitions and divestitures. How do I account for these? CHAPTER 5
- How do I identify my company's emission sources? CHAPTER 6
- What kinds of tools are there to help me calculate emissions? CHAPTER 6
- What data collection activities and data management issues do my facilities have to deal with? CHAPTER 6
- What determines the quality and credibility of my emissions information? CHAPTER 7
- How should I account for and report GHG offsets that I sell or purchase? CHAPTER 8
- What information should be included in a GHG public emissions report? CHAPTER 9
- What data must be available to obtain external verification of the inventory data? CHAPTER 10
- What is involved in setting an emissions target and how do I report performance in relation to my target? CHAPTER 11

NOTES

[1] GHG program is a generic term used to refer to any voluntary or mandatory international, national, sub-national government or non-governmental authority that registers, certifies, or regulates GHG emissions or removals.

[2] Throughout the rest of this document, the term "company" or "business" is used as shorthand for companies, businesses and other types of organizations.

[3] For example, WRI uses the *GHG Protocol Corporate Standard* to publicly report its own emissions on an annual basis and to participate in the Chicago Climate Exchange.

[4] Trading programs that operate at the level of facilities primarily use the GHG Protocol Initiative calculation tools.

STANDARD

# 1 GHG Accounting and Reporting Principles

As with financial accounting and reporting, generally accepted GHG accounting principles are intended to underpin and guide GHG accounting and reporting to ensure that the reported information represents a faithful, true, and fair account of a company's GHG emissions.

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GHG accounting and reporting practices are evolving and are new to many businesses; however, the principles listed below are derived in part from generally accepted financial accounting and reporting principles. They also reflect the outcome of a collaborative process involving stakeholders from a wide range of technical, environmental, and accounting disciplines.

GHG accounting and reporting shall be based on the following principles:

**RELEVANCE**

Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.

**COMPLETENESS**

Account for and report on all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions.

**CONSISTENCY**

Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.

**TRANSPARENCY**

Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.

**ACCURACY**

Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

STANDARD

These principles are intended to underpin all aspects of GHG accounting and reporting. Their application will ensure that the GHG inventory constitutes a true and fair representation of the company's GHG emissions. Their primary function is to guide the implementation of the *GHG Protocol Corporate Standard*, particularly when the application of the standards to specific issues or situations is ambiguous.

## Relevance

For an organization's GHG report to be relevant means that it contains the information that users—both internal and external to the company—need for their decision making. An important aspect of relevance is the selection of an appropriate inventory boundary that reflects the substance and economic reality of the company's business relationships, not merely its legal form. The choice of the inventory boundary is dependent on the characteristics of the company, the intended purpose of information, and the needs of the users. When choosing the inventory boundary, a number of factors should be considered, such as:

- Organizational structures: control (operational and financial), ownership, legal agreements, joint ventures, etc.
- Operational boundaries: on-site and off-site activities, processes, services, and impacts
- Business context: nature of activities, geographic locations, industry sector(s), purposes of information, and users of information

More information on defining an appropriate inventory boundary is provided in chapters 2, 3, and 4.

## Completeness

All relevant emissions sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled. In practice, a lack of data or the cost of gathering data may be a limiting factor. Sometimes it is tempting to define a minimum emissions accounting threshold (often referred to as a materiality threshold) stating that a source not exceeding a certain size can be omitted from the inventory. Technically, such a threshold is simply a predefined and accepted negative bias in estimates (i.e., an underestimate). Although it appears useful in theory, the practical implementation of such a threshold is not compatible with the completeness principle of the *GHG Protocol Corporate Standard*. In order to utilize a materiality specification, the emissions from a particular source or activity would have to be quantified to ensure they were under the threshold. However, once emissions are quantified, most of the benefit of having a threshold is lost.

A threshold is often used to determine whether an error or omission is a material discrepancy or not. This is not the same as a de minimis for defining a complete inventory. Instead companies need to make a good faith effort to provide a complete, accurate, and consistent accounting of their GHG emissions. For cases where emissions have not been estimated, or estimated at an insufficient level of quality, it is important that this is transparently documented and justified. Verifiers can determine the potential impact and relevance of the exclusion, or lack of quality, on the overall inventory report.

More information on completeness is provided in chapters 7 and 10.

## Consistency

Users of GHG information will want to track and compare GHG emissions information over time in order to identify trends and to assess the performance of the reporting company. The consistent application of accounting approaches, inventory boundary, and calculation methodologies is essential to producing comparable GHG emissions data over time. The GHG information for all operations within an organization's inventory boundary needs to be compiled in a manner that ensures that the aggregate information is internally consistent and comparable over time. If there are changes in the inventory boundary, methods, data or any other factors affecting emission estimates, they need to be transparently documented and justified.

More information on consistency is provided in chapters 5 and 9.

### Volkswagen: Maintaining completeness over time

Volkswagen is a global auto manufacturer and the largest automaker in Europe. While working on its GHG inventory, Volkswagen realized that the structure of its emission sources had undergone considerable changes over the last seven years. Emissions from production processes, which were considered to be irrelevant at a corporate level in 1996, today constitute almost 20 percent of aggregated GHG emissions at the relevant plant sites. Examples of growing emissions sources are new sites for engine testing or the investment into magnesium die-casting equipment at certain production sites. This example shows that emissions sources have to be regularly re-assessed to maintain a complete inventory over time.

## Transparency

Transparency relates to the degree to which information on the processes, procedures, assumptions, and limitations of the GHG inventory are disclosed in a clear, factual, neutral, and understandable manner based on clear documentation and archives (i.e., an audit trail). Information needs to be recorded, compiled, and analyzed in a way that enables internal reviewers and external verifiers to attest to its credibility. Specific exclusions or inclusions need to be clearly identified and justified, assumptions disclosed, and appropriate references provided for the methodologies applied and the data sources used. The information should be sufficient to enable a third party to derive the same results if provided with the same source data. A "transparent" report will provide a clear understanding of the issues in the context of the reporting company and a meaningful assessment of performance. An independent external verification is a good way of ensuring transparency and determining that an appropriate audit trail has been established and documentation provided.

More information on transparency is provided in chapters 9 and 10.

## Accuracy

Data should be sufficiently precise to enable intended users to make decisions with reasonable assurance that the reported information is credible. GHG measurements, estimates, or calculations should be systemically neither over nor under the actual emissions value, as far as can be judged, and that uncertainties are reduced as far as practicable. The quantification process should be conducted in a manner that minimizes uncertainty. Reporting on measures taken to ensure accuracy in the accounting of emissions can help promote credibility while enhancing transparency.

More information on accuracy is provided in chapter 7.

### The Body Shop: Solving the trade-off between accuracy and completeness

As an international, values-driven retailer of skin, hair, body care, and make-up products, the Body Shop operates nearly 2,000 locations, serving 51 countries in 29 languages. Achieving both accuracy and completeness in the GHG inventory process for such a large, disaggregated organization, is a challenge. Unavailable data and costly measurement processes present significant obstacles to improving emission data accuracy. For example, it is difficult to disaggregate energy consumption information for shops located within shopping centers. Estimates for these shops are often inaccurate, but excluding sources due to inaccuracy creates an incomplete inventory.

The Body Shop, with help from the Business Leaders Initiative on Climate Change (BLICC) program, approached this problem with a two-tiered solution. First, stores were encouraged to actively pursue direct consumption data through disaggregated data or direct monitoring. Second, if unable to obtain direct consumption data, stores were given standardized guidelines for estimating emissions based on factors such as square footage, equipment type, and usage hours. This system replaced the prior fragmentary approach, provided greater accuracy, and provided a more complete account of emissions by including facilities that previously were unable to calculate emissions. If such limitations in the measurement processes are made transparent, users of the information will understand the basis of the data and the trade-off that has taken place.

# 2 Business Goals and Inventory Design



Improving your understanding of your company's GHG emissions by compiling a GHG inventory makes good business sense. Companies frequently cite the following five business goals as reasons for compiling a GHG inventory:

- Managing GHG risks and identifying reduction opportunities
- Public reporting and participation in voluntary GHG programs
- Participating in mandatory reporting programs
- Participating in GHG markets
- Recognition for early voluntary action

Companies generally want their GHG inventory to be capable of serving multiple goals. It therefore makes sense to design the process from the outset to provide information for a variety of different users and uses—both current and future. The *GHG Protocol Corporate Standard* has been designed as a comprehensive GHG accounting and reporting framework to provide the information building blocks capable of serving most business goals (see Box 1). Thus the inventory data collected according to the *GHG Protocol Corporate Standard* can be aggregated and disaggregated for various organizational and operational boundaries and for different business geographic scales (state, country, Annex 1 countries, non-Annex 1 countries, facility, business unit, company, etc.).

### BOX 1. Business goals served by GHG inventories

**Managing GHG risks and identifying reduction opportunities**
- Identifying risks associated with GHG constraints in the future
- Identifying cost effective reduction opportunities
- Setting GHG targets, measuring and reporting progress

**Public reporting and participation in voluntary GHG programs**
- Voluntary stakeholder reporting of GHG emissions and progress towards GHG targets
- Reporting to government and NGO reporting programs, including GHG registries
- Eco-labelling and GHG certification

**Participating in mandatory reporting programs**
- Participating in government reporting programs at the national, regional, or local level

**Participating in GHG markets**
- Supporting internal GHG trading programs
- Participating in external cap and trade allowance trading programs
- Calculating carbon/GHG taxes

**Recognition for early voluntary action**
- Providing information to support "baseline protection" and/or credit for early action

Appendix C provides an overview of various GHG programs—many of which are based on the *GHG Protocol Corporate Standard*. The guidance sections of chapters 3 and 4 provide additional information on how to design an inventory for different goals and uses.

## Managing GHG risks and identifying reduction opportunities

Compiling a comprehensive GHG inventory improves a company's understanding of its emissions profile and any potential GHG liability or "exposure." A company's GHG exposure is increasingly becoming a management issue in light of heightened scrutiny by the insurance industry, shareholders, and the emergence of environmental regulations/policies designed to reduce GHG emissions.

In the context of future GHG regulations, significant GHG emissions in a company's value chain may result in increased costs (upstream) or reduced sales (downstream), even if the company itself is not directly subject to regulations. Thus investors may view significant indirect emissions upstream or downstream of a company's operations as potential liabilities that need to be managed and reduced. A limited focus on direct emissions from a company's own operations may miss major GHG risks and opportunities, while leading to a misinterpretation of the company's actual GHG exposure.

On a more positive note, what gets measured gets managed. Accounting for emissions can help identify the most effective reduction opportunities. This can drive increased materials and energy efficiency as well as the development of new products and services that reduce the GHG impacts of customers or suppliers. This in turn can reduce production costs and help differentiate the company in an increasingly environmentally conscious marketplace. Conducting a rigorous GHG inventory is also a prerequisite for setting an internal or public GHG target and for subsequently measuring and reporting progress.

## IBM: The role of renewable energy in reducing GHG emissions

Indirect emissions associated with the consumption of purchased electricity are a required element of any company's accounting and reporting under the *GHG Protocol Corporate Standard*. Because purchased electricity is a major source of GHG emissions for companies, it presents a significant reduction opportunity. IBM, a major information technology company and a member of the WRI's Green Power Market Development Group, has systematically accounted for these indirect emissions and thus identified the significant potential to reduce them. The company has implemented a variety of strategies that would reduce either their demand for purchased energy or the GHG intensity of that purchased energy. One strategy has been to pursue the renewable energy market to reduce the GHG intensity of its purchased electricity.

IBM succeeded in reducing its GHG emissions at its facility in Austin, Texas, even as energy use stayed relatively constant, through a contract for renewable electricity with the local utility company, Austin Energy. Starting in 2001, this five-year contract is for 5.25 million kWhs of wind-power per year. This zero emission power lowered the facility's inventory by more than 4,100 tonnes of $CO_2$ compared to the previous year and represents nearly 5% of the facility's total electricity consumption. Company-wide, IBM's 2002 total renewable energy procurement was 66.2 million kWh, which represented 1.3% of its electricity consumption worldwide and 31,550 tonnes of $CO_2$ compared to the previous year. Worldwide, IBM purchased a variety of sources of renewable energy including wind, biomass and solar.

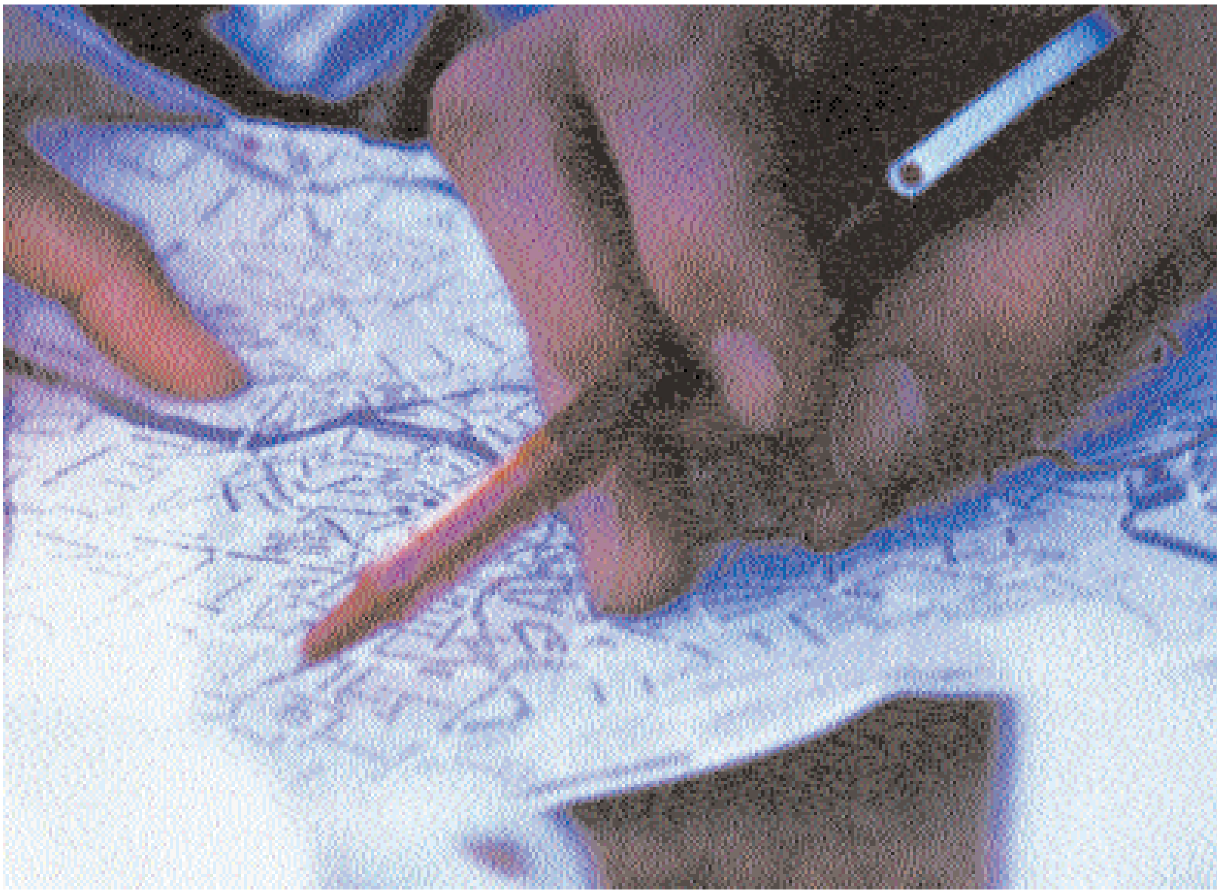
By accounting for these indirect emissions and looking for associated reduction opportunities, IBM has successfully reduced an important source of its overall GHG emissions.

## Public reporting and participation in voluntary GHG programs

As concerns over climate change grow, NGOs, investors, and other stakeholders are increasingly calling for greater corporate disclosure of GHG information. They are interested in the actions companies are taking and in how the companies are positioned relative to their competitors in the face of emerging regulations. In response, a growing number of companies are preparing stakeholder reports containing information on GHG emissions. These may be stand-alone reports on GHG emissions or broader environmental or sustainability reports. For example, companies preparing sustainability reports using the Global Reporting Initiative guidelines should include information on GHG emissions in accordance with the *GHG Protocol Corporate Standard* (GRI, 2002). Public reporting can also strengthen relationships with other stakeholders. For instance, companies can improve their standing with customers and with the public by being recognized for participating in voluntary GHG programs.

Some countries and states have established GHG registries where companies can report GHG emissions in a public database. Registries may be administered by governments (e.g., U.S. Department of Energy 1605b Voluntary Reporting Program), NGOs (e.g., California Climate Action Registry), or industry groups (e.g., World Economic Forum Global GHG Registry). Many GHG programs also provide help to companies setting voluntary GHG targets.

Most voluntary GHG programs permit or require the reporting of direct emissions from operations (including all six GHGs), as well as indirect GHG emissions from purchased electricity. A GHG inventory prepared in accordance with the *GHG Protocol Corporate Standard* will usually be compatible with most requirements (Appendix C provides an overview of the reporting requirements of some GHG programs). However, since the accounting guidelines of many voluntary programs are periodically updated, companies planning to participate are advised to contact the program administrator to check the current requirements.



## Participating in mandatory reporting programs

Some governments require GHG emitters to report their emissions annually. These typically focus on direct emissions from operations at operated or controlled facilities in specific geographic jurisdictions. In Europe, facilities falling under the requirements of the Integrated Pollution Prevention and Control (IPPC) Directive must report emissions exceeding a specified threshold for each of the six GHGs. The reported emissions are included in a European Pollutant Emissions Register (EPER), a publicly accessible internet-based database that permits comparisons of emissions from individual facilities or industrial sectors in different countries (EC-DGE, 2000). In Ontario, Ontario Regulation 127 requires the reporting of GHG emissions (Ontario MOE, 2001).

## Participating in GHG markets

Market-based approaches to reducing GHG emissions are emerging in some parts of the world. In most places, they take the form of emissions trading programs, although there are a number of other approaches adopted by countries, such as the taxation approach used in Norway. Trading programs can be implemented on a mandatory (e.g., the forthcoming EU ETS) or voluntary basis (e.g., CCX).

Although trading programs, which determine compliance by comparing emissions with an emissions reduction target or cap, typically require accounting only for direct emissions, there are exceptions. The UK ETS, for example, requires direct entry participants to account for GHG emissions from the generation of purchased electricity (DEFRA, 2003). The CCX allows its members the option of counting indirect emissions associated with electricity purchases as a supplemental reduction commitment. Other types of indirect emissions can be more difficult to verify and may present challenges in terms of avoiding double counting. To facilitate independent verification, emissions trading may require participating companies to establish an audit trail for GHG information (see chapter 10).

GHG trading programs are likely to impose additional layers of accounting specificity relating to which approach is used for setting organizational boundaries; which GHGs and sources are addressed; how base years are established; the type of calculation methodology used; the choice of emission factors; and the monitoring and verification approaches employed. The broad participation and best practices incorporated into the *GHG Protocol Corporate Standard* are likely to inform the accounting requirements of emerging programs, and have indeed done so in the past.

## Recognition for early voluntary action

A credible inventory may help ensure that a corporation's early, voluntary emissions reductions are recognized in future regulatory programs. To illustrate, suppose that in 2000 a company started reducing its GHG emissions by shifting its on-site powerhouse boiler fuel from coal to landfill gas. If a mandatory GHG reduction program is later established in 2005 and it sets 2003 as the base against which reductions are to be measured, the program might not allow the emissions reductions achieved by the green power project prior to 2003 to count toward its target.

However, if a company's voluntary emissions reductions have been accounted for and registered, they are more likely to be recognized and taken into account when regulations requiring reductions go into effect. For instance, the state of California has stated that it will use its best efforts to ensure that organizations that register certified emission results with the California Climate Action Registry receive appropriate consideration under any future international, federal, or state regulatory program relating to GHG emissions.

### Tata Steel: Development of institutional capacity in GHG accounting and reporting

For Tata Steel, Asia's first and India's largest integrated private sector steel company, reducing its GHG emissions through energy efficiency is a key element of its primary business goal: the acceptability of its product in international markets. Each year, in pursuit of this goal, the company launches several energy efficiency projects and introduces less-GHG-intensive processes. The company is also actively pursuing GHG trading markets as a means of further improving its GHG performance. To succeed in these efforts and be eligible for emerging trading schemes, Tata Steel must have an accurate GHG inventory that includes all processes and activities, allows for meaningful benchmarking, measures improvements, and promotes credible reporting.

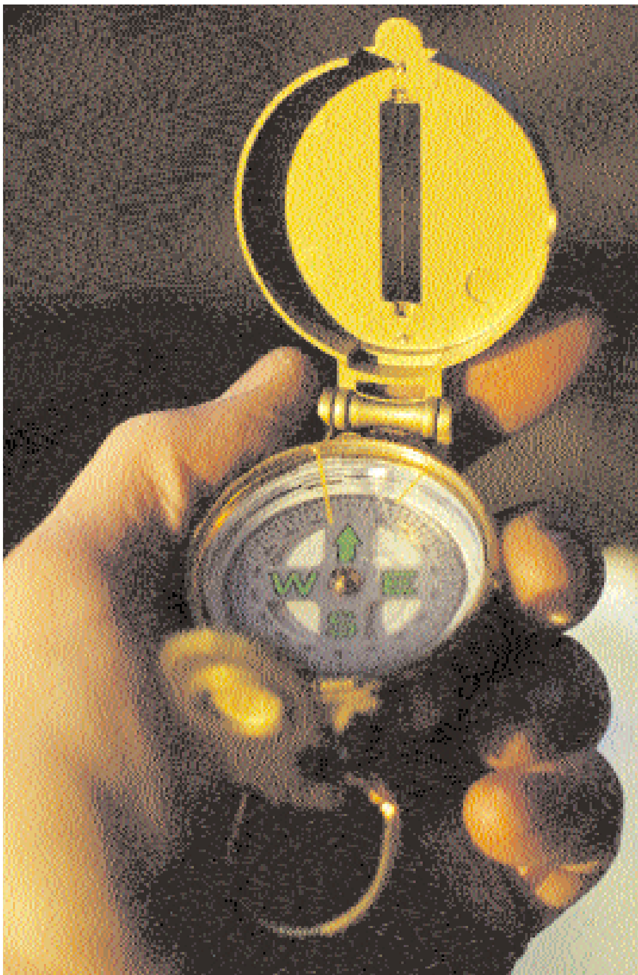
Tata Steel has developed the capacity to measure its progress in reducing GHG emissions. Tata Steel's managers have access to on-line information on energy usage, material usage, waste and byproduct generation, and other material streams. Using this data and the GHG Protocol calculation tools, Tata Steel generates two key long-term, strategic performance indicators: specific energy consumption (Giga calorie / tonne of crude steel) and GHG intensity (tonne of $CO_2$equivalent / tonne of crude steel). These indicators are key sustainability metrics in the steel sector worldwide, and help ensure market acceptability and competitiveness. Since the company adopted the *GHG Protocol Corporate Standard*, tracking performance has become more structured and streamlined. This system allows Tata Steel quick and easy access to its GHG inventory and helps the company maximize process and material flow efficiencies.

## Ford Motor Company: Experiences using the *GHG Protocol Corporate Standard*

When Ford Motor Company, a global automaker, embarked on an effort to understand and reduce its GHG impacts, it wanted to track emissions with enough accuracy and detail to manage them effectively. An internal cross-functional GHG inventory team was formed to accomplish this goal. Although the company was already reporting basic energy and carbon dioxide data at the corporate level, a more detailed understanding of these emissions was essential to set and measure progress against performance targets and evaluate potential participation in external trading schemes.

For several weeks, the team worked on creating a more comprehensive inventory for stationary combustion sources, and quickly found a pattern emerging. All too often team members left meetings with as many questions as answers, and the same questions kept coming up from one week to the next. How should they draw boundaries? How do they account for acquisitions and divestitures? What emission factors should be used? And perhaps most importantly, how could their methodology be deemed credible with stakeholders? Although the team had no shortage of opinions, there also seemed to be no clearly right or wrong answers.

The *GHG Protocol Corporate Standard* helped answer many of these questions and the Ford Motor Company now has a more robust GHG inventory that can be continually improved to fulfill its rapidly emerging GHG management needs. Since adopting the *GHG Protocol Corporate Standard*, Ford has expanded the coverage of its public reporting to all of its brands globally; it now includes direct emissions from sources it owns or controls and indirect emissions resulting from the generation of purchased electricity, heat, or steam. In addition, Ford is a founding member of the Chicago Climate Exchange, which uses some of the *GHG Protocol* calculation tools for emissions reporting purposes.

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# 3 Setting Organizational Boundaries

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Business operations vary in their legal and organizational structures; they include wholly owned operations, incorporated and non-incorporated joint ventures, subsidiaries, and others. For the purposes of financial accounting, they are treated according to established rules that depend on the structure of the organization and the relationships among the parties involved. In setting organizational boundaries, a company selects an approach for consolidating GHG emissions and then consistently applies the selected approach to define those businesses and operations that constitute the company for the purpose of accounting and reporting GHG emissions.

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For corporate reporting, two distinct approaches can be used to consolidate GHG emissions: the equity share and the control approaches. Companies shall account for and report their consolidated GHG data according to either the equity share or control approach as presented below. If the reporting company wholly owns all its operations, its organizational boundary will be the same whichever approach is used.[1] For companies with joint operations, the organizational boundary and the resulting emissions may differ depending on the approach used. In both wholly owned and joint operations, the choice of approach may change how emissions are categorized when operational boundaries are set (see chapter 4).

## Equity share approach

Under the equity share approach, a company accounts for GHG emissions from operations according to its share of equity in the operation. The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation. Typically, the share of economic risks and rewards in an operation is aligned with the company's percentage ownership of that operation, and equity share will normally be the same as the ownership percentage. Where this is not the case, the economic substance of the relationship the company has with the operation always overrides the legal ownership form to ensure that equity share reflects the percentage of economic interest. The principle of economic substance taking precedent over legal form is consistent with international financial reporting standards. The staff preparing the inventory may therefore need to consult with the company's accounting or legal staff to ensure that the appropriate equity share percentage is applied for each joint operation (see Table 1 for definitions of financial accounting categories).

## Control approach

Under the control approach, a company accounts for 100 percent of the GHG emissions from operations over which it has control. It does not account for GHG emissions from operations in which it owns an interest but has no control. Control can be defined in either financial or operational terms. When using the control approach to consolidate GHG emissions, companies shall choose between either the operational control or financial control criteria.

In most cases, whether an operation is controlled by the company or not does not vary based on whether the financial control or operational control criterion is used. A notable exception is the oil and gas industry, which often has complex ownership / operatorship structures. Thus, the choice of control criterion in the oil and gas industry can have substantial consequences for a company's GHG inventory. In making this choice, companies should take into account how GHG emissions accounting and reporting can best be geared to the requirements of emissions reporting and trading schemes, how it can be aligned with financial and environmental reporting, and which criterion best reflects the company's actual power of control.

- Financial Control. The company has financial control over the operation if the former has the ability to direct the financial and operating policies of the latter with a view to gaining economic benefits from its activities.[2] For example, financial control usually exists if the company has the right to the majority of benefits of the operation, however these rights are conveyed. Similarly, a company is considered to financially control an operation if it retains the majority risks and rewards of ownership of the operation's assets.

  Under this criterion, the economic substance of the relationship between the company and the operation takes precedence over the legal ownership status, so that the company may have financial control over the operation even if it has less than a 50 percent interest in that operation. In assessing the economic substance of the relationship, the impact of potential voting rights, including both those held by the company and those held by other parties, is also taken into account. This criterion is consistent with international financial accounting standards; therefore, a company has financial control over an operation for GHG accounting purposes if the operation is considered as a group company or subsidiary for the purpose of financial

STANDARD

consolidation, i.e., if the operation is fully consolidated in financial accounts. If this criterion is chosen to determine control, emissions from joint ventures where partners have joint financial control are accounted for based on the equity share approach (see Table 1 for definitions of financial accounting categories).

- Operational Control. A company has operational control over an operation if the former or one of its subsidiaries (see Table 1 for definitions of financial accounting categories) has the full authority to introduce and implement its operating policies at the operation. This criterion is consistent with the current accounting and reporting practice of many companies that report on emissions from facilities, which they operate (i.e., for which they hold the operating license). It is expected that except in very rare circumstances, if the company or one of its subsidiaries is the operator of a facility, it will have the full authority to introduce and implement its operating policies and thus has operational control.

  Under the operational control approach, a company accounts for 100% of emissions from operations over which it or one of its subsidiaries has operational control.

  It should be emphasized that having operational control does not mean that a company necessarily has authority to make all decisions concerning an operation. For example, big capital investments will likely require the approval of all the partners that have joint financial control. Operational control does mean that a company has the authority to introduce and implement its operating policies.

  More information on the relevance and application of the operational control criterion is provided in petroleum industry guidelines for reporting GHG emissions (IPIECA, 2003).

Sometimes a company can have joint financial control over an operation, but not operational control. In such cases, the company would need to look at the contractual arrangements to determine whether any one of the partners has the authority to introduce and implement its operating policies at the operation and thus has the responsibility to report emissions under operational control. If the operation itself will introduce and implement its own operating policies, the partners with joint financial control over the operation will not report any emissions under operational control.

Table 2 in the guidance section of this chapter illustrates the selection of a consolidation approach at the corporate level and the identification of which joint operations will be in the organizational boundary depending on the choice of the consolidation approach.

## Consolidation at multiple levels

The consolidation of GHG emissions data will only result in consistent data if all levels of the organization follow the same consolidation policy. In the first step, the management of the parent company has to decide on a consolidation approach (i.e., either the equity share or the financial or operational control approach). Once a corporate consolidation policy has been selected, it shall be applied to all levels of the organization.

## State-ownership

The rules provided in this chapter shall also be applied to account for GHG emissions from industry joint operations that involve state ownership or a mix of private/state ownership.

### BP: Reporting on the basis of equity share

BP reports GHG emissions on an equity share basis, including those operations where BP has an interest, but where BP is not the operator. In determining the extent of the equity share reporting boundary BP seeks to achieve close alignment with financial accounting procedures. BP's equity share boundary includes all operations undertaken by BP and its subsidiaries, joint ventures and associated undertakings as determined by their treatment in the financial accounts. Fixed asset investments, i.e., where BP has limited influence, are not included.

GHG emissions from facilities in which BP has an equity share are estimated according to the requirements of the BP Group Reporting Guidelines for Environmental Performance (BP 2000). In those facilities where BP has an equity share but is not the operator, GHG emissions data may be obtained directly from the operating company using a methodology consistent with the BP Guidelines, or is calculated by BP using activity data provided by the operator.

BP reports its equity share GHG emissions every year. Since 2000, independent external auditors have expressed the opinion that the reported total has been found to be free from material misstatement when audited against the BP Guidelines.

TABLE 1. Financial accounting categories

| ACCOUNTING CATEGORY | FINANCIAL ACCOUNTING DEFINITION | ACCOUNTING FOR GHG EMISSIONS ACCORDING TO *GHG PROTOCOL CORPORATE STANDARD* | |
|---|---|---|---|
| | | BASED ON EQUITY SHARE | BASED ON FINANCIAL CONTROL |
| Group companies / subsidiaries | The parent company has the ability to direct the financial and operating policies of the company with a view to gaining economic benefits from its activities. Normally, this category also includes incorporated and non-incorporated joint ventures and partnerships over which the parent company has financial control. Group companies/subsidiaries are fully consolidated, which implies that 100 percent of the subsidiary's income, expenses, assets, and liabilities are taken into the parent company's profit and loss account and balance sheet, respectively. Where the parent's interest does not equal 100 percent, the consolidated profit and loss account and balance sheet shows a deduction for the profits and net assets belonging to minority owners. | Equity share of GHG emissions | 100% of GHG emissions |
| Associated / affiliated companies | The parent company has significant influence over the operating and financial policies of the company, but does not have financial control. Normally, this category also includes incorporated and non-incorporated joint ventures and partnerships over which the parent company has significant influence, but not financial control. Financial accounting applies the equity share method to associated/affiliated companies, which recognizes the parent company's share of the associate's profits and net assets. | Equity share of GHG emissions | 0% of GHG emissions |
| Non-incorporated joint ventures/ partnerships/ operations where partners have joint financial control | Joint ventures/partnerships/operations are proportionally consolidated, i.e., each partner accounts for their proportionate interest of the joint venture's income, expenses, assets, and liabilities. | Equity share of GHG emissions | Equity share of GHG emissions |
| Fixed asset investments | The parent company has neither significant influence nor financial control. This category also includes incorporated and non-incorporated joint ventures and partnerships over which the parent company has neither significant influence nor financial control. Financial accounting applies the cost/dividend method to fixed asset investments. This implies that only dividends received are recognized as income and the investment is carried at cost. | 0% | 0% |
| Franchises | Franchises are separate legal entities. In most cases, the franchiser will not have equity rights or control over the franchise. Therefore, franchises should not be included in consolidation of GHG emissions data. However, if the franchiser does have equity rights or operational/financial control, then the same rules for consolidation under the equity or control approaches apply. | Equity share of GHG emissions | 100% of GHG emissions |

NOTE: Table 1 is based on a comparison of UK, US, Netherlands and International Financial Reporting Standards (KPMG, 2000).

STANDARD

When planning the consolidation of GHG data, it is important to distinguish between GHG accounting and GHG reporting. GHG accounting concerns the recognition and consolidation of GHG emissions from operations in which a parent company holds an interest (either control or equity) and linking the data to specific operations, sites, geographic locations, business processes, and owners. GHG reporting, on the other hand, concerns the presentation of GHG data in formats tailored to the needs of various reporting uses and users.

Most companies have several goals for GHG reporting, e.g., official government reporting requirements, emissions trading programs, or public reporting (see chapter 2). In developing a GHG accounting system, a fundamental consideration is to ensure that the system is capable of meeting a range of reporting requirements. Ensuring that data are collected and recorded at a sufficiently disaggregated level, and capable of being consolidated in various forms, will provide companies with maximum flexibility to meet a range of reporting requirements.

## Double counting

When two or more companies hold interests in the same joint operation and use different consolidation approaches (e.g., Company A follows the equity share approach while Company B uses the financial control approach), emissions from that joint operation could be double counted. This may not matter for voluntary corporate public reporting as long as there is adequate disclosure from the company on its consolidation approach. However, double counting of emissions needs to be avoided in trading schemes and certain mandatory government reporting programs.

## Reporting goals and level of consolidation

Reporting requirements for GHG data exist at various levels, from a specific local facility level to a more aggregated corporate level. Examples of drivers for various levels of reporting include:

- Official government reporting programs or certain emissions trading programs may require GHG data to be reported at a facility level. In these cases, consolidation of GHG data at a corporate level is not relevant
- Government reporting and trading programs may require that data be consolidated within certain geographic and operational boundaries (e.g., the U.K. Emissions Trading Scheme)
- To demonstrate the company's account to wider stakeholders, companies may engage in voluntary public reporting, consolidating GHG data at a corporate level in order to show the GHG emissions of their entire business activities.

## Contracts that cover GHG emissions

To clarify ownership (rights) and responsibility (obligations) issues, companies involved in joint operations may draw up contracts that specify how the ownership of emissions or the responsibility for managing emissions and associated risk is distributed between the parties. Where such arrangements exist, companies may optionally provide a description of the contractual arrangement and include information on allocation of $CO_2$ related risks and obligations (see Chapter 9).

## Using the equity share or control approach

Different inventory reporting goals may require different data sets. Thus companies may need to account for their GHG emissions using both the equity share and the control approaches. The *GHG Protocol Corporate Standard* makes no recommendation as to whether voluntary public GHG emissions reporting should be based on the equity share or any of the two control approaches, but encourages companies to account for their emissions applying the equity share and a control approach separately. Companies need to decide on the approach best suited to their business activities and GHG accounting and reporting requirements. Examples of how these may drive the choice of approach include the following:

- Reflection of commercial reality. It can be argued that a company that derives an economic profit from a certain activity should take ownership for any GHG emissions generated by the activity. This is achieved by using the equity share approach, since this approach assigns ownership for GHG emissions on the basis of economic interest in a business activity. The control approaches do not always reflect the full GHG emissions portfolio of a company's business activities, but have the advantage that a company takes full ownership of all GHG emissions that it can directly influence and reduce.

- Government reporting and emissions trading programs. Government regulatory programs will always need to monitor and enforce compliance. Since compliance responsibility generally falls to the operator (not equity holders or the group company that has financial control), governments will usually require reporting on the basis of operational control, either through a facility level-based system or involving the consolidation of data within certain geographical boundaries (e.g. the EU ETS will allocate emission permits to the operators of certain installations).

- Liability and risk management. While reporting and compliance with regulations will most likely continue to be based directly on operational control, the ultimate financial liability will often rest with the group company that holds an equity share in the operation or has financial control over it. Hence, for assessing risk, GHG reporting on the basis of the equity share and financial control approaches provides a more complete picture. The equity share approach is likely to result in the most comprehensive coverage of liability and risks. In the future, companies might incur liabilities for GHG emissions produced by joint operations in which they have an interest, but over which they do not have financial control. For example, a company that is an equity shareholder in an operation but has no financial control over it might face demands by the companies with a controlling share to cover its requisite share of GHG compliance costs.

- Alignment with financial accounting. Future financial accounting standards may treat GHG emissions as liabilities and emissions allowances/credits as assets. To assess the assets and liabilities a company creates by its joint operations, the same consolidation rules that are used in financial accounting should be applied in GHG accounting. The equity share and financial control approaches result in closer alignment between GHG accounting and financial accounting.

- Management information and performance tracking. For the purpose of performance tracking, the control approaches seem to be more appropriate since managers can only be held accountable for activities under their control.

- Cost of administration and data access. The equity share approach can result in higher administrative costs than the control approach, since it can be difficult and time consuming to collect GHG emissions data from joint operations not under the control of the reporting company. Companies are likely to have better access to operational data and therefore greater ability to ensure that it meets minimum quality standards when reporting on the basis of control.

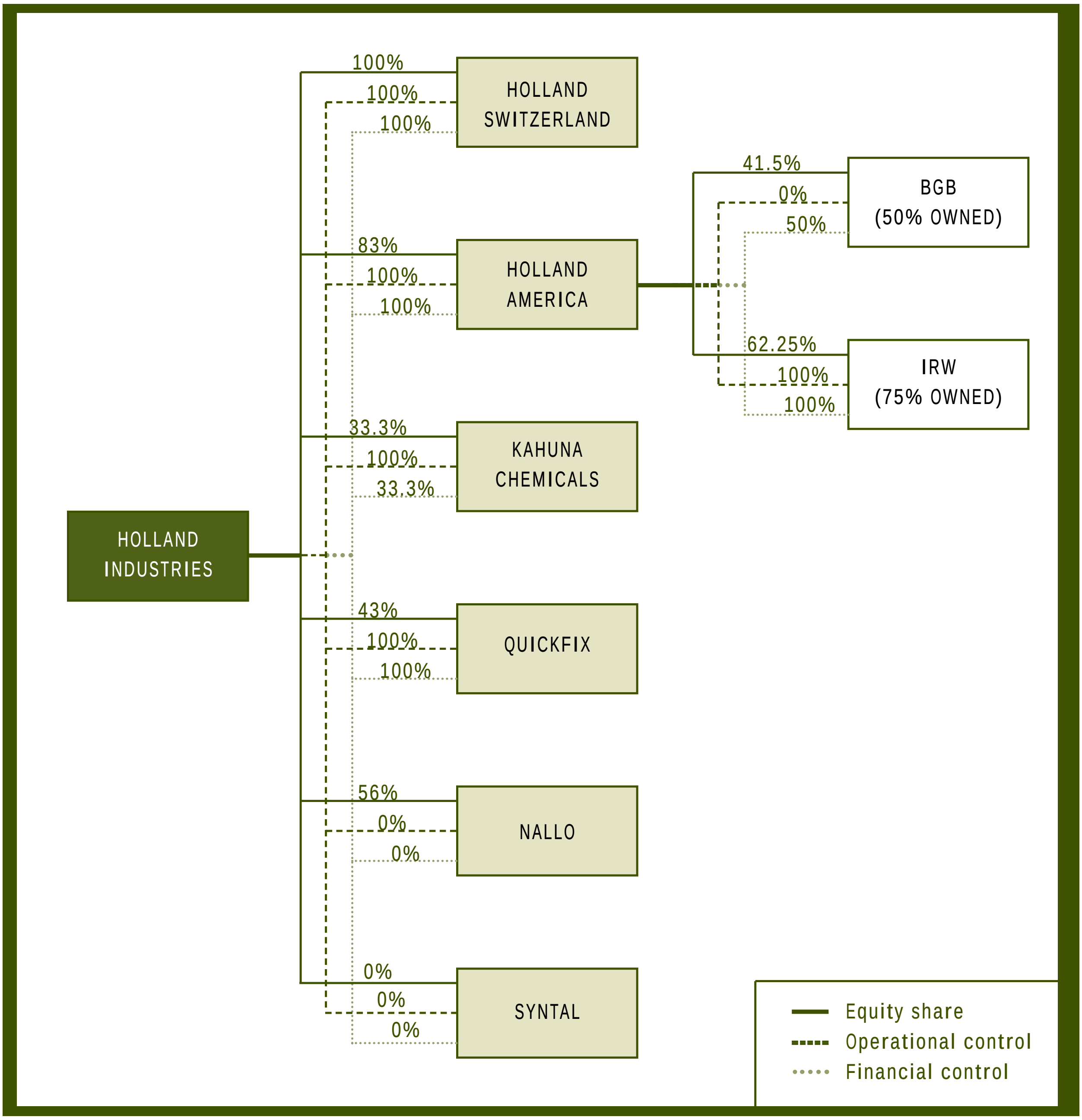
- Completeness of reporting. Companies might find it difficult to demonstrate completeness of reporting when the operational control criterion is adopted, since there are unlikely to be any matching records or lists of financial assets to verify the operations that are included in the organizational boundary.

### Royal Dutch/Shell: Reporting on the basis of operational control

In the oil and gas industry, ownership and control structures are often complex. A group may own less than 50 percent of a venture's equity capital but have operational control over the venture. On the other hand, in some situations, a group may hold a majority interest in a venture without being able to exert operational control, for example, when a minority partner has a veto vote at the board level. Because of these complex ownership and control structures, Royal Dutch/Shell, a global group of energy and petrochemical companies, has chosen to report its GHG emissions on the basis of operational control. By reporting 100 percent of GHG emissions from all ventures under its operational control, irrespective of its share in the ventures' equity capital, Royal Dutch/Shell can ensure that GHG emissions reporting is in line with its operational policy including its Health, Safety and Environmental Performance Monitoring and Reporting Guidelines. Using the operational control approach, the group generates data that is consistent, reliable, and meets its quality standards.

GUIDANCE

FIGURE 1. Defining the organizational boundary of Holland Industries




AN ILLUSTRATION:
THE EQUITY SHARE AND CONTROL APPROACHES

Holland Industries is a chemicals group comprising a number of companies/joint ventures active in the production and marketing of chemicals. Table 2 outlines the organizational structure of Holland Industries and shows how GHG emissions from the various wholly owned and joint operations are accounted for under both the equity share and control approaches.

In setting its organizational boundary, Holland Industries first decides whether to use the equity or control approach for consolidating GHG data at the corporate level. It then determines which operations at the corporate level meet its selected consolidation approach. Based on the selected consolidation approach, the consolidation process is repeated for each lower operational level. In this process, GHG emissions are first apportioned at the lower operational level (subsidiaries, associate, joint ventures, etc.) before they are consolidated at the corporate level. Figure 1 presents the organizational boundary of Holland Industries based on the equity share and control approaches.

TABLE 2. Holland Industries - organizational structure and GHG emissions accounting

| WHOLLY OWNED AND JOINT OPERATIONS OF HOLLAND | LEGAL STRUCTURE AND PARTNERS | ECONOMIC INTEREST HELD BY HOLLAND INDUSTRIES | CONTROL OF OPERATING POLICIES | TREATMENT IN HOLLAND INDUSTRIES' FINANCIAL ACCOUNTS (SEE TABLE 1) | EMISSIONS ACCOUNTED FOR AND REPORTED BY HOLLAND INDUSTRIES | |
|---|---|---|---|---|---|---|
| | | | | | EQUITY SHARE APPROACH | CONTROL APPROACH |
| Holland Switzerland | Incorporated company | 100% | Holland Industries | Wholly owned subsidiary | 100% | 100% for operational control<br>100% for financial control |
| Holland America | Incorporated company | 83% | Holland Industries | Subsidiary | 83% | 100% for operational control<br>100% for financial control |
| BGB | Joint venture, partners have joint financial control other partner Rearden | 50% by Holland America | Rearden | via Holland America | 41.5%<br>(83% x 50%) | 0% for operational control<br>50% for financial control (50% x 100%) |
| IRW | Subsidiary of Holland America | 75% by Holland America | Holland America | via Holland America | 62.25%<br>(83% x 75%) | 100% for operational control<br>100% for financial control |
| Kahuna Chemicals | Non-incorporated joint venture; partners have joint financial control; two other partners: ICT and BCSF | 33.3% | Holland Industries | Proportionally consolidated joint venture | 33.3% | 100% for operational control<br>33.3% for financial control |
| QuickFix | Incorporated joint venture, other partner Majox | 43% | Holland Industries | Subsidiary<br>(Holland Industries has financial control since it treats Quick Fix as a subsidiary in its financial accounts) | 43% | 100% for operational control<br>100% for financial control |
| Nallo | Incorporated joint venture, other partner Nagua Co. | 56% | Nallo | Associated company (Holland Industries does not have financial control since it treats Nallo as an Associated company in its financial accounts) | 56% | 0% for operational control<br>0% for financial control |
| Syntal | Incorporated company, subsidiary of Erewhon Co. | 1% | Erewhon Co. | Fixed asset investment | 0% | 0% for operational control<br>0% for financial control |

In this example, Holland America (not Holland Industries) holds a 50 percent interest in BGB and a 75 percent interest in IRW. If the activities of Holland Industries itself produce GHG emissions (e.g., emissions associated with electricity use at the head office), then these emissions should also be included in the consolidation at 100 percent.

NOTES

[1] The term "operations" is used here as a generic term to denote any kind of business activity, irrespective of its organizational, governance, or legal structures.

[2] Financial accounting standards use the generic term "control" for what is denoted as "financial control" in this chapter.

# 4 Setting Operational Boundaries

STANDARD

After a company has determined its organizational boundaries in terms of the operations that it owns or controls, it then sets its operational boundaries. This involves identifying emissions associated with its operations, categorizing them as direct and indirect emissions, and choosing the scope of accounting and reporting for indirect emissions.

STANDARD

GUIDANCE

For effective and innovative GHG management, setting operational boundaries that are comprehensive with respect to direct and indirect emissions will help a company better manage the full spectrum of GHG risks and opportunities that exist along its value chain.

Direct GHG emissions are emissions from sources that are owned or controlled by the company.[1]

Indirect GHG emissions are emissions that are a consequence of the activities of the company but occur at sources owned or controlled by another company.

What is classified as direct and indirect emissions is dependent on the consolidation approach (equity share or control) selected for setting the organizational boundary (see chapter 3). Figure 2 below shows the relationship between the organizational and operational boundaries of a company.

## Introducing the concept of "scope"

To help delineate direct and indirect emission sources, improve transparency, and provide utility for different types of organizations and different types of climate policies and business goals, three "scopes" (scope 1, scope 2, and scope 3) are defined for GHG accounting and reporting purposes. Scopes 1 and 2 are carefully defined in this standard to ensure that two or more companies will not account for emissions in the same scope. This makes the scopes amenable for use in GHG programs where double counting matters.

Companies shall separately account for and report on scopes 1 and 2 at a minimum.

## Scope 1: Direct GHG emissions

Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment.

Direct $CO_2$ emissions from the combustion of biomass shall not be included in scope 1 but reported separately (see chapter 9).

GHG emissions not covered by the Kyoto Protocol, e.g. CFCs, NOx, etc. shall not be included in scope 1 but may be reported separately (see chapter 9).

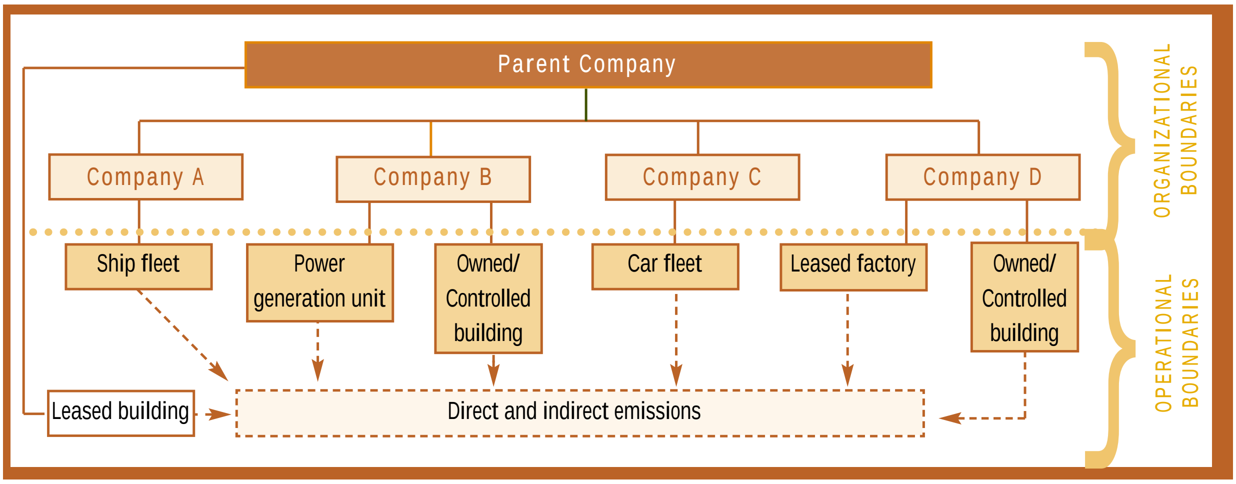
## Scope 2: Electricity indirect GHG emissions

Scope 2 accounts for GHG emissions from the generation of purchased electricity[2] consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

## Scope 3: Other indirect GHG emissions

Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

FIGURE 2. Organizational and operational boundaries of a company




STANDARD

# Setting Operational Boundaries

An operational boundary defines the scope of direct and indirect emissions for operations that fall within a company's established organizational boundary. The operational boundary (scope 1, scope 2, scope 3) is decided at the corporate level after setting the organizational boundary. The selected operational boundary is then uniformly applied to identify and categorize direct and indirect emissions at each operational level (see Box 2). The established organizational and operational boundaries together constitute a company's inventory boundary.

**BOX 2. Organizational and operational boundaries**

Organization X is a parent company that has full ownership and financial control of operations A and B, but only a 30% non-operated interest and no financial control in operation C.

Setting Organizational Boundary: X would decide whether to account for GHG emissions by equity share or financial control. If the choice is equity share, X would include A and B, as well as 30% of C's emissions. If the approach chosen is financial control, X would count only A and B's emissions as relevant and subject to consolidation. Once this has been decided, the organizational boundary has been defined.

Setting Operational Boundary: Once the organizational boundary is set, X then needs to decide, on the basis of its business goals, whether to account only for scope 1 and scope 2, or whether to include relevant scope 3 categories for its operations.

Operations A, B and C (if the equity approach is selected) account for the GHG emissions in the scopes chosen by X, i.e., they apply the corporate policy in drawing up their operational boundaries.

## Accounting and reporting on scopes

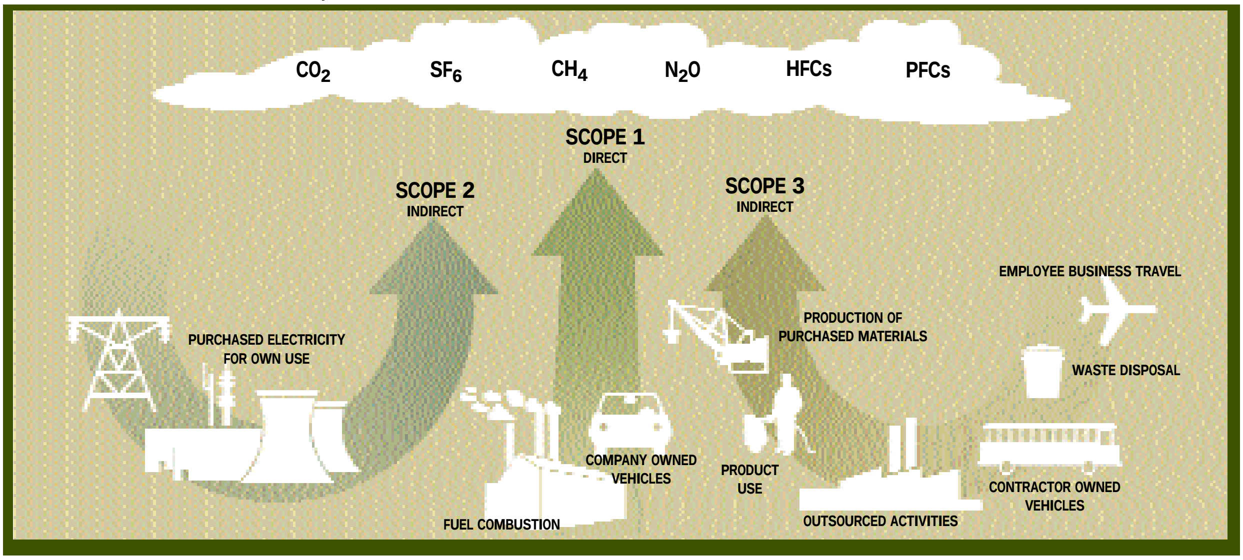
Companies account for and report emissions from scope 1 and 2 separately. Companies may further subdivide emissions data within scopes where this aids transparency or facilitates comparability over time. For example, they may subdivide data by business unit/facility, country, source type (stationary combustion, process, fugitive, etc.), and activity type (production of electricity, consumption of electricity, generation or purchased electricity that is sold to end users, etc.).

In addition to the six Kyoto gases, companies may also provide emissions data for other GHGs (e.g., Montreal Protocol gases) to give context to changes in emission levels of Kyoto Protocol gases. Switching from a CFC to HFC, for example, will increase emissions of Kyoto Protocol gases. Information on emissions of GHGs other than the six Kyoto gases may be reported separately from the scopes in a GHG public report.

Together the three scopes provide a comprehensive accounting framework for managing and reducing direct and indirect emissions. Figure 3 provides an overview of the relationship between the scopes and the activities that generate direct and indirect emissions along a company's value chain.

A company can benefit from efficiency gains throughout the value chain. Even without any policy drivers, accounting for GHG emissions along the value chain may reveal potential for greater efficiency and lower costs (e.g., the use of fly ash as a clinker substitute in the manufacture of cement that reduces downstream emissions from processing of waste fly ash, and upstream

**FIGURE 3. Overview of scopes and emissions across a value chain**




Adopted from NZBCSD, 2002

emissions from producing clinker). Even if such "win-win" options are not available, indirect emissions reductions may still be more cost effective to accomplish than scope 1 reductions. Thus accounting for indirect emissions can help identify where to allocate limited resources in a way that maximizes GHG reduction and return on investment.

Appendix D lists GHG sources and activities along the value chain by scopes for various industry sectors.

## Scope 1: Direct GHG emissions

Companies report GHG emissions from sources they own or control as scope 1. Direct GHG emissions are principally the result of the following types of activities undertaken by the company:

- Generation of electricity, heat, or steam. These emissions result from combustion of fuels in stationary sources, e.g., boilers, furnaces, turbines
- Physical or chemical processing.[3] Most of these emissions result from manufacture or processing of chemicals and materials, e.g., cement, aluminum, adipic acid, ammonia manufacture, and waste processing
- Transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources (e.g., trucks, trains, ships, airplanes, buses, and cars)
- Fugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

### SALE OF OWN-GENERATED ELECTRICITY

Emissions associated with the sale of own-generated electricity to another company are not deducted/netted from scope 1. This treatment of sold electricity is consistent with how other sold GHG intensive products are accounted, e.g., emissions from the production of sold clinker by a cement company or the production of scrap steel by an iron and steel company are not subtracted from their scope 1 emissions. Emissions associated with the sale/transfer of own-generated electricity may be reported in optional information (see chapter 9).

## Scope 2: Electricity indirect GHG emissions

Companies report the emissions from the generation of purchased electricity that is consumed in its owned or controlled equipment or operations as scope 2. Scope 2 emissions are a special category of indirect emissions. For many companies, purchased electricity represents one of the largest sources of GHG emissions and the most significant opportunity to reduce these emissions. Accounting for scope 2 emissions allows companies to assess the risks and opportunities associated with changing electricity and GHG emissions costs. Another important reason for companies to track these emissions is that the information may be needed for some GHG programs.

Companies can reduce their use of electricity by investing in energy efficient technologies and energy conservation. Additionally, emerging green power markets[4] provide opportunities for some companies to switch to less GHG intensive sources of electricity. Companies can also install an efficient on site co-generation plant, particularly if it replaces the purchase of more GHG intensive electricity from the grid or electricity supplier. Reporting of scope 2 emissions allows transparent accounting of GHG emissions and reductions associated with such opportunities.

### INDIRECT EMISSIONS ASSOCIATED WITH TRANSMISSION AND DISTRIBUTION

Electric utility companies often purchase electricity from independent power generators or the grid and resell it to end-consumers through a transmission and distribution (T&D) system.[5] A portion of the electricity purchased by a utility company is consumed (T&D loss) during its transmission and distribution to end-consumers (see Box 3).

Consistent with the scope 2 definition, emissions from the generation of purchased electricity that is consumed during transmission and distribution are reported in scope 2 by the company that owns or controls the T&D operation. End consumers of the purchased electricity do not report indirect emissions associated with T&D losses in scope 2 because they do not own or control the T&D operation where the electricity is consumed (T&D loss).

**BOX 3. Electricity balance**

| | | |
|---|---|---|
| GENERATED ELECTRICITY | = | Purchased electricity consumed by the utility company during T&D<br>+<br>Purchased electricity consumed by end consumers |

This approach ensures that there is no double counting within scope 2 since only the T&D utility company will account for indirect emissions associated with T&D losses in scope 2. Another advantage of this approach is that it adds simplicity to the reporting of scope 2 emissions by allowing the use of commonly available emission factors that in most cases do not include T&D losses. End consumers may, however, report their indirect emissions associated with T&D losses in scope 3 under the category "generation of electricity consumed in a T&D system." Appendix A provides more guidance on accounting for emissions associated with T&D losses.

### OTHER ELECTRICITY-RELATED INDIRECT EMISSIONS

Indirect emissions from activities upstream of a company's electricity provider (e.g., exploration, drilling, flaring, transportation) are reported under scope 3. Emissions from the generation of electricity that has been purchased for resale to end-users are reported in scope 3 under the category "generation of electricity that is purchased and then resold to end users." Emissions from the generation of purchased electricity for resale to non-end-users (e.g., electricity traders) may be reported separately from scope 3 in "optional information."

The following two examples illustrate how GHG emissions are accounted for from the generation, sale, and purchase of electricity.

Example one (Figure 4): Company A is an independent power generator that owns a power generation plant. The power plant produces 100 MWh of electricity and releases 20 tonnes of emissions per year. Company B is an electricity trader and has a supply contract with company A to purchase all its electricity. Company B resells the purchased electricity (100 MWh) to company C, a utility company that owns / controls the T&D system. Company C consumes 5 MWh of electricity in its T&D system and sells the remaining 95 MWh to company D. Company D is an end user who consumes the purchased electricity (95 MWh) in its own operations. Company A reports its direct emissions from power generation under scope 1. Company B reports emissions from the purchased electricity sold to a non-end-user as optional information separately from scope 3. Company C reports the indirect emissions from the generation of the part of the purchased electricity that is sold to the end-user under scope 3 and the part of the purchased electricity that it consumes in its T&D system under scope 2. End-user D reports the indirect emissions associated with its own consumption of purchased electricity under scope 2 and can optionally report emissions associated with upstream T&D losses in scope 3. Figure 4 shows the accounting of emissions associated with these transactions.

Example two: Company D installs a co-generation unit and sells surplus electricity to a neighboring company E for its consumption. Company D reports all direct emissions from the co-generation unit under scope 1. Indirect emissions from the generation of electricity for export to E are reported by D under optional information separately

## Seattle City Light: Accounting for the purchase of electricity sold to end users

Seattle City Light (SCL), Seattle's municipal utility company, sells electricity to its end-use customers that is either produced at its own hydropower facilities, purchased through long-term contracts, or purchased on the short-term market. SCL used the first edition of the *GHG Protocol Corporate Standard* to estimate its year 2000 and year 2002 GHG emissions, and emissions associated with generation of net purchased electricity sold to end-users was an important component of that inventory. SCL tracks and reports the amount of electricity sold to end-users on a monthly and annual basis.

SCL calculates net purchases from the market (brokers and other utility companies) by subtracting sales to the market from purchases from the market, measured in MWh. This allows a complete accounting of all emissions impacts from its entire operation, including interactions with the market and end-users. On an annual basis, SCL produces more electricity than there is end-use demand, but the production does not match load in all months. So SCL accounts for both purchases from the market and sales into the market. SCL also includes the scope 3 upstream emissions from natural gas production and delivery, operation of SCL facilities, vehicle fuel use, and airline travel.

SCL believes that sales to end-users are a critical part of the emissions profile for an electric utility company. Utility companies need to provide information on their emissions profile to educate end-users and adequately represent the impact of their business, the providing of electricity. End-use customers need to rely on their utility company to provide electricity, and except in some instances (green power programs), do not have a choice in where their electricity is purchased. SCL meets a customer need by providing emissions information to customers who are doing their own emissions inventory.

from scope 3. Company E reports indirect emissions associated with the consumption of electricity purchased from the company D's co-generation unit under scope 2.

For more guidance, see Appendix A on accounting for indirect emissions from purchased electricity.

## Scope 3: Other indirect GHG emissions

Scope 3 is optional, but it provides an opportunity to be innovative in GHG management. Companies may want to focus on accounting for and reporting those activities that are relevant to their business and goals, and for which they have reliable information. Since companies have discretion over which categories they choose to report, scope 3 may not lend itself well to comparisons across companies. This section provides an indicative list of scope 3 categories and includes case studies on some of the categories.

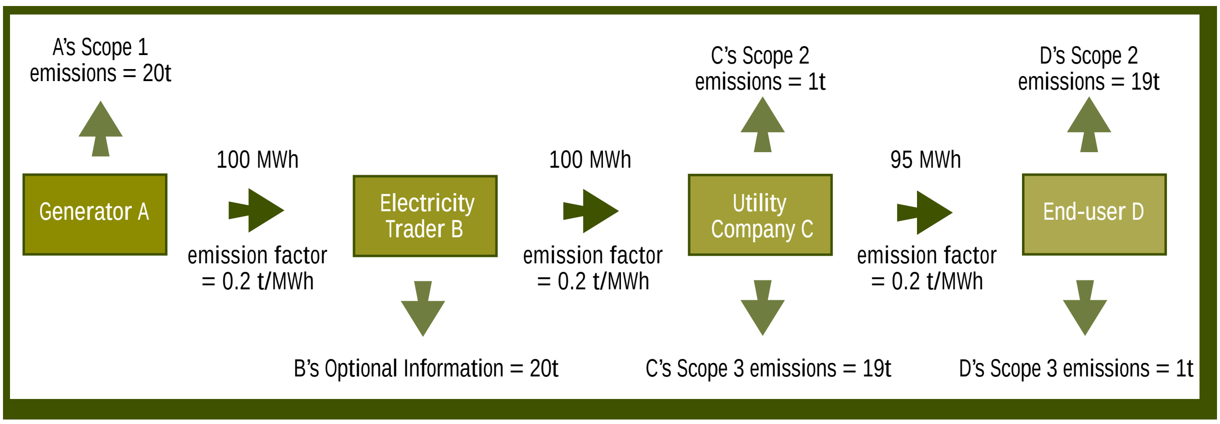
Some of these activities will be included under scope 1 if the pertinent emission sources are owned or controlled by the company (e.g., if the transportation of products is done in vehicles owned or controlled by the company). To determine if an activity falls within scope 1 or scope 3, the company should refer to the selected consolidation approach (equity or control) used in setting its organizational boundaries.

- Extraction and production of purchased materials and fuels[6]
- Transport-related activities
  - Transportation of purchased materials or goods
  - Transportation of purchased fuels
  - Employee business travel
  - Employees commuting to and from work
  - Transportation of sold products
  - Transportation of waste
- Electricity-related activities not included in scope 2 (see Appendix A)
  - Extraction, production, and transportation of fuels consumed in the generation of electricity (either purchased or own generated by the reporting company)
  - Purchase of electricity that is sold to an end user (reported by utility company)
  - Generation of electricity that is consumed in a T&D system (reported by end-user)
- Leased assets, franchises, and outsourced activities—emissions from such contractual arrangements are only classified as scope 3 if the selected consolidation approach (equity or control) does not apply to them. Clarification on the classification of leased assets should be obtained from the company accountant (see section on leases below).
- Use of sold products and services
- Waste disposal
  - Disposal of waste generated in operations
  - Disposal of waste generated in the production of purchased materials and fuels
  - Disposal of sold products at the end of their life

### ACCOUNTING FOR SCOPE 3 EMISSIONS

Accounting for scope 3 emissions need not involve a full-blown GHG life cycle analysis of all products and operations. Usually it is valuable to focus on one or two major GHG-generating activities. Although it is difficult to provide generic guidance on which scope 3 emissions to include in an inventory, some general steps can be articulated:

FIGURE 4. GHG accounting from the sale and purchase of electricity



1. Describe the value chain. Because the assessment of scope 3 emissions does not require a full life cycle assessment, it is important, for the sake of transparency, to provide a general description of the value chain and the associated GHG sources. For this step, the scope 3 categories listed can be used as a checklist. Companies usually face choices on how many levels up- and downstream to include in scope 3. Consideration of the company's inventory or business goals and relevance of the various scope 3 categories will guide these choices.

2. Determine which scope 3 categories are relevant. Only some types of upstream or downstream emissions categories might be relevant to the company. They may be relevant for several reasons:

- They are large (or believed to be large) relative to the company's scope 1 and scope 2 emissions
- They contribute to the company's GHG risk exposure
- They are deemed critical by key stakeholders (e.g., feedback from customers, suppliers, investors, or civil society)
- There are potential emissions reductions that could be undertaken or influenced by the company.

The following examples may help decide which scope 3 categories are relevant to the company.

- If fossil fuel or electricity is required to use the company's products, product use phase emissions may be a relevant category to report. This may be especially important if the company can influence product design attributes (e.g., energy efficiency) or customer behavior in ways that reduce GHG emissions during the use of the products.

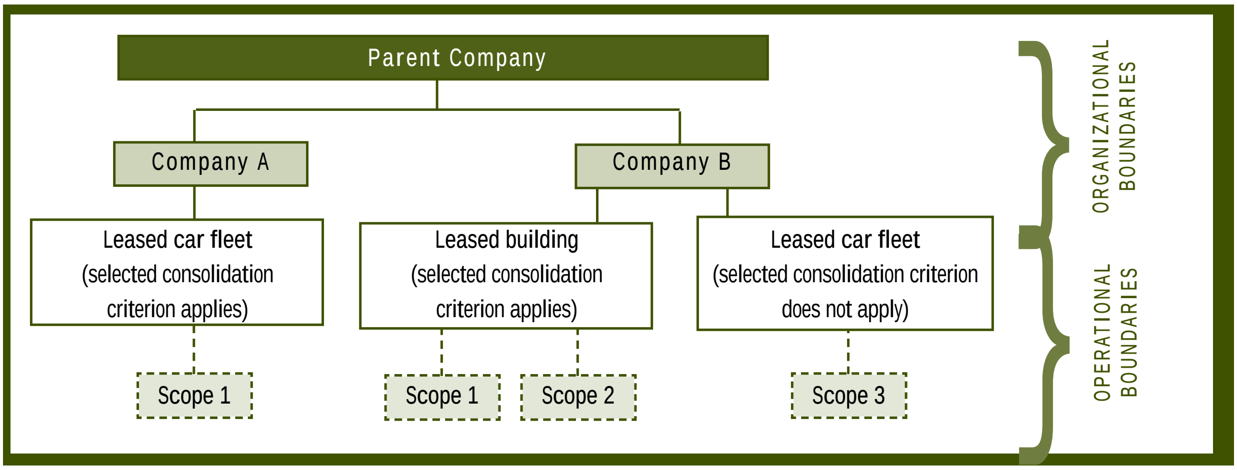
## DHL Nordic Express: The business case for accounting for outsourced transportation services

As a major transportation and logistics company in northern Europe, DHL Express Nordic serves large loads and special transport needs as well as world wide express package and document deliveries and offers courier, express, parcel, systemized and specialty business services. Through participation in the Business Leaders Initiative on Climate Change, the company found that 98 percent of its emissions in Sweden originate from the transport of goods via outsourced partner transportation firms. Each partner is required, as an element of the subcontract payment scheme, to enter data on vehicles used, distance traveled, fuel efficiency, and background data. This data is used to calculate total emissions via a tailored calculation tool for outsourced transportation which gives a detailed picture of its scope 3 emissions. Linking data to specific carriers allows the company to screen individual carriers for environmental performance and affect decisions based on each carrier's emissions performance, which is seen through scope 3 as DHL's own performance.

By including scope 3 and promoting GHG reductions throughout the value chain, DHL Express Nordic increased the relevance of its emissions footprint, expanded opportunities for reducing its impacts and improved its ability to recognize cost saving opportunities. Without scope 3, DHL Express Nordic would have lacked much of the information needed to be able to understand and effectively manage its emissions.

| SCOPE | EMISSIONS ($tCO_2$) |
|---|---|
| Scope 1 | 7,265 |
| Scope 2 | 52 |
| Scope 3 | 327,634 |
| Total | 334,951 |

FIGURE 5. Accounting of emissions from leased assets



- Outsourced activities are often candidates for scope 3 emissions assessments. It may be particularly important to include these when a previously outsourced activity contributed significantly to a company's scope 1 or scope 2 emissions.
- If GHG-intensive materials represent a significant fraction of the weight or composition of a product used or manufactured (e.g., cement, aluminum), companies may want to examine whether there are opportunities to reduce their consumption of the product or to substitute less GHG-intensive materials.
- Large manufacturing companies may have significant emissions related to transporting purchased materials to centralized production facilities.
- Commodity and consumer product companies may want to account for GHGs from transporting raw materials, products, and waste.
- Service sector companies may want to report on emissions from employee business travel; this emissions source is not as likely to be significant for other kinds of companies (e.g., manufacturing companies).

3. Identify partners along the value chain. Identify any partners that contribute potentially significant amounts of GHGs along the value chain (e.g., customers/users, product designers/manufacturers, energy providers, etc.). This is important when trying to identify sources, obtain relevant data, and calculate emissions.

4. Quantify scope 3 emissions. While data availability and reliability may influence which scope 3 activities are included in the inventory, it is accepted that data accuracy may be lower. It may be more important to understand the relative magnitude of and possible changes to scope 3 activities. Emission estimates are acceptable as long as there is transparency with regard to the estimation approach, and the data used for the analysis are adequate to support the objectives of the inventory. Verification of scope 3 emissions will often be difficult and may only be considered if data is of reliable quality.

### IKEA: Customer transportation to and from its retail stores

IKEA, an international home furniture and furnishings retailer, decided to include scope 3 emissions from customer travel when it became clear, through participation in the Business Leaders Initiative on Climate Change (BLICC) program, that these emissions were large relative its scope 1 and scope 2 emissions. Furthermore, these emissions are particularly relevant to IKEA's store business model. Customer travel to its stores, often from long distances, is directly affected by IKEA's choice of store location and the warehouse shopping concept.

Customer transportation emission calculations were based on customer surveys at selected stores. Customers were asked for the distance they traveled to the store (based on home postal code), the number of customers in their car, the number of other stores they intended to visit at that shopping center that day, and whether they had access to public transportation to the store. Extrapolating this data to all IKEA stores and multiplying distance by average vehicle efficiencies for each country, the company calculated that 66 percent of its emissions inventory was from scope 3 customer travel. Based on this information, IKEA will have significant influence over future scope 3 emissions by considering GHG emissions when developing public transportation options and home delivery services for its existing and new stores.

## Leased assets, outsourcing, and franchises

The selected consolidation approach (equity share or one of the control approaches) is also applied to account for and categorize direct and indirect GHG emissions from contractual arrangements such as leased assets, outsourcing, and franchises. If the selected equity or control approach does not apply, then the company may account for emissions from the leased assets, outsourcing, and franchises under scope 3. Specific guidance on leased assets is provided below:

- USING EQUITY SHARE OR FINANCIAL CONTROL: The lessee only accounts for emissions from leased assets that are treated as wholly owned assets in financial accounting and are recorded as such on the balance sheet (i.e., finance or capital leases).

- USING OPERATIONAL CONTROL: The lessee only accounts for emissions from leased assets that it operates (i.e., if the operational control criterion applies).

Guidance on which leased assets are operating and which are finance leases should be obtained from the company accountant. In general, in a finance lease, an organization assumes all rewards and risks from the leased asset, and the asset is treated as wholly owned and is recorded as such on the balance sheet. All leased assets that do not meet those criteria are operating leases. Figure 5 illustrates the application of consolidation criteria to account for emissions from leased assets.

## Double counting

Concern is often expressed that accounting for indirect emissions will lead to double counting when two different companies include the same emissions in their respective inventories. Whether or not double counting occurs depends on how consistently companies with shared ownership or trading program administrators choose the same approach (equity or control) to set the organizational boundaries. Whether or not double counting matters, depends on how the reported information is used.

Double counting needs to be avoided when compiling national (country) inventories under the Kyoto Protocol, but these are usually compiled via a top-down exercise using national economic data, rather than aggregation of bottom-up company data. Compliance regimes are more likely to focus on the "point of release" of emissions (i.e., direct emissions) and/or indirect emissions from use of electricity. For GHG risk management and voluntary reporting, double counting is less important.

### World Resources Institute: Innovations in estimating employee commuting emissions

The World Resources Institute has a long-standing commitment to reduce its annual GHG emissions to net zero through a combination of internal reduction efforts and external offset purchases. WRI's emissions inventory includes scope 2 indirect emissions associated with the consumption of purchased electricity and scope 3 indirect emissions associated with business air travel, employee commuting, and paper use. WRI has no scope 1 direct emissions.

Collecting employee commuting activity data from WRI's 140 staff can be challenging. The method used is to survey employees once each year about their average commuting habits. In the first two years of the initiative, WRI used an Excel spreadsheet accessible to all employees on a shared internal network, but only achieved a 48 percent participation rate. A simplified, web-based survey that downloaded into a spreadsheet improved participation to 65 percent in the third year. Using feedback on the survey design, WRI further simplified and refined survey questions, improved user friendliness, and reduced the time needed to complete the survey to less than a minute. Employee participation rate rose to 88 percent.

Designing a survey that was easily navigable and had clearly articulated questions significantly improved the completeness and accuracy of the employee commuting activity data. An added benefit was that employees felt a certain amount of pride at having contributed to the inventory development process. The experience also provided a positive internal communications opportunity.

WRI has developed a guide consistent with *GHG Protocol Corporate Standard* to help office-based organizations understand how to track and manage their emissions. *Working 9 to 5 on Climate Change: An Office Guide* is accompanied by a suite of calculation tools, including one for using a survey method to estimate employee commuting emissions. The Guide and tools can be downloaded from the GHG Protocol Initiative website (www.ghgprotocol.org).

Transportation-related emissions are the fastest growing GHG emissions category in the United States. This includes commercial, business, and personal travel as well as commuting. By accounting for commuting emissions, companies may find that several practical opportunities exist for reducing them. For example, when WRI moved to new office space, it selected a building located close to public transportation, reducing the need for employees to drive to work. In its lease, WRI also negotiated access to a locked bike room for those employees who cycle to work. Finally, telework programs significantly reduce commuting emissions by avoiding or decreasing the need to travel.

For participating in GHG markets or obtaining GHG credits, it would be unacceptable for two organizations to claim ownership of the same emissions commodity and it is therefore necessary to make sufficient provisions to ensure that this does not occur between participating companies (see chapter 11).

## SCOPES AND DOUBLE COUNTING

The *GHG Protocol Corporate Standard* is designed to prevent double counting of emissions between different companies within scope 1 and 2. For example, the scope 1 emissions of company A (generator of electricity) can be counted as the scope 2 emissions of company B (end-user of electricity) but company A's scope 1 emissions cannot be counted as scope 1 emissions by company C (a partner organization of company A) as long as company A and company C consistently apply the same control or equity share approach when consolidating emissions.

Similarly, the definition of scope 2 does not allow double counting of emissions within scope 2, i.e., two different companies cannot both count scope 2 emissions from the purchase of the same electricity. Avoiding this type of double counting within scope 2 emissions makes it a useful accounting category for GHG trading programs that regulate end users of electricity.

When used in external initiatives such as GHG trading, the robustness of the scope 1 and 2 definitions combined with the consistent application of either the control or equity share approach for defining organizational boundaries allows only one company to exercise ownership of scope 1 or scope 2 emissions.

### ABB: Calculating product use phase emissions associated with electrical appliances

ABB, an energy and automation technology company based in Switzerland, produces a variety of appliances and equipment, such as circuit breakers and electrical drives, for industrial applications. ABB has a stated goal to issue Environmental Product Declarations (EPDs) for all its core products based on life cycle assessment. As a part of its committment, ABB reports both manufacturing and product use phase GHG emissions for a variety of its products using a standardized calculation method and set of assumptions. For example, product use phase calculations for ABB's 4 kW DriveIT Low Voltage AC drive are based on a 15-year expected lifetime and an average of 5,000 annual operating hours. This activity data is multiplied by the average electricity emission factor for OECD countries to produce total lifetime product use emissions.

Compared with manufacturing emissions, product use phase emissions account for about 99 percent of total life cycle emissions for this type of drive. The magnitude of these emissions and ABB's control of the design and performance of this equipment clearly give the company significant leverage on its customers' emissions by improving product efficiency or helping customers design better overall systems in which ABB's products are involved. By clearly defining and quantifying significant value chain emissions, ABB has gained insight into and influence over its emissions footprint.

NOTES

[1] The terms "direct" and "indirect" as used in this document should not be confused with their use in national GHG inventories where 'direct' refers to the six Kyoto gases and 'indirect' refers to the precursors NOx, NMVOC, and CO.

[2] The term "electricity" is used in this chapter as shorthand for electricity, steam, and heating/cooling.

[3] For some integrated manufacturing processes, such as ammonia manufacture, it may not be possible to distinguish between GHG emissions from the process and those from the production of electricity, heat, or steam.

[4] Green power includes renewable energy sources and specific clean energy technologies that reduce GHG emissions relative to other sources of energy that supply the electric grid, e.g., solar photovoltaic panels, geothermal energy, landfill gas, and wind turbines.

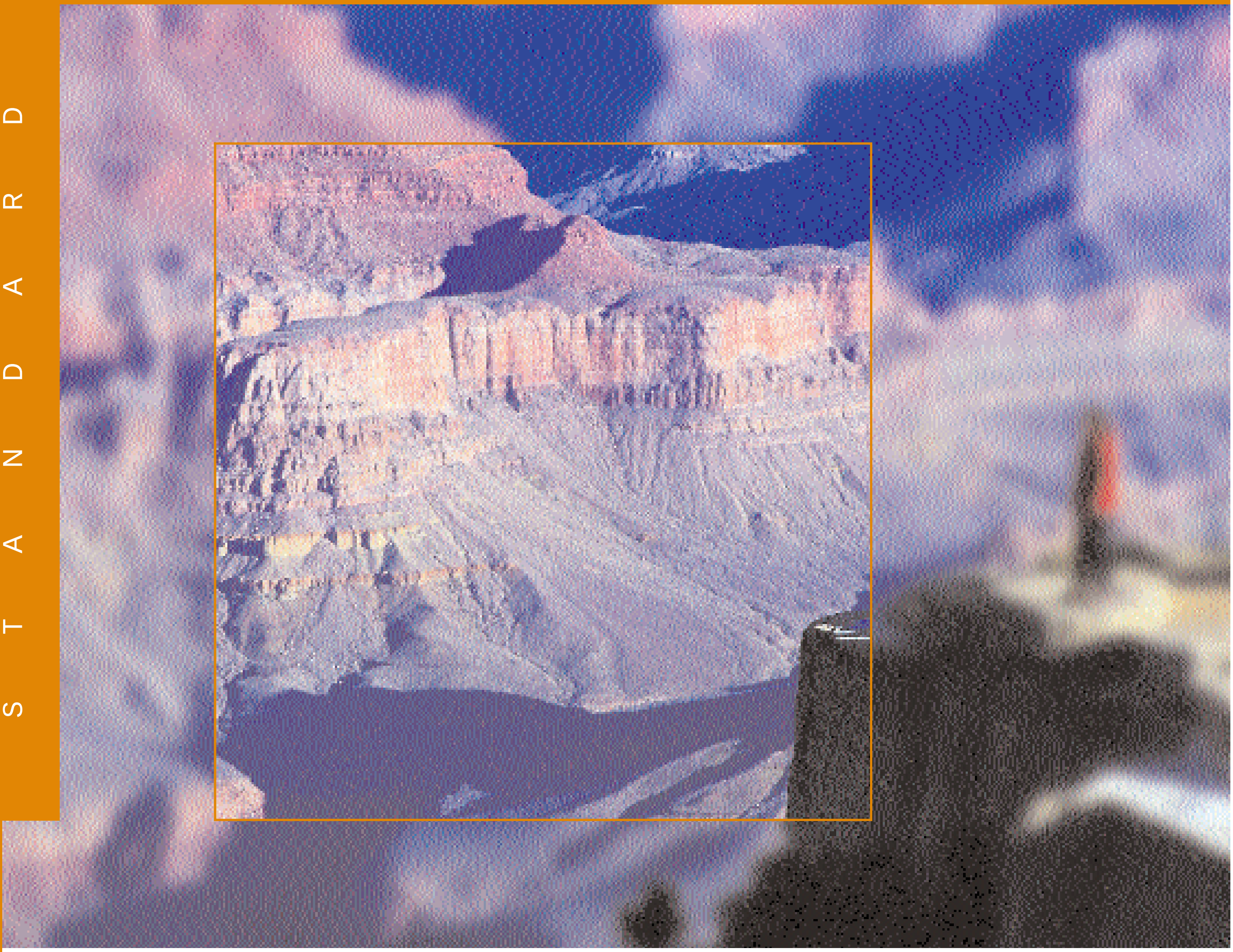
[5] A T&D system includes T&D lines and other T&D equipment (e.g., transformers).

[6] "Purchased materials and fuels" is defined as material or fuel that is purchased or otherwise brought into the organizational boundary of the company.

GUIDANCE

# 5 Tracking Emissions Over Time

S T A N D A R D



Companies often undergo significant structural changes such as acquisitions, divestments, and mergers. These changes will alter a company's historical emission profile, making meaningful comparisons over time difficult. In order to maintain consistency over time, or in other words, to keep comparing "like with like", historic emission data will have to be recalculated.

S T A N D A R D

G U I D A N C E

Companies may need to track emissions over time in response to a variety of business goals, including:

- Public reporting
- Establishing GHG targets
- Managing risks and opportunities
- Addressing the needs of investors and other stakeholders

A meaningful and consistent comparison of emissions over time requires that companies set a performance datum with which to compare current emissions. This performance datum is referred to as the base year[1] emissions. For consistent tracking of emissions over time, the base year emissions may need to be recalculated as companies undergo significant structural changes such as acquisitions, divestments, and mergers.

The first step in tracking emissions, however, is the selection of a base year.

## Choosing a base year

Companies shall choose and report a base year for which verifiable emissions data are available and specify their reasons for choosing that particular year.

Most companies select a single year as their base year. However, it is also possible to choose an average of annual emissions over several consecutive years. For example, the U.K. ETS specifies an average of 1998–2000 emissions as the reference point for tracking reductions. A multi-year average may help smooth out unusual fluctuations in GHG emissions that would make a single year's data unrepresentative of the company's typical emissions profile.

The inventory base year can also be used as a basis for setting and tracking progress towards a GHG target in which case it is referred to as a target base year (see chapter 11).

## Recalculating base year emissions

Companies shall develop a base year emissions recalculation policy, and clearly articulate the basis and context for any recalculations. If applicable, the policy shall state any "significance threshold" applied for deciding on historic emissions recalculation. "Significance threshold" is a qualitative and/or quantitative criterion used to define any significant change to the data, inventory boundary, methods, or any other relevant factors. It is the responsibility of the company to determine the "significance threshold" that triggers base year emissions recalculation and to disclose it. It is the responsibility of the verifier to confirm the company's adherence to its threshold policy. The following cases shall trigger recalculation of base year emissions:

- Structural changes in the reporting organization that have a significant impact on the company's base year emissions. A structural change involves the transfer of ownership or control of emissions-generating activities or operations from one company to another. While a single structural change might not have a significant impact on the base year emissions, the cumulative effect of a number of minor structural changes can result in a significant impact. Structural changes include:
  - Mergers, acquisitions, and divestments
  - Outsourcing and insourcing of emitting activities
- Changes in calculation methodology or improvements in the accuracy of emission factors or activity data that result in a significant impact on the base year emissions data
- Discovery of significant errors, or a number of cumulative errors, that are collectively significant.

In summary, base year emissions shall be retroactively recalculated to reflect changes in the company that would otherwise compromise the consistency and relevance of the reported GHG emissions information. Once a company has determined its policy on how it will recalculate base year emissions, it shall apply this policy in a consistent manner. For example, it shall recalculate for both GHG emissions increases and decreases.

S T A N D A R D

# Tracking Emissions Over Time

Selection and recalculation of a base year should relate to the business goals and the particular context of the company:

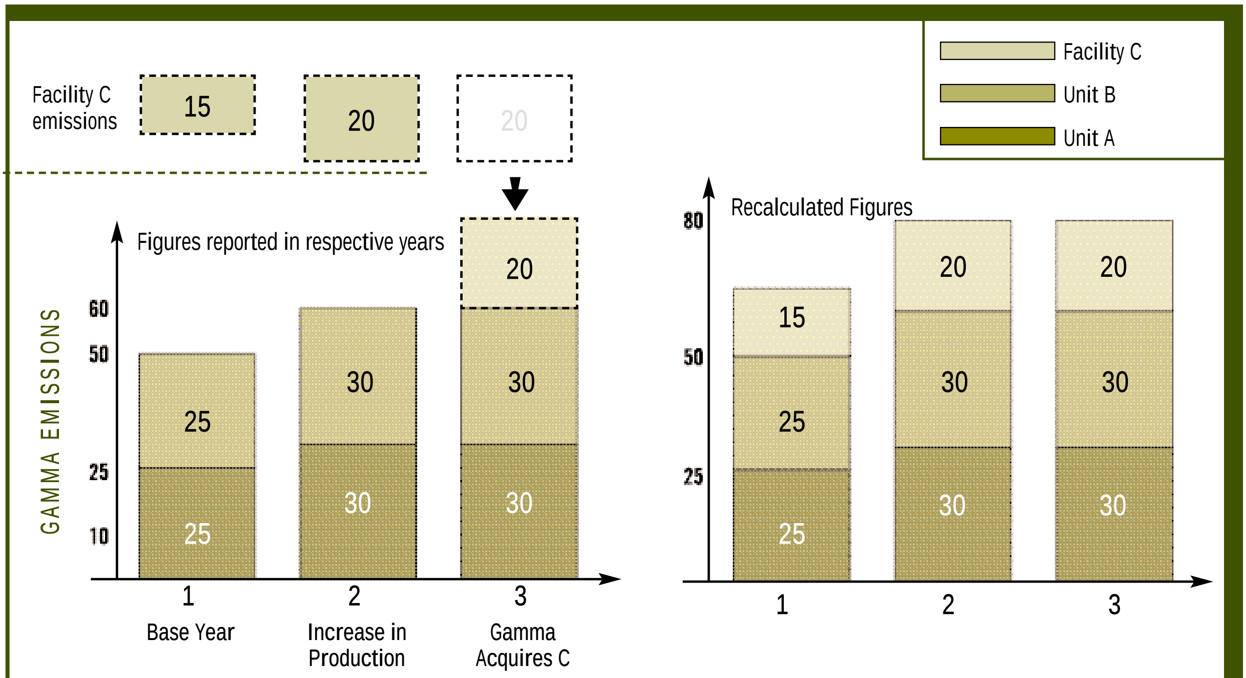
- For the purpose of reporting progress towards voluntary public GHG targets, companies may follow the standards and guidance in this chapter
- A company subject to an external GHG program may face external rules governing the choice and recalculation of base year emissions
- For internal management goals, the company may follow the rules and guidelines recommended in this document, or it may develop its own approach, which should be followed consistently.

## Choosing a base year

Companies should choose as a base year the earliest relevant point in time for which they have reliable data. Some organizations have adopted 1990 as a base year in order to be consistent with the Kyoto Protocol. However, obtaining reliable and verifiable data for historical base years such as 1990 can be very challenging.

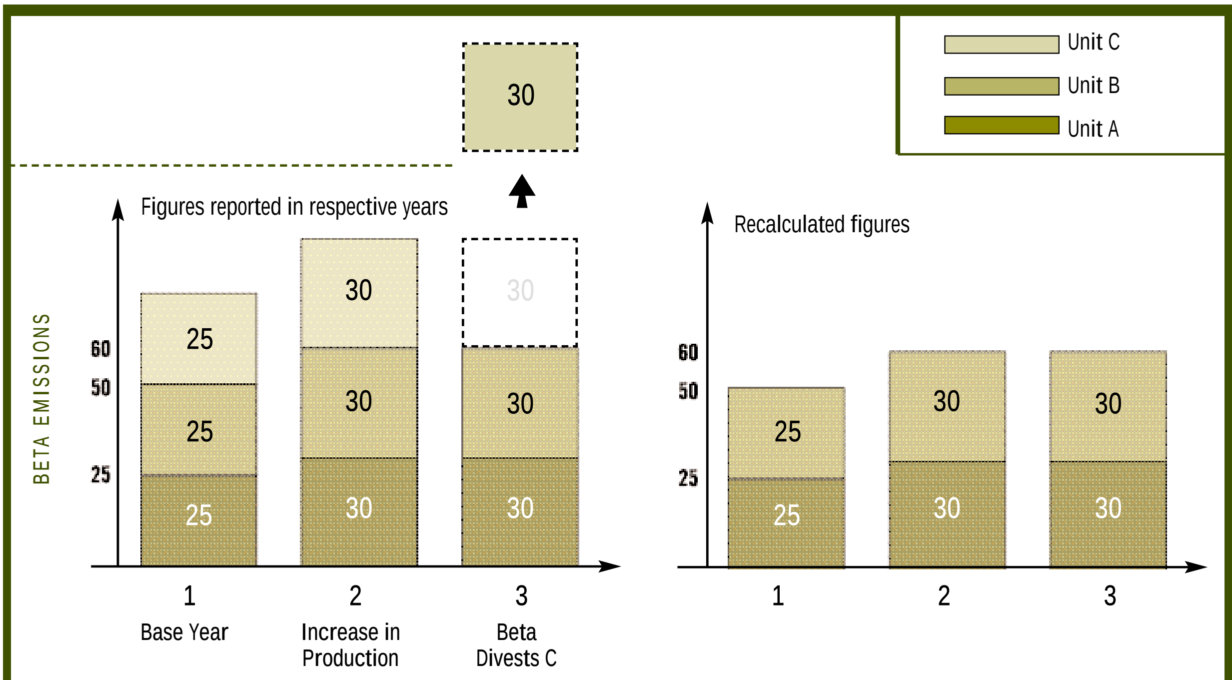
If a company continues to grow through acquisitions, it may adopt a policy that shifts or "rolls" the base year forward by a number of years at regular intervals. Chapter 11 contains a description of such a "rolling base year," including a comparison with the fixed base year approach described in this chapter. A fixed base year has the advantage of allowing emissions data to be compared on a like-with-like basis over a longer time period than a rolling base year approach. Most emissions trading and registry programs require a fixed base year policy to be implemented.

FIGURE 6. Base year emissions recalculation for an acquisition




Company Gamma consists of two business units (A and B). In its base year (year one), each business unit emits 25 tonnes $CO_2$. In year two, the company undergoes "organic growth," leading to an increase in emissions to 30 tonnes $CO_2$ per business unit, i.e., 60 tonnes $CO_2$ in total. The base year emissions are not recalculated in this case. At the beginning of year three, the company acquires production facility C from another company. The annual emissions of facility C in year one were 15 tonnes $CO_2$, and 20 tonnes $CO_2$ in years two and three. The total emission of company Gamma in year three, including facility C, are therefore 80 tonnes $CO_2$. To maintain consistency over time, the company recalculates its base year emissions to take into account the acquisition of facility C. The base year emissions increase by 15 tonnes $CO_2$—the quantity of emissions produced by facility C in Gamma's base year. The recalculated base year emissions are 65 tonnes $CO_2$. Gamma also (optionally) reports 80 tonnes $CO_2$ as the recalculated emissions for year two.

FIGURE 7. Base year emissions recalculation for a divestment




Company Beta consists of three business units (A, B, and C). Each business unit emits 25 tonnes $CO_2$ and the total emissions for the company are 75 tonnes $CO_2$ in the base year (year one). In year two, the output of the company grows, leading to an increase in emissions to 30 tonnes $CO_2$ per business unit, i.e., 90 tonnes $CO_2$ in total. At the beginning of year three, Beta divests business unit C and its annual emissions are now 60 tonnes, representing an apparent reduction of 15 tonnes relative to the base year emissions. However, to maintain consistency over time, the company recalculates its base year emissions to take into account the divestment of business unit C. The base year emissions are lowered by 25 tonnes $CO_2$—the quantity of emissions produced by the business unit C in the base year. The recalculated base year emissions are 50 tonnes $CO_2$, and the emissions of company Beta are seen to have risen by 10 tonnes $CO_2$ over the three years. Beta (optionally) reports 60 tonnes $CO_2$ as the recalculated emissions for year two.

## Significance thresholds for recalculations

Whether base year emissions are recalculated depends on the significance of the changes. The determination of a significant change may require taking into account the cumulative effect on base year emissions of a number of small acquisitions or divestments. The *GHG Protocol Corporate Standard* makes no specific recommendations as to what constitutes "significant." However, some GHG programs do specify numerical significance thresholds, e.g., the California Climate Action Registry, where the change threshold is 10 percent of the base year emissions, determined on a cumulative basis from the time the base year is established.

## Base year emissions recalculation for structural changes

Structural changes trigger recalculation because they merely transfer emissions from one company to another without any change of emissions released to the atmosphere, for example, an acquisition or divestment only transfers existing GHG emissions from one company's inventory to another.

Figures 6 and 7 illustrate the effect of structural changes and the application of this standard on recalculation of base year emissions.

## Timing of recalculations for structural changes

When significant structural changes occur during the middle of the year, the base year emissions should be recalculated for the entire year, rather than only for the remainder of the reporting period after the structural change occurred. This avoids having to recalculate base year emissions again in the succeeding year. Similarly, current year emissions should be recalculated for the entire year to maintain consistency with the base year recalculation. If it is not possible to make a recalculation in the year of the structural change (e.g., due to

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lack of data for an acquired company), the recalculation may be carried out in the following year.[2]

## Recalculations for changes in calculation methodology or improvements in data accuracy

A company might report the same sources of GHG emissions as in previous years, but measure or calculate them differently. For example, a company might have used a national electric power generation emissions factor to estimate scope 2 emissions in year one of reporting. In later years, it may obtain more accurate utility-specific emission factors (for the current as well as past years) that better reflect the GHG emissions associated with the electricity that it has purchased. If the differences in emissions resulting from such a change are significant, historic data is recalculated applying the new data and/or methodology.

Sometimes the more accurate data input may not reasonably be applied to all past years or new data points may not be available for past years. The company may then have to backcast these data points, or the change in data source may simply be acknowledged without recalculation. This acknowledgement should be made in the report each year in order to enhance transparency; otherwise, new users of the report in the two or three years after the change may make incorrect assumptions about the performance of the company.

Any changes in emission factor or activity data that reflect real changes in emissions (i.e., changes in fuel type or technology) do not trigger a recalculation.

## Optional reporting for recalculations

Optional information that companies may report on recalculations includes:

- The recalculated GHG emissions data for all years between the base year and the reporting year
- All actual emissions as reported in respective years in the past, i.e., the figures that have not been recalculated. Reporting the original figures in addition to the recalculated figures contributes to transparency since it illustrates the evolution of the company's structure over time.

## No base year emissions recalculations for facilities that did not exist in the base year

Base year emissions are not recalculated if the company makes an acquisition of (or insources) operations that did not exist in its base year. There may only be a recalculation of historic data back to the year in which the acquired company came into existence. The same applies to cases where the company makes a divestment of (or outsources) operations that did not exist in the base year.

Figure 8 illustrates a situation where no recalculation of base year emissions is required, since the acquired facility came into existence after the base year was set.

## No recalculation for "outsourcing/insourcing" if reported under scope 2 and/or scope 3

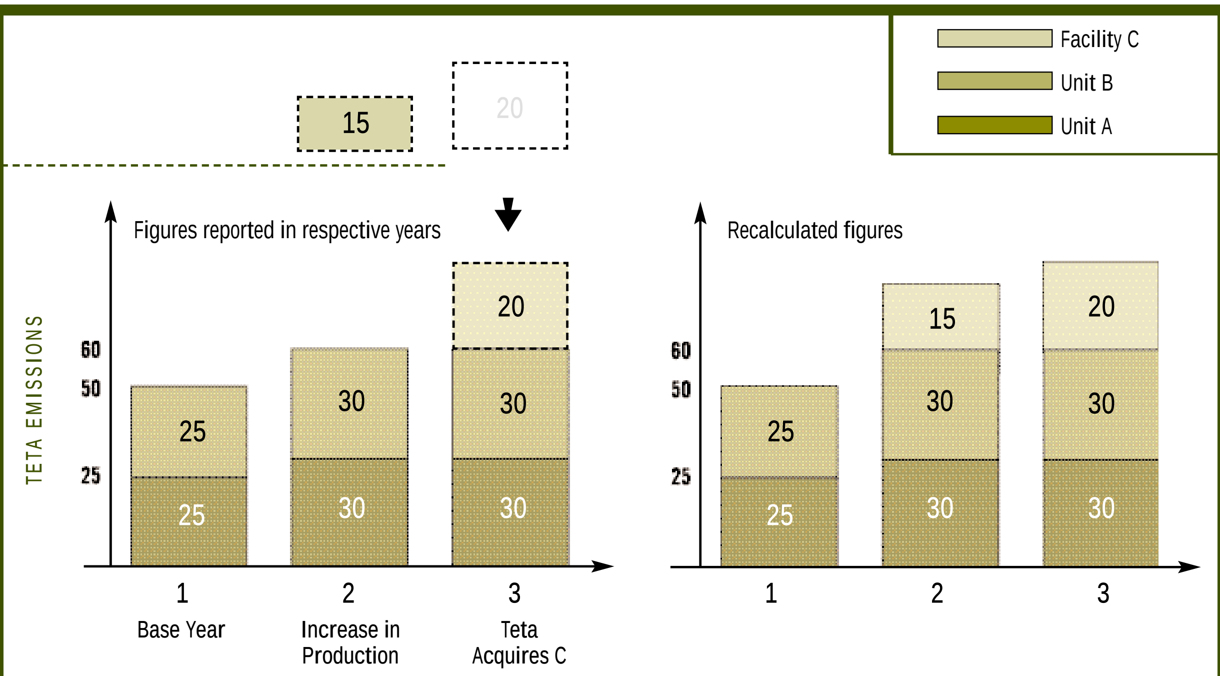
Structural changes due to "outsourcing" or "insourcing" do not trigger base year emissions recalculation if the company is reporting its indirect emissions from relevant outsourced or insourced activities. For example, outsourcing production of electricity, heat, or steam does not trigger base year emissions recalculation, since the *GHG Protocol Corporate Standard* requires scope 2 reporting. However, outsourcing/insourcing that shifts significant emissions between scope 1 and scope 3 when scope 3 is not reported does trigger a base year emissions recalculation (e.g., when a company outsources the transportation of products).

In case a company decides to track emissions over time separately for different scopes, and has separate base years for each scope, base year emissions recalculation for outsourcing or insourcing is made.

### ENDESA: Recalculation of base year emissions because of structural changes

The *GHG Protocol Corporate Standard* requires setting a base year for comparing emissions over time. To be able to compare over time, the base year emissions must be recalculated if any structural changes occur in the company. In a deal completed January 2002, the ENDESA Group, a power generation company based in Spain, sold its 87.5 percent holding in Viesgo, a part of its Spanish power generation business, to ENEL, an Italian power company. To account for this structural change, historical emissions from the six power plants included in the sale were no longer accounted for in the Endesa GHG inventory and therefore removed from its base year emissions. This recalculation provides ENDESA with a complete and comparable picture of its historical emissions.

FIGURE 8. Acquisition of a facility that came into existence after the base year was set




Company Teta consists of two business units (A and B). In its base year (year one), the company emits 50 tonnes $CO_2$. In year two, the company undergoes organic growth, leading to an increase in emissions to 30 tonnes $CO_2$ per business unit, i.e., 60 tonnes $CO_2$ in total. The base year emissions are not recalculated in this case. At the beginning of year three, Teta acquires a production facility C from another company. Facility C came into existence in year two, its emissions being 15 tonnes $CO_2$ in year two and 20 tonnes $CO_2$ in year three. The total emissions of company Teta in year three, including facility C, are therefore 80 tonnes $CO_2$. In this acquisition case, the base year emissions of company Teta do not change because the acquired facility C did not exist in year one when the base year of Teta was set. The base year emissions of Teta therefore remain at 50 tonnes $CO_2$. Teta (optionally) reports 75 tonnes as the recalculated figure for year two emissions.

## No recalculation for organic growth or decline

Base year emissions and any historic data are not recalculated for organic growth or decline. Organic growth/decline refers to increases or decreases in production output, changes in product mix, and closures and openings of operating units that are owned or controlled by the company. The rationale for this is that organic growth or decline results in a change of emissions to the atmosphere and therefore needs to be counted as an increase or decrease in the company's emissions profile over time.

NOTES

[1] Terminology on this topic can be confusing. Base year emissions should be differentiated from the term "baseline," which is mostly used in the context of project-based accounting. The term base year focuses on a comparison of emissions over time, while a baseline is a hypothetical scenario for what GHG emissions would have been in the absence of a GHG reduction project or activity.

[2] For more information on the timing of base year emissions recalculations, see the guidance document "Base year recalculation methodologies for structural changes" on the GHG Protocol website (www.ghgprotocol.org).

# 6 Identifying and Calculating GHG Emissions

G U I D A N C E

Once the inventory boundary has been established, companies generally calculate GHG emissions using the following steps:

1. Identify GHG emissions sources
2. Select a GHG emissions calculation approach
3. Collect activity data and choose emission factors
4. Apply calculation tools
5. Roll-up GHG emissions data to corporate level.

This chapter describes these steps and the calculation tools developed by the GHG Protocol. The calculation tools are available on the GHG Protocol Initiative website at www.ghgprotocol.org.

G U I D A N C E

To create an accurate account of their emissions, companies have found it useful to divide overall emissions into specific categories. This allows a company to use specifically developed methodologies to accurately calculate the emissions from each sector and source category.

## Identify GHG emissions sources

The first of the five steps in identifying and calculating a company's emissions as outlined in Figure 9 is to categorize the GHG sources within that company's boundaries. GHG emissions typically occur from the following source categories:

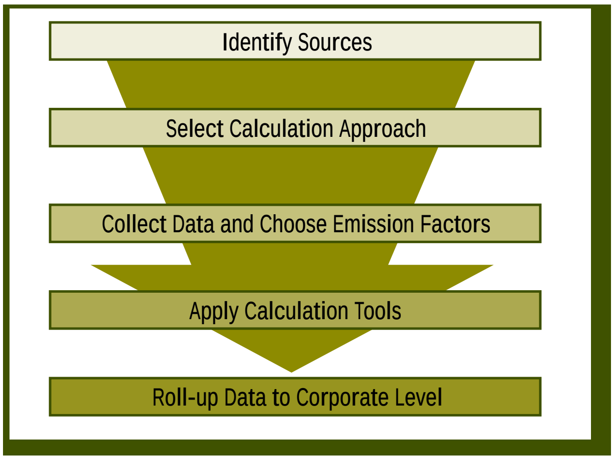
- Stationary combustion: combustion of fuels in stationary equipment such as boilers, furnaces, burners, turbines, heaters, incinerators, engines, flares, etc.
- Mobile combustion: combustion of fuels in transportation devices such as automobiles, trucks, buses, trains, airplanes, boats, ships, barges, vessels, etc.
- Process emissions: emissions from physical or chemical processes such as $CO_2$ from the calcination step in cement manufacturing, $CO_2$ from catalytic cracking in petrochemical processing, PFC emissions from aluminum smelting, etc.
- Fugitive emissions: intentional and unintentional releases such as equipment leaks from joints, seals, packing, gaskets, as well as fugitive emissions from coal piles, wastewater treatment, pits, cooling towers, gas processing facilities, etc.

Every business has processes, products, or services that generate direct and/or indirect emissions from one or more of the above broad source categories. The *GHG Protocol* calculation tools are organized based on these categories. Appendix D provides an overview of direct and indirect GHG emission sources organized by scopes and industry sectors that may be used as an initial guide to identify major GHG emission sources.

### IDENTIFY SCOPE 1 EMISSIONS

As a first step, a company should undertake an exercise to identify its direct emission sources in each of the four source categories listed above. Process emissions are usually only relevant to certain industry sectors like oil and gas, aluminum, cement, etc. Manufacturing companies that generate process emissions and own or control a power production facility will likely have direct emissions from all the main source categories. Office-based organizations may not have any direct GHG emissions except in cases where they own or operate a vehicle, combustion device, or refrigeration and air-conditioning equipment. Often companies are surprised to realize that significant emissions come from sources that are not initially obvious (see United Technologies case study).

FIGURE 9.
Steps in identifying and calculating GHG emissions




### IDENTIFY SCOPE 2 EMISSIONS

The next step is to identify indirect emission sources from the consumption of purchased electricity, heat, or steam. Almost all businesses generate indirect emissions due to the purchase of electricity for use in their processes or services.

### IDENTIFY SCOPE 3 EMISSIONS

This optional step involves identification of other indirect emissions from a company's upstream and downstream activities as well as emissions associated with outsourced/contract manufacturing, leases, or franchises not included in scope 1 or scope 2.

The inclusion of scope 3 emissions allows businesses to expand their inventory boundary along their value chain and to identify all relevant GHG emissions. This provides a broad overview of various business linkages and possible opportunities for significant GHG emission reductions that may exist upstream or downstream of a company's immediate operations (see chapter 4 for an overview of activities that can generate GHG emissions along a company's value chain).

## Select a calculation approach

Direct measurement of GHG emissions by monitoring concentration and flow rate is not common. More often, emissions may be calculated based on a mass balance or stoichiometric basis specific to a facility or process. However, the most common approach for calculating GHG emissions is through the application of documented emission factors. These factors are calculated ratios relating GHG emissions to a proxy measure of activity at an emissions source. The IPCC guidelines (IPCC, 1996) refer to a hierarchy of calculation approaches and techniques ranging from the application of generic emission factors to direct monitoring.

In many cases, particularly when direct monitoring is either unavailable or prohibitively expensive, accurate emission data can be calculated from fuel use data. Even small users usually know both the amount of fuel consumed and have access to data on the carbon content of the fuel through default carbon content coefficients or through more accurate periodic fuel sampling. Companies should use the most accurate calculation approach available to them and that is appropriate for their reporting context.

## Collect activity data and choose emission factors

For most small to medium-sized companies and for many larger companies, scope 1 GHG emissions will be calculated based on the purchased quantities of commercial fuels (such as natural gas and heating oil) using published emission factors. Scope 2 GHG emissions will primarily be calculated from metered electricity consumption and supplier-specific, local grid, or other published emission factors. Scope 3 GHG emissions will primarily be calculated from activity data such as fuel use or passenger miles and published or third-party emission factors. In most cases, if source- or facility-specific emission factors are available, they are preferable to more generic or general emission factors.

Industrial companies may be faced with a wider range of approaches and methodologies. They should seek guidance from the sector-specific guidelines on the GHG Protocol website (if available) or from their industry associations (e.g., International Aluminum Institute, International Iron and Steel Institute, American Petroleum Institute, WBCSD Sustainable Cement Initiative, International Petroleum Industry Environmental Conservation Association).

### United Technologies Corporation: More than meets the eye

In 1996, United Technologies Corporation (UTC), a global aerospace and building systems technology corporation, appointed a team to set boundaries for the company's new Natural Resource Conservation, Energy and Water Use Reporting Program. The team focused on what sources of energy should be included in the program's annual report of energy consumption. The team decided jet fuel needed to be reported in the annual report; jet fuel was used by a number of UTC divisions for engine and flight hardware testing and for test firing. Although the amount of jet fuel used in any given year was subject to wide variation due to changing test schedules, the total amount consumed in an average year was believed to be large and potentially small enough to be specifically excluded. However, jet fuel consumption reports proved that initial belief incorrect. Jet fuel has accounted for between 9 and 13 percent of the corporation's total annual use of energy since the program commenced. Had UTC not included the use of jet fuel in annual data collection efforts, a significant emissions source would have been overlooked.

## Apply calculation tools

This section provides an overview of the GHG calculation tools and guidance available on the GHG Protocol Initiative website (www.ghgprotocol.org). Use of these tools is encouraged as they have been peer reviewed by experts and industry leaders, are regularly updated, and are believed to be the best available. The tools, however, are optional. Companies may substitute their own GHG calculation methods, provided they are more accurate than or are at least consistent with the *GHG Protocol Corporate Standards* approaches.

There are two main categories of calculation tools:

- Cross-sector tools that can be applied to different sectors. These include stationary combustion, mobile combustion, HFC use in refrigeration and air conditioning, and measurement and estimation uncertainty.
- Sector-specific tools that are designed to calculate emissions in specific sectors such as aluminum, iron and steel, cement, oil and gas, pulp and paper, office-based organizations.

Most companies will need to use more than one calculation tool to cover all their GHG emission sources. For example, to calculate GHG emissions from an aluminum production facility, the company would use the calculation tools for aluminum production, stationary combustion (for any consumption of purchased electricity, generation of energy on-site, etc), mobile combustion (for transportation of materials and products by train, vehicles employed on-site, employee business travel, etc), and HFC use (for refrigeration, etc). See Table 3 for the full list of tools.

### STRUCTURE OF GHG PROTOCOL CALCULATION TOOLS

Each of the cross-sector and sector-specific calculation tools on the website share a common format and include step-by-step guidance on measuring and calculating emissions data. Each tool consists of a guidance section and automated worksheets with explanations on how to use them.

The guidance for each calculation tool includes the following sections:

- Overview: provides an overview of the purpose and content of the tool, the calculation method used in the tool, and a process description
- Choosing activity data and emission factors: provides sector-specific good practice guidance and references for default emission factors
- Calculation methods: describes different calculation methods depending on the availability of site-specific activity data and emission factors
- Quality control: provides good practice guidance
- Internal reporting and documentation: provides guidance on internal documentation to support emissions calculations.

## ChevronTexaco: The SANGEA™ accounting and reporting system

ChevronTexaco, a global energy company, has developed and implemented energy utilization and GHG estimation and reporting software consistent with the *GHG Protocol Corporate Standard*. This software is available free of charge and makes it easier, more accurate, and less costly to institute a corporate-wide GHG accounting and reporting system in the oil and gas sector. Called the SANGEA™ Energy and Greenhouse Gas Emissions Estimating System, it is currently in use at all ChevronTexaco facilities worldwide, comprising more than 70 reporting entities.

The system is an auditable, Excel-and-Visual-Basic-based tool for estimating GHG emissions and energy utilization. It streamlines corporate-level data consolidation by allowing the inventory coordinator at each facility to configure a spreadsheet, enter monthly data, and send quarterly reports to a centralized database.

In practice, the SANGEA™ system employs a variety of strategies to ensure consistent calculation methods and ease company-wide standardization:

- Spreadsheet configuration and material input information for specific facilities can be carried over from year to year. Inventory specialists can easily modify configurations as a facility changes (due to new construction, retirement of units, etc.).
- Updates are efficient. Methodologies for estimating emissions, emission factors, and calculation equations are stored centrally in the software, easing updates when methodologies or default factors change. Updates to this central reference are automatically applied to the existing configuration and input data. Updates will mirror the timing and content of updates to the American Petroleum Institute Compendium of GHG emission estimating methodologies.
- The system is auditable. The software requires detailed audit trail information on data inputs and system users. There is documented accountability of who made any change to the system.
- Using one system saves money. Significant cost savings are achieved by using the same system in all facilities, as compared to conventional, disparate systems.

ChevronTexaco's one-off investment in developing the SANGEA™ system has already shown results: A rough cost estimate for ChevronTexaco's Richmond, California, refinery indicates savings of more than 70 percent over a five-year period compared with the conventional approaches based on locally developed reporting systems. SANGEA™ is expected to reduce the long term expenses of maintaining a legacy system and hiring independent consultants. Employing a combination of the *GHG Protocol Corporate Standard*s and SANGEA™ calculation software to replace a diverse and confusing set of accounting and reporting templates yields significant efficiency and accuracy gains, and allows the company to more accurately manage GHG emissions and institute specific emissions improvements.

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TABLE 3. Overview of GHG calculation tools available on the GHG Protocol website

| | CALCULATION TOOLS | MAIN FEATURES |
|---|---|---|
| CROSS-SECTOR TOOLS | Stationary Combustion | • Calculates direct and indirect $CO_2$ emissions from fuel combustion in stationary equipment<br>• Provides two options for allocating GHG emissions from a co-generation facility<br>• Provides default fuel and national average electricity emission factors |
| | Mobile Combustion | • Calculates direct and indirect $CO_2$ emissions from fuel combustion in mobile sources<br>• Provides calculations and emission factors for road, air, water, and rail transport |
| | HFC from Air Conditioning and Refrigeration Use | • Calculates direct HFC emissions during manufacture, use and disposal of refrigeration and air-conditioning equipment in commercial applications<br>• Provides three calculation methodologies: a sales-based approach, a life cycle stage based approach, and an emission factor based approach |
| | Measurement and Estimation Uncertainty for GHG Emissions | • Introduces the fundamentals of uncertainty analysis and quantification<br>• Calculates statistical parameter uncertainties due to random errors related to calculation of GHG emissions<br>• Automates the aggregation steps involved in developing a basic uncertainty assessment for GHG inventory data |
| SECTOR-SPECIFIC TOOLS | Aluminum and other non-Ferrous Metals Production | • Calculates direct GHG emissions from aluminum production ($CO_2$ from anode oxidation, PFC emissions from the "anode effect," and $SF_6$ used in non-ferrous metals production as a cover gas) |
| | Iron and Steel | • Calculates direct GHG emissions ($CO_2$) from oxidation of the reducing agent, from the calcination of the flux used in steel production, and from the removal of carbon from the iron ore and scrap steel used |
| | Nitric Acid Manufacture | • Calculates direct GHG emissions ($N_2O$) from the production of nitric acid |
| | Ammonia Manufacture | • Calculates direct GHG emissions ($CO_2$) from ammonia production. This is for the removal of carbon from the feedstock stream only; combustion emissions are calculated with the stationary combustion module |
| | Adipic Acid Manufacture | • Calculates direct GHG emissions ($N_2O$) from adipic acid production |
| | Cement | • Calculates direct $CO_2$ emissions from the calcination process in cement manufacturing (WBCSD tool also calculates combustion emissions)<br>• Provides two calculation methodologies: the cement-based approach and the clinker-based approach |
| | Lime | • Calculates direct GHG emissions from lime manufacturing ($CO_2$ from the calcination process) |
| | HFC-23 from HCFC-22 Production | • Calculates direct HFC-23 emissions from production of HCFC-22 |
| | Pulp and Paper | • Calculates direct $CO_2$, $CH_4$, and $N_2O$ emissions from production of pulp and paper. This includes calculation of direct and indirect $CO_2$ emissions from combustion of fossil fuels, bio-fuels, and waste products in stationary equipment |
| | Semi-Conductor Wafer Production | • Calculates PFC emission from the production of semi-conductor wafers |
| | Guide for Small Office-Based Organizations | • Calculates direct $CO_2$ emissions from fuel use, indirect $CO_2$ emissions from electricity consumption, and other indirect $CO_2$ emissions from business travel and commuting |

In the automated worksheet section, it is only necessary to insert activity data into the worksheets and to select an appropriate emission factor or factors. Default emission factors are provided for the sectors covered, but it is also possible to insert customized emission factors that are more representative of the reporting company's operations. The emissions of each GHG ($CO_2$, $CH_4$, $N_2O$, etc.) are calculated separately and then converted to $CO_2$ equivalents on the basis of their global warming potential.

Some tools, such as the iron and steel sector tool and the HFC cross-sector tool, take a tiered approach, offering a choice between a simple and a more advanced calculation methodology. The more advanced methods are expected to produce more accurate emissions estimates but usually require collection of more detailed data and a more thorough understanding of a company's technologies.

## Roll-up GHG emissions data to corporate level

To report a corporation's total GHG emissions, companies will usually need to gather and summarize data from multiple facilities, possibly in different countries and business divisions. It is important to plan this process carefully to minimize the reporting burden, reduce the risk of errors that might occur while compiling data, and ensure that all facilities are collecting information on an approved, consistent basis. Ideally, corporations will integrate GHG reporting with their existing reporting tools and processes, and take advantage of any relevant data already collected and reported by facilities to division or corporate offices, regulators or other stakeholders.

The tools and processes chosen to report data will depend upon the information and communication infrastructure already in place (i.e., how easy is it to include new data categories in corporate databases). It will also depend upon the amount of detail that corporate headquarters wishes to be reported from facilities. Data collection and management tools could include:

- Secure databases available over the company intranet or internet, for direct data entry by facilities
- Spreadsheet templates filled out and e-mailed to a corporate or division office, where data is processed further
- Paper reporting forms faxed to a corporate or division office where data is re-entered in a corporate database. However, this method may increase the likelihood of errors if there are not sufficient checks in place to ensure the accurate transfer of the data.

### BP: A standardized system for internal reporting of GHGs

BP, a global energy company, has been collecting GHG data from the different parts of its operations since 1997 and has consolidated its internal reporting processes into one central database system. The responsibility for reporting environmental emissions lies with about 320 individual BP facilities and business departments, which are termed "reporting units." All reporting units have to complete a standard Excel pro-forma spreadsheet every quarter, stating actual emissions for the preceding three months and updates to forecasts for the current year and the next two years. In addition, reporting units are asked to account for all significant variances, including sustainable reductions. The reporting units all use the same BP GHG Reporting Guidelines "Protocol" (BP, 2000) for quantifying their emissions of carbon dioxide and methane.

All pro-forma spreadsheets are e-mailed automatically by the central database to the reporting units, and the completed e-mail returns are uploaded into the database by a corporate team, who check the quality of the incoming data. The data are then compiled, by the end of the month following each quarter end, to provide the total emission inventory and forecasts for analysis against BP's GHG target. Finally, the inventory is reviewed by a team of independent external auditors to provide assurance on the quality and accuracy of the data.

For internal reporting up to the corporate level, it is recommended that standardized reporting formats be used to ensure that data received from different business units and facilities is comparable, and that internal reporting rules are observed (see BP case study). Standardized formats can significantly reduce the risk of errors.

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## Approaches for rolling up GHG emissions data to corporate level

There are two basic approaches for gathering data on GHG emissions from a corporation's facilities (Figure 10):

- Centralized: individual facilities report activity/fuel use data (such as quantity of fuel used) to the corporate level, where GHG emissions are calculated.
- Decentralized: individual facilities collect activity/fuel use data, directly calculate their GHG emissions using approved methods, and report this data to the corporate level.

FIGURE 10. Approaches to gathering data

| | SITE LEVEL | CORPORATE LEVEL |
|---|---|---|
| CENTRALIZED | Activity data | Sites report activity data (GHG emissions calculated at corporate level: activity data x emissions factor = GHG emissions) |
| DECENTRALIZED | Activity data x emission factor = GHG emissions | Sites report GHG emissions |

The difference between these two approaches is in where the emissions calculations occur (i.e., where activity data is multiplied by the appropriate emission factors) and in what type of quality management procedures must be put in place at each level of the corporation. Facility-level staff is generally responsible for initial data collection under both approaches.

Under both approaches, staff at corporate and lower levels of consolidation should take care to identify and exclude any scope 2 or 3 emissions that are also accounted for as scope 1 emissions by other facilities, business units, or companies included in the emissions inventory consolidation.

### CENTRALIZED APPROACH: INDIVIDUAL FACILITIES REPORT ACTIVITY/FUEL USE DATA

This approach may be particularly suitable for office-based organizations. Requesting that facilities report their activity/fuel use data may be the preferred option if:

- The staff at the corporate or division level can calculate emissions data in a straightforward manner on the basis of activity/fuel use data; and
- Emissions calculations are standard across a number of facilities.

### DECENTRALIZED APPROACH: INDIVIDUAL FACILITIES CALCULATE GHG EMISSIONS DATA

Asking facilities to calculate GHG emissions themselves will help to increase their awareness and understanding of the issue. However, it may also lead to resistance, increased training needs, an increase in calculation errors, and a greater need for auditing of calculations. Requesting that facilities calculate GHG emissions themselves may be the preferred option if:

- GHG emission calculations require detailed knowledge of the kind of equipment being used at facilities;
- GHG emission calculation methods vary across a number of facilities;
- Process emissions (in contrast to emissions from burning fossil fuels) make up an important share of total GHG emissions;
- Resources are available to train facility staff to conduct these calculations and to audit them;
- A user-friendly tool is available to simplify the calculation and reporting task for facility-level staff; or
- Local regulations require reporting of GHG emissions at a facility level.

The choice of collection approach depends on the needs and characteristics of the reporting company. For example, United Technologies Corporation uses the centralized approach, leaving the choice of emission factors and calculations to corporate staff, while BP uses the decentralized approach and follows up with audits to ensure calculations are correct, documented, and follow approved methods. To maximize accuracy and minimize reporting burdens, some companies use a combination of the two approaches. Complex facilities with process emissions calculate their emissions at the facility level, while facilities with uniform emissions from standard sources only report fuel use, electricity consumption, and travel activity. The corporate database or reporting tool then calculates total GHG emissions for each of these standard activities.

The two approaches are not mutually exclusive and should produce the same result. Thus companies desiring a consistency check on facility-level calculations can follow both approaches and compare the results. Even when facilities calculate their own GHG emissions, corporate staff may still wish to gather activity/fuel use data to double-check calculations and explore opportunities for emissions reductions. These data should be available and transparent to staff at all corporate levels. Corporate staff should also verify that facility-reported data are based on well defined, consistent, and approved inventory boundaries, reporting periods, calculation methodologies, etc.

## Common guidance on reporting to corporate level

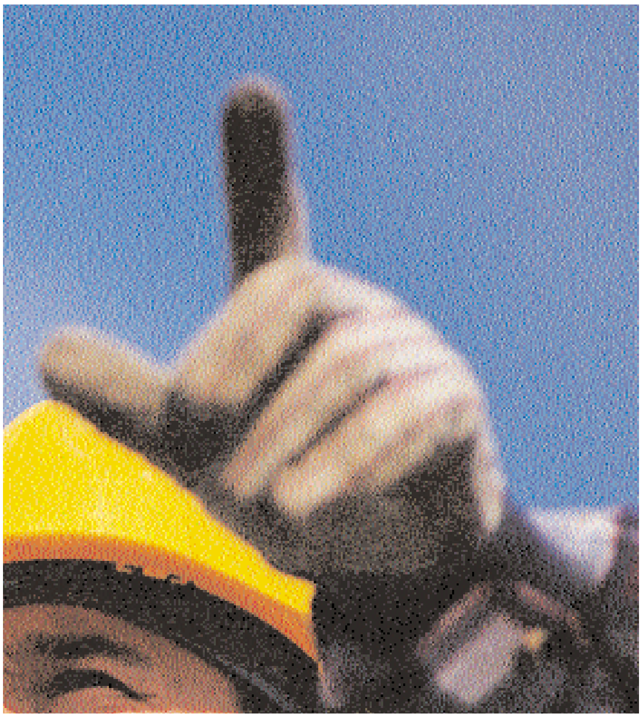
Reports from facility level to corporate or division offices should include all relevant information as specified in chapter 9. Some reporting categories are common to both the centralized and decentralized approaches and should be reported by facilities to their corporate offices. These include:

- A brief description of the emission sources
- A list and justification of specific exclusion or inclusion of sources
- Comparative information from previous years
- The reporting period covered
- Any trends evident in the data
- Progress towards any business targets
- A discussion of uncertainties in activity/fuel use or emissions data reported, their likely cause, and recommendations for how data can be improved
- A description of events and changes that have an impact on reported data (acquisitions, divestitures, closures, technology upgrades, changes of reporting boundaries or calculation methodologies applied, etc.).

### REPORTING FOR THE CENTRALIZED APPROACH

In addition to the activity/fuel use data and aforementioned common categories of reporting data, facilities following the centralized approach by reporting activity/fuel use data to the corporate level should also report the following:

- Activity data for freight and passenger transport activities (e.g., freight transport in tonne-kilometers)
- Activity data for process emissions (e.g., tonnes of fertilizer produced, tonnes of waste in landfills)
- Clear records of any calculations undertaken to derive activity/fuel use data
- Local emission factors necessary to translate fuel use and/or electricity consumption into $CO_2$ emissions.



### REPORTING FOR THE DECENTRALIZED APPROACH

In addition to the GHG emissions data and aforementioned common categories of reporting data, individual facilities following the decentralized approach by reporting calculated GHG emissions to the corporate level should also report the following:

- A description of GHG calculation methodologies and any changes made to those methodologies relative to previous reporting periods
- Ratio indicators (see chapter 9)
- Details on any data references used for the calculations, in particular information on emission factors used.

Clear records of calculations undertaken to derive emissions data should be kept for any future internal or external verification.

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# 7 Managing Inventory Quality

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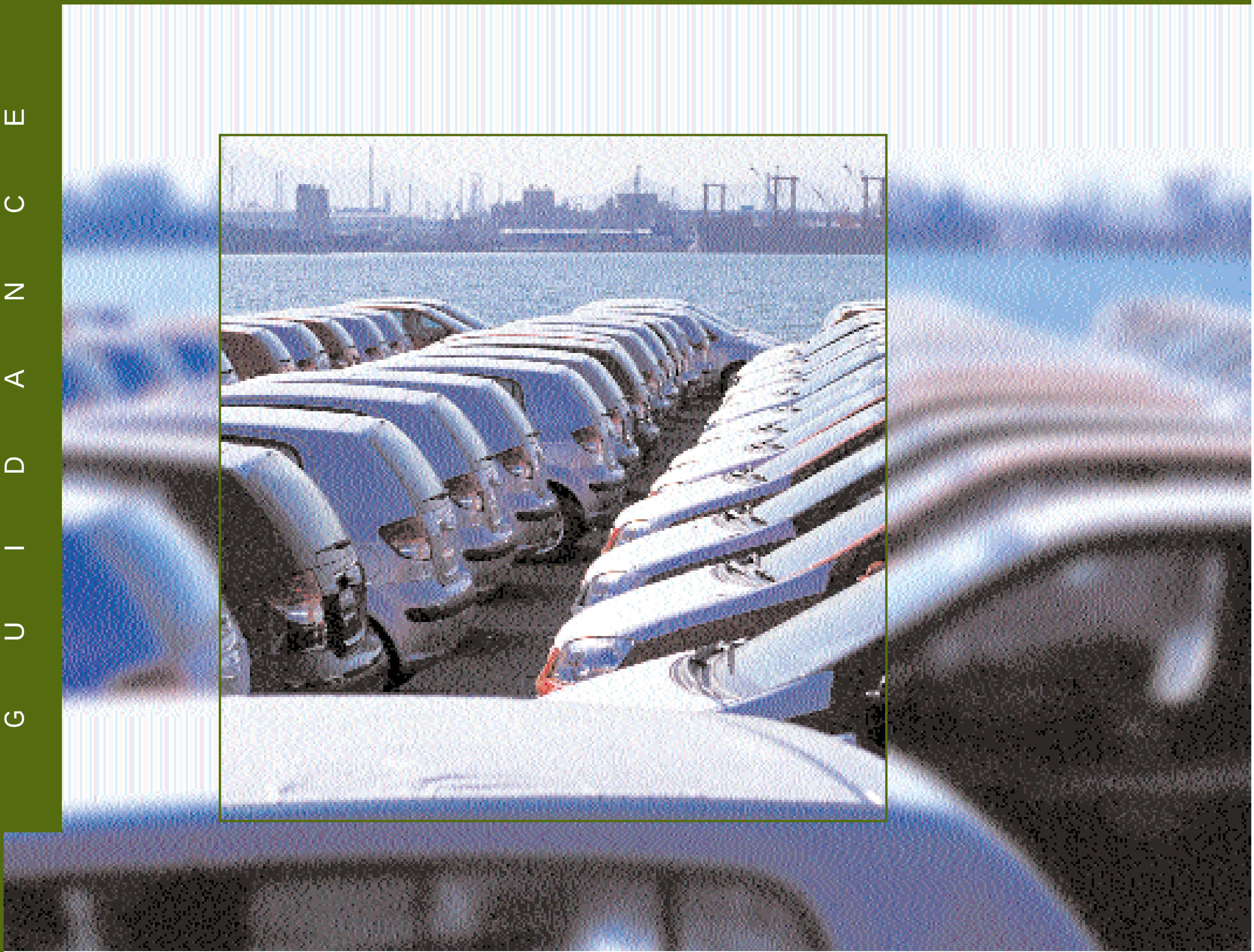


Companies have different reasons for managing the quality of their GHG emissions inventory, ranging from identifying opportunities for improvement to stakeholder demand to preparation for regulation. The *GHG Protocol Corporate Standard* recognizes that these reasons are a function of a company's goals and its expectations for the future. A company's goals for and vision of the evolution of the GHG emissions issue should guide the design of its corporate inventory, the implementation of a quality management system, and the treatment of uncertainty within its inventory.

A corporate GHG inventory program includes all institutional, managerial, and technical arrangements made for the collection of data, preparation of the inventory, and implementation of steps to manage the quality of the inventory.[1] The guidance in this chapter is intended to help companies develop and implement a quality management system for their inventory.

Given an uncertain future, high quality information will have greater value and more uses, while low quality information may have little or no value or use and may even incur penalties. For example, a company may currently be focusing on a voluntary GHG program but also want its inventory data to meet the anticipated requirements of a future when emissions may have monetary value. A quality management system is essential to ensuring that an inventory continues to meet the principles of the *GHG Protocol Corporate Standard* and anticipates the requirements of future GHG emissions programs.

Even if a company is not anticipating a future regulatory mechanism, internal and external stakeholders will demand high quality inventory information. Therefore, the implementation of some type of quality management system is important. However, the *GHG Protocol Corporate Standard* recognizes that companies do not have unlimited resources, and, unlike financial accounting, corporate GHG inventories involve a level of scientific and engineering complexity. Therefore, companies should develop their inventory program and quality management system as a cumulative effort in keeping with their resources, the broader evolution of policy, and their own corporate vision.

A quality management system provides a systematic process for preventing and correcting errors, and identifies areas where investments will likely lead to the greatest improvement in overall inventory quality. However, the primary objective of quality management is ensuring the credibility of a company's GHG inventory information. The first step towards achieving this objective is defining inventory quality.

## Defining inventory quality

The *GHG Protocol Corporate Standard* outlines five accounting principles that set an implicit standard for the faithful representation of a company's GHG emission through its technical, accounting, and reporting efforts (see chapter 1). Putting these principles into practice will result in a credible and unbiased treatment and presentation of issues and data. For a company to follow these principles, quality management needs to be an integral part of its corporate inventory program. The goal of a quality management system is to ensure that these principles are put into practice.

### KPMG: The value of integrating GHG management with existing systems

KPMG, a global services company, found that a key factor in the derivation of reliable, verifiable GHG data is the integration of GHG data management and reporting mechanisms with companies' core operational management and assurance processes. This is because:

- It is more efficient to widen the scope of existing embedded management and assurance processes than to develop a separate function responsible for generating and reporting GHG information.
- As GHG information becomes increasingly monetized, it will attract the same attention as other key performance indicators of businesses. Therefore, management will need to ensure adequate procedures are in place to report reliable data. These procedures can most effectively be implemented by functions within the organization that oversee corporate governance, internal audit, IT, and company reporting.

Another factor that is often not given sufficient emphasis is training of personnel and communication of GHG objectives. Data generation and reporting systems are only as reliable as the people who operate them. Many well-designed systems fail because the precise reporting needs of the company are not adequately explained to the people who have to interpret a reporting standard and calculation tools. Given the complexity of accounting boundaries and an element of subjectivity that must accompany source inclusion and equity share, inconsistent interpretation of reporting requirements is a real risk. It is also important that those responsible for supplying input data are aware of its use. The only way to minimize this risk is through clear communication, adequate training and knowledge sharing.

## An inventory program framework

A practical framework is needed to help companies conceptualize and design a quality management system and to help plan for future improvements. This framework focuses on the following institutional, managerial, and technical components of an inventory (Figure 11):

METHODS: These are the technical aspects of inventory preparation. Companies should select or develop methodologies for estimating emissions that accurately represent the characteristics of their source categories. The *GHG Protocol* provides many default methods and calculation tools to help with this effort. The design of an inventory program and quality management system should provide for the selection, application, and updating of inventory methodologies as new research becomes available, changes are made to business operations, or the importance of inventory reporting is elevated.

DATA: This is the basic information on activity levels, emission factors, processes, and operations. Although methodologies need to be appropriately rigorous and detailed, data quality is more important. No methodology can compensate for poor quality input data. The design of a corporate inventory program should facilitate the collection of high quality inventory data and the maintenance and improvement of collection procedures.

INVENTORY PROCESSES AND SYSTEMS: These are the institutional, managerial, and technical procedures for preparing GHG inventories. They include the team and processes charged with the goal of producing a high quality inventory. To streamline GHG inventory quality management, these processes and systems may be integrated, where appropriate, with other corporate processes related to quality.

DOCUMENTATION: This is the record of methods, data, processes, systems, assumptions, and estimates used to prepare an inventory. It includes everything employees need to prepare and improve a company's inventory. Since estimating GHG emissions is inherently technical (involving engineering and science), high quality, transparent documentation is particularly important to credibility. If information is not credible, or fails to be effectively communicated to either internal or external stakeholders, it will not have value.

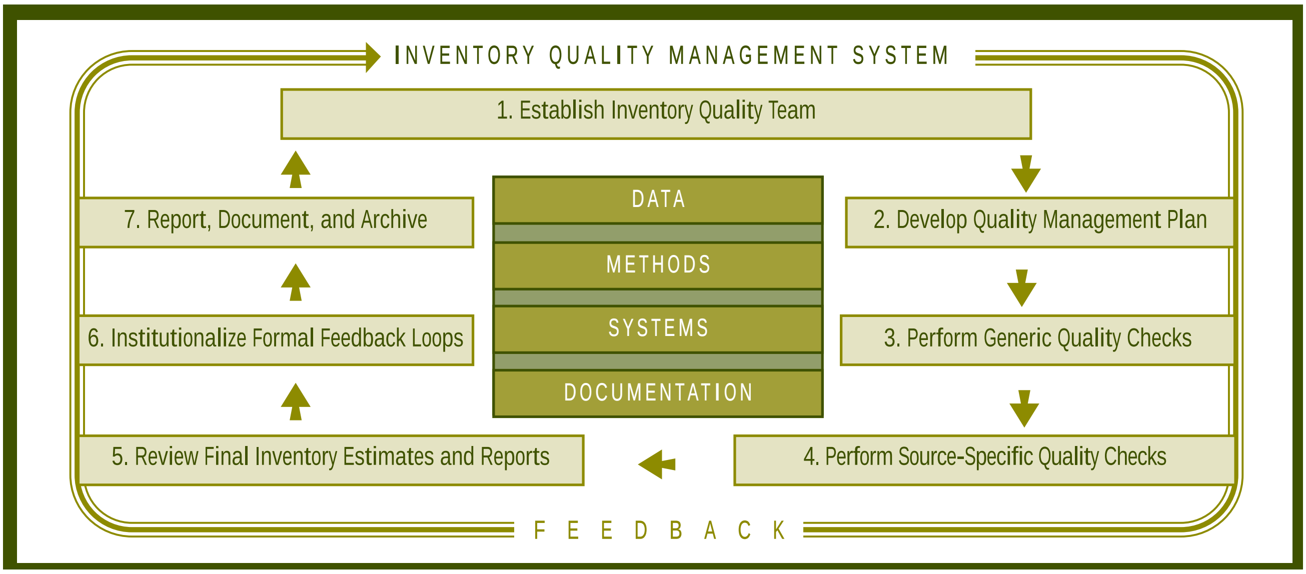
Companies should seek to ensure the quality of these components at every level of their inventory design.

## Implementing an inventory quality management system

A quality management system for a company's inventory program should address all four of the inventory components described above. To implement the system, a company should take the following steps:

1. Establish an inventory quality team. This team should be responsible for implementing a quality management system, and continually improving inventory quality. The team or manager should coordinate interactions between relevant business units, facilities and external entities such as government agency programs, research institutions, verifiers, or consulting firms.

FIGURE 11: Inventory quality management system



2. Develop a quality management plan. This plan describes the steps a company is taking to implement its quality management system, which should be incorporated into the design of its inventory program from the beginning, although further rigor and coverage of certain procedures may be phased in over multiple years. The plan should include procedures for all organizational levels and inventory development processes—from initial data collection to final reporting of accounts. For efficiency and comprehensiveness, companies should integrate (and extend as appropriate) existing quality systems to cover GHG management and reporting, such as any ISO procedures. To ensure accuracy, the bulk of the plan should focus on practical measures for implementing the quality management system, as described in steps three and four.

3. Perform generic quality checks. These apply to data and processes across the entire inventory, focusing on appropriately rigorous quality checks on data handling, documentation, and emission calculation activities (e.g., ensuring that correct unit conversions are used). Guidance on quality checking procedures is provided in the section on implementation below (see table 4).

TABLE 4. Generic quality management measures

| DATA GATHERING, INPUT, AND HANDLING ACTIVITIES |
|---|
| • Check a sample of input data for transcription errors |
| • Identify spreadsheet modifications that could provide additional controls or checks on quality |
| • Ensure that adequate version control procedures for electronic files have been implemented |
| • Others |
| **DATA DOCUMENTATION** |
| • Confirm that bibliographical data references are included in spreadsheets for all primary data |
| • Check that copies of cited references have been archived |
| • Check that assumptions and criteria for selection of boundaries, base years, methods, activity data, emission factors, and other parameters are documented |
| • Check that changes in data or methodology are documented |
| • Others |
| **CALCULATING EMISSIONS AND CHECKING CALCULATIONS** |
| • Check whether emission units, parameters, and conversion factors are appropriately labeled |
| • Check if units are properly labeled and correctly carried through from beginning to end of calculations |
| • Check that conversion factors are correct |
| • Check the data processing steps (e.g., equations) in the spreadsheets |
| • Check that spreadsheet input data and calculated data are clearly differentiated |
| • Check a representative sample of calculations, by hand or electronically |
| • Check some calculations with abbreviated calculations (i.e., back of the envelope calculations) |
| • Check the aggregation of data across source categories, business units, etc. |
| • Check consistency of time series inputs and calculations |
| • Others |

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4. Perform source-category-specific quality checks. This includes more rigorous investigations into the appropriate application of boundaries, recalculation procedures, and adherence to accounting and reporting principles for specific source categories, as well as the quality of the data input used (e.g., whether electricity bills or meter readings are the best source of consumption data) and a qualitative description of the major causes of uncertainty in the data. The information from these investigations can also be used to support a quantitative assessment of uncertainty. Guidance on these investigations is provided in the section on implementation below.

5. Review final inventory estimates and reports. After the inventory is completed, an internal technical review should focus on its engineering, scientific, and other technical aspects. Subsequently, an internal managerial review should focus on securing official corporate approval of and support for the inventory. A third type of review involving experts external to the company's inventory program is addressed in chapter 10.

6. Institutionalize formal feedback loops. The results of the reviews in step five, as well as the results of every other component of a company's quality management system, should be fed back via formal feedback procedures to the person or team identified in step one. Errors should be corrected and improvements implemented based on this feedback.

7. Establish reporting, documentation, and archiving procedures. The system should contain record keeping procedures that specify what information will be documented for internal purposes, how that information should be archived, and what information is to be reported for external stakeholders. Like internal and external reviews, these record keeping procedures include formal feedback mechanisms.

A company's quality management system and overall inventory program should be treated as evolving, in keeping with a company's reasons for preparing an inventory. The plan should address the company's strategy for a multi-year implementation (i.e., recognize that inventories are a long-term effort), including steps to ensure that all quality control findings from previous years are adequately addressed.

## Practical measures for implementation

Although principles and broad program design guidelines are important, any guidance on quality management would be incomplete without a discussion of practical inventory quality measures. A company should implement these measures at multiple levels within the company, from the point of primary data collection to the final corporate inventory approval process. It is important to implement these measures at points in the inventory program where errors are mostly likely to occur, such as the initial data collection phase and during calculation and data aggregation. While corporate level inventory quality may initially be emphasized, it is important to ensure quality measures are implemented at all levels of disaggregation (e.g., facility, process, geographical, according to a particular scope, etc) to be better prepared for GHG markets or regulatory rules in the future.

Companies also need to ensure the quality of their historical emission estimates and trend data. They can achieve this by employing inventory quality measures to minimize biases that can arise from changes in the characteristics of the data or methods used to calculate historical emission estimates, and by following the standards and guidance of chapter 5.

The third step of a quality management system, as described above, is to implement generic quality checking measures. These measures apply to all source categories and all levels of inventory preparation. Table 4 provides a sample list of such measures.

The fourth step of a quality management system is source category-specific data quality investigations. The information gathered from these investigations can also be used for the quantitative and qualitative assessment of data uncertainty (see section on uncertainty). Addressed below are the types of source-specific quality measures that can be employed for emission factors, activity data, and emission estimates.

### EMISSION FACTORS AND OTHER PARAMETERS

For a particular source category, emissions calculations will generally rely on emission factors and other parameters (e.g., utilization factors, oxidation rates, methane conversion factors).[2] These factors and parameters may be published or default factors, based on company-specific data, site-specific data, or direct emission or other measurements. For fuel consumption, published emission factors based on fuel energy content are generally more accurate than those based on mass or volume, except when mass or volume based factors have been measured at the company- or site-specific level. Quality investigations need to assess the representativeness and applicability of emission factors and other parameters to the specific characteristics of a company. Differences between measured and default values need to be qualitatively explained and justified based upon the company's operational characteristics.

### ACTIVITY DATA

The collection of high quality activity data will often be the most significant limitation for corporate GHG inventories. Therefore, establishing robust data collection procedures needs to be a priority in the design of any company's inventory program. The following are useful measures for ensuring the quality of activity data:

- Develop data collection procedures that allow the same data to be efficiently collected in future years.
- Convert fuel consumption data to energy units before applying carbon content emission factors, which may be better correlated to a fuel's energy content than its mass.
- Compare current year data with historical trends. If data do not exhibit relatively consistent changes from year to year then the causes for these patterns should be investigated (e.g., changes of over 10 percent from year to year may warrant further investigation).
- Compare activity data from multiple reference sources (e.g., government survey data or data compiled by trade associations) with corporate data when possible. Such checks can ensure that consistent data is being reported to all parties. Data can also be compared among facilities within a company.
- Investigate activity data that is generated for purposes other than preparing a GHG inventory. In doing so, companies will need to check the applicability of this data to inventory purposes, including completeness, consistency with the source category definition, and consistency with the emission factors used. For example, data from different facilities may be examined for inconsistent measurement techniques, operating conditions, or technologies. Quality control measures (e.g., ISO) may have already been conducted during the data's original preparation. These measures can be integrated with the company's inventory quality management system.
- Check that base year recalculation procedures have been followed consistently and correctly (see chapter 5).
- Check that operational and organizational boundary decisions have been applied correctly and consistently to the collection of activity data (see chapters 3 and 4).

### Interface: Integration of emissions and business data systems

Interface, Inc., is the world's largest manufacturer of carpet tiles and upholstery fabrics for commercial interiors. The company has established an environmental data system that mirrors its corporate financial data reporting. The Interface EcoMetrics system is designed to provide activity and material flow data from business units in a number of countries (the United States, Canada, Australia, the United Kingdom, Thailand and throughout Europe) and provides metrics for measuring progress on environmental issues such as GHG emissions. Using company-wide accounting guidelines and standards, energy and material input data are reported to a central database each quarter and made available to sustainability personnel. These data are the foundation of Interface's annual inventory and enable data comparison over time in the pursuit of improved quality.

Basing emissions data systems on financial reporting helps Interface improve its data quality. Just as financial data need to be documented and defensible, Interface's emissions data are held to standards that promote an increasingly transparent, accurate, and high-quality inventory. Integrating its financial and emissions data systems has made Interface's GHG accounting and reporting more useful as it strives to be a "completely sustainable company" by 2020.

- Investigate whether biases or other characteristics that could affect data quality have been previously identified (e.g., by communicating with experts at a particular facility or elsewhere). For example, a bias could be the unintentional exclusion of operations at smaller facilities or data that do not correspond exactly with the company's organizational boundaries.
- Extend quality management measures to cover any additional data (sales, production, etc.) used to estimate emission intensities or other ratios.

### EMISSION ESTIMATES

Estimated emissions for a source category can be compared with historical data or other estimates to ensure they fall within a reasonable range. Potentially unreasonable estimates provide cause for checking emission factors or activity data and determining whether changes in methodology, market forces, or other events are sufficient reasons for the change. In situations where actual emission monitoring occurs (e.g., power plant $CO_2$ emissions), the data from monitors can be compared with calculated emissions using activity data and emission factors.

If any of the above emission factor, activity data, emission estimate, or other parameter checks indicate a problem, more detailed investigations into the accuracy of the data or appropriateness of the methods may be required. These more detailed investigations can also be utilized to better assess the quality of data. One potential measure of data quality is a quantitative and qualitative assessment of their uncertainty.

### Vauxhall Motors: The importance of accuracy checks

The experience of the U.K. automotive manufacturer Vauxhal Motors illustrates the importance of attention to detail in setting up GHG information collection systems. The company wished to calculate GHG emissions from staff air travel. However, when determining the impact of flight travel, it is important to make sure that the round trip distance is used when calculating emissions. Fortunately, Vauxhall's review of its assumptions and calculation methodologies revealed this fact and avoided reporting emissions that were 50 percent lower than the actual value.

## Inventory quality and inventory uncertainty

Preparing a GHG inventory is inherently both an accounting and a scientific exercise. Most applications for company-level emissions and removal estimates require that these data be reported in a format similar to financial accounting data. In financial accounting, it is standard practice to report individual point estimates (i.e., single value versus a range of possible values). In contrast, the standard practice for most scientific studies of GHG and other emissions is to report quantitative data with estimated error bounds (i.e., uncertainty). Just like financial figures in a profit and loss or bank account statement, point estimates in a corporate emission inventory have obvious uses. However, how would or should the addition of some quantitative measure of uncertainty to an emission inventory be used?

In an ideal situation, in which a company had perfect quantitative information on the uncertainty of its emission estimates at all levels, the primary use of this information would almost certainly be comparative. Such comparisons might be made across companies, across business units, across source categories, or through time. In this situation, inventory estimates could even be rated or discounted based on their quality before they were used, with uncertainty being the objective quantitative metric for quality. Unfortunately, such objective uncertainty estimates rarely exist.

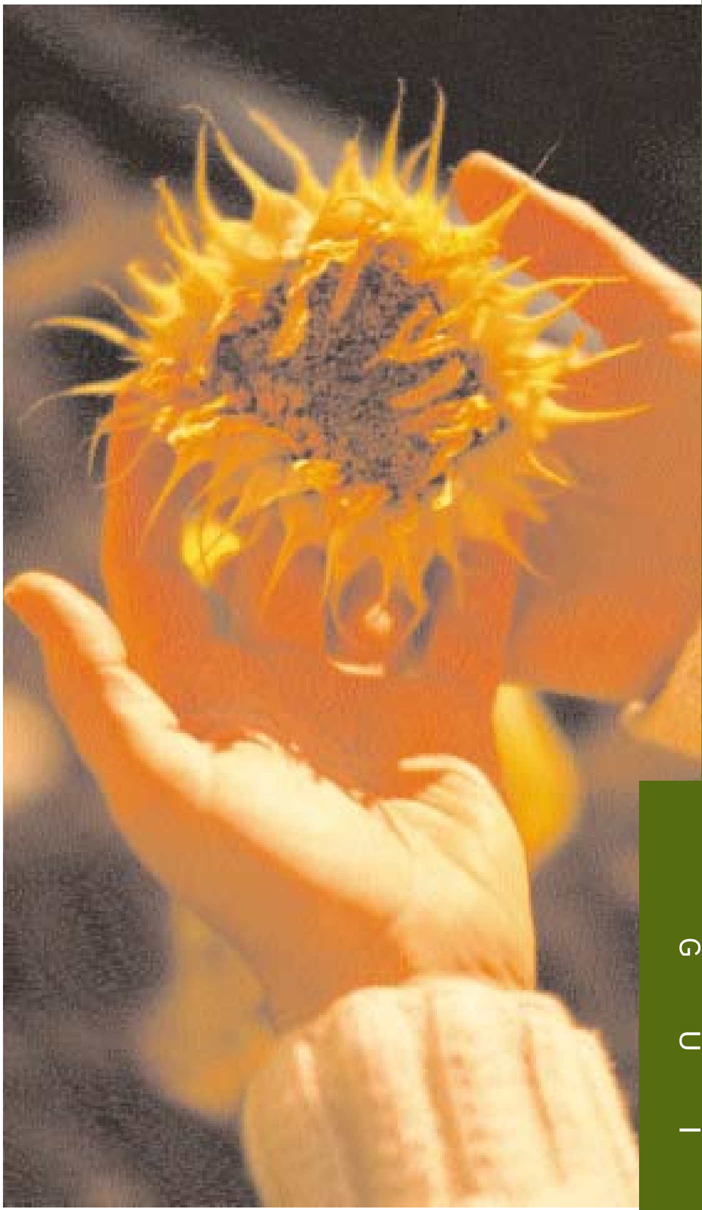
### TYPES OF UNCERTAINTIES

Uncertainties associated with GHG inventories can be broadly categorized into *scientific uncertainty* and *estimation uncertainty*. Scientific uncertainty arises when the science of the actual emission and/or removal process is not completely understood. For example, many direct and indirect factors associated with global warming potential (GWP) values that are used to combine emission estimates for various GHGs involve significant scientific uncertainty. Analyzing and quantifying such scientific uncertainty is extremely problematic and is likely to be beyond the capacity of most company inventory programs.

Estimation uncertainty arises any time GHG emissions are quantified. Therefore all emissions or removal estimates are associated with estimation uncertainty. Estimation uncertainty can be further classified into two types: *model uncertainty* and *parameter uncertainty.*[3]

Model uncertainty refers to the uncertainty associated with the mathematical equations (i.e., models) used to characterize the relationships between various parameters and emission processes. For example, model uncertainty may arise either due to the use of an incorrect mathematical model or inappropriate input into the model. As with scientific uncertainty, estimating model uncertainty is likely to be beyond most company's inventory efforts; however, some companies may wish to utilize their unique scientific and engineering expertise to evaluate the uncertainty in their emission estimation models.

Parameter uncertainty refers to the uncertainty associated with quantifying the parameters used as inputs (e.g., activity data and emission factors) into estimation models. Parameter uncertainties can be evaluated through statistical analysis, measurement equipment precision determinations, and expert judgment. Quantifying parameter uncertainties and then estimating source category uncertainties based on these parameter uncertainties will be the primary focus of companies that choose to investigate the uncertainty in their emission inventories.



### LIMITATIONS OF UNCERTAINTY ESTIMATES

Given that only parameter uncertainties are within the feasible scope of most companies, uncertainty estimates for corporate GHG inventories will, of necessity, be imperfect. Complete and robust sample data will not always be available to assess the statistical uncertainty[4] in every parameter. For most parameters (e.g., liters of gasoline purchased or tonnes of limestone consumed), only a single data point may be available. In some cases, companies can utilize instrument precision or calibration information to inform their assessment of statistical uncertainty. However, to quantify some of the systematic uncertainties[5] associated with parameters and to supplement statistical uncertainty estimates, companies will usually have to rely on expert judgment.[6] The problem with expert judgment, though, is that it is difficult to obtain in a comparable (i.e., unbiased) and consistent manner across parameters, source categories, or companies.

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For these reasons, almost all comprehensive estimates of uncertainty for GHG inventories will be not only imperfect but also have a *subjective* component and, despite the most thorough efforts, are themselves considered highly uncertain. In most cases, uncertainty estimates cannot be interpreted as an objective measure of quality. Nor can they be used to compare the quality of emission estimates between source categories or companies.

Exceptions to this include the following cases in which it is assumed that either statistical or instrument precision data are available to objectively estimate each parameter's statistical uncertainty (i.e., expert judgment is not needed):

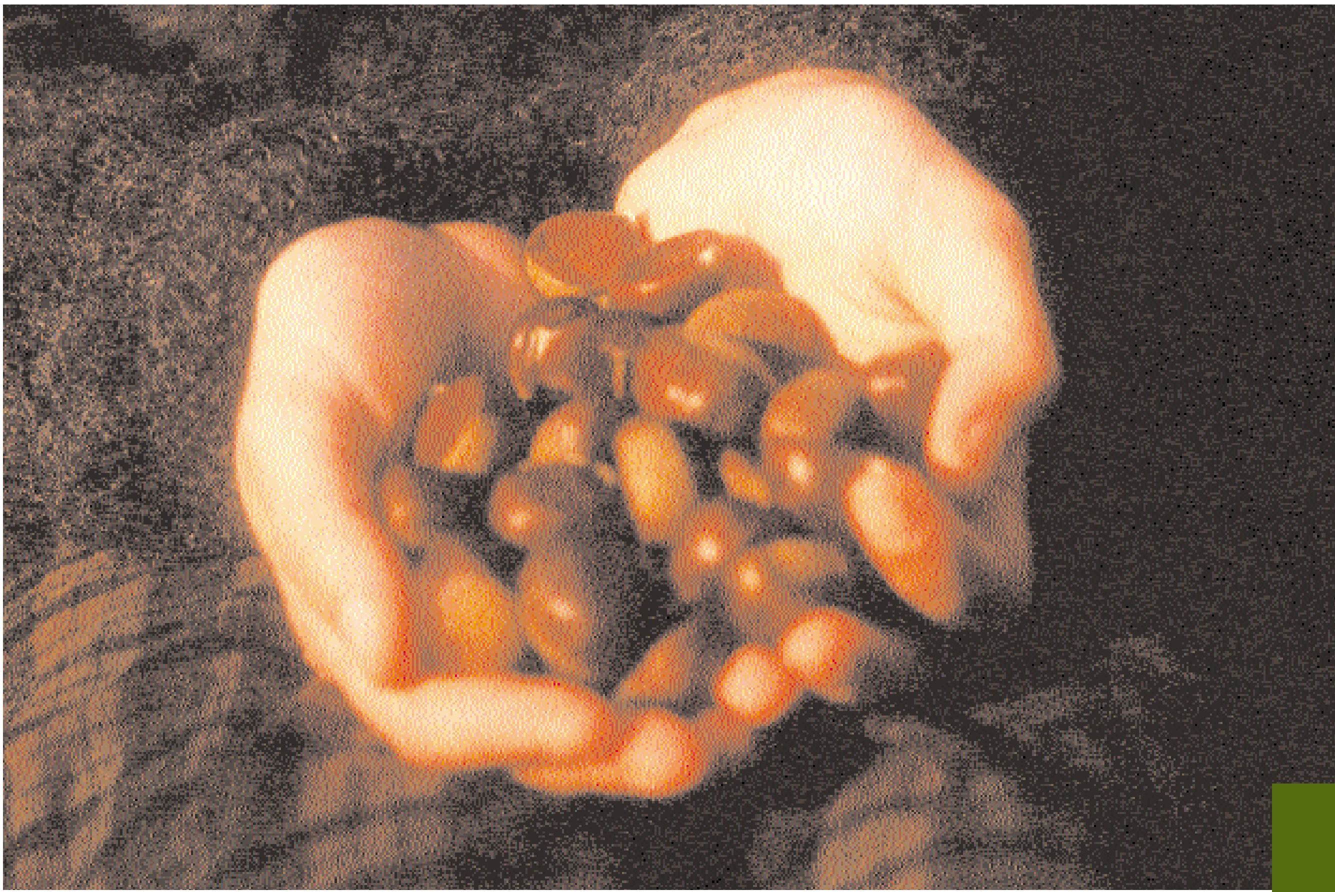
- When two operationally similar facilities use identical emission estimation methodologies, the differences in scientific or model uncertainties can, for the most part, be ignored. Then quantified estimates of statistical uncertainty can be treated as being comparable between facilities. This type of comparability is what is aimed for in some trading programs that prescribe specific monitoring, estimation, and measurement requirements. However, even in this situation, the degree of comparability depends on the flexibility that participants are given for estimating emissions, the homogeneity across facilities, as well as the level of enforcement and review of the methodologies used.
- Similarly, when a single facility uses the same estimation methodology each year, the systematic parameter uncertainties—in addition to scientific and model uncertainties—in a source's emission estimates for two years are, for the most part, identical.[7] Because the systematic parameter uncertainties then cancel out, the uncertainty in an emission trend (e.g., the difference between the estimates for two years) is generally less than the uncertainty in total emissions for a single year. In such a situation, quantified uncertainty estimates can be treated as being comparable over time and used to track relative changes in the quality of a facility's emission estimates for that source category. Such estimates of uncertainty in emission trends can also be used as a guide to setting a facility's emissions reduction target. Trend uncertainty estimates are likely to be less useful for setting broader (e.g., company-wide) targets (see chapter 11) because of the general problems with comparability between uncertainty estimates across gases, sources, and facilities.

Given these limitations, the role of qualitative and quantitative uncertainty assessments in developing GHG inventories include:

- Promoting a broader learning and quality feedback process.
- Supporting efforts to qualitatively understand and document the causes of uncertainty and help identify ways of improving inventory quality. For example, collecting the information needed to determine the statistical properties of activity data and emission factors forces one to ask hard questions and to carefully and systematically investigate data quality.
- Establishing lines of communication and feedback with data suppliers to identify specific opportunities to improve quality of the data and methods used.
- Providing valuable information to reviewers, verifiers, and managers for setting priorities for investments into improving data sources and methodologies.

The *GHG Protocol Corporate Standard* has developed a supplementary guidance document on uncertainty assessments ("Guidance on uncertainty assessment in GHG inventories and calculating statistical parameter uncertainty") along with an uncertainty calculation tool, both of which are available on the GHG Protocol website. The guidance document describes how to use the calculation tool in aggregating uncertainties. It also discusses in more depth different types of uncertainties, the limitations of quantitative uncertainty assessment, and how uncertainty estimates should be properly interpreted.

Additional guidance and information on assessing uncertainty—including optional approaches to developing quantitative uncertainty estimates and eliciting judgments from experts—can also be found in EPA's Emissions Inventory Improvement Program, Volume VI: Quality Assurance/Quality Control (1999) and in chapter 6 of the IPCC's Good Practice Guidance (2000a).



NOTES

1 Although the term “emissions inventory” is used throughout this chapter, the guidance equally applies to estimates of removals due to sink categories (e.g., forest carbon sequestration).

2 Some emission estimates may be derived using mass or energy balances, engineering calculations, or computer simulation models. In addition to investigating the input data to these models, companies should also consider whether the internal assumptions (including assumed parameters in the model) are appropriate to the nature of the company’s operations.

3 Emissions estimated from direct emissions monitoring will generally only involve parameter uncertainty (e.g., equipment measurement error).

4 Statistical uncertainty results from natural variations (e.g., random human errors in the measurement process and fluctuations in measurement equipment). Statistical uncertainty can be detected through repeated experiments or sampling of data.

5 Systematic parameter uncertainty occurs if data are systematically biased. In other words, the average of the measured or estimated value is always less or greater than the true value. Biases arise, for example, because emission factors are constructed from non-representative samples, all relevant source activities or categories have not been identified, or incorrect or incomplete estimation methods or faulty measurement equipment have been used. Because the true value is unknown, such systematic biases cannot be detected through repeated experiments and, therefore, cannot be quantified through statistical analysis. However, it is possible to identify biases and, sometimes, to quantify them through data quality investigations and expert judgments.

6 The role of expert judgment can be twofold: First, it can provide the data necessary to estimate the parameter. Second, it can help (in combination with data quality investigations) identify, explain, and quantify both statistical and systematic uncertainties.

7 It should be recognized, however, that biases may not be constant from year to year but instead may exhibit a pattern over time (e.g., may be growing or falling). For example, a company that continues to disinvest in collecting high quality data may create a situation in which the biases in its data get worse each year. These types of data quality issues are extremely problematic because of the effect they can have on calculated emission trends. In such cases, systematic parameter uncertainties cannot be ignored.

# 8 Accounting for GHG Reductions



As voluntary reporting, external GHG programs, and emission trading systems evolve, it is becoming more and more essential for companies to understand the implications of accounting for GHG emissions changes over time on the one hand, and, on the other hand, accounting for offsets or credits that result from GHG reduction projects. This chapter elaborates on the different issues associated with the term “GHG reductions.”

The *GHG Protocol Corporate Standard* focuses on accounting and reporting for GHG emissions at the company or organizational level. Reductions in corporate emissions are calculated by comparing changes in the company's actual emissions inventory over time relative to a base year. Focusing on overall corporate or organizational level emissions has the advantage of helping companies manage their aggregate GHG risks and opportunities more effectively. It also helps focus resources on activities that result in the most cost-effective GHG reductions.

In contrast to corporate accounting, the forthcoming *GHG Protocol Project Quantification Standard* focuses on the quantification of GHG reductions from GHG mitigation projects that will be used as offsets. Offsets are discrete GHG reductions used to compensate for (i.e., offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the project.

## Corporate GHG reductions at facility or country level

From the perspective of the earth's atmosphere, it does not matter where GHG emissions or reductions occur. From the perspective of national and international policymakers addressing global warming, the location where GHG reductions are achieved is relevant, since policies usually focus on achieving reductions within specific countries or regions, as spelled out, for example, in the Kyoto Protocol. Thus companies with global operations will have to respond to an array of state, national, or regional regulations and requirements that address GHGs from operations or facilities within a specific geographic area.

The *GHG Protocol Corporate Standard* calculates GHG emissions using a bottom-up approach. This involves calculating emissions at the level of an individual source or facility and then rolling this up to the corporate level. Thus a company's overall emissions may decrease, even if increases occur at specific sources, facilities, or operations and vice-versa. This bottom-up approach enables companies to report GHG emissions information at different scales, e.g., by individual sources or facilities, or by a collection of facilities within a given country. Companies can meet an array of government requirements or voluntary commitments by comparing actual emissions over time for the relevant scale. On a corporate-wide scale, this information can also be used when setting and reporting progress towards a corporate-wide GHG target (see chapter 11).

In order to track and explain changes in GHG emissions over time, companies may find it useful to provide information on the nature of these changes. For example, BP asks each of its reporting units to provide such information in an accounting movement format using the following categories (BP 2000):

- Acquisitions and divestments
- Closure
- Real reductions (e.g., efficiency improvements, material or fuel substitution)
- Change in production level
- Changes in estimation methodology
- Other

This type of information can be summarized at the corporate level to provide an overview of the company's performance over time.

## Reductions in indirect emissions

Reductions in indirect emissions (changes in scope 2 or 3 emissions over time) may not always capture the actual emissions reduction accurately. This is because there is not always a direct cause-effect relationship between the activity of the reporting company and the resulting GHG emissions. For example, a reduction in air travel would reduce a company's scope 3 emissions. This reduction is usually quantified based on an average emission factor of fuel use per passenger. However, how this reduction actually translates into a change in GHG emissions to the atmosphere would depend on a number of factors, including whether another person takes the "empty seat" or whether this unused seat contributes to reduced air traffic over the longer term. Similarly, reductions in scope 2 emissions calculated with an average grid emissions factor may over- or underestimate the actual reduction depending on the nature of the grid.

Generally, as long as the accounting of indirect emissions over time recognizes activities that in aggregate change global emissions, any such concerns over accuracy should not inhibit companies from reporting their indirect emissions. In cases where accuracy is more important, it may be appropriate to undertake a more detailed assessment of the actual reduction using a project quantification methodology.

## Project based reductions and offsets/credits

Project reductions that are to be used as offsets should be quantified using a project quantification method, such as the forthcoming *GHG Protocol Project Quantification Standard,* that addresses the following accounting issues:

- SELECTION OF A BASELINE SCENARIO AND EMISSION. The baseline scenario represents what would have happened in the absence of the project. Baseline emissions are the hypothetical emissions associated with this scenario. The selection of a baseline scenario always involves uncertainty because it represents a hypothetical scenario for what would have happened without the project. The project reduction is calculated as the difference between the baseline and project emissions. This differs from the way corporate or organizational reductions are measured in this document, i.e., in relation to an actual historical base year.
- DEMONSTRATION OF ADDITIONALITY. This relates to whether the project has resulted in emission reductions or removals in addition to what would have happened in the absence of the project. If the project reduction is used as an offset, the quantification procedure should address additionality and demonstrate that the project itself is not the baseline and that project emissions are less than baseline emissions. Additionality ensures the integrity of the fixed cap or target for which the offset is used. Each reduction unit from a project used as an offset allows the organization or facility with a cap or target one additional unit of emissions. If the project were going to happen anyway (i.e., is non-additional), global emissions will be higher by the number of reduction units issued to the project.
- IDENTIFICATION AND QUANTIFICATION OF RELEVANT SECONDARY EFFECTS. These are GHG emissions changes resulting from the project not captured by the primary effect(s).[1] Secondary effects are typically the small, unintended GHG consequences of a project and include leakage (changes in the availability or quantity of a product or service that results in changes in GHG emissions elsewhere) as well as changes in GHG emissions up- and downstream of the project. If relevant, secondary effects should be incorporated into the calculation of the project reduction.
- CONSIDERATION OF REVERSIBILITY. Some projects achieve reductions in atmospheric carbon dioxide levels by capturing, removing and/or storing carbon or GHGs in biological or non-biological sinks (e.g., forestry, land use management, underground reservoirs). These reductions may be temporary in that the removed carbon dioxide may be returned to the atmosphere at some point in the future through intentional activities or accidental occurrences—such as harvesting of forestland or forest fires, etc.[2] The risk of reversibility should be assessed, together with any mitigation or compensation measures included in the project design.
- AVOIDANCE OF DOUBLE COUNTING. To avoid double counting, the reductions giving rise to the offset must occur at sources or sinks not included in the target or cap for which the offset is used. Also, if the reductions occur at sources or sinks owned or controlled by someone other than the parties to the project (i.e., they are indirect), the ownership of the reduction should be clarified to avoid double counting.

Offsets may be converted into credits when used to meet an externally imposed target. Credits are convertible and transferable instruments usually bestowed by an external GHG program. They are typically generated from an activity such as an emissions reduction project and then used to meet a target in an otherwise closed system, such as a group of facilities with an absolute emissions cap placed across them. Although a credit is usually based on the underlying reduction calculation, the conversion of an offset into a credit is usually subject to strict rules, which may differ from program to program. For example, a Certified Emission Reduction (CER) is a credit issued by the Kyoto Protocol Clean Development Mechanism. Once issued, this credit can be traded and ultimately used to meet Kyoto Protocol targets. Experience from the "pre-compliance" market in GHG credits highlights the importance of delineating project reductions that are to be used as offsets with a credible quantification method capable of providing verifiable data.

## Reporting project based reductions

It is important for companies to report their physical inventory emissions for their chosen inventory boundaries separately and independently of any GHG trades they undertake. GHG trades[3] should be reported in its public GHG report under optional information—either in relation to a target (see chapter 11) or corporate inventory (see chapter 9). Appropriate information addressing the credibility of purchased or sold offsets or credits should be included.

When companies implement internal projects that reduce GHGs from their operations, the resulting reductions are usually captured in their inventory's boundaries. These reductions need not be reported separately unless they are sold, traded externally, or otherwise used as an offset or credit. However, some companies may be able to make changes to their own operations that result in GHG emissions changes at sources not included in their own inventory boundary, or not captured by comparing emissions changes over time. For example:

- Substituting fossil fuel with waste-derived fuel that might otherwise be used as landfill or incinerated without energy recovery. Such substitution may have no direct effect on (or may even increase) a company's own GHG emissions. However, it could result in emissions reductions elsewhere by another organization, e.g., through avoiding landfill gas and fossil fuel use.
- Installing an on-site power generation plant (e.g., a combined heat and power, or CHP, plant) that provides surplus electricity to other companies may increase a company's direct emissions, while displacing the consumption of grid electricity by the companies supplied. Any resulting emissions reductions at the plants where this electricity would have otherwise been produced will not be captured in the inventory of the company installing the on-site plant.
- Substituting purchased grid electricity with an on-site power generation plant (e.g., CHP) may increase a company's direct GHG emissions, while reducing the GHG emissions associated with the generation of grid electricity. Depending on the GHG intensity and the supply structure of the electricity grid, this reduction may be over- or underestimated when merely comparing scope 2 emissions over time, if the latter are quantified using an average grid emission factor.

## Alcoa: Taking advantage of renewable energy certificates

Alcoa, a global manufacturer of aluminum, is implementing a variety of strategies to reduce its GHG emissions. One approach has been to purchase renewable energy certificates, or RECs, to offset some of the company's GHG emissions. RECs, which represent the environmental benefits of renewable energy unbundled from the actual flow of electrons, are an innovative method of providing renewable energy to individual customers. RECs represent the unbundled environmental benefits, such as avoided $CO_2$ emissions, generated by producing electricity from renewable rather than fossil sources. RECs can be sold bundled with the electricity (as green power) or separately to customers interested in supporting renewable energy.

Alcoa found that RECs offer a variety of advantages, including direct access to the benefits of renewable energy for facilities that may have limited renewable energy procurement options. In October 2003, Alcoa began purchasing RECs equivalent to 100% of the electricity used annually at four corporate offices in Tennessee, Pennsylvania, and New York. The RECs Alcoa is purchasing effectively mean that the four corporate centers are now operating on electricity generated by projects that produce electricity from landfill gas, avoiding the emission of more than 6.3 million kilograms (13.9 million pounds) of carbon dioxide annually. Alcoa chose RECs in part because the supplier was able to provide RECs to all four facilities through one contract. This flexibility lowered the administrative cost of purchasing renewable energy for multiple facilities that are served by different utilities.

For more information on RECs, see the Green Power Market Development Group's Corporate Guide to Green Power Markets: Installment #5 (WRI, 2003).

These reductions may be separately quantified, for example using the *GHG Protocol Project Quantification Standard,* and reported in a company's public GHG report under optional information in the same way as GHG trades described above.

NOTES

[1] Primary effects are the specific GHG reducing elements or activities (reducing GHG emissions, carbon storage, or enhancing GHG removals) that the project is intended to achieve.

[2] This problem with the temporary nature of GHG reductions is sometimes referred to as the "permanence" issue.

[3] The term "GHG trades" refers to all purchases or sales of allowances, offsets, and credits.

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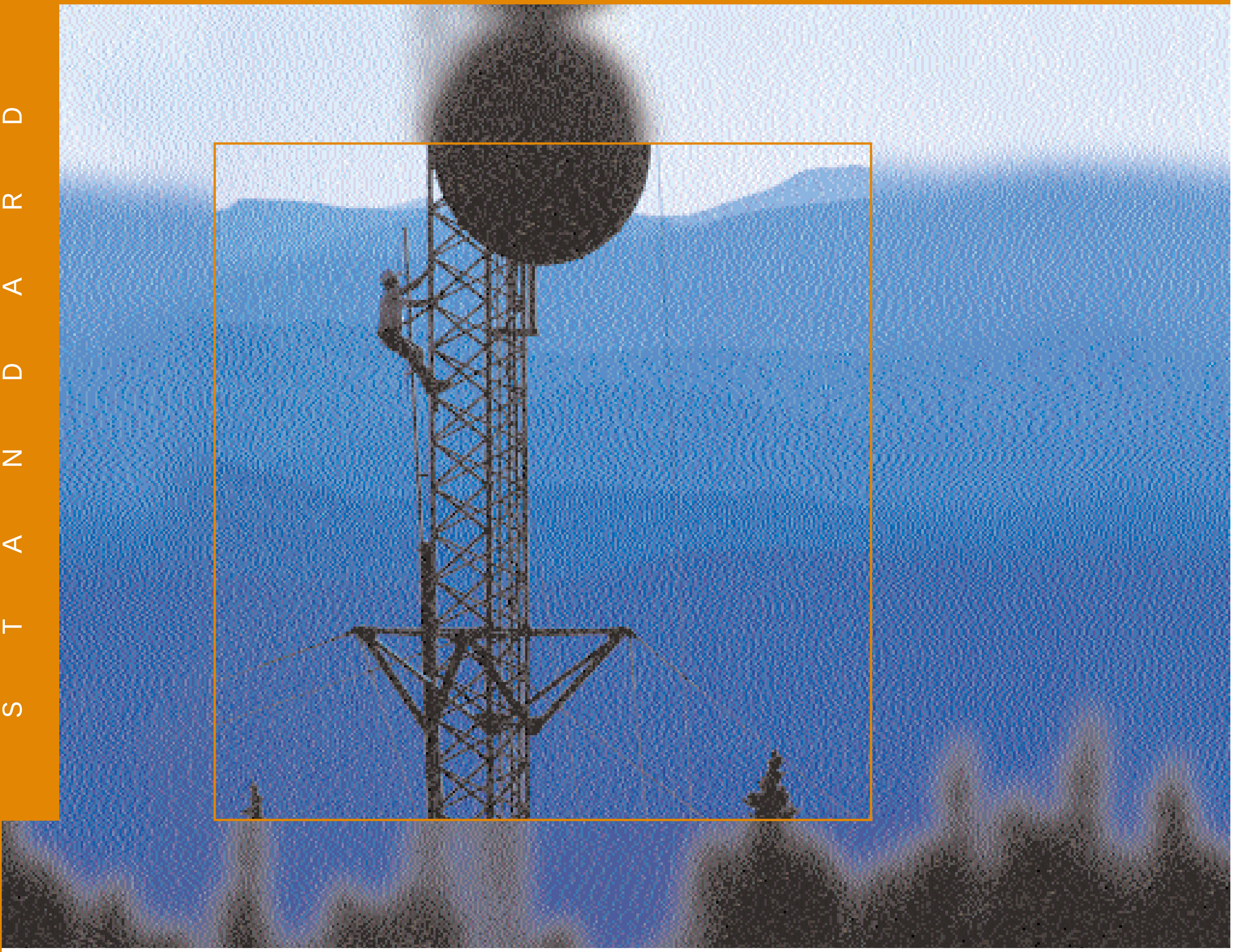
# 9 Reporting GHG Emissions

STANDARD



A credible GHG emissions report presents relevant information that is complete, consistent, accurate and transparent. While it takes time to develop a rigorous and complete corporate inventory of GHG emissions, knowledge will improve with experience in calculating and reporting data. It is therefore recommended that a public GHG report:

- Be based on the best data available at the time of publication, while being transparent about its limitations
- Communicate any material discrepancies identified in previous years
- Include the company's gross emissions for its chosen inventory boundary separate from and independent of any GHG trades it might engage in.

STANDARD

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Reported information shall be "relevant, complete, consistent, transparent and accurate." The *GHG Protocol Corporate Standard* requires reporting a minimum of scope 1 and scope 2 emissions.

## Required information

A public GHG emissions report that is in accordance with the *GHG Protocol Corporate Standard* shall include the following information:

### DESCRIPTION OF THE COMPANY AND INVENTORY BOUNDARY

- An outline of the organizational boundaries chosen, including the chosen consolidation approach.
- An outline of the operational boundaries chosen, and if scope 3 is included, a list specifying which types of activities are covered.
- The reporting period covered.

### INFORMATION ON EMISSIONS

- Total scope 1 and 2 emissions independent of any GHG trades such as sales, purchases, transfers, or banking of allowances.
- Emissions data separately for each scope.
- Emissions data for all six GHGs separately ($CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, $SF_6$) in metric tonnes and in tonnes of $CO_2$ equivalent.
- Year chosen as base year, and an emissions profile over time that is consistent with and clarifies the chosen policy for making base year emissions recalculations.
- Appropriate context for any significant emissions changes that trigger base year emissions recalculation (acquisitions/divestitures, outsourcing/insourcing, changes in reporting boundaries or calculation methodologies, etc.).
- Emissions data for direct $CO_2$ emissions from biologically sequestered carbon (e.g., $CO_2$ from burning biomass/biofuels), reported separately from the scopes.
- Methodologies used to calculate or measure emissions, providing a reference or link to any calculation tools used.
- Any specific exclusions of sources, facilities, and /or operations.

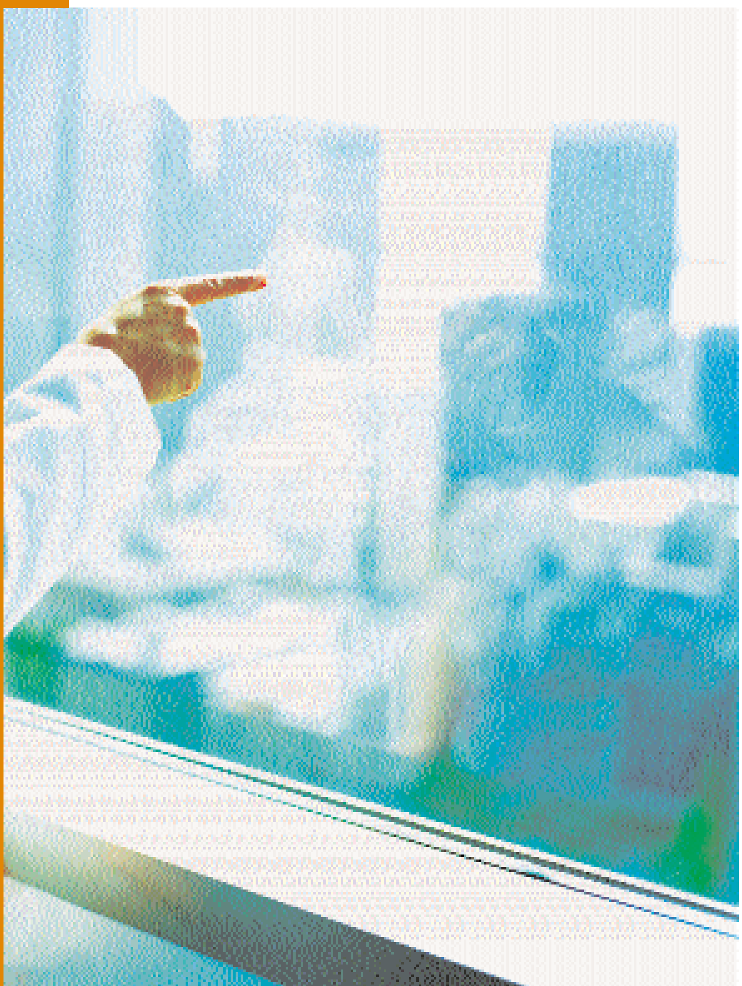
## Optional information

A public GHG emissions report should include, when applicable, the following additional information:

### INFORMATION ON EMISSIONS AND PERFORMANCE

- Emissions data from relevant scope 3 emissions activities for which reliable data can be obtained.
- Emissions data further subdivided, where this aids transparency, by business units/facilities, country, source types (stationary combustion, process, fugitive, etc.), and activity types (production of electricity, transportation, generation of purchased electricity that is sold to end users, etc.).
- Emissions attributable to own generation of electricity, heat, or steam that is sold or transferred to another organization (see chapter 4).
- Emissions attributable to the generation of electricity, heat or steam that is purchased for re-sale to non-end users (see chapter 4).
- A description of performance measured against internal and external benchmarks.
- Emissions from GHGs not covered by the Kyoto Protocol (e.g., CFCs, $NO_x$,), reported separately from scopes.
- Relevant ratio performance indicators (e.g. emissions per kilowatt-hour generated, tonne of material production, or sales).
- An outline of any GHG management/reduction programs or strategies.
- Information on any contractual provisions addressing GHG-related risks and obligations.
- An outline of any external assurance provided and a copy of any verification statement, if applicable, of the reported emissions data.

- Information on the causes of emissions changes that did not trigger a base year emissions recalculation (e.g., process changes, efficiency improvements, plant closures).
- GHG emissions data for all years between the base year and the reporting year (including details of and reasons for recalculations, if appropriate)
- Information on the quality of the inventory (e.g., information on the causes and magnitude of uncertainties in emission estimates) and an outline of policies in place to improve inventory quality. (see chapter 7).
- Information on any GHG sequestration.
- A list of facilities included in the inventory.
- A contact person.



INFORMATION ON OFFSETS

- Information on offsets that have been purchased or developed outside the inventory boundary, subdivided by GHG storage/removals and emissions reduction projects. Specify if the offsets are verified/certified (see chapter 8) and/or approved by an external GHG program (e.g., the Clean Development Mechanism, Joint Implementation).
- Information on reductions at sources inside the inventory boundary that have been sold/transferred as offsets to a third party. Specify if the reduction has been verified/certified and/or approved by an external GHG program (see chapter 8).

By following the *GHG Protocol Corporate Standard* reporting requirements, users adopt a comprehensive standard with the necessary detail and transparency for credible public reporting. The appropriate level of reporting of optional information categories can be determined by the objectives and intended audience for the report. For national or voluntary GHG programs, or for internal management purposes, reporting requirements may vary (Appendix C summarizes the requirements of various GHG programs).

For public reporting, it is important to differentiate between a summary of a public report that is, for example, published on the Internet or in Sustainability/ Corporate Social Responsibility reporting (e.g., Global Reporting Initiative) and a full public report that contains all the necessary data as specified by the reporting standard spelled out in this volume. Not every circulated report must contain all information as specified by this standard, but a link or reference needs to be made to a publicly available full report where all information is available.

For some companies, providing emissions data for specific GHGs or facilities/business units, or reporting ratio indicators, may compromise business confidentiality. If this is the case, the data need not be publicly reported, but can be made available to those auditing the GHG emissions data, assuming confidentiality is secured.

Companies should strive to create a report that is as transparent, accurate, consistent and complete as possible. Structurally, this may be achieved by adopting the reporting categories of the standard (e.g., required description of the company and inventory boundary, required information on corporate emissions, optional information on emissions and performance, and optional information on offsets) as a basis of the report. Qualitatively, including a discussion of the reporting company's strategy and goals for GHG accounting, any particular challenges or tradeoffs faced, the context of decisions on boundaries and other accounting parameters, and an analysis of emissions trends may help provide a complete picture of the company's inventory efforts.

## Double Counting

Companies should take care to identify and exclude from reporting any scope 2 or scope 3 emissions that are also reported as scope 1 emissions by other facilities, business units, or companies included in the emissions inventory consolidation (see chapter 6).

## Use of ratio indicators

Two principal aspects of GHG performance are of interest to management and stakeholders. One concerns the overall GHG impact of a company—that is the absolute quantity of GHG emissions released to the atmosphere. The other concerns the company's GHG emissions normalized by some business metric that results in a ratio indicator. The *GHG Protocol Corporate Standard* requires reporting of absolute emissions; reporting of ratio indicators is optional.

Ratio indicators provide information on performance relative to a business type and can facilitate comparisons between similar products and processes over time. Companies may choose to report GHG ratio indicators in order to:

- Evaluate performance over time (e.g., relate figures from different years, identify trends in the data, and show performance in relation to targets and base years (see chapter 11).
- Establish a relationship between data from different categories. For example, a company may want to establish a relationship between the value that an action provides (e.g., price of a tonne of product) and its impact on society or on the environment (e.g., emissions from product manufacturing).
- Improve comparability between different sizes of business and operations by normalizing figures (e.g., by assessing the impact of different sized businesses on the same scale).

It is important to recognize that the inherent diversity of businesses and the circumstances of individual companies can result in misleading indicators. Apparently minor differences in process, product, or location can be significant in terms of environmental effect. Therefore, it is necessary to know the business context in order to be able to design and interpret ratio indicators correctly.

Companies may develop ratios that make most sense for their business and are relevant to their decision-making needs. They may select ratios for external reporting that improve the understanding and clarify the interpretation of their performance for their stakeholders. It is important to provide some perspective on issues such as scale and limitations of indicators in a way that users understand the nature of the information provided. Companies should consider what ratio indicators best capture the benefits and impacts of their business, i.e., its operations, its products, and its effects on the marketplace and on the entire economy. Some examples of different ratio indicators are provided here.

PRODUCTIVITY/EFFICIENCY RATIOS. Productivity/efficiency ratios express the value or achievement of a business divided by its GHG impact. Increasing efficiency ratios reflect a positive performance improvement. Examples of productivity/efficiency ratios include resource productivity (e.g., sales per GHG) and process eco-efficiency (e.g., production volume per amount of GHG).

## MidAmerican: Setting ratio indicators for a utility company

MidAmerican Energy Holdings Company, an energy company based in Iowa, wanted a method to track a power plant's GHG intensity, while also being able to roll individual plant results into a corporate "generation portfolio" GHG intensity indicator. MidAmerican also wanted to be able to take into account the GHG benefits from planned renewable generation, as well as measure the impacts of other changes to its generation portfolio over time (e.g., unit retirements or new construction). The company adopted a GHG intensity indicator that specifically measures pounds of direct emissions over total megawatt hours generated (lbs/MWh).

To measure its direct emissions, the company leverages data currently gathered to satisfy existing regulatory requirements and, where gaps might exist, uses fuel calculations. For coal-fired units, that means mainly using continuous emissions monitoring (CEM) data and the U.S. Environmental Protection Agency's emission factors for natural gas- and fuel oil-fired units. Using the *GHG Protocol Corporate Standard*, the company completes an annual emission inventory for each of its fossil-fired plants, gathering together a) fuel volume and heat input data, b) megawatt production data, c) CEMs data, and d) fuel calculations using appropriate emission factors.

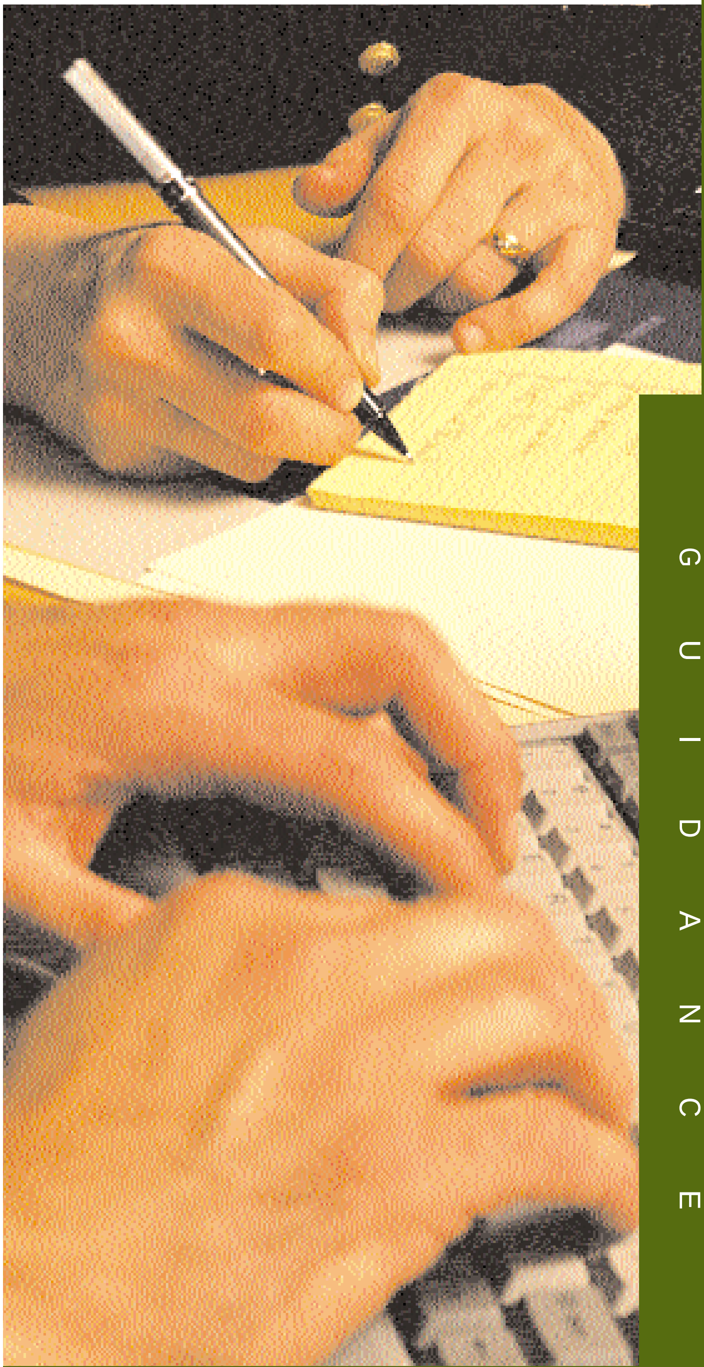
For example, in 2001, using CEM data and fuel calculations, the company's Iowa utility business emitted roughly 23 million tonnes of $CO_2$, while generating approximately 21 million megawatt hours. Its 2001 GHG intensity indicator calculates to approximately 2,177 lbs/MWh of $CO_2$, reflecting the Iowa utility company's reliance on traditional coal-fired generation.

By 2008, the Iowa utility company will have constructed a new 790 MW coal-fueled plant, a 540 MW combined-cycle natural gas plant, and a 310 MW wind-turbine farm and added them to its generation portfolio. The utility company's overall $CO_2$ emissions will increase, but so will its megawatt production. The combined emissions from the new coal- and gas-fired plants will be added to the GHG intensity indicator's numerator, while the megawatt production data from all three facilities will be added to the indicator's denominator. More importantly, and the ratio indicator illustrates this, over time MidAmerican's GHG intensity will decline as more efficient generation is brought online and older power plants are used less or retired altogether.

INTENSITY RATIOS. Intensity ratios express GHG impact per unit of physical activity or unit of economic output. A physical intensity ratio is suitable when aggregating or comparing across businesses that have similar products. An economic intensity ratio is suitable when aggregating or comparing across businesses that produce different products. A declining intensity ratio reflects a positive performance improvement. Many companies historically tracked environmental performance with intensity ratios. Intensity ratios are often called "normalized" environmental impact data. Examples of intensity ratios include product emission intensity (e.g., tonnes of $CO_2$ emissions per electricity generated); service intensity (e.g., GHG emissions per function or per service); and sales intensity (e.g., emissions per sales).

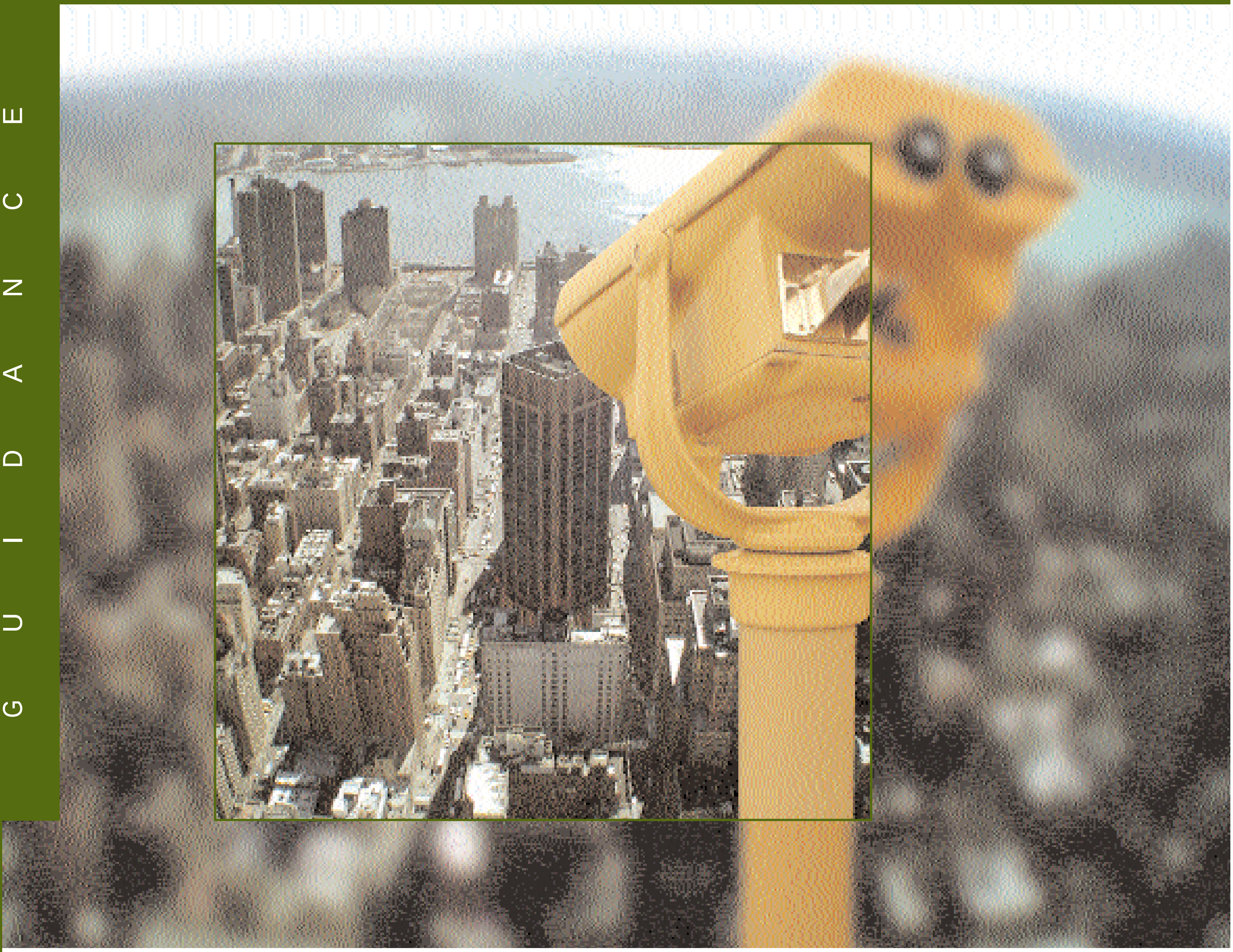
PERCENTAGES. A percentage indicator is a ratio between two similar issues (with the same physical unit in the numerator and the denominator). Examples of percentages that can be meaningful in performance reports include current GHG emissions expressed as a percentage of base year GHG emissions.

For further guidance on ratio indicators refer to CCAR, 2003; GRI, 2002; Verfaillie and Bidwell, 2000.



# 10 Verification of GHG Emissions

GUIDANCE



Verification is an objective assessment of the accuracy and completeness of reported GHG information and the conformity of this information to pre-established GHG accounting and reporting principles. Although the practice of verifying corporate GHG inventories is still evolving the emergence of widely accepted standards, such as the *GHG Protocol Corporate Standard* and the forth-coming *GHG Protocol Project Quantification Standard*, should help GHG verification become more uniform, credible, and widely accepted.

This chapter provides an overview of the key elements of a GHG verification process. It is relevant to companies who are developing GHG inventories and have planned for, or are considering, obtaining an independent verification of their results and systems. Furthermore, as the process of developing a verifiable inventory is largely the same as that for obtaining reliable and defensible data, this chapter is also relevant to all companies regardless of any intention to commission a GHG verification.

Verification involves an assessment of the risks of material discrepancies in reported data. Discrepancies relate to differences between reported data and data generated from the proper application of the relevant standards and methodologies. In practice, verification involves the prioritization of effort by the verifier towards the data and associated systems that have the greatest impact on overall data quality.

## Relevance of GHG principles

The primary aim of verification is to provide confidence to users that the reported information and associated statements represent a faithful, true, and fair account of a company's GHG emissions. Ensuring transparency and verifiability of the inventory data is crucial for verification. The more transparent, well controlled and well documented a company's emissions data and systems are, the more efficient it will be to verify. As outlined in chapter 1, there are a number of GHG accounting and reporting principles that need to be adhered to when compiling a GHG inventory. Adherence to these principles and the presence of a transparent, well-documented system (sometimes referred to as an audit trail) is the basis of a successful verification.

## Goals

Before commissioning an independent verification, a company should clearly define its goals and decide whether they are best met by an external verification. Common reasons for undertaking a verification include:

- Increased credibility of publicly reported emissions information and progress towards GHG targets, leading to enhanced stakeholder trust
- Increased senior management confidence in reported information on which to base investment and target-setting decisions
- Improvement of internal accounting and reporting practices (e.g., calculation, recording and internal reporting systems, and the application of GHG accounting and reporting principles), and facilitating learning and knowledge transfer within the company
- Preparation for mandatory verification requirements of GHG programs.

## Internal assurance

While verification is often undertaken by an independent, external third party, this may not always be the case. Many companies interested in improving their GHG inventories may subject their information to internal verification by personnel who are independent of the GHG accounting and reporting process. Both internal and external verification should follow similar procedures and processes. For external stakeholders, external third part verification is likely to significantly increase the credibility of the GHG inventory. However, independent internal verifications can also provide valuable assurance over the reliability of information.

Internal verification can be a worthwhile learning experience for a company prior to commissioning an external verification by a third party. It can also provide external verifiers with useful information to begin their work.

## The concept of materiality

The concept of "materiality" is essential to understanding the process of verification. Chapter 1 provides a useful interpretation of the relationship between the principle of completeness and the concept of materiality. Information is considered to be material if, by its inclusion or exclusion, it can be seen to influence any decisions or actions taken by users of it. A material discrepancy is an error (for example, from an oversight, omission or miscalculation) that results in a reported quantity or statement being significantly different to the true value or meaning. In order to express an opinion on data or information, a verifier would need to form a view on the materiality of all identified errors or uncertainties.

While the concept of materiality involves a value judgment, the point at which a discrepancy becomes material (materiality threshold) is usually pre-defined. As a rule of thumb, an error is considered to be materially misleading if its value exceeds 5% of the total inventory for the part of the organization being verified.

The verifier needs to assess an error or omission in the full context within which information is presented. For example, if a 2% error prevents a company from achieving its corporate target then this would most likely be considered material. Understanding how verifiers apply a materiality threshold will enable companies to more readily establish whether the omissions of an individual source or activity from their inventory is likely to raise questions of materiality.

Materiality thresholds may also be outlined in the requirements of a specific GHG program or determined by a national verification standard, depending on who is requiring the verification and for what reasons. A materiality threshold provides guidance to verifiers on what may be an immaterial discrepancy so that they can concentrate their work on areas that are more likely to lead to materially misleading errors. A materiality threshold is not the same as de minimis emissions, or a permissible quantity of emissions that a company can leave out of its inventory.

## Assessing the risk of material discrepancy

Verifiers need to assess the risk of material discrepancy of each component of the GHG information collection and reporting process. This assessment is used to plan and direct the verification process. In assessing this risk, they will consider a number of factors, including:

- The structure of the organization and the approach used to assign responsibility for monitoring and reporting GHG emissions
- The approach and commitment of management to GHG monitoring and reporting
- Development and implementation of policies and processes for monitoring and reporting (including documented methods explaining how data is generated and evaluated)
- Processes used to check and review calculation methodologies
- Complexity and nature of operations
- Complexity of the computer information system used to process the information
- The state of calibration and maintenance of meters used, and the types of meters used
- Reliability and availability of input data
- Assumptions and estimations applied
- Aggregation of data from different sources
- Other assurance processes to which the systems and data are subjected (e.g., internal audit, external reviews and certifications).

## Establishing the verification parameters

The scope of an independent verification and the level of assurance it provides will be influenced by the company's goals and/or any specific jurisdictional requirements. It is possible to verify the entire GHG inventory or specific parts of it. Discrete parts may be specified in terms of geographic location, business units, facilities, and type of emissions. The verification process may also examine more general managerial issues, such as quality management procedures, managerial awareness, availability of resources, clearly defined responsibilities, segregation of duties, and internal review procedures.

The company and verifier should reach an agreement upfront on the scope, level and objective of the verification. This agreement (often referred to as the scope of work) will address issues such as which information is to be included in the verification (e.g., head office consolidation only or information from all sites), the level of scrutiny to which selected data will be subjected (e.g., desk top review or on-site review), and the intended use of the results of the verification). The materiality threshold is another item to be considered in the scope of work. It will be of key consideration for both the verifier and the company, and is linked to the objectives of the verification.

The scope of work is influenced by what the verifier actually finds once the verification commences and, as a result, the scope of work must remain sufficiently flexible to enable the verifier to adequately complete the verification.

A clearly defined scope of work is not only important to the company and verifier, but also for external stakeholders to be able to make informed and appropriate decisions. Verifiers will ensure that specific exclusions have not been made solely to improve the company's performance. To enhance transparency and credibility companies should make the scope of work publicly available.

## Site visits

Depending on the level of assurance required from verification, verifiers may need to visit a number of sites to enable them to obtain sufficient, appropriate evidence over the completeness, accuracy and reliability of reported information. The sites visited should be representative of the organization as a whole. The selection of sites to be visited will be based on consideration of a number of factors, including:

- Nature of the operations and GHG sources at each site
- Complexity of the emissions data collection and calculation process
- Percentage contribution to total GHG emissions from each site
- The risk that the data from sites will be materially misstated
- Competencies and training of key personnel
- Results of previous reviews, verifications, and uncertainty analyses.

## Timing of the verification

The engagement of a verifier can occur at various points during the GHG preparation and reporting process. Some companies may establish a semi-permanent internal verification team to ensure that GHG data standards are being met and improved on an on-going basis.

Verification that occurs during a reporting period allows for any reporting deficiencies or data issues to be addressed before the final report is prepared. This may be particularly useful for companies preparing high profile public reports. However, some GHG programs may require, often on a random selection basis, an independent verification of the GHG inventory following the submission of a report (e.g., World Economic Forum Global GHG Registry, Greenhouse Challenge program in Australia, EU ETS). In both cases the verification cannot be closed out until the final data for the period has been submitted.

### PricewaterhouseCoopers: GHG inventory verification- lessons from the field

PricewaterhouseCoopers (PwC), a global services company, has been conducting GHG emissions verifications for the past 10 years in various sectors, including energy, chemicals, metals, semiconductors, and pulp and paper. PwC's verification process involves two key steps:

1. An evaluation of whether the GHG accounting and reporting methodology (e.g., *GHG Protocol Corporate Standard*) has been correctly implemented
2. Identification of any material discrepancies.

The *GHG Protocol Corporate Standard* has been crucial in helping PwC to design an effective GHG verification methodology. Since the publication of the first edition, PwC has witnessed rapid improvements in the quality and verifiability of GHG data reported. In particular the quantification on non-$CO_2$ GHGs and combustion emissions has dramatically improved. Cement sector emissions verification has been made easier by the release of the WBCSD cement sector tool. GHG emissions from purchased electricity are also easy to verify since most companies have reliable data on MWh consumed and emission factors are publicly available.

However, experience has shown that for most companies, GHG data for 1990 is too unreliable to provide a verifiable base year for the purposes of tracking emissions over time or setting a GHG target. Challenges also remain in auditing GHG emissions embedded in waste fuels, co-generation, passenger travel, and shipping.

Over the past 3 years PwC has noticed a gradual evolution of GHG verification practices from "customized" and "voluntary" to "standardized" and "mandatory." The California Climate Action Registry, World Economic Forum Global GHG Registry and the forthcoming EU ETS (covering 12,000 industrial sites in Europe) require some form of emissions verification. In the EU ETS GHG verifiers will likely have to be accredited by a national body. GHG verifier accreditation processes have already been established in the UK for its domestic trading scheme, and in California for registering emissions in the CCAR.

GUIDANCE

## Selecting a verifier

Some factors to consider when selecting a verifier include their:

- previous experience and competence in undertaking GHG verifications
- understanding of GHG issues including calculation methodologies
- understanding of the company's operations and industry
- objectivity, credibility, and independence.

It is important to recognize that the knowledge and qualifications of the individual(s) conducting the verification can be more important than those of the organization(s) they come from. Companies should select organizations based on the knowledge and qualifications of their actual verifiers and ensure that the lead verifier assigned to them is appropriately experienced. Effective verification of GHG inventories often requires a mix of specialized skills, not only at a technical level (e.g., engineering experience, industry specialists) but also at a business level (e.g., verification and industry specialists).

## Preparing for a GHG verification

The internal processes described in chapter 7 are likely to be similar to those followed by an independent verifier. Therefore, the materials that the verifiers need are similar. Information required by an external verifier is likely to include the following:

- Information about the company's main activities and GHG emissions (types of GHG produced, description of activity that causes GHG emissions)
- Information about the company/groups/organization (list of subsidiaries and their geographic location, ownership structure, financial entities within the organization)
- Details of any changes to the company's organizational boundaries or processes during the period, including justification for the effects of these changes on emissions data
- Details of joint venture agreements, outsourcing and contractor agreements, production sharing agreements, emissions rights and other legal or contractual documents that determine the organizational and operational boundaries
- Documented procedures for identifying sources of emissions within the organizational and operational boundaries
- Information on other assurance processes to which the systems and data are subjected (e.g. internal audit, external reviews and certifications)
- Data used for calculating GHG emissions. This might, for example, include:
  - Energy consumption data (invoices, delivery notes, weigh-bridge tickets, meter readings: electricity, gas pipes, steam, and hot water, etc.)
  - Production data (tonnes of material produced, kWh of electricity produced, etc.)
  - Raw material consumption data for mass balance calculations (invoices, delivery notes, weighbridge tickets, etc.)
  - Emission factors (laboratory analysis etc.).
- Description of how GHG emissions data have been calculated:
  - Emission factors and other parameters used and their justification
  - Assumptions on which estimations are based
  - Information on the measurement accuracy of meters and weigh-bridges (e.g., calibration records), and other measurement techniques
  - Equity share allocations and their alignment with financial reporting
  - Documentation on what, if any, GHG sources or activities are excluded due to, for example, technical or cost reasons.
- Information gathering process:
  - Description of the procedures and systems used to collect, document and process GHG emissions data at the facility and corporate level
  - Description of quality control procedures applied (internal audits, comparison with last year's data, recalculation by second person, etc.).

- Other information:
  - Selected consolidation approach as defined in chapter 3
  - list of (and access to) persons responsible for collecting GHG emissions data at each site and at the corporate level (name, title, e-mail, and telephone numbers)
  - information on uncertainties, qualitative and if available, quantitative.

Appropriate documentation needs to be available to support the GHG inventory being subjected to external verification. Statements made by management for which there is no available supporting documentation cannot be verified. Where a reporting company has not yet implemented systems for routinely accounting and recording GHG emissions data, an external verification will be difficult and may result in the verifier being unable to issue an opinion. Under these circumstances, the verifiers may make recommendations on how current data collection and collation process should be improved so that an opinion can be obtained in future years.

Companies are responsible for ensuring the existence, quality and retention of documentation so as to create an audit trail of how the inventory was compiled. If a company issues a specific base year against which it assesses its GHG performance, it should retain all relevant historical records to support the base year data. These issues should be born in mind when designing and implementing GHG data processes and procedures.

## Using the verification findings

Before the verifiers will verify that an inventory has met the relevant quality standard, they may require the company to adjust any material errors that they identified during the course of the verification. If the verifiers and the company cannot come to an agreement regarding adjustments, then the verifier may not be able to provide the company with an unqualified opinion. All material errors (individually or in aggregate) need to be amended prior to the final verification sign off.

As well as issuing an opinion on whether the reported information is free from material discrepancy, the verifiers may, depending on the agreed scope of work, also issue a verification report containing a number of recommendations for future improvements. The process of verification should be viewed as a valuable input to the process of continual improvement. Whether verification is undertaken for the purposes of internal review, public reporting or to certify compliance with a particular GHG program, it will likely contain useful information and guidance on how to improve and enhance a company's GHG accounting and reporting system.

Similar to the process of selecting a verifier, those selected to be responsible for assessing and implementing responses to the verification findings should also have the appropriate skills and understanding of GHG accounting and reporting issues.

# 11 Setting a GHG Target

G U I D A N C E

Setting targets is a routine business practice that helps ensure that an issue is kept on senior management's "radar screen" and factored into relevant decisions about what products and services to provide and what materials and technologies to use. Often, a corporate GHG emission reduction target is the logical follow-up to developing a GHG inventory.

G U I D A N C E

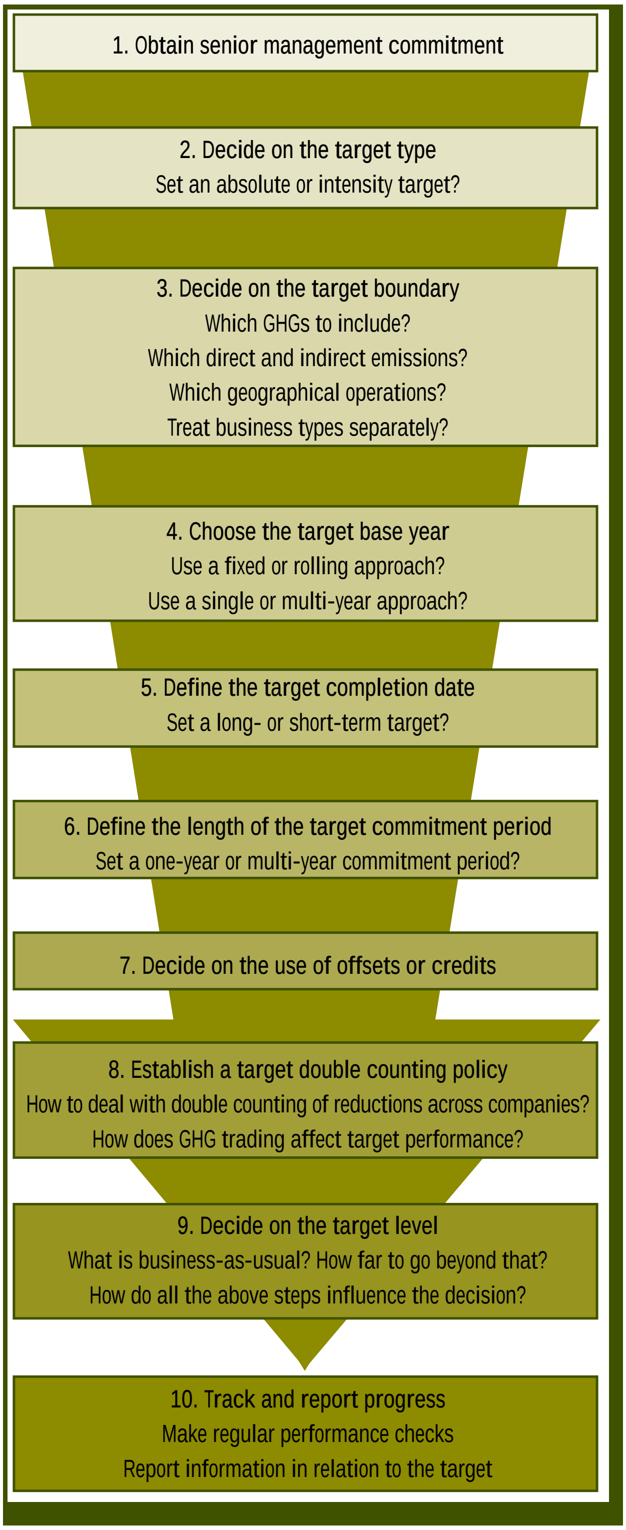
This chapter provides guidance on the process of setting and reporting on a corporate GHG target. Although the chapter focuses on emissions, many of the considerations equally apply to GHG sequestration (see Appendix B). It is not the purpose of this chapter to prescribe what a company's target should be, rather the focus is on the steps involved, the choices to be made, and the implications of those choices.

## Why Set a GHG Target?

Any robust business strategy requires setting targets for revenues, sales, and other core business indicators, as well as tracking performance against those targets. Likewise, effective GHG management involves setting a GHG target. As companies develop strategies to reduce the GHG emissions of their products and operations, corporate-wide GHG targets are often key elements of these efforts, even if some parts of the company are or will be subject to mandatory GHG limits. Common drivers for setting a GHG target include:

- **MINIMIZING AND MANAGING GHG RISKS**
  While developing a GHG inventory is an important step towards identifying GHG risks and opportunities, a GHG target is a planning tool that can actually drive GHG reductions. A GHG target will help raise internal awareness about the risks and opportunities presented by climate change and ensure the issue is on the business agenda. This can serve to minimize and more effectively manage the business risks associated with climate change.
- **ACHIEVING COST SAVINGS AND STIMULATING INNOVATION**
  Implementing a GHG target can result in cost savings by driving improvements in process innovation and resource efficiency. Targets that apply to products can drive R&D, which in turn creates products and services that can increase market share and reduce emissions associated with the use of products.
- **PREPARING FOR FUTURE REGULATIONS**
  Internal accountability and incentive mechanisms that are established to support a target's implementation can also equip companies to respond more effectively to future GHG regulations. For example, some companies have found that experimenting with internal GHG trading programs has allowed them to better understand the possible impacts of future trading programs on the company.

FIGURE 12. Steps in setting a GHG target



- DEMONSTRATING LEADERSHIP AND CORPORATE RESPONSIBILITY
  With the emergence of GHG regulations in many parts of the world, as well as growing concern about the effects of climate change, a commitment such as setting a public corporate GHG target demonstrates leadership and corporate responsibility. This can improve a company's standing with customers, employees, investors, business partners, and the public, and enhance brand reputation.

- PARTICIPATING IN VOLUNTARY PROGRAMS
  A growing number of voluntary GHG programs are emerging to encourage and assist companies in setting, implementing, and tracking progress toward GHG targets. Participation in voluntary programs can result in public recognition, may facilitate recognition of early action by future regulations, and enhance a company's GHG accounting and reporting capacity and understanding.

## Steps in Setting a Target

Setting a GHG target involves making choices among various strategies for defining and achieving a GHG reduction. The business goals, any relevant policy context, and stakeholder discussions should inform these choices.

The following sections outline the ten steps involved. Although presented sequentially, in practice target setting involves cycling back and forth between the steps. It is assumed that the company has developed a GHG inventory before implementing these steps. Figure 12 summarizes the steps.

### 1. Obtain senior management commitment

As with any corporate wide target, senior management buy-in and commitment particularly at the board/CEO level is a prerequisite for a successful GHG reduction program. Implementing a reduction target is likely to necessitate changes in behavior and decision-making throughout the organization. It also requires establishing an internal accountability and incentive system and providing adequate resources to achieve the target. This will be difficult, if not impossible, without senior management commitment.

### BOX 4. Comparing absolute and intensity targets

ABSOLUTE TARGETS reduce absolute emissions over time (Example: reduce $CO_2$ by 25 percent below 1994 levels by 2010)

**Advantages**

- Designed to achieve a reduction in a specified quantity of GHGs emitted to the atmosphere
- Environmentally robust as it entails a commitment to reduce GHGs by a specified amount
- Transparently addresses potential stakeholder concerns about the need to manage absolute emissions

**Disadvantages**

- Target base year recalculations for significant structural changes to the organization add complexity to tracking progress over time
- Does not allow comparisons of GHG intensity/efficiency
- Recognizes a company for reducing GHGs by decreasing production or output (organic decline, see chapter 5)
- May be difficult to achieve if the company grows unexpectedly and growth is linked to GHG emissions

INTENSITY TARGETS reduce the ratio of emissions relative to a business metric over time (Example: reduce $CO_2$ by 12 percent per tonne of clinker between 2000 and 2008)

**Advantages**

- Reflects GHG performance improvements independent of organic growth or decline
- Target base year recalculations for structural changes are usually not required (see step 4)
- May increase the comparability of GHG performance among companies

**Disadvantages**

- No guarantee that GHG emissions to the atmosphere will be reduced—absolute emissions may rise even if intensity goes down and output increases
- Companies with diverse operations may find it difficult to define a single common business metric
- If a monetary variable is used for the business metric, such as dollar of revenue or sales, it must be recalculated for changes in product prices and product mix, as well as inflation, adding complexity to the tracking process

## Royal Dutch/Shell: The target cascade

The Royal Dutch/Shell Group, a global energy corporation, discovered when implementing its voluntary GHG reduction target that one of the biggest challenges was to cascade the target down to the actions of all employees who influence target performance. It was concluded that successful implementation required different targets at different levels of the company. This is because each of the components that underlie absolute GHG emissions is influenced by decision-making at various management levels (from the corporate level down to individual businesses and facilities).

Absolute GHG emissions at a plant (tonnes of $CO_2$-e.) = Function (MP x BPE x PE)

**MP** Quantity of product manufactured by a facility. This is fundamental to the need to grow and is therefore controlled at corporate level. GHG emissions are typically not managed by limiting this component.

**BPE** Best process energy use per tonne. The optimal (or theoretical) energy consumed (translates to emissions) by a particular design of plant. The type of plant built is a business-level decision. Significant capital decisions may be involved in building a new plant incorporating new technology. For existing plants, BPE is improved by significant design change and retrofitting. This could also involve large capital expenditure.

**PE** Plant efficiency index. An index that indicates how the plant is actually performing relative to BPE. PE is a result of day-to-day decisions taken by plant operators and technicians. It is improved also by the Shell Global Solutions Energise™ programme, which typically requires low capital expenditure to implement.

Royal Dutch/Shell found that while this model is probably an oversimplification when it comes to exploration and production facilities, it is suitable for manufacturing facilities (e.g., refineries and chemical plants). It illustrates that an absolute target could only be set at the corporate level, while lower levels require intensity or efficiency targets.

| TYPE OF TARGET | ACTIONS THAT REDUCE EMISSIONS | LEVEL OF DECISION-MAKING (IN GENERAL AND ON TARGET) |
|---|---|---|
| Reduce absolute emissions | See below | Corporate |
| MP: not normally constrained | -------- | All levels depending on scale (e.g. new venture, new plant, operational) |
| Reduce GHG intensity | See below | Business in consultation with corporate |
| Improve BPE (efficiency) | Building new plants with new technology | Business |
| | Retrofitting and changing design of plants | Business |
| Improve PE (efficiency) | Increase plant operating efficiency | Facility, supported by Shell Global Solutions Energise™ |

## 2. Decide on the target type

There are two broad types of GHG targets: absolute and intensity-based. An absolute target is usually expressed in terms of a reduction over time in a specified quantity of GHG emissions to the atmosphere, the unit typically being tonnes of $CO_2$-e. An intensity target is usually expressed as a reduction in the ratio of GHG emissions relative to another business metric.[1] The comparative metric should be carefully selected. It can be the output of the company (e.g. tonne $CO_2$-e per tonne product, per kWh, per tonne mileage) or some other metric such as sales, revenues or office space. To facilitate transparency, companies using an intensity target should also report the absolute emissions from sources covered by the target.

Box 4 summarizes the advantages and disadvantages of each type of target. Some companies have both an absolute and an intensity target. Box 5 provides examples of corporate GHG targets. The Royal Dutch/Shell case study illustrates how a corporate wide absolute target can be implemented by formulating a combination of intensity targets at lower levels of decision-making within the company.

## 3. Decide on the target boundary

The target boundary defines which GHGs, geographic operations, sources, and activities are covered by the target. The target and inventory boundary can be identical, or the target may address a specified subset of the sources included in the company inventory. The quality of the GHG inventory should be a key factor informing this choice. The questions to be addressed in this step include the following:

- WHICH GHGS? Targets usually include one or more of the six major GHGs covered by the Kyoto Protocol. For companies with significant non-$CO_2$ GHG sources it usually makes sense to include these to increase the range of reduction opportunities. However, practical monitoring limitations may apply to smaller sources.
- WHICH GEOGRAPHICAL OPERATIONS? Only country or regional operations with reliable GHG inventory data should be included in the target. For companies with global operations, it makes sense to limit the target's geographical scope until a robust and reliable inventory has been developed for all operations. Companies that participate in GHG programs involving trading[2] will need to decide whether or not to include the emissions sources covered in the trading program in their corporate target. If common sources are included, i.e., if there is overlap in sources covered between the corporate target and the trading program, companies should consider how they will address any double counting resulting from the trading of GHG reductions in the trading program (see step 8).
- WHICH DIRECT AND INDIRECT EMISSION SOURCES? Including indirect GHG emissions in a target will facilitate more cost-effective reductions by increasing the reduction opportunities available. However, indirect emissions are generally harder to measure accurately and verify than direct emissions although some categories, such as scope 2 emissions from purchased electricity, may be amenable to accurate measurement and verification. Including indirect emissions can raise issues with regard to ownership and double counting of reductions, as indirect emissions are by definition someone else's direct emissions (see step 8).
- SEPARATE TARGETS FOR DIFFERENT TYPES OF BUSINESSES? For companies with diverse operations it may make more sense to define separate GHG targets for different core businesses, especially when using an intensity target, where the most meaningful business metric for defining the target varies across business units (e.g., GHGs per tonne of cement produced or barrel of oil refined).

### BOX 5. Selected corporate GHG targets

ABSOLUTE TARGETS

- **ABB** Reduce GHGs by 1 percent each year from 1998 through 2005
- **Alcoa** Reduce GHGs by 25 percent from 1990 levels by 2010, and 50 percent from 1990 levels over same period, if inert anode technology succeeds
- **BP** Hold net GHGs stable at 1990 levels through 2012
- **Dupont** Reduce GHGs by 65 percent from 1990 levels by 2010
- **Entergy** Stabilize $CO_2$ from U.S. generating facilities at 2000 levels through 2005
- **Ford** Reduce $CO_2$ by 4 percent over 2003-2006 timeframe based upon average 1998-2001 baseline as part of Chicago Climate Exchange
- **Intel** Reduce PFCs by 10 percent from 1995 levels by 2010
- **Johnson & Johnson** Reduce GHGs by 7 percent from 1990 levels by 2010, with interim goal of 4 percent below 1990 levels by 2005
- **Polaroid** Reduce $CO_2$ emissions 20 percent below its 1994 emissions by year-end 2005; 25 percent by 2010
- **Royal Dutch/Shell** Manage GHG emissions so that they are still 5 percent or more below the 1990 baseline by 2010, even while growing the business
- **Transalta** Reduce GHGs to 1990 levels by 2000. Achieve zero net GHGs from Canadian operations by 2024

INTENSITY TARGETS

- **Holcim Ltd.** Reduce by the year 2010 the Group average specific[3] net $CO_2$ emissions by 20 percent from the reference year 1990
- **Kansai Electric Power Company** Reduce $CO_2$ emissions per kWh sold in fiscal 2010 to approx. 0.34 kg-$CO_2$/kWh
- **Miller Brewing Company** Reduce GHGs by 18 percent per barrel of production from 2001 to 2006
- **National Renewable Energy Laboratory** Reduce GHGs by 10 percent per square foot from 2000 to 2005

COMBINED ABSOLUTE & INTENSITY TARGETS

- **SC Johnson** GHG emissions intensity reduction of 23 percent by 2005, which represents an absolute or actual GHG reduction of 8 percent
- **Lafarge** Reduce absolute gross $CO_2$ emissions in Annex I countries 10 percent below 1990 levels by the year 2010. Reduce worldwide average specific net $CO_2$ emissions 20 percent below 1990 levels by the year 2010[3]

## 4. Choose the target base year

For a target to be credible, it has to be transparent how target emissions are defined in relation to past emissions. Two general approaches are available: a fixed target base year or a rolling target base year.

- USING A FIXED TARGET BASE YEAR. Most GHG targets are defined as a percentage reduction in emissions below a fixed target base year (e.g., reduce $CO_2$ emissions 25 percent below 1994 levels by 2010). Chapter 5 describes how companies should track emissions in their inventory over time in reference to a fixed base year. Although it is possible to use different years for the inventory base year and the target base year, to streamline the inventory and target reporting process, it usually makes sense to use the same year for both. As with the inventory base year, it is important to ensure that the emissions data for the target base year are reliable and verifiable. It is possible to use a multi-year average target base year. The same considerations as described for multi-year average base years in chapter 5 apply.

  Chapter 5 provides standards on when and how to recalculate base year emissions in order to ensure like-with-like comparisons over time when structural changes (e.g., acquisitions/divestitures) or changes in measurement and calculation methodologies alter the emissions profile over time. In most cases, this will also be an appropriate approach for recalculating data for a fixed target base year.

- USING A ROLLING TARGET BASE YEAR. Companies may consider using a rolling target base year if obtaining and maintaining reliable and verifiable data for a fixed target base year is likely to be challenging (for example, due to frequent acquisitions). With a rolling target base year, the base year rolls forward at regular time intervals, usually one year, so that emissions are always compared against the previous year.[4] However, emission reductions can still be collectively

TABLE 5. Comparing targets with rolling and fixed base years

| | FIXED TARGET BASE YEAR | ROLLING TARGET BASE YEAR |
|---|---|---|
| How might the target be stated? | A target might take the form "we will emit X% less in year B than in year A" | A target might take the form of "over the next X years we will reduce emissions every year by Y% compared to the previous year"[5] |
| What is the target base year? | A fixed reference year in the past | The previous year |
| How far back is like-with-like comparison possible? | The time series of absolute emissions will compare like with like | If there have been significant structural changes the time series of absolute emissions will not compare like with like over more than two years at a time |
| What is the basis for comparing emissions between the target base year and completion year? (see also Figure 14) | The comparison over time is based on what is owned/controlled by the company in the target completion year. | The comparison over time is based on what was owned/controlled by the company in the years the information was reported[6] |
| How far back are recalculations made? | Emissions are recalculated for all years back to the fixed target base year | Emissions are recalculated only for the year prior to the structural change, or ex-post for the year of the structural change which then becomes the base year. |
| How reliable are the target base year emissions? | If a company with a target acquires a company that did not have reliable GHG data in the target base year; back-casting of emissions becomes necessary, reducing the reliability of the base year | Data from an acquired company's GHG emissions are only necessary for the year before the acquisition (or even only from the acquisition onwards), reducing or eliminating the need for back-casting |
| When are recalculations made? | The circumstances which trigger recalculations for structural changes etc. (see chapter 5) are the same under both approaches | |

stated over several years. An example would be "from 2001 through 2012, emissions will be reduced by one percent every year, compared to the previous year." When structural or methodological changes occur, recalculations only need to be made to the previous year.[7] As a result, like-with-like comparisons of emissions in the "target starting year" (2001 in the example) and "target completion year" (2012) cannot be made because emissions are not recalculated for all years back to the target starting year.

The definition of what triggers a base-year emissions recalculation is the same as under the fixed base year approach. The difference lies in how far back emissions are recalculated. Table 5 compares targets using the rolling and fixed base year approaches while Figure 14 illustrates one of the key differences.

### RECALCULATIONS UNDER INTENSITY TARGETS

While the standard in chapter 5 applies to absolute inventory emissions of companies using intensity targets, recalculations for structural changes for the purposes of the target are not usually needed unless the structural change results in a significant change in the GHG intensity. However, if recalculations for structural changes are made for the purposes of the target, they should be made for both the absolute emissions and the business metric. If the target business metric becomes irrelevant through a structural change, a reformulation of the target might be needed (e.g., when a company refocuses on a different industry but had used an industry-specific business metric before).

## 5. Define the target completion date

The target completion date determines whether the target is relatively short- or long-term. Long-term targets (e.g., with a completion year ten years from the time the target is set) facilitate long-term planning for large capital investments with GHG benefits. However, they might encourage later phase-outs of less efficient equipment. Generally, long-term targets depend on uncertain future developments, which can have opportunities as well as risks, which is illustrated in Figure 13. A five-year target period may be more practical for organizations with shorter planning cycles.

## 6. Define the length of the commitment period

The target commitment period is the period of time during which emissions performance is actually measured against the target. It ends with the target completion date. Many companies use single-year commitment periods, whereas the Kyoto Protocol, for example, specifies a multi-year "first commitment period" of five years (2008–2012). The length of the target commitment period is an important factor in determining a company's level of commitment. Generally, the longer the target commitment period, the longer the period during which emissions performance counts towards the target.

- **EXAMPLE OF A SINGLE YEAR COMMITMENT PERIOD.** Company Beta has a target of reducing emissions by 10 percent compared to its target base year 2000, by the commitment year 2010. For Beta to meet its target, it is sufficient for its emissions to be, in the year 2010, no more than 90 percent of year 2000 emissions.
- **EXAMPLE OF A MULTI-YEAR COMMITMENT PERIOD.** Company Gamma has a target of reducing emissions by 10 percent, compared to its target base year 2000, by the commitment period 2008–2012. For Gamma to meet its target, its sum total emissions from 2008–2012 must not exceed 90 percent of year 2000 emissions times five (number of years in the

FIGURE 13. Defining the target completion date

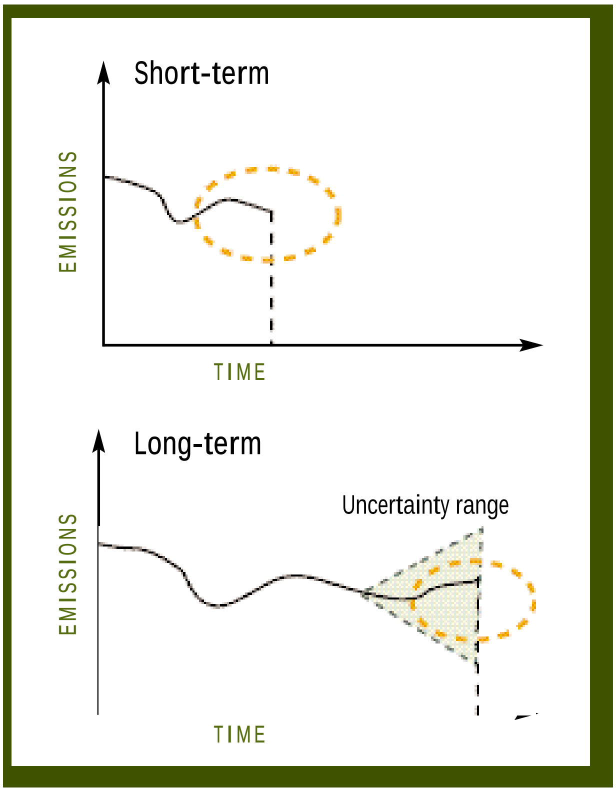
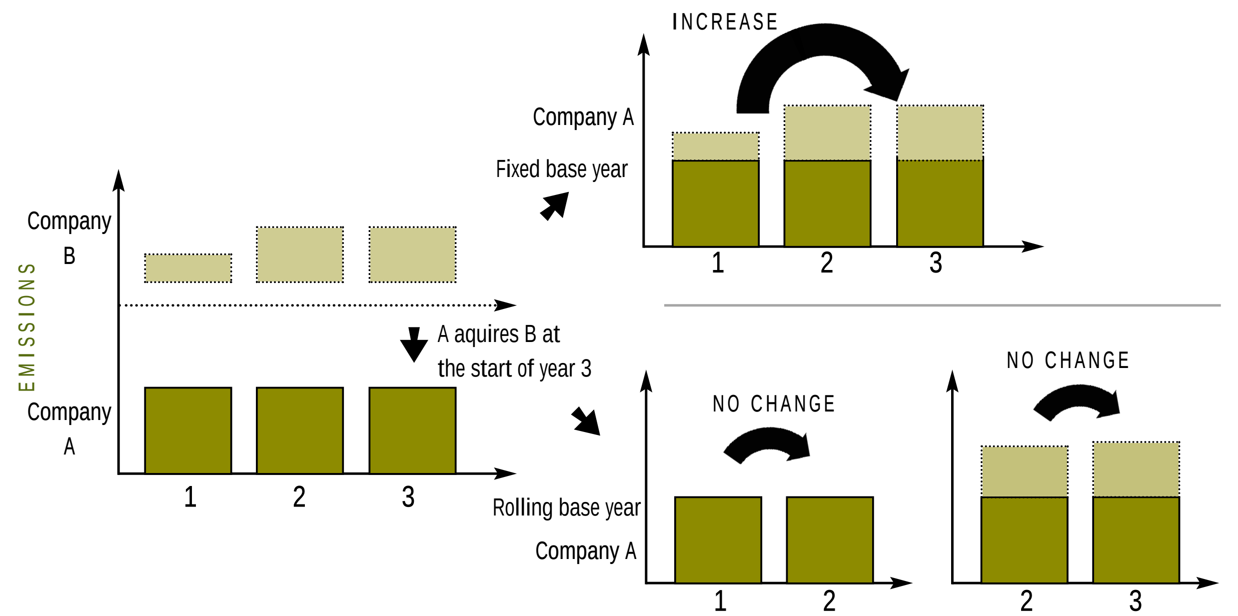


FIGURE 14. Comparing a stabilization target under the fixed and rolling target base year approach




A stabilization target is one that aims to keep emissions constant over time. In this example, company A acquires company B, which has experienced organic GHG growth since the target base year (or "starting" year). Under the rolling approach, emissions growth in the acquired company (B) from year 1 to year 2 does not appear as an emissions increase in relation to the target of the acquiring company (A). Thus company A would meet its stabilization target when using the rolling approach but not when using the fixed approach. In parallel to the example in chapter 5, past GHG growth or decline in divested facilities (GHG changes before the divestment) would affect the target performance under the rolling approach, while it would not be counted under the fixed approach.

commitment period). In other words, its average emissions over those five years must not exceed 90 percent of year 2000 emissions.

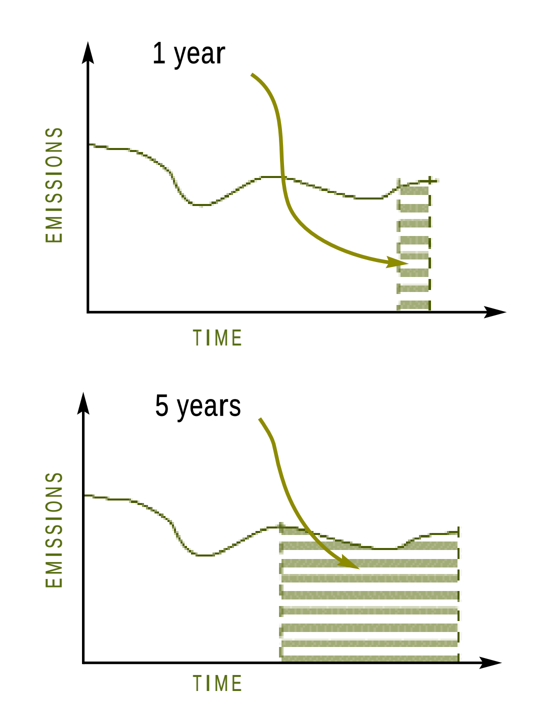
Target commitment periods longer than one year can be used to mitigate the risk of unpredictable events in one particular year influencing performance against the target. Figure 15 shows that the length of the target commitment period determines how many emissions are actually relevant for target performance.

For a target using a rolling base year, the commitment period applies throughout: emission performance is continuously being measured against the target every year from when the target is set until the target completion date.

## 7. Decide on the use of GHG offsets or credits[8]

A GHG target can be met entirely from internal reductions at sources included in the target boundary or through additionally using offsets that are generated from GHG reduction projects that reduce emissions at sources (or enhance sinks) external to the target boundary.[9] The use of offsets may be appropriate when

FIGURE 15. Short vs. long commitment periods




GUIDANCE

the cost of internal reductions is high, opportunities for reductions limited, or the company is unable to meet its target because of unexpected circumstances. When reporting on the target, it should be specified whether offsets are used and how much of the target reduction was achieved using them.

### CREDIBILITY OF OFFSETS AND TRANSPARENCY

There are currently no generally accepted methodologies for quantifying GHG offsets. The uncertainties that surround GHG project accounting make it difficult to establish that an offset is equivalent in magnitude to the internal emissions it is offsetting.[10] This is why companies should always report their own internal emissions in separate accounts from offsets used to meet the target, rather than providing a net figure (see step 10). It is also important to carefully assess the credibility of offsets used to meet a target and to specify the origin and nature of the offsets when reporting. Information needed includes:

- the type of project
- geographic and organizational origin
- how offsets have been quantified
- whether they have been recognized by external programs (CDM, JI, etc.)

One important way to ensure the credibility of offsets is to demonstrate that the quantification methodology adequately addresses all of the key project accounting challenges in chapter 8. Taking these challenges into account, the forthcoming *GHG Protocol Project Quantification Standard* aims to improve the consistency, credibility, and rigor of project accounting.

Additionally, it is important to check that offsets have not also been counted towards another organization's GHG target. This might involve a contract between the buyer and seller that transfers ownership of the offset. Step 8 provides more information on accounting for GHG trades in relation to a corporate target, including establishing a policy on double counting.

### OFFSETS AND INTENSITY TARGETS

When using offsets under intensity targets, all the above considerations apply. In order to determine compliance with the target, the offsets can be subtracted from the figure used for absolute emissions (the numerator); the resulting difference is then divided by the corresponding metric. It is important, however, that absolute emissions are still reported separately both from offsets and the business metric (see step 9 below).

## 8. Establish a target double counting policy

This step addresses double counting of GHG reductions and offsets, as well as allowances issued by external trading programs. It applies only to companies that engage in trading (sale or purchase) of GHG offsets or whose corporate target boundaries interface with other companies' targets or external programs.

Given that there is currently no consensus on how such double counting issues should be addressed, companies should develop their own "Target Double Counting Policy." This should specify how reductions and trades related to other targets and programs will be reconciled with their corporate target, and accordingly which types of double counting situations are regarded as relevant. Listed here are some examples of double counting that might need to be addressed in the policy.

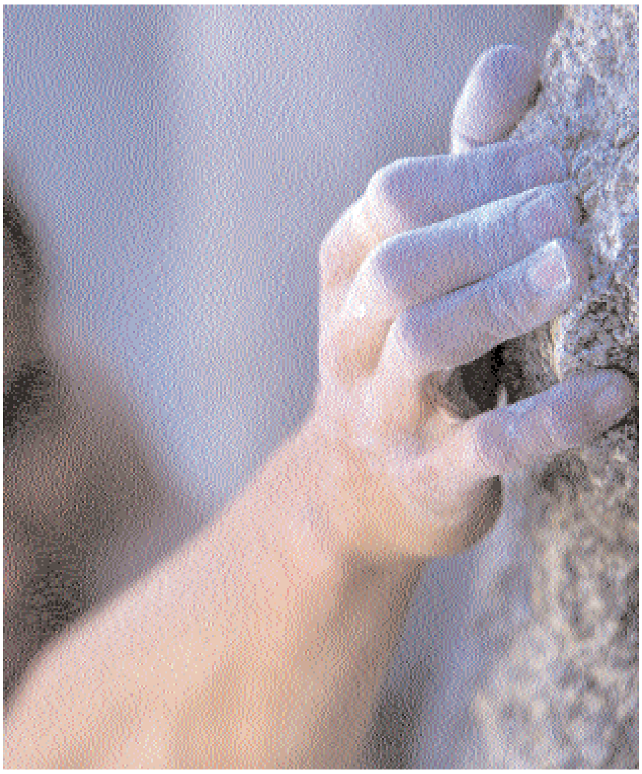
- DOUBLE COUNTING OF OFFSETS. This can occur when a GHG offset is counted towards the target by both the selling and purchasing organizations. For example, company A undertakes an internal reduction project that reduces GHGs at sources included in its own target. Company A then sells this project reduction to company B to use as an offset towards its target, while still counting it toward its own target. In this case, reductions are counted by two different organizations against targets that cover different emissions sources. Trading programs address this by using registries that allocate a serial number to all traded offsets or credits and ensuring the serial numbers are retired once they are used. In the absence of registries this could be addressed by a contract between seller and buyer.
- DOUBLE COUNTING DUE TO TARGET OVERLAP.[11] This can occur when sources included under a company's corporate target are also subject to limits by an external program or another company's target. Two examples:
    - Company A has a corporate target that includes GHG sources that are also regulated under a trading program. In this case, reductions at the common sources are used by company A to meet both its corporate target and the trading program target.

- Company B has a corporate target to reduce its direct emissions from the generation of electricity.[12] Company C who purchases electricity directly from company B also has a corporate target that includes indirect emissions from the purchase of electricity (scope 2). Company C undertakes energy efficiency measures to reduce its indirect emissions from the use of the electricity. These will usually show up as reductions in both companies' targets.[13]

These two examples illustrate that double counting is inherent when the GHG sources where the reductions occur are included in more than one target of the same or different organizations. Without limiting the scope of targets it may be difficult to avoid this type of double counting and it probably does not matter if the double counting is restricted to the organizations sharing the same sources in their targets (i.e., when the two targets overlap).

- DOUBLE COUNTING OF ALLOWANCES TRADED IN EXTERNAL PROGRAMS. This occurs when a corporate target overlaps with an external trading program and allowances that cover the common sources are sold in the trading program for use by another organization and reconciled with the regulatory target, but not reconciled with the corporate target. This example differs from the previous example in that double counting occurs across two targets that are not overlapping (i.e., they do not cover the same sources). This type of double counting could be avoided if the company selling the allowances reconciles the trade with its corporate target (see Holcim case study). Whatever the company decides to do in this situation, in order to maintain credibility, it should address buying and selling of allowances in trading programs in a consistent way. For example, if it decides not to reconcile allowances that it sells in a trading program with its corporate target, it should also not count any allowances of the same type that it purchases to meet its corporate target.

Ideally a company should try to avoid double counting in its corporate target if this undermines the environmental integrity of the target. Also, any prevented double counting between two organizations provides an additional incentive for one of these companies to further reduce emissions. However, in practice the avoidance of double counting can be quite challenging, particularly for companies subject to multiple external programs and when indirect GHG emissions are included in the target. Companies should therefore be transparent about their double counting policy and state any reasons for choosing not to address some double counting situations.



The Holcim case study describes how one company has chosen to track performance towards its target and address double counting issues.

## 9. Decide on the target level

The decision on setting the target level should be informed by all the previous steps. Other considerations to take into account include:

- Understanding the key drivers affecting GHG emissions by examining the relationship between GHG emissions and other business metrics, such as production, square footage of manufacturing space, number of employees, sales, revenue, etc.
- Developing different reduction strategies based on the major reduction opportunities available and examining their effects on total GHG emissions. Investigate how emissions projections change with different mitigation strategies.
- Looking at the future of the company as it relates to GHG emissions.
- Factoring in relevant growth factors such as production plans, revenue or sales targets, and Return on Investment (ROI) of other criteria that drive investment strategy.

G U I D A N C E

## Holcim: Using a GHG balance sheet to track performance towards the target

Holcim, a global cement producer, tracks its performance in relation to its voluntary corporate target using a GHG balance sheet. This balance sheet shows, for each commitment period and for each country business, on one side the actual GHG emissions and on the other side the GHG "assets" and "instruments." These assets and instruments consist of the voluntary GHG target itself (the "voluntary cap"; in other words, the allowances that Holcim provides for itself), a regulatory target ("cap") if applicable, plus the CDM credits purchased (added) or sold (subtracted), and any regulatory emissions trading allowances purchased (added) or sold (subtracted). Thus if any country business sells CDM credits (generated at sources inside the voluntary target boundary), it is ensured that only the buying organization counts the credit (see first example of double counting in step 8).

At the end of the commitment period, every country business must demonstrate a neutral or positive balance towards Holcim's target. Those companies whose voluntary cap overlaps with a regulatory cap (e.g., in Europe) must also demonstrate a neutral or positive balance towards the regulatory cap. GHG reductions in Europe are thus reported towards both targets (see second example of double counting in step 8).

Both sides of the country business balance sheets are consolidated to group level. Credits and allowances traded within the group simply cancel out in the asset column of the consolidated corporate level GHG balance sheet. Any credits or allowances traded externally are reconciled with both the voluntary and regulatory caps at the bottom line of the asset column of the balance sheet. This ensures that any sold allowance is only counted by the buying organization (when Holcim's target and that of the buying organization do not overlap). A purchased allowance or credit is counted towards both the voluntary and regulatory targets of the European business (these two targets overlap).

**GHG balance sheet** (All values in tonnes $CO_2$-e/year)

| GHG ASSETS & INSTRUMENTS | GHG EMISSIONS |
|---|---|
| **Holcim (country A in Europe)** | |
| | |
| Voluntary cap (direct emissions) | Emissions, direct, indirect + biomass |
| Regulatory cap (direct emissions) | |
| Reg. allowances purchased (+) or sold (-) | |
| CDM credits purchased (+) or sold (-) | |
| Sum of voluntary cap, reg. allowances & credits | Sum of direct emissions |
| Sum of regulatory cap, reg. allowances & credits | Sum of direct emissions, according to EU ETS |
| | |
| **Holcim (country X in Latin America)** | |
| Voluntary cap | Emissions, direct, indirect + biomass |
| CDM credits purchased (+) or sold (-) | |
| Sum of voluntary cap & credits | Sum of direct emissions |
| | |
| **Holcim Group** | |
| Sum of voluntary cap, reg. allowances & credits | Sum of direct emissions |

- Considering whether there are any existing environmental or energy plans, capital investments, product/service changes, or targets that will affect GHG emissions. Are there plans already in place for fuel switching, on site power generation, and/or renewable energy investments that affect the future GHG trajectory?
- Benchmarking GHG emissions with similar organizations. Generally, organizations that have not previously invested in energy and other GHG reductions should be capable of meeting more aggressive reduction levels because they would have more cost-effective reduction opportunities.

## 10. Track and report progress

Once the target has been set, it is necessary to track performance against it in order to check compliance, and also—in order to maintain credibility—to report emissions and any external reductions in a consistent, complete and transparent manner.

- CARRY OUT REGULAR PERFORMANCE CHECKS. In order to track performance against a target, it is important to link the target to the annual GHG inventory process and make regular checks of emissions in relation to the target. Some companies use interim targets for this purpose (a target using a rolling target base year automatically includes interim targets every year).
- REPORT INFORMATION IN RELATION TO THE TARGET. Companies should include the following information when setting and reporting progress in relation to a target:

  1. Description of the target
     - Provide an outline of the target boundaries chosen
     - Specify target type, target base year, target completion date, and length of commitment period
     - Specify whether offsets can be used to meet the target; if yes, specify the type and amount
     - Describe the target double counting policy
     - Specify target level.
  2. Information on emissions and performance in relation to the target
     - Report emissions from sources inside the target boundary separately from any GHG trades
     - If using an intensity target, report absolute emissions from within the target boundary separately, both from any GHG trades and the business metric
     - Report GHG trades that are relevant to compliance with the target (including how many offsets were used to meet the target)
     - Report any internal project reductions sold or transferred to another organization for use as an offset
     - Report overall performance in relation to the target.

NOTES

[1] Some companies may formulate GHG efficiency targets by formulating this ratio the other way around.

[2] Examples include the U.K. ETS, the CCX, and the EU ETS.

[3] Holcim's and Lafarge's target have been formulated using the terminology of the WBCSD Cement $CO_2$ Protocol (WBCSD, 2001), which uses "specific" to denote emissions per tonne of cement produced.

[4] It is possible to use an interval other than one year. However, the longer the interval at which the base year rolls forward, the more this approach becomes like a fixed target base year. This discussion is based on a rolling target base year that moves forward at annual intervals.

[5] Note that simply adding the yearly emissions changes under the rolling base year yields a different result from the comparison over time made with a fixed base year, even without structural changes. In absolute terms, an X% reduction every year over 5 years (compared to the previous year) is not the same as an (X times 5) reduction in year 5 compared to year 1.

[6] Depending on which recalculation methodology is used when applying the rolling base year, the comparison over time can include emissions that occurred when the company did not own or control the emission sources. However, the inclusion of this type of information is minimized. See also the guidance document "Base year recalculation methodologies for structural changes" on the GHG Protocol website (www.ghgprotocol.org).

[7] For further details on different recalculation methodologies, see the guidance document "Base year recalculation methodologies for structural changes" on the GHG Protocol website (www.ghgprotocol.org).

[8] As noted in chapter 8, offsets can be converted to credits. Credits are thus understood to be a subset of offsets. This chapter uses the term offsets as a generic term.

[9] For the purposes of this chapter, the terms "internal" and "external" refer to whether the reductions occur at sources inside (internal) or outside (external) the target boundary.

[10] This equivalence is sometimes referred to as "fungibility." However, "fungibility" can also refer to equivalence in terms of the value in meeting a target (two fungible offsets have the same value in meeting a target, i.e., they can both be applied to the same target).

[11] Overlap here refers to a situation when two or more targets include the same sources in their target boundaries.

[12] Similarly, company A in this example could be subject to a mandatory cap on its direct emissions under a trading program and engage in trading allowances covering the common sources it shares with company B. In this case, the example in the section "Double counting of allowances traded in external programs" is more relevant.

[13] The energy efficiency measures implemented by company C may not always result in an actual reduction of company B's emissions. See chapter 8 for further details on reductions in indirect emissions.

GUIDANCE

# A Accounting for Indirect Emissions from Purchased Electricity

APPENDIX

This appendix provides guidance on how to account for and report indirect emissions associated with the purchase of electricity. Figure A–1 provides an overview of the transactions associated with purchased electricity and the corresponding emissions.

## Purchased electricity for own consumption

Emissions associated with the generation of purchased electricity that is consumed by the reporting company are reported in scope 2. Scope 2 only accounts for the portion of the direct emissions from generating electricity that is actually consumed by the company. A company that purchases electricity and transports it in a transmission and distribution (T&D) system that it owns or controls reports the emissions associated with T&D losses under scope 2. However, if the reporting company owns or controls the T&D system but generates (rather than purchases) the electricity transmitted through its wires, the emissions associated with T&D losses are not reported under scope 2, as they would already be accounted for under scope 1. This is the case when generation, transmission, and distribution systems are vertically integrated and owned or controlled by the same company.

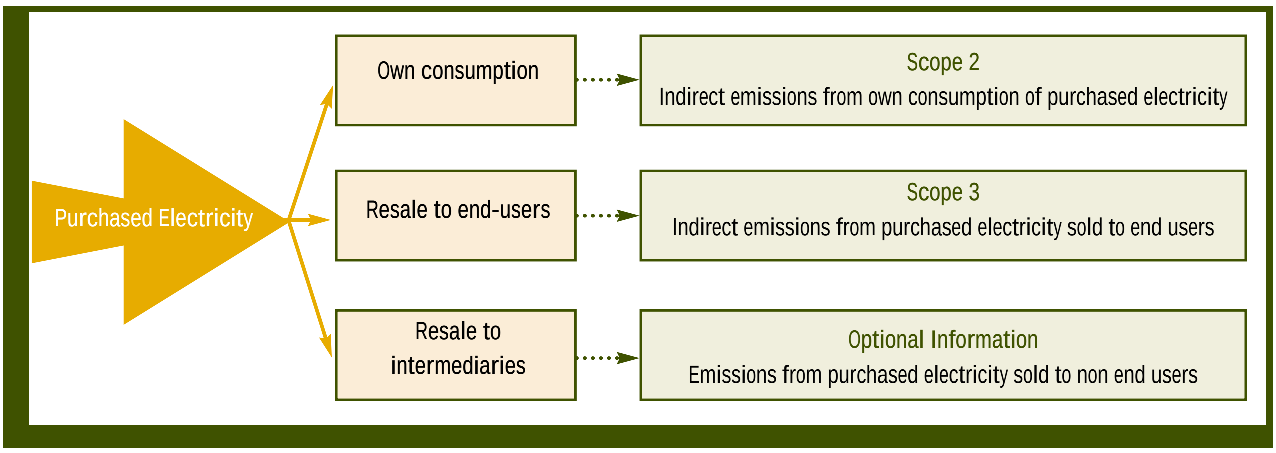
## Purchased electricity for resale to end-users

Emissions from the generation of purchased electricity for resale to end-users, for example purchases by a utility company, may be reported under scope 3 in the category "generation of purchased electricity that is sold to end-users." This reporting category is particularly relevant for utility companies that purchase wholesale electricity supplied by independent power producers for resale to their customers. Since utility companies and electricity suppliers often exercise choice over where they purchase electricity, this provides them with an important GHG reduction opportunity (see Seattle City Light case study in chapter 4). Since scope 3 is optional, companies that are unable to track their electricity sales in terms of end users and non-end users can choose not to report these emissions in scope 3. Instead, they can report the total emissions associated with purchased electricity that is sold to both end- and non-end-users under optional information in the category "generation of purchased electricity, heat, or steam for re-sale to non-end users."

## Purchased electricity for resale to intermediaries

Emissions associated with the generation of purchased electricity that is resold to an intermediary (e.g., trading transactions) may be reported under optional information under the category "Generation of purchased electricity, heat, or steam for re-sale to non-end users." Examples of trading transactions include brokerage/trading room transactions involving purchased electricity or any other transaction in which electricity is purchased directly from one source or the spot market and then resold to an intermediary (e.g., a non-end user). These emissions are reported under optional information separately from scope 3 because there could be a number of trading transactions before the electricity finally reaches the end-user. This may cause duplicative reporting of indirect emissions from a series of electricity trading transactions for the same electricity.

FIGURE A-1. Accounting for the indirect GHG emissions associated with purchased electricity



## GHG emissions upstream of the generation of electricity

Emissions associated with the extraction and production of fuels consumed in the generation of purchased electricity may be reported in scope 3 under the category "extraction, production, and transportation of fuels consumed in the generation of electricity." These emissions occur upstream of the generation of electricity. Examples include emissions from mining of coal, refining of gasoline, extraction of natural gas, and production of hydrogen (if used as a fuel).

## Choosing electricity emission factors

To quantify scope 2 emissions, the *GHG Protocol Corporate Standard* recommends that companies obtain source/supplier specific emission factors for the electricity purchased. If these are not available, regional or grid emission factors should be used. For more information on choosing emission factors, see the relevant GHG Protocol calculation tools available on the GHG Protocol website (www.ghgprotocol.org).

## GHG emissions associated with the consumption of electricity in T&D

Emissions from the generation of electricity that is consumed in a T&D system may be reported in scope 3 under the category "generation of electricity that is consumed in a T&D system" by end-users. Published electricity grid emission factors do not usually include T&D losses. To calculate these emissions, it may be necessary to apply supplier or location specific T&D loss factors. Companies that purchase electricity and transport it in their own T&D systems would report the portion of electricity consumed in T&D under scope 2.

## Accounting for indirect emissions associated with T&D losses

There are two types of electricity emission factors: Emission factor at generation (EFG) and Emissions factor at consumption (EFC). EFG is calculated from $CO_2$ emissions from generation of electricity divided by amount of electricity generated. EFC is calculated from $CO_2$ emissions from generation divided by amount of electricity consumed.

$$\text{EFG} = \frac{\text{TOTAL } CO_2 \text{ EMISSIONS FROM GENERATION}}{\text{ELECTRICITY GENERATED}}$$

$$\text{EFC} = \frac{\text{TOTAL } CO_2 \text{ EMISSIONS FROM GENERATION}}{\text{ELECTRICITY CONSUMED}}$$

EFC and EFG are related as shown below.

$$\text{EFC x ELECTRICITY CONSUMED} = \text{EFG x (ELECTRICITY CONSUMED + T\&D LOSSES)}$$

$$\text{EFC} = \text{EFG x } \left(1 + \frac{\text{T\&D LOSSES}}{\text{ELECTRICITY CONSUMED}}\right)$$

As these equations indicate, EFC multiplied by the amount of consumed electricity yields the sum of emissions attributable to electricity consumed during end use and transmission and distribution. In contrast, EFG multiplied by the amount of consumed electricity yields emissions attributable to electricity consumed during end use only.

Consistent with the scope 2 definition (see chapter 4), the *GHG Protocol Corporate Standard* requires the use of EFG to calculate scope 2 emissions. The use of EFG ensures internal consistency in the treatment of electricity related upstream emissions categories and avoids double counting in scope 2. Additionally, there are several other advantages in using EFG:

1) It is simpler to calculate and widely available in published regional, national, and international sources.

2) It is based on a commonly used approach to calculate emissions intensity, i.e., emissions per unit of production output.

3) It ensures transparency in reporting of indirect emissions from T&D losses.

The formula to account for emissions associated with T&D losses is the following:

$$\text{EFG x ELECTRICITY CONSUMED DURING T\&D} = \text{INDIRECT EMISSIONS FROM CONSUMPTION OF ELECTRICITY DURING T\&D}$$

In some countries such as Japan, local regulations may require utility companies to provide both EFG and EFC to its consumers, and consumers may be required to use EFC to calculate indirect emissions from the consumption of purchased electricity. In this case, a company still needs to use EFG to report its scope 2 emissions for a GHG report prepared in accordance with *GHG Protocol Corporate Standard*.

# B Accounting for Sequestered Atmospheric Carbon

A key purpose of the *GHG Protocol Corporate Standard* is to provide companies with guidance on how to develop inventories that provide an accurate and complete picture of their GHG emissions both from their direct operations as well as those along the value chain.[1] For some types of companies, this is not possible without addressing the company's impacts on sequestered atmospheric carbon.[2]

Information on a company's impacts on sequestered atmospheric carbon can be used for strategic planning, for educating stakeholders, and for identifying opportunities for improving the company's GHG profile. Opportunities may also exist to create value from reductions created along the value chain by companies acting alone or in partnership with raw material providers or customers.

## Sequestered atmospheric carbon

During photosynthesis, plants remove carbon (as $CO_2$) from the atmosphere and store it in plant tissue. Until this carbon is cycled back into the atmosphere, it resides in one of a number of "carbon pools." These pools include (a) above ground biomass (e.g., vegetation) in forests, farmland, and other terrestrial environments, (b) below ground biomass (e.g., roots), and (c) biomass-based products (e.g., wood products) both while in use and when stored in a landfill.

Carbon can remain in some of these pools for long periods of time, sometimes for centuries. An increase in the stock of sequestered carbon stored in these pools represents a net removal of carbon from the atmosphere; a decrease in the stock represents a net addition of carbon to the atmosphere.

## Why include impacts on sequestered carbon in corporate GHG inventories?

It is generally recognized that changes in stocks of sequestered carbon and the associated exchanges of carbon with the atmosphere are important to national level GHG emissions inventories, and consequently, these impacts on sequestered carbon are commonly addressed in national inventories (UNFCCC, 2000). Similarly, for companies in biomass-based industries, such as the forest products industry, some of the most significant aspects of a company's overall impact on atmospheric $CO_2$ levels will occur as a result of impacts on sequestered carbon in their direct operations as well as along their value chain. Some forest product companies have begun to address this aspect of their GHG footprint within their corporate GHG inventories (Georgia Pacific, 2002). Moreover, WBCSD's Sustainable Forest Products Industry Working Group—which represents a significant cluster of integrated forestry companies operating internationally—is developing a project that will further investigate carbon measurement, accounting, reporting, and ownership issues associated with the forest products value chain.

## Accounting for sequestered carbon in the context of the GHG Protocol Corporate Standard

Consensus methods have yet to be developed under the *GHG Protocol Corporate Standard* for accounting of sequestered atmospheric carbon as it moves through the value chain of biomass-based industries. Nonetheless, some issues that would need to be addressed when addressing impacts on sequestered carbon in corporate inventories can be examined in the context of existing guidance provided by the *GHG Protocol Corporate Standard* as highlighted below.

### SETTING ORGANIZATIONAL BOUNDARIES

The *GHG Protocol Corporate Standard* outlines two approaches for consolidating GHG data—the equity share approach and the control approach. In some cases, it may be possible to apply these approaches directly to emissions/removals associated with sequestered atmospheric carbon. Among the issues that may need to be examined is the ownership of sequestered carbon under the different types of contractual arrangements involving land and wood ownership, harvesting rights, and control of land management and harvesting decisions. The transfer of ownership as carbon moves through the value chain may also need to be addressed. In some cases, as part of a risk management program for instance, companies may be interested in performing value chain assessments of sequestered carbon without regard to ownership or control just as they might do for scope 2 and 3 emissions.

### SETTING OPERATIONAL BOUNDARIES

As with GHG emissions accounting, setting operational boundaries for sequestered carbon inventories would help companies transparently report their impacts on sequestered carbon along their value chain. Companies may, for example, provide a description of the value chain capturing impacts that are material to the results of the analysis. This should include which pools are included in the analysis, which are not, and the rationale for the selections. Until consensus methods are developed for characterizing impacts on sequestered atmospheric carbon along the value chain, this information can be included in the "optional information" section of a GHG inventory compiled using the *GHG Protocol Corporate Standard.*

## TRACKING REMOVALS OVER TIME

As is sometimes the case with accounting for GHG emissions, base year data for impacts on sequestered carbon may need to be averaged over multiple years to accommodate the year-to-year variability expected of these systems. The temporal scale used in sequestered carbon accounting will often be closely tied to the spatial scale over which the accounting is done. The question of how to recalculate base years to account for land acquisition and divestment, land use changes, and other activities also needs to be addressed.

## IDENTIFYING AND CALCULATING GHG REMOVALS

The *GHG Protocol Corporate Standard* does not include consensus methods for sequestered carbon quantification. Companies should, therefore, explain the methods used. In some instances, quantification methods used in national inventories can be adapted for corporate-level quantification of sequestered carbon. IPCC (1997; 2000b) provides useful information on how to do this. In 2004, IPCC is expected to issue Good Practice Guidance for Land Use, Land Use Change and Forestry, with information on methods for quantification of sequestered carbon in forests and forest products. Companies may also find it useful to consult the methods used to prepare national inventories for those countries where significant parts of their company's value chain reside.

In addition, although corporate inventory accounting differs from project-based accounting (as discussed below), it may be possible to use some of the calculation and monitoring methods derived from project level accounting of sequestration projects.

## ACCOUNTING FOR REMOVAL ENHANCEMENTS

A corporate inventory can be used to account for yearly removals within the corporate inventory boundary. In contrast, the forthcoming *GHG Protocol Project Quantification Standard* is designed to calculate project reductions that will be used as offsets, relative to a hypothetical baseline scenario for what would have happened without the project. In the forestry sector, projects take the form of removal enhancements.

Chapter 8 in this document addresses some of the issues that must be addressed when accounting for offsets from GHG reduction projects. Much of this guidance is also applicable to removal enhancement projects. One example is the issue of reversibility of removals — also briefly described in chapter 8.

## REPORTING GHG REMOVALS

Until consensus methods are developed for characterizing impacts on sequestered atmospheric carbon along the value chain, this information can be included in the "optional information" section of the inventory (See chapter 9). Information on sequestered carbon in the company's inventory boundary should be kept separate from project-based reductions at sources that are not in the inventory boundary. Where removal enhancement projects take place within a company's inventory boundary they would normally show up as an increase in carbon removals over time, but can also be reported in optional information. However, they should also be identified separately to ensure that they are not double counted. This is especially important when they are sold as offsets or credits to a third party.

As companies develop experience using various methods for characterizing impacts on sequestered carbon, more information will become available on the level of accuracy to expect from these methods. In the early stages of developing this experience, however, companies may find it difficult to assess the uncertainty associated with the estimates and therefore may need to give special care to how the estimates are represented to stakeholders.

## NOTES

1 In this Appendix, "value chain" means a series of operations and entities, starting with the forest and extending through end-of-life management, that (a) supply or add value to raw materials and intermediate products to produce final products for the marketplace and (b) are involved in the use and end-of-life management of these products.

2 In this Appendix the term "sequestered atmospheric carbon" refers exclusively to sequestration by biological sinks.

APPENDIX

# C Overview of GHG Programs

| NAME OF PROGRAM | TYPE OF PROGRAM | FOCUS (Organization, project, facility) | GASES COVERED | ORGANIZATIONAL PROJECT BOUNDARIES |
|---|---|---|---|---|
| California Climate Action Registry www.climateregisty.org | Voluntary registry | Organization (Projects possible in 2004) | Organizations report $CO_2$ for first three years of participation, all six GHGs thereafter. | Equity share or control for California or US operations |
| US EPA Climate Leaders www.epa.gov/climateleaders | Voluntary reduction program | Organization | Six | Equity share or control for US operations at a minimum |
| WWF Climate Savers www.worldwildlife.org/climatesavers | Voluntary registry | Organization | $CO_2$ | Equity share or control for worldwide operations |
| World Economic Forum Global GHG Register www.weforum.org | Voluntary registry | Organization | Six | Equity share or control for worldwide operations |
| EU GHG Emissions Allowance Trading Scheme www.europa.eu.int/comm/environment/ | Mandatory allowance trading scheme | Facility | Six | Facilities in selected sectors |
| European Pollutant Emission Registry www.europa.eu.int/comm/environment/ippc/eper/index.htm | Mandatory registry for large industrial facilities | Facility | Six Kyoto gases as well as other pollutants | Facilities that fall under EU IPPC directive |
| Chicago Climate Exchange www.chicagoclimateexchange.com | Voluntary allowance trading scheme | Organization and project | Six | Equity share |
| Respect Europe BLICC www.respecteurope.com/rt2/blicc/ | Voluntary reduction program | Organization | Six | Equity share or control for worldwide operations |

| OPERATIONAL BOUNDARIES | NATURE/PURPOSE OF PROGRAM | BASE YEAR | TARGET | VERIFICATION |
|---|---|---|---|---|
| Scope 1 and 2 required, scope 3 to be decided | Baseline protection, public reporting, possible future targets | Specific to each organization, recalculation consistent with GHG Protocol Corporate Standard required | Encouraged but optional | Required through certified third party verifier |
| Scope 1 and 2 required, scope 3 optional | Public recognition, assistance setting targets and achieving reductions | Year that organization joins program, recalculation consistent with GHG Protocol Corporate Standard required | Required, specific to each organization | Optional, provides guidance and checklist of components that should be included if undertaken |
| Scope 1 and 2 required, scope 3 optional | Achieve targets, public recognition, expert assistance | Chosen year since 1990, specific to each organization, recalculation consistent with GHG Protocol Corporate Standard required | Required, specific to each organization | Third party verifier |
| Scope 1 and 2 required, scope 3 optional | Baseline protection, public reporting, targets encouraged but optional | Chosen year since 1990, specific to each organization, recalculation consistent with GHG Protocol Corporate Standard required | Encouraged but optional | Third party verifier or spot checks by WEF |
| Scope 1 | Achieve annual caps through tradable allowance market, initial period from 2005 to 2007 | Determined by member country for allowance allocation | Annual compliance with allocated and traded allowances, EU committed to 8% overall reduction below 1990 | Third party verifier |
| Scope 1 required | Permit individual industrial facilities | Not applicable | Not applicable | Local permitting authority |
| Direct combustion and process emission sources and indirect emissions optional. | Achieve annual targets through tradable allowance market | Average of 1998 through 2001 | 1% below its baseline in 2003, 2% below baseline in 2004, 3% below baseline in 2005 and 4% below baseline in 2006 | Third party verifier |
| Scope 1 and 2 required, scope 3 strongly encouraged | Achieve targets, public recognition, expert assistance | Specific to each organization, recalculation consistent with GHG Protocol Corporate Standard required | Mandatory, specific to each organization | Third party verifier |

# Industry Sectors and Scopes

| SECTOR | SCOPE 1 EMISSION SOURCES | SCOPE 2 EMISSION SOURCES | SCOPE 3 EMISSION SOURCES[1] |
|---|---|---|---|
| **ENERGY** | | | |
| Energy Generation | • Stationary combustion (boilers and turbines used in the production of electricity, heat or steam, fuel pumps, fuel cells, flaring)<br>• Mobile combustion (trucks, barges and trains for transportation of fuels)<br>• Fugitive emissions ($CH_4$ leakage from transmission and storage facilities, HFC emissions from LPG storage facilities, $SF_6$ emissions from transmission and distribution equipment) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (mining and extraction of fuels, energy for refining or processing fuels)<br>• Process emissions (production of fuels, $SF_6$ emissions[2])<br>• Mobile combustion (transportation of fuels/waste, employee business travel, employee commuting)<br>• Fugitive emissions ($CH_4$ and $CO_2$ from waste landfills, pipelines, $SF_6$ emissions) |
| Oil and Gas[3] | • Stationary combustion (process heaters, engines, turbines, flares, incinerators, oxidizers, production of electricity, heat and steam)<br>• Process emissions (process vents, equipment vents, maintenance/turnaround activities, non-routine activities)<br>• Mobile combustion (transportation of raw materials/products/waste; company owned vehicles)<br>• Fugitive emissions (leaks from pressurized equipment, wastewater treatment, surface impoundments) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (product use as fuel or combustion for the production of purchased materials)<br>• Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting, product use as fuel)<br>• Process emissions (product use as feedstock or emissions from the production of purchased materials)<br>• Fugitive emissions ($CH_4$ and $CO_2$ from waste landfills or from the production of purchased materials) |
| Coal Mining | • Stationary combustion (methane flaring and use, use of explosives, mine fires)<br>• Mobile combustion (mining equipment, transportation of coal)<br>• Fugitive emissions ($CH_4$ emissions from coal mines and coal piles) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (product use as fuel)<br>• Mobile combustion (transportation of coal/waste, employee business travel, employee commuting)<br>• Process emissions (gasification) |
| **METALS** | | | |
| Aluminum[4] | • Stationary combustion (bauxite to aluminum processing, coke baking, lime, soda ash and fuel use, on-site CHP)<br>• Process emissions (carbon anode oxidation, electrolysis, PFC)<br>• Mobile combustion (pre- and post-smelting transportation, ore haulers)<br>• Fugitive emissions (fuel line $CH_4$, HFC and PFC, $SF_6$ cover gas) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (raw material processing and coke production by second party suppliers, manufacture of production line machinery)<br>• Mobile combustion (transportation services, business travel, employee commuting)<br>• Process emissions (during production of purchased materials)<br>• Fugitive emissions (mining and landfill $CH_4$ and $CO_2$, outsourced process emissions) |
| Iron and Steel[5] | • Stationary combustion (coke, coal and carbonate fluxes, boilers, flares)<br>• Process emissions (crude iron oxidation, consumption of reducing agent, carbon content of crude iron/ferroalloys)<br>• Mobile combustion (on-site transportation)<br>• Fugitive emission ($CH_4$, $N_2O$) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (mining equipment, production of purchased materials)<br>• Process emissions (production of ferroalloys)<br>• Mobile combustion (transportation of raw materials/products/waste and intermediate products)<br>• Fugitive emissions ($CH_4$ and $CO_2$ from waste landfills) |
| **CHEMICALS** | | | |
| Nitric acid, Ammonia, Adipic acid, Urea, and Petrochemicals | • Stationary combustion (boilers, flaring, reductive furnaces, flame reactors, steam reformers)<br>• Process emissions (oxidation/reduction of substrates, impurity removal, $N_2O$ byproducts, catalytic cracking, myriad other emissions individual to each process)<br>• Mobile combustion (transportation of raw materials/products/waste)<br>• Fugitive emissions (HFC use, storage tank leakage) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (production of purchased materials, waste combustion)<br>• Process emissions (production of purchased materials)<br>• Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting)<br>• Fugitive emissions ($CH_4$ and $CO_2$ from waste landfills and pipelines) |

| SECTOR | SCOPE 1 EMISSION SOURCES | SCOPE 2 EMISSION SOURCES | SCOPE 3 EMISSION SOURCES |
|---|---|---|---|
| **MINERALS** | | | |
| Cement and Lime[6] | • Process emissions (calcination of limestone)<br>• Stationary combustion (clinker kiln, drying of raw materials, production of electricity)<br>• Mobile combustion (quarry operations, on-site transportation) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (production of purchased materials, waste combustion)<br>• Process emissions (production of purchased clinker and lime)<br>• Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting)<br>• Fugitive emissions (mining and landfill $CH_4$ and $CO_2$, outsourced process emissions) |
| **WASTE**[7] | | | |
| Landfills, Waste combustion, Water services | • Stationary combustion (incinerators, boilers, flaring)<br>• Process emissions (sewage treatment, nitrogen loading)<br>• Fugitive emissions ($CH_4$ and $CO_2$ emissions from waste and animal product decomposition)<br>• Mobile combustion (transportation of waste/products) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion(recycled waste used as a fuel)<br>• Process emissions (recycled waste used as a feedstock)<br>• Mobile combustion (transportation of waste/products, employee business travel, employee commuting) |
| **PULP & PAPER** | | | |
| Pulp and Paper[8] | • Stationary combustion (production of steam and electricity, fossil fuel-derived emissions from calcination of calcium carbonate in lime kilns, drying products with infrared driers fired with fossil fuels)<br>• Mobile combustion (transportation of raw materials, products, and wastes, operation of harvesting equipment)<br>• Fugitive emissions ($CH_4$ and $CO_2$ from waste) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (production of purchased materials, waste combustion)<br>• Process emissions (production of purchased materials)<br>• Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting)<br>• Fugitive emissions (landfill $CH_4$ and $CO_2$ emissions) |
| **HFC, PFC, $SF_6$ & HCFC 22 PRODUCTION**[9] | | | |
| HCFC 22 production | • Stationary combustion(production of electricity, heat or steam)<br>• Process emissions (HFC venting)<br>• Mobile combustion (transportation of raw materials/products/waste)<br>• Fugitive emissions (HFC use) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (production of purchased materials)<br>• Process emissions (production of purchased materials)<br>• Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting)<br>• Fugitive emissions(fugitive leaks in product use, $CH_4$ and $CO_2$ from waste landfills) |
| **SEMICONDUCTOR PRODUCTION** | | | |
| Semiconductor production | • Process emissions ($C_2F_6$, $CH_4$, $CHF_3$, $SF_6$, $NF_3$, $C_3F_8$, $C_4F_8$, $N_2O$ used in wafer fabrication, $CF_4$ created from $C_2F_6$ and $C_3F_8$ processing)<br>• Stationary combustion (oxidation of volatile organic waste, production of electricity, heat or steam)<br>• Fugitive emissions (process gas storage leaks, container remainders/heel leakage)<br>• Mobile combustion (transportation of raw materials/products/waste) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (production of imported materials, waste combustion, upstream T&D losses of purchased electricity)<br>• Process emissions (production of purchased materials, outsourced disposal of returned process gases and container remainder/heel)<br>• Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting)<br>• Fugitive emissions (landfill $CH_4$ and $CO_2$ emissions, downstream process gas container remainder/heel leakage) |
| **OTHER SECTORS**[10] | | | |
| Service sector/ Office based organizations[10] | • Stationary combustion (production of electricity, heat or steam)<br>• Mobile combustion (transportation of raw materials/waste)<br>• Fugitive emissions (mainly HFC emissions during use of refrigeration and air-conditioning equipment) | • Stationary combustion (consumption of purchased electricity, heat or steam) | • Stationary combustion (production of purchased materials)<br>• Process emissions (production of purchased materials)<br>• Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) |

NOTES

[1] Scope 3 activities of outsourcing, contract manufacturing, and franchises are not addressed in this table because the inclusion of specific GHG sources will depend on the nature of the outsourcing.

[2] Guidelines on unintentional $SF_6$ process emissions are to be developed.

[3] The American Petroleum Institute's Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry (2004) provides guidelines and calculation methodology for calculating GHG emissions from the oil and gas sector.

[4] The International Aluminum Institute's Aluminum Sector Greenhouse Gas Protocol (2003), in cooperation with WRI and WBCSD, provides guidelines and tools for calculating GHG emissions from the aluminum sector.

[5] The International Iron and Steel Institute's Iron and Steel sector guidelines, in cooperation with WRI and WBCSD, are under development.

[6] The WBCSD Working Group Cement: Toward a Sustainable Cement Industry has developed The Cement $CO_2$ Protocol: $CO_2$ Emissions Monitoring and Reporting Protocol for the Cement Industry (2002), which includes guidelines and tools to calculate GHG emissions from the cement sector.

[7] Guidelines for waste sector are to be developed.

[8] The Climate Change Working Group of the International Council of Forest and Paper Associations has developed Calculation Tools for Estimating Greenhouse Gas Emissions from Pulp and Paper Mills (2002), which includes guidelines and tools to calculate GHG emissions from the pulp and paper sector.

[9] Guidelines for PFC and $SF_6$ production are to be developed.

[10] Businesses in "other sectors" can estimate GHG emissions using cross-sectoral estimation tools—stationary combustion, mobile (transportation) combustion, HFC use, measurement and estimation uncertainty, and waste.

[11] WRI has developed Working 9 to 5 on Climate Change: An Office Guide (2002) and www.Safeclimate.net, which include guidelines and calculation tools for calculating GHG emissions from office-based organizations.

# Acronyms



| | |
|---|---|
| CDM | Clean Development Mechanism |
| CEM | Continuous Emission Monitoring |
| $CH_4$ | Methane |
| CER | Certified Emission Reduction |
| CCAR | California Climate Action Registry |
| CCX | Chicago Climate Exchange |
| $CO_2$ | Carbon Dioxide |
| $CO_2$-e | Carbon Dioxide Equivalent |
| EPER | European Pollutant Emission Register |
| EU ETS | European Union Emissions Allowance Trading Scheme |
| GHG | Greenhouse Gas |
| GAAP | Generally Accepted Accounting Principles |
| HFCs | Hydrofluorocarbons |
| IPCC | Intergovernmental Panel on Climate Change |
| IPIECA | International Petroleum Industry Environmental Conservation Association |
| ISO | International Standards Organization |
| JI | Joint Implementation |
| $N_4O$ | Nitrous Oxide |
| NGO | Non-Governmental Organization |
| PFCs | Perfluorocarbons |
| $SF_6$ | Sulfur Hexafluoride |
| T&D | Transmission and Distribution |
| UK ETS | United Kingdom Emission Trading Scheme |
| WBCSD | World Business Council for Sustainable Development |
| WRI | World Resources Institute |

| | |
|---|---|
| Absolute target | A target defined by reduction in absolute emissions over time e.g., reduces $CO_2$ emissions by 25% below 1994 levels by 2010. (Chapter 11) |
| Additionality | A criterion for assessing whether a project has resulted in GHG emission reductions or removals in addition to what would have occurred in its absence. This is an important criterion when the goal of the project is to offset emissions elsewhere. (Chapter 8) |
| Allowance | A commodity giving its holder the right to emit a certain quantity of GHG. (Chapter 11) |
| Annex 1 countries | Defined in the International Climate Change Convention as those countries taking on emissions reduction obligations: Australia; Austria; Belgium; Belarus; Bulgaria; Canada; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Latvia; Liechtenstein; Lithuania; Luxembourg; Monaco; Netherlands; New Zealand; Norway; Poland; Portugal; Romania; Russian Federation; Slovakia; Slovenia; Spain; Sweden; Switzerland; Ukraine; United Kingdom; USA. |
| Associated/affiliated company | The parent company has significant influence over the operating and financial policies of the associated/affiliated company, but not financial control. (Chapter 3) |
| Audit Trail | Well organized and transparent historical records documenting how an inventory was compiled. |
| Baseline | A hypothetical scenario for what GHG emissions, removals or storage would have been in the absence of the GHG project or project activity. (Chapter 8) |
| Base year | A historic datum (a specific year or an average over multiple years) against which a company's emissions are tracked over time. (Chapter 5) |
| Base year emissions | GHG emissions in the base year. (Chapter 5) |
| Base year emissions recalculation | Recalculation of emissions in the base year to reflect a change in the structure of the company, or to reflect a change in the accounting methodology used. This ensures data consistency over time, i.e., comparisons of like with like over time. (Chapter 5, 11) |
| Biofuels | Fuel made from plant material, e.g. wood, straw and ethanol from plant matter (Chapter 4, 9, Appendix B) |
| Boundaries | GHG accounting and reporting boundaries can have several dimensions, i.e. organizational, operational, geographic, business unit, and target boundaries. The inventory boundary determines which emissions are accounted and reported by the company. (Chapter 3, 4, 11) |
| Cap and trade system | A system that sets an overall emissions limit, allocates emissions allowances to participants, and allows them to trade allowances and emission credits with each other. (Chapter 2, 8, 11) |
| Capital Lease | A lease which transfers substantially all the risks and rewards of ownership to the lessee and is accounted for as an asset on the balance sheet of the lessee. Also known as a Financial or Finance Lease. Leases other than Capital/Financial/Finance leases are Operating leases. Consult an accountant for further detail as definitions of lease types differ between various accepted financial standards. (Chapter 4) |
| Carbon sequestration | The uptake of $CO_2$ and storage of carbon in biological sinks. |
| Clean Development Mechanism (CDM) | A mechanism established by Article 12 of the Kyoto Protocol for project-based emission reduction activities in developing countries. The CDM is designed to meet two main objectives: to address the sustainability needs of the host country and to increase the opportunities available to Annex 1 Parties to meet their GHG reduction commitments. The CDM allows for the creation, acquisition and transfer of CERs from climate change mitigation projects undertaken in non-Annex 1 countries. |

| | |
|---|---|
| Certified Emission Reductions (CERs) | A unit of emission reduction generated by a CDM project. CERs are tradable commodities that can be used by Annex 1 countries to meet their commitments under the Kyoto Protocol. |
| Co-generation unit/Combined heat and power (CHP) | A facility producing both electricity and steam/heat using the same fuel supply. (Chapter 3) |
| Consolidation | Combination of GHG emissions data from separate operations that form part of one company or group of companies. (Chapter 3, 4) |
| Control | The ability of a company to direct the policies of another operation. More specifically, it is defined as either operational control (the organization or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation) or financial control (the organization has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities). (Chapter 3) |
| Corporate inventory program | A program to produce annual corporate inventories that are in keeping with the principles, standards, and guidance of the GHG Protocol Corporate Standard. This includes all institutional, managerial and technical arrangements made for the collection of data, preparation of a GHG inventory, and implementation of the steps taken to manage the quality of their emission inventory. |
| $CO_2$ equivalent ($CO_2$-e) | The universal unit of measurement to indicate the global warming potential (GWP) of each of the six greenhouse gases, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoiding releasing) different greenhouse gases against a common basis. |
| Cross-sector calculation tool | A GHG Protocol calculation tool that addresses GHG sources common to various sectors, e.g. emissions from stationary or mobile combustion. See also GHG Protocol calculation tools (www.ghgprotocol.org). |
| Direct GHG emissions | Emissions from sources that are owned or controlled by the reporting company. (Chapter 4) |
| Direct monitoring | Direct monitoring of exhaust stream contents in the form of continuous emissions monitoring (CEM) or periodic sampling. (Chapter 6) |
| Double counting | Two or more reporting companies take ownership of the same emissions or reductions. (Chapter 3, 4, 8, 11) |
| Emissions | The release of GHG into the atmosphere. |
| Emission factor | A factor allowing GHG emissions to be estimated from a unit of available activity data (e.g. tonnes of fuel consumed, tonnes of product produced) and absolute GHG emissions. (Chapter 6) |
| Emission Reduction Unit (ERU) | A unit of emission reduction generated by a Joint Implementation (JI) project. ERUs are tradable commodities which can be used by Annex 1 countries to help them meet their commitment under the Kyoto Protocol. |
| Equity share | The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation. Typically, the share of economic risks and rewards in an operation is aligned with the company's percentage ownership of that operation, and equity share will normally be the same as the ownership percentage. (Chapter 3) |
| Estimation uncertainty | Uncertainty that arises whenever GHG emissions are quantified, due to uncertainty in data inputs and calculation methodologies used to quantify GHG emissions. (Chapter 7) |
| Finance lease | A lease which transfers substantially all the risks and rewards of ownership to the lessee and is accounted for as an asset on the balance sheet of the lessee. Also known as a Capital or Financial Lease. Leases other than Capital/Financial/Finance leases are Operating leases. Consult an accountant for further detail as definitions of lease types differ between various accepted accounting principles. (Chapter 4) |

| | |
|---|---|
| Fixed asset investment | Equipment, land, stocks, property, incorporated and non-incorporated joint ventures, and partnerships over which the parent company has neither significant influence nor control. (Chapter 3) |
| Fugitive emissions | Emissions that are not physically controlled but result from the intentional or unintentional releases of GHGs. They commonly arise from the production, processing transmission storage and use of fuels and other chemicals, often through joints, seals, packing, gaskets, etc. (Chapter 4, 6) |
| Green power | A generic term for renewable energy sources and specific clean energy technologies that emit fewer GHG emissions relative to other sources of energy that supply the electric grid. Includes solar photovoltaic panels, solar thermal energy, geothermal energy, landfill gas, low-impact hydropower, and wind turbines. (Chapter 4) |
| Greenhouse gases (GHG) | For the purposes of this standard, GHGs are the six gases listed in the Kyoto Protocol: carbon dioxide ($CO_2$); methane ($CH_4$); nitrous oxide ($N_2O$); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride ($SF_6$). |
| GHG capture | Collection of GHG emissions from a GHG source for storage in a sink. |
| GHG credit | GHG offsets can be converted into GHG credits when used to meet an externally imposed target. A GHG credit is a convertible and transferable instrument usually bestowed by a GHG program. (Chapter 8, 11) |
| GHG offset | Offsets are discrete GHG reductions used to compensate for (i.e., offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the offsets. To avoid double counting, the reduction giving rise to the offset must occur at sources or sinks not included in the target or cap for which it is used. |
| GHG program | A generic term used to refer to any voluntary or mandatory international, national, sub-national, government or non-governmental authority that registers, certifies, or regulates GHG emissions or removals outside the company. e.g. CDM, EU ETS, CCX, and CCAR. |
| GHG project | A specific project or activity designed to achieve GHG emission reductions, storage of carbon, or enhancement of GHG removals from the atmosphere. GHG projects may be stand-alone projects, or specific activities or elements within a larger non-GHG related project. (Chapter 8, 11) |
| GHG Protocol calculation tools | A number of cross-sector and sector-specific tools that calculate GHG emissions on the basis of activity data and emission factors (available at www.ghgprotocol.org). |
| GHG Protocol Initiative | A multi-stakeholder collaboration convened by the World Resources Institute and World Business Council for Sustainable Development to design, develop and promote the use of accounting and reporting standards for business. It comprises of two separate but linked standards—the GHG Protocol Corporate Accounting and Reporting Standard and the GHG Protocol Project Quantification Standard. |
| GHG Protocol Project Quantification Standard | An additional module of the GHG Protocol Initiative addressing the quantification of GHG reduction projects. This includes projects that will be used to offset emissions elsewhere and/or generate credits. More information available at www.ghgprotocol.org. (Chapter 8, 11) |
| GHG Protocol sector specific calculation tools | A GHG calculation tool that addresses GHG sources that are unique to certain sectors, e.g., process emissions from aluminum production. (see also GHG Protocol Calculation tools) |
| GHG public report | Provides, among other details, the reporting company's physical emissions for its chosen inventory boundary. (Chapter 9) |

| | |
|---|---|
| GHG registry | A public database of organizational GHG emissions and/or project reductions. For example, the US Department of Energy 1605b Voluntary GHG Reporting Program, CCAR, World Economic Forum's Global GHG Registry. Each registry has its own rules regarding what and how information is reported. (Introduction, Chapter 2, 5, 8, 10) |
| GHG removal | Absorbtion or sequestration of GHGs from the atmosphere. |
| GHG sink | Any physical unit or process that stores GHGs; usually refers to forests and underground/deep sea reservoirs of $CO_2$. |
| GHG source | Any physical unit or process which releases GHG into the atmosphere. |
| GHG trades | All purchases or sales of GHG emission allowances, offsets, and credits. |
| Global Warming Potential (GWP) | A factor describing the radiative forcing impact (degree of harm to the atmosphere) of one unit of a given GHG relative to one unit of $CO_2$. |
| Group company /subsidiary | The parent company has the ability to direct the financial and operating policies of a group company/subsidiary with a view to gaining economic benefits from its activities. (Chapter 3) |
| Heating value | The amount of energy released when a fuel is burned completely. Care must be taken not to confuse higher heating values (HHVs), used in the US and Canada, and lower heating values, used in all other countries (for further details refer to the calculation tool for stationary combustion available at www.ghgprotocol.org). |
| Indirect GHG emissions | Emissions that are a consequence of the operations of the reporting company, but occur at sources owned or controlled by another company. (Chapter 4) |
| Insourcing | The administration of ancillary business activities, formally performed outside of the company, using resources within a company. (Chapter 3, 4, 5, 9) |
| Intensity ratios | Ratios that express GHG impact per unit of physical activity or unit of economic value (e.g. tonnes of $CO_2$ emissions per unit of electricity generated). Intensity ratios are the inverse of productivity/efficiency ratios. (Chapter 9, 11) |
| Intensity target | A target defined by reduction in the ratio of emissions and a business metric over time e.g., reduce $CO_2$ per tonne of cement by 12% between 2000 and 2008. (Chapter 11) |
| Intergovernmental Panel on Climate Change (IPCC) | International body of climate change scientists. The role of the IPCC is to assess the scientific, technical and socio-economic information relevant to the understanding of the risk of human-induced climate change (www.ipcc.ch). |
| Inventory | A quantified list of an organization's GHG emissions and sources. |
| Inventory boundary | An imaginary line that encompasses the direct and indirect emissions that are included in the inventory. It results from the chosen organizational and operational boundaries. (Chapter 3, 4) |
| Inventory quality | The extent to which an inventory provides a faithful, true and fair account of an organization's GHG emissions. (Chapter 7) |
| Joint Implementation (JI) | The JI mechanism was established in Article 6 of the Kyoto Protocol and refers to climate change mitigation projects implemented between two Annex 1 countries. JI allows for the creation, acquisition and transfer of "emission reduction units" (ERUs). |
| Kyoto Protocol | A protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Once entered into force it will require countries listed in its Annex B (developed nations) to meet reduction targets of GHG emissions relative to their 1990 levels during the period of 2008–12. |

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| Leakage (Secondary effect) | Leakage occurs when a project changes the availability or quantity of a product or service that results in changes in GHG emissions elsewhere. (Chapter 8) |
| Life Cycle Analysis | Assessment of the sum of a product's effects (e.g. GHG emissions) at each step in its life cycle, including resource extraction, production, use and waste disposal. (Chapter 4) |
| Material discrepancy | An error (for example from an oversight, omission, or miscalculation) that results in the reported quantity being significantly different to the true value to an extent that will influence performance or decisions. Also known as material misstatement.(Chapter 10) |
| Materiality threshold | A concept employed in the process of verification. It is often used to determine whether an error or omission is a material discrepancy or not. It should not be viewed as a de minimus for defining a complete inventory. (Chapter 10) |
| Mobile combustion | Burning of fuels by transportation devices such as cars, trucks, trains, airplanes, ships etc. (Chapter 6) |
| Model uncertainty | GHG quantification uncertainty associated with mathematical equations used to characterize the relationship between various parameters and emission processes. (Chapter 7) |
| Non-Annex 1 countries | Countries that have ratified or acceded to the UNFCC but are not listed under Annex 1 and are therefore not under any emission reduction obligation (see also Annex 1 countries). |
| Operation | A generic term used to denote any kind of business, irrespective of its organizational, governance, or legal structures. An operation can be a facility, subsidiary, affiliated company or other form of joint venture. (Chapter 3, 4) |
| Operating lease | A lease which does not transfer the risks and rewards of ownership to the lessee and is not recorded as an asset in the balance sheet of the lessee. Leases other than Operating leases are Capital/Financial/Finance leases. Consult an accountant for further detail as definitions of lease types differ between various accepted financial standards. (Chapter 4) |
| Operational boundaries | The boundaries that determine the direct and indirect emissions associated with operations owned or controlled by the reporting company. This assessment allows a company to establish which operations and sources cause direct and indirect emissions, and to decide which indirect emissions to include that are a consequence of its operations. (Chapter 4) |
| Organic growth/decline | Increases or decreases in GHG emissions as a result of changes in production output, product mix, plant closures and the opening of new plants. (Chapter 5) |
| Organizational boundaries | The boundaries that determine the operations owned or controlled by the reporting company, depending on the consolidation approach taken (equity or control approach). (Chapter 3) |
| Outsourcing | The contracting out of activities to other businesses. (Chapter 3, 4, 5) |
| Parameter uncertainty | GHG quantification uncertainty associated with quantifying the parameters used as inputs to estimation models. (Chapter 7) |
| Primary effects | The specific GHG reducing elements or activities (reducing GHG emissions, carbon storage, or enhancing GHG removals) that the project is intended to achieve. (Chapter 8) |
| Process emissions | Emissions generated from manufacturing processes, such as the $CO_2$ that is arises from the breakdown of calcium carbonate ($CaCO_3$) during cement manufacture. (Chapter 4, Appendix D) |
| Productivity/efficiency ratios | Ratios that express the value or achievement of a business divided by its GHG impact. Increasing efficiency ratios reflect a positive performance improvement. e.g. resource productivity(sales per tonne GHG). Productivity/efficiency ratios are the inverse of intensity ratios. (Chapter 9) |
| Ratio indicator | Indicators providing information on relative performance such as intensity ratios or productivity/efficiency ratios. (Chapter 9) |

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| Renewable energy | Energy taken from sources that are inexhaustible, e.g. wind, water, solar, geothermal energy, and biofuels. |
| Reporting | Presenting data to internal management and external users such as regulators, shareholders, the general public or specific stakeholder groups. (Chapter 9) |
| Reversibility of reductions | This occurs when reductions are temporary, or where removed or stored carbon may be returned to the atmosphere at some point in the future. (Chapter 8) |
| Rolling base year | The process of shifting or rolling the base year forward by a certain number of years at regular intervals of time. (Chapter 5, 11) |
| Scientific Uncertainty | Uncertainty that arises when the science of the actual emission and/or removal process is not completely understood. (Chapter 7) |
| Scope | Defines the operational boundaries in relation to indirect and direct GHG emissions. (Chapter 4) |
| Scope 1 inventory | A reporting organization's direct GHG emissions. (Chapter 4) |
| Scope 2 inventory | A reporting organization's emissions associated with the generation of electricity, heating/cooling, or steam purchased for own consumption. (Chapter 4) |
| Scope 3 inventory | A reporting organization's indirect emissions other than those covered in scope 2. (Chapter 4) |
| Scope of works | An up-front specification that indicates the type of verification to be undertaken and the level of assurance to be provided between the reporting company and the verifier during the verification process. (Chapter 10) |
| Secondary effects (Leakage) | GHG emissions changes resulting from the project not captured by the primary effect(s). These are typically the small, unintended GHG consequences of a project. (Chapter 8) |
| Sequestered atmospheric carbon | Carbon removed from the atmosphere by biological sinks and stored in plant tissue. Sequestered atmospheric carbon does not include GHGs captured through carbon capture and storage. |
| Significance threshold | A qualitative or quantitative criteria used to define a significant structural change. It is the responsibility of the company/verifier to determine the "significance threshold" for considering base year emissions recalculation. In most cases the "significance threshold" depends on the use of the information, the characteristics of the company, and the features of structural changes. (Chapter 5) |
| Stationary Combustion | Burning of fuels to generate electricity, steam, heat, or power in stationary equipment such as boilers, furnaces etc. |
| Structural change | A change in the organizational or operational boundaries of a company that result in the transfer of ownership or control of emissions from one company to another. Structural changes usually result from a transfer of ownership of emissions, such as mergers, acquisitions, divestitures, but can also include outsourcing/insourcing. (Chapter 5) |
| Target base year | The base year used for defining a GHG target, e.g. to reduce $CO_2$ emissions 25% below the target base year levels by the target base year 2000 by the year 2010. (Chapter 11) |
| Target boundary | The boundary that defines which GHG's, geographic operations, sources and activities are covered by the target. (Chapter 11) |
| Target commitment period | The period of time during which emissions performance is actually measured against the target. It ends with the target completion date. (Chapter 11) |
| Target completion date | The date that defines the end of the target commitment period and determines whether the target is relatively short- or long-term. (Chapter 11) |

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| Target double counting policy | A policy that determines how double counting of GHG reductions or other instruments, such as allowances issued by external trading programs, is dealt with under a GHG target. It applies only to companies that engage in trading (sale or purchase) of offsets or whose corporate target boundaries interface with other companies' targets or external programs. (Chapter 11) |
| Uncertainty | 1. Statistical definition: A parameter associated with the result of a measurement that characterizes the dispersion of the values that could be reasonably attributed to the measured quantity. (e.g., the sample variance or coefficient of variation). (Chapter 7) |
| | 2. Inventory definition: A general and imprecise term which refers to the lack of certainty in emissions-related data resulting from any causal factor, such as the application of non-representative factors or methods, incomplete data on sources and sinks, lack of transparency etc. Reported uncertainty information typically specifies a quantitative estimates of the likely or perceived difference between a reported value and a qualitative description of the likely causes of the difference. (Chapter 7). |
| United Nations Framework Convention on Climate Change (UNFCCC) | Signed in 1992 at the Rio Earth Summit, the UNFCCC is a milestone Convention on Climate Change treaty that provides an overall framework for international efforts to (UNFCCC) mitigate climate change. The Kyoto Protocol is a protocol to the UNFCCC. |
| Value chain emissions | Emissions from the upstream and downstream activities associated with the operations of the reporting company. (Chapter 4) |
| Verification | An independent assessment of the reliability (considering completeness and accuracy) of a GHG inventory. (Chapter 10) |

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## Appendix CL2.11

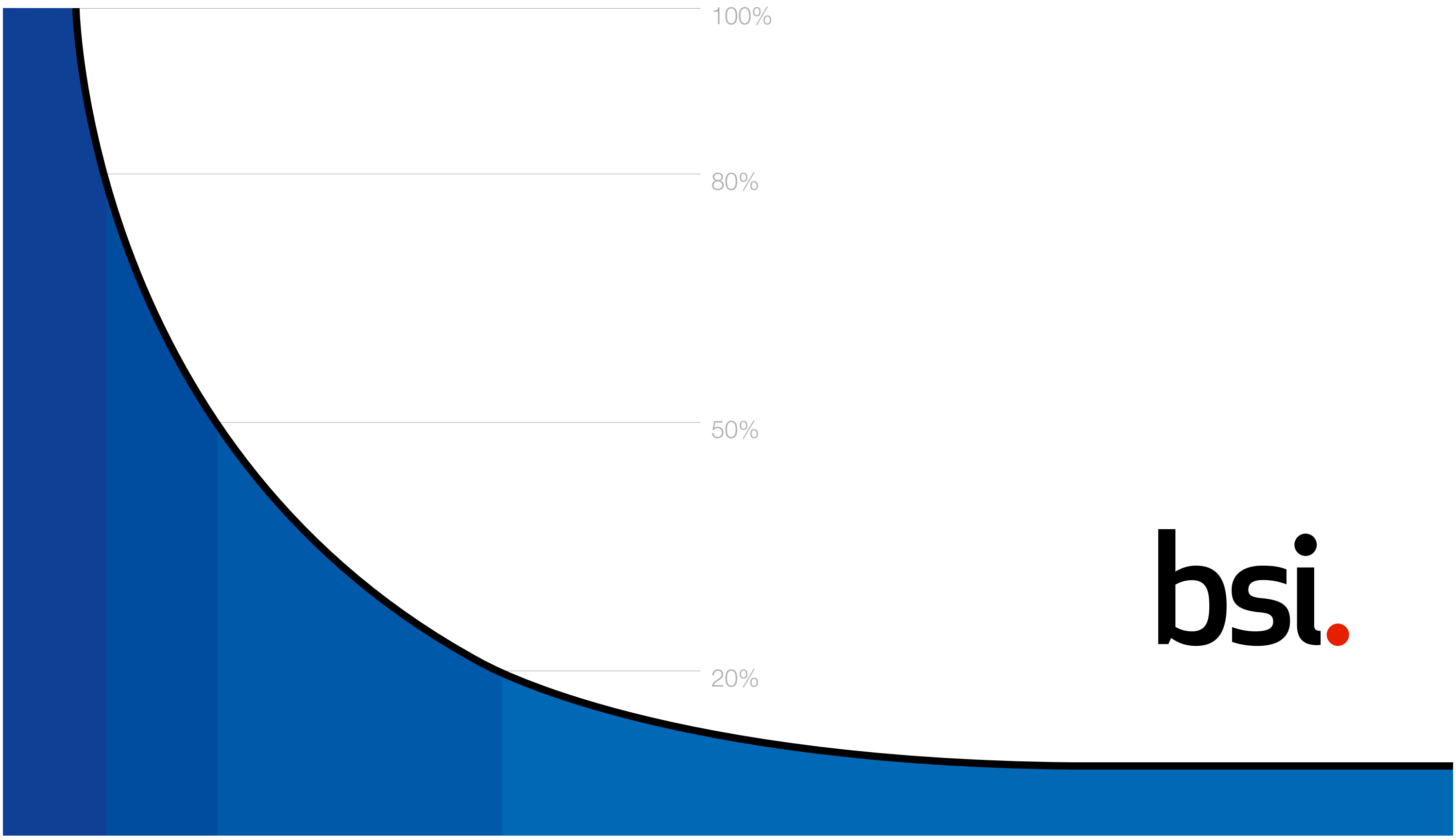
## BSI (2016). PAS 2080:2016 Carbon management in Infrastructure

# PAS 2080:2016

# Carbon Management in Infrastructure

Construction Leadership Council

The Green Construction Board

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# Foreword

This Publicly Available Specification (PAS) was commissioned by the Green Construction Board (GCB). Its development was facilitated by BSI Standards Limited. It is published under licence from The British Standards Institution and came into effect on 4 May 2016.

This PAS was developed from a preliminary draft prepared by a Technical Authoring Team from Mott Macdonald and Arup, who have continued to support the development of the specification as members of the Steering Group.

Particular thanks are extended to the Carbon Trust for their pre-review contribution to the draft PAS and acknowledgement is also given to the following organizations that were involved in the development of this PAS as members of the Steering Group:

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This PAS is not to be regarded as a British Standard. It will be withdrawn upon publication of its content in, or as, a British Standard.

## Use of this document

### Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its methods are expressed as a set of instructions, a description, or in sentences in which the principal auxiliary verb is "shall".

The blue bordered boxes in clauses **5** through to **10**, each provides a short summary of the intention for its relevant clause but does not include specific requirements.

### Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a PAS cannot confer immunity from legal obligations.

# Executive Summary

Working together, infrastructure organizations have the power to use PAS 2080 to transform the benefits that a national economy gains from its infrastructure systems and to provide a sustainable legacy. If all parties involved across the value chain work collaboratively, towards a common goal to reduce carbon, the following outcomes can be achieved:

- Reduced carbon, reduced cost infrastructure;
- More collaborative ways of working will promote innovation, delivering benefit to society and communities served by economic infrastructure;
- Effective carbon management in infrastructure will make an important contribution to tackling climate change and leave a positive legacy for future generations;
- Delivering more sustainable solutions, at lower cost, will enhance the reputation of the infrastructure industry, generating pride for those who work in it and attracting new people and skills;

The challenges set out in PAS 2080 will create a platform for innovation to thrive, leading to more vibrant and rewarding workplaces.

The Infrastructure Carbon Review recognized the opportunity and PAS 2080 will help the infrastructure value chain turn this into reality.

Targeted at leaders and practitioner-level individuals in different value chain organizations (asset owners/managers, designers, constructors and product/material suppliers) responsible for delivering infrastructure, PAS 2080 provides a common framework for all infrastructure sectors and value chain members, on how to manage whole life carbon when delivering infrastructure assets and programmes of work. Use of the PAS will promote reduced carbon, reduced cost infrastructure delivery, more collaborative ways of working and a culture of challenge in the infrastructure value chain through which innovation can be fostered.

- This PAS includes requirements for all value chain members to show the right leadership and to establish effective governance systems for reducing whole life carbon through the use of a carbon management process. The individual value chain requirements in the carbon management process are structured around the following components:
- setting appropriate carbon reduction targets;
- determining baselines against which to assess carbon reduction performance;
- establishing metrics (e.g. Key Performance Indicators) for credible carbon emissions quantification and reporting;
- selecting carbon emissions quantification methodologies (to include defining boundaries and cut off rules);
- reporting at appropriate stages in the infrastructure work stages to enable visibility of performance; and
- continual improvement of carbon management and performance.

All value chain members can claim conformity to PAS 2080 by demonstrating that relevant requirements set out in the different PAS clauses have been met. This will illustrate that the right organizational capability, for working collaboratively under a carbon management process to deliver low carbon assets and programmes of work, is actively in place.

The PAS is supplemented by the “Guidance Document for PAS2080” which provides practical advice on how to implement the different PAS requirements and addresses current good practice through worked examples and case studies.

# 0 Introduction

## 0.1 Infrastructure and greenhouse gas emissions

The Infrastructure Carbon Review (ICR)[1] showed that infrastructure is associated with over half of UK Greenhouse Gas (GHG) emissions:

- 30% of which are directly attributed to the construction, operation and maintenance of infrastructure assets (emissions that infrastructure directly controls); and
- 70% of which are attributed to the users of infrastructure (emissions over which infrastructure has influence)

**Figure 1** illustrates the importance of infrastructure in relation to the overall challenge of reducing national carbon emissions targets.

Reducing carbon emissions associated with infrastructure is fundamental to addressing the global challenge of climate change.

PAS 2080 is applicable to anyone involved in the delivery of infrastructure, including asset owners/managers, designers, constructors and product/material suppliers.

Complying with the requirements of PAS 2080 will help all value chain members understand and manage carbon associated with the development of infrastructure from its inception to the end of its life and is equally applicable to individual assets or to programmes.

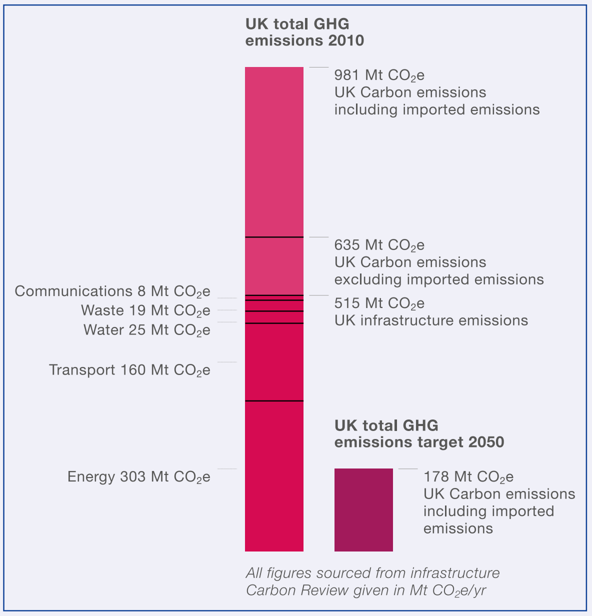
In this regard PAS 2080 is a specification for whole life carbon management and is not a detailed quantification protocol. As such it avoids the duplication of existing quantification protocols.

*NOTE 1 The word 'carbon' used in this document is used as shorthand for GHG emissions as defined in Clause **3.18**.*

*NOTE 2 Figure 1 GHG emissions outside the UK infrastructure sector include: transport related emissions from imported products; emissions from agriculture, land use change and industrial process emissions outside infrastructure. Readers should refer to the Infrastructure Carbon Review Technical Report for details of the GHG emissions attributed to the different infrastructure sectors.*

PAS 2080 should be read in conjunction with the "Guidance Document for using PAS 2080" [2] which is designed to help practitioners implement the requirements of the PAS with the aid of real case studies and worked examples.

**Figure 1** – Infrastructure is responsible for over half of the UK's consumption GHG emissions

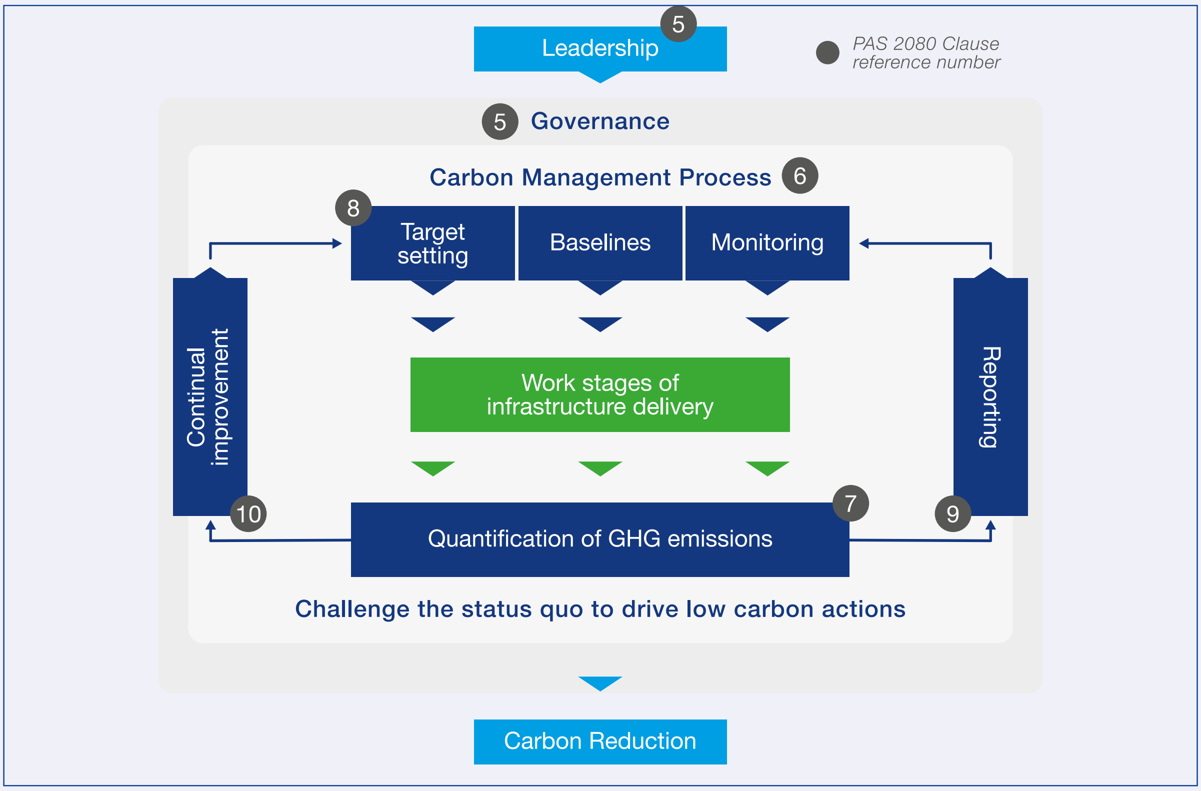



## 0.2 Whole life carbon and cost reduction

PAS 2080 sets out the general principles and components of a carbon management process, to promote carbon and cost reduction in infrastructure delivery on a whole life basis. The individual clauses of the PAS are arranged in accordance with the components illustrated in **Figure 2** .

[1] 2013 by HM Treasury, BIS and the Green Construction Board
[2] Published by the Green Construction Board, see www.greenconstructionboard.org.

**Figure 2** – Process map summarising the key components of the PAS 2080 carbon management process and their respective clause numbers in this document




***NOTE** to **Figure 2**: Clauses **1** to **4** are excluded from Figure 2 as they do not set out any requirements which directly relate to the carbon management process.*

Achieving carbon reductions in infrastructure depends on robust leadership and governance and the integration of the key carbon management process components (i.e. baseline and target setting, monitoring, quantification, reporting and continuous improvement) into existing infrastructure delivery processes. Developing and implementing a carbon management process within infrastructure delivery processes will help join up the value chain, create a strong innovation culture, challenge the current status quo and thereby maximise reductions in both carbon and cost.

## 0.3 The aim of PAS 2080

The aim for PAS 2080 is that it should set out a carbon management process for use in infrastructure delivery that can be undertaken collaboratively, applied by all parties across the value chain and against which compliance can be either:

- monitored and self-validated by the applying entity; or
- assessed and validated uniformly by other parties or by independent certification bodies accredited to undertake certification services against PAS 2080, with the primary objective of reducing carbon emissions from infrastructure in a manner that also reduces cost.

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# 1 Scope

This PAS specifies requirements for the management of whole life carbon in infrastructure – defined as the transport, energy, water, waste and communications, sectors – both in the provision of new infrastructure assets and programmes of work and the refurbishment of existing infrastructure.

The scope of the PAS is summarised in **Table 1**.[3]

**Table 1** – The scope of PAS 2080

| PAS 2080 is about: | PAS 2080 is not about: |
|---|---|
| Carbon management (as part of wider climate change mitigation). | Wider environmental or sustainability issues[3]. |
| Consistency in the use of data, reporting, quantification, benchmarking, target setting, continuous improvement, leadership, inclusion in BIM, etc. | Prescriptive approaches to quantifying GHG emissions, including the use of specific data or methods. |
| Management of capital and operational carbon under direct control of the value chain, and user carbon over which the value chain has influence. | Management of user carbon which relies on government policy or action, or where other parties are better placed to manage. |
| Promoting whole life cost reductions through whole life carbon reduction | Whole life cost management |

Because of the evidence included in the Infrastructure Carbon Review that reduced carbon infrastructure is related to reduced cost, PAS 2080 has been developed to:

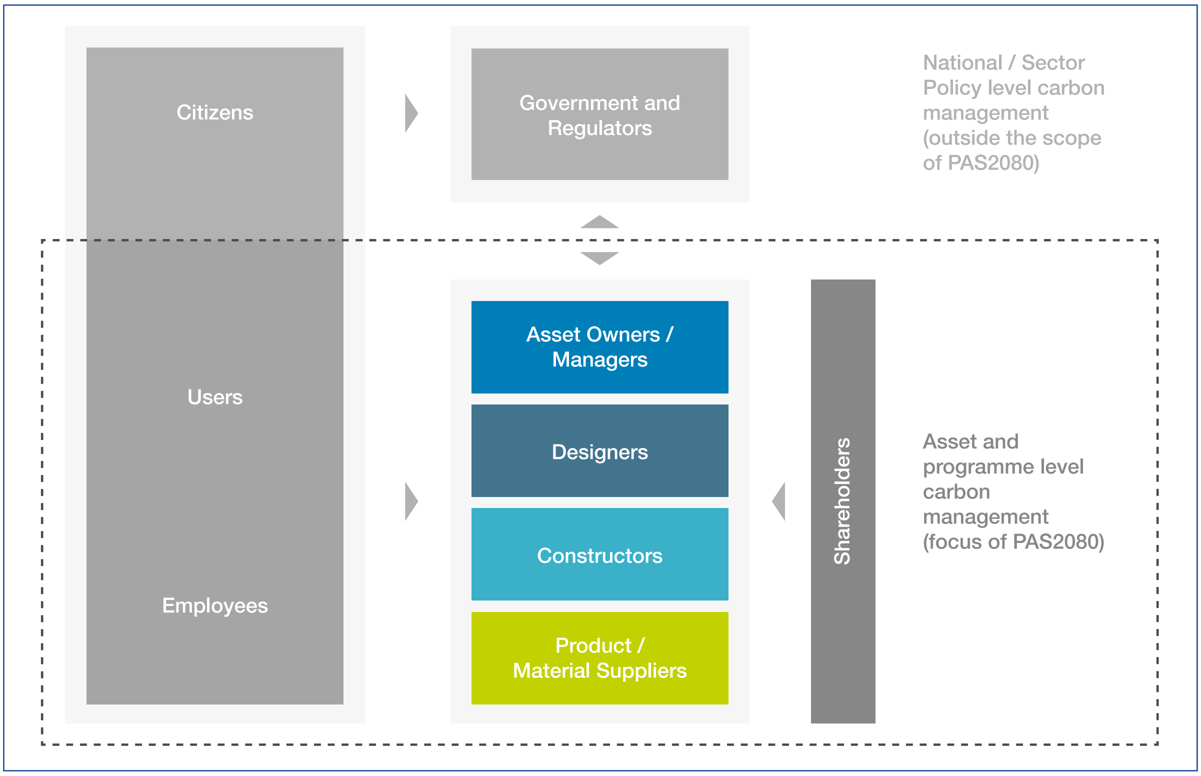
- Provide a specification for infrastructure carbon management which is compatible with international and sectoral norms, relevant existing standards and guidance, with the view of reducing whole life carbon in infrastructure delivery and;
- Bringing consistency to the practice of carbon management;
- Encouraging wider uptake and action on carbon management;
- Helping the infrastructure value chain to become more efficient – to reduce carbon and cost in infrastructure delivery;
- Improving the accuracy, transparency, consistency, relevance and completeness of carbon management and GHG emissions quantification;
- Improving the knowledge and understanding of carbon management by infrastructure practitioners throughout the value chain; and
- Supporting evidence-based decision making and identification of opportunities for carbon reduction.

Although asset owners/managers have the primary responsibility for delivering and managing infrastructure assets, all value chain members share responsibility for the management of the associated carbon emissions. Asset owners/managers can only realise the intended reductions within a fully integrated value chain involving designers, constructors and product/material suppliers.

To reflect this the PAS is applicable to all value chain members involved in the delivery of infrastructure, including asset owners/managers, designers, constructors and product/material suppliers. There are national and sectoral policies covering infrastructure carbon management, however these are mainly the responsibility of Governments and Regulators and are not in the PAS scope. **Figure 3** illustrates the value chain members involved in infrastructure management for whom this PAS is applicable.

[3] While this standard is not about environmental or sustainability issues generally, it is important that such issues are taken into full account both in the provision of new infrastructure assets and programmes of work and the refurbishment of existing infrastructure assets.

**Figure 3** – Infrastructure value chain members responsible for carbon management. The focus of PAS 2080 is on value chain members responsible for asset and programme level carbon management




To help each value chain member to contribute effectively, the responsibilities set out in each clause of this PAS are arranged under the following headings:

- Requirements for all value chain members;
- Asset owner/manager requirements;
- Designer requirements;
- Constructor requirements; and
- Product/material supplier requirements.

In order to successfully claim compliance with the requirements of this PAS, each value chain member is required to declare the role(s) they undertake (from the above list). They can then demonstrate conformity with the clauses under the "requirements for all value chain members" heading and those under other headings pertaining to their role(s).

***NOTE*** *All value chain members will be able to claim conformity with PAS 2080 as: PAS 2080 Asset Owner/Manager; PAS 2080 Designer; PAS 2080 Constructor; and PAS 2080 Product/Material Supplier (refer to Clause* ***12****).*

To achieve compliance, value chain members must be able to demonstrate relevant organizational capability appropriate to the point(s) of infrastructure delivery at which they are involved.

To maximise carbon and cost reduction, it is recognised that the asset owner/manager has primary responsibility for integrating the work of all value chain members under a common carbon management process that is specifically developed for delivering assets and programmes of work.

The PAS is targeted at both leaders and practitioner-level individuals who are responsible for the day-to-day aspects of infrastructure delivery and carbon management. Practitioner roles range from strategic planning, procurement, design to construction and operations.

***NOTE*** *Further details on the specific practitioner-level roles in each value chain organization that are intended to implement PAS2080 are included in the "Guidance Document for PAS2080".*

This PAS includes requirements for developing a carbon management process built around the following components:

1) Quantification of GHG emissions;
2) Target setting, baseline setting and monitoring;
3) Reporting; and
4) Continual improvement.

**Annex C** includes reference to a range of external documents from which value chain members seeking to comply with PAS2080 will be able to select approaches and methodologies to assist them.

# 2 Normative references

Normative references identify documents external to the specification from which they are cross referenced, the applications of which are requirements of that specification. Users of PAS 2080 might therefore expect to find several documents normatively referenced here.

However, in view of the breadth of target subjects existing in the infrastructure sector, the approach taken in PAS 2080 deliberately avoids normative reference to such external documents so as to provide asset owners/managers with the flexibility to select the external methodologies most appropriate for their particular sphere of activity. Consequently, the PAS does specify requirements for transparency and disclosure and the provision of evidence that the selections made are justified.

# 3 Terms and definitions

For the purposes of this PAS, the following terms and definitions apply.

## 3.1 activity data

data based on a unit quantity of input or output of the studied system or a process within it

***NOTE*** *Activity data may be a physical quantity such as mass (kg), a unit of cost (£) or a unit of energy (kWh), etc.*

## 3.2 asset

physical entity forming part of infrastructure that has potential or actual value to an organization and its stakeholders

[adapted from BS ISO 55000: 2014]

## 3.3 asset owner/manager

organization that manages and is responsible for providing, operating and maintaining infrastructure assets

***NOTE*** *Typically the asset owner/manager is the asset owner, but on occasion an asset owner/manager might also be the organization charged with operating infrastructure, a project sponsor, a service provider, the entity undertaking project works, or the organization charged with providing services from infrastructure.-*

## 3.4 baseline

scenario for what carbon emissions would have been in the absence of planned measures aiming to reduce emissions

[adapted from Greenhouse Gas Protocol: 2009]

## 3.5 carbon management

assessment, removal and reduction of GHG emissions during the delivery of new, or the management of existing, infrastructure assets and programmes

## 3.6 carbon reduction

process of minimising GHG emissions in the development of new infrastructure assets and programmes of work or the refurbishment of existing assets

***NOTE*** *the outcome of carbon reduction process would be a quantified reduction in existing sources of GHG emissions or the avoidance of GHG emissions associated with new or existing infrastructure.*

## 3.7 carbon dioxide equivalent ($CO_2e$)

unit for comparing the radiative forcing of a greenhouse gas to carbon dioxide

[BS ISO 14064-1: 2006; PAS 2050: 2011]

***NOTE*** *The carbon dioxide equivalent is calculated using the mass of a given GHG multiplied by its global warming potential (see 3.16).*

## 3.8 capital carbon

GHG emissions associated with the creation, refurbishment and end of life treatment of an asset

***NOTE*** *The term capital carbon is being adopted in the infrastructure sector as it accords with the concept of capital cost. The related term 'embodied carbon' will continue to be used at a product or material level whereas capital carbon will have greater relevance at an asset level.*

## 3.9 constructor

entity that undertakes work to construct, build, maintain or disassemble an infrastructure asset

***NOTE*** *A constructor may be a product/material supplier.*

## 3.10 control

where asset owner/managers have the ability to manage, through direct requirement of infrastructure design and operational approach, specific objectives for capital and operational carbon emissions

## 3.11 designer

entity that creates, prepares or specifies the design of an asset that is to be constructed or maintained

***NOTE*** *A designer may be an asset owner/manager, consultant, constructor, or product/material supplier.*

## 3.12 infrastructure

transport, energy, water, waste and communications sectors, as defined in the UK National Infrastructure Plan 2014

## 3.13 emissions factor

amount of greenhouse gases emitted, expressed as $CO_2e$ and relative to a unit of activity

[PAS 2050: 2011; ISO 55000: 2013; ISO 14064: 2012; ISO 14033: 2013]

## 3.14 direct influence

where asset owners/managers have the ability to use enablers to encourage users to make low carbon decisions

## 3.15 functional unit

quantified performance of a product or system for use as a reference unit

[BS EN ISO 14044: 2006, 3.20]

***NOTE*** *The functional unit takes into account a function, a quantity, a duration, and a quality of the infrastructure asset or programme of work being assessed. Refer to Clause **7.1.2** and the Guidance Document for PAS2080 for further explanation and examples of functional units.*

## 3.16 global warming potential (GWP)

factor describing the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of $CO_2$ over a given period of time

[BS ISO 14064-1: 2006]

### 3.17 greenhouse gases (GHGs)

gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds

***NOTE 1*** *Throughout PAS 2080 the term 'carbon' is often used (e.g. Capital Carbon, User Carbon, Operational Carbon). This is applied as short-hand for GHGs as defined by the UNFCC Kyoto Protocol six main greenhouse gases.*

***NOTE 2*** *The UNFCC Kyoto Protocol six main greenhouse gases include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perluorocarbons (PCFs) and sulphur hexafluoride ($SF_6$).*

[BS ISO 14064-1: 2006]

### 3.18 greenhouse gas (GHG) emissions

total mass of GHGs released to the atmosphere over a specific period of time

[BS ISO 14064-1: 2006]

### 3.19 organization

company, corporation, firm, enterprise, authority or institution, or part or combination thereof, public or private, that has its own function and administration

[adapted from ISO 14064-1: 2012]

### 3.20 operational carbon

GHG emissions associated with the operation of infrastructure required to enable it to operate and deliver its service

***NOTE*** *This is primarily defined as stages B6, B7 and B8, but on occasion might also include modules B2, B3, B4 and B5 depending on organisational setting. Refer to* ***Figure 7***

### 3.21 practitioner

individual responsible for different aspects of infrastructure delivery and carbon management including, strategic planning, procurement, programme manager, operator, designer/technical advisor, construction manager, material/product developer, environment or sustainability manager, etc.

***NOTE*** *Each value chain member will have different practitioner roles. For more details on practitioner roles, refer to the "Guidance Document for PAS 2080".*

### 3.22 programme

defined set of works related to the construction, maintenance or operation of an infrastructure asset or assets

### 3.23 product/material supplier

organization which extracts, manufactures or produces materials or products for incorporation into works to construct, build or maintain an asset

### 3.24 sector

collection of organizations involved in the delivery and operation of infrastructure assets for the purpose of providing an infrastructure service (e.g. energy, water, telecommunications)

## 3.25 system boundary

set of criteria specifying the life cycle, spatial and temporal extent of a GHG quantification or management system

[adapted from BS EN ISO 14040: 2006, 3.32]

## 3.26 specific data

data representative of a product, product group or construction service provided by one supplier

[from BS EN ISO 15804: 2012]

## 3.27 target

the desired quantity of carbon emissions (defined as an absolute value, or as a reduction amount against a baseline value) that an asset or programme of works is to achieve during infrastructure delivery

***NOTE*** *A target should be specific and appropriate to an asset or programme of works, it must be measurable, and it must be time bound.*

## 3.28 user carbon

GHG emissions associated with Users' utilisation of infrastructure and the service it provides during operation

***NOTE 1*** *This is equivalent to the operation work stage, as show in* ***Figure 4.***

***NOTE 2*** *Although user carbon is not directly controlled by infrastructure asset owners/managers, they may have a direct influence on user carbon emissions.*

***NOTE 3 Annex A*** *lists the User GHG emissions in each infrastructure sector.*

## 3.29 value chain

organizations and stakeholders involved in creating and managing infrastructure assets. These include asset owners/managers, designers, constructors and product/material suppliers

***NOTE*** *Government and users of infrastructure can also influence infrastructure asset management however they are not the primary focus of PAS2080 (refer to* ***Figure 3*** *)*

## 3.30 whole life cycle carbon emissions

sum of GHG emissions from all stages of the life cycle of a product or asset and within the specified system boundaries of the product or asset

***NOTE*** *This includes all GHG emissions and removals associated with the processes within the boundary of the life cycle of infrastructure assets. To avoid undue repetition, reference to removals is not commonly included in the text, but it is intended that assessment should include removals wherever they occur.*

[adapted from PAS 2050: 2011]

# 4 General Principles

## 4.1 Context

The principles set out in **4.2** to **4.6** are fundamental principles underpinning the carbon management process presented in PAS 2080. Their application ensures that practitioners undertaking carbon management activities are able to demonstrate that a true and fair approach has been adopted.

## 4.2 Relevance

Data and assessment methods relevant to the defined boundary of carbon management and assessment are to be selected, documented and used.

[adapted from PAS 2050: 2011]

## 4.3 Completeness

All life cycle carbon emissions arising within the defined infrastructure system boundary which provide a material contribution to the management and assessment of carbon emissions are to be included.

[adapted from PAS 2050: 2011]

***NOTE** Clause **7.1.3.2** sets out criteria which identify how to identify emissions which are deemed to be material.*

## 4.4 Consistency

Consistent methodologies and data sources for carbon management and assessment are to be used to allow comparisons of emissions over time. Any changes to methodologies, assumptions or data sources are to be transparently documented.

[adapted from GHG Protocol: 2009]

## 4.5 Accuracy

The quantification of carbon emissions is to neither over nor under estimate actual emissions, as far as can be judged, and uncertainties are to be reduced as far as reasonably practicable. A sufficient level of accuracy is to be achieved to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

[adapted from GHG Protocol: 2009]

## 4.6 Transparency

Where the outputs of a carbon management approach carried out in accordance with this PAS are to be disclosed to a third party, information shall be made available on the methodology and data sources used and any relevant assumptions to allow such a third party to make associated decisions with confidence.

# 5 Leadership and Governance

**Leadership is recognised as a key enabler of carbon management in infrastructure. It provides the vision to drive the organization's carbon management process, and motivates the necessary behaviours and actions from the value chain. Leadership is expected from all levels of the value chain and it is essential that value chain members take responsibility for implementing the PAS 2080 leadership and governance requirements. Asset owners/managers must encourage their value chain to challenge the existing 'business as usual' approach to leadership of infrastructure delivery, to reduce carbon and cost in assets and programmes of work.**

## 5.1 Requirements for all value chain members

Leaders in each value chain member organization shall implement the following, in the areas under their control:

a) Set an organizational policy and strategy for carbon management and align these with business goals;

b) Support the development and implementation of a carbon management process within their organization to support low carbon infrastructure delivery;

c) Communicate consistently and regularly to staff at all levels within their own organization on the importance of carbon management;

d) Communicate consistently with other value chain members to develop collaborative relationships with the goal of reducing carbon emissions;

e) Challenge targets (which their own organizations have set /or which have been set for them) where they consider there is potential for greater carbon reduction;

f) Ensure that training programmes are in place to fill gaps in knowledge and skills;

g) Ensure that adequate human resources are available for the development and implementation of the carbon management process;

h) Ensure that the requirements of the carbon management process are compatible and integrated with existing business processes (e.g. asset management, procurement, health and safety, cost management, quality, delivery programme, sustainability, environmental management, etc.);

i) Demonstrate a commitment to continuous improvement through the sharing of current good practice;

j) Promote a culture that rewards the challenging of the status quo when it comes to carbon management during infrastructure delivery;

k) Implement governance structures where:

- Carbon management underpins the delivery of an asset or programme of work (as per the requirements of the carbon management process components Clauses **6** to **10**);
- Roles and responsibilities for carbon management are established to promote the desired carbon management values and behaviours;
- The implementation of low carbon solutions in their own operations (Clause **6.1.4**) are fully supported;
- Feedback from value chain members is used to improve business processes to drive low carbon solutions;
- All decision making that has a material effect on carbon management within the organization and through the value chain, receives appropriate senior management support and approval;
- Procedures are established and maintained for document retention and record keeping, in support of carbon management.

## 5.2 Asset owner/manager requirements

In addition to Clause **5.1** asset owners/managers' leadership shall:

a) Clearly document and communicate the desired carbon management outcomes to their value chain;

b) Encourage value chain members to challenge the status quo to drive low carbon solutions;

c) Consider appropriate mechanisms to recognise, and where possible reward, performance in the value chain to drive low carbon solutions (e.g. can include relevant KPIs, financial incentives, etc.);

d) Be accountable for delivery of carbon emissions reductions in assets and programmes of work.

## 5.3 Designer requirements

In addition to Clause **5.1** designers' leadership shall:

a) Put systems in place to ensure collaboration with constructors and product/material suppliers to examine the feasibility of low carbon solutions (including material and product supply options, design solutions, and construction techniques);

b) Put systems in place to ensure they challenge the asset owners/managers' asset standards, or equivalent, to drive low carbon solutions.

## 5.4 Constructor requirements

In addition to Clause **5.1** constructors' leadership shall:

a) Promote early involvement in the delivery of infrastructure and put systems in place to ensure collaboration with asset owners/managers, designers and material / product suppliers;

b) Challenge their product/material suppliers to provide low carbon solutions.

## 5.5 Product/material suppliers

In addition to Clause **5.1** product/material leadership suppliers shall:

a) Promote low carbon solutions to all value chain members during early infrastructure work stages;

b) Promote carbon management within their supply chain;

c) Proactively communicate carbon information to other value chain members.

# 6 The carbon management process

**A carbon management process which is integrated into infrastructure delivery processes will drive the value chain to collaborate and create a culture of innovation. This supports reductions in carbon and cost during infrastructure delivery by driving the use of low carbon solutions.**

## 6.1 Requirements for all value chain members

### 6.1.1 Carbon management process

All value chain members shall:

a) Implement an organizational carbon management process to help them meet their requirements (Clauses **5** to **10**) when delivering assets and/or programmes of work. The components of the organizational carbon management process shall follow those described in Clause **6.2.1** in a manner that will enable integration of their process with the carbon management process deployed by other value chain members;

b) Assign roles and responsibilities to people within their organization in support of their carbon management process; and

c) Engage with other value chain members during the delivery of assets and programmes of work when working under the asset owner/manager's carbon management process (Clause **6.2.1**) as applied to infrastructure delivery (refer to **Annex B** for an example of such engagement).

***NOTE*** *An organizational carbon management process is a process that will enable a value chain member to establish their own organization capability for the delivery of low carbon assets and programmes of work aligning with the asset owner/manager's carbon management process as defined in Clause **6.2**.*

### 6.1.2 Meeting carbon reduction targets

During the delivery of assets and programmes of work, all value chain members shall:

a) Take early action to reduce carbon emissions, where the reduction opportunity is greatest (see **Figure 4**);

b) Demonstrate they have investigated alternative solutions for carbon reduction at relevant work stages;

c) Follow the carbon reduction hierarchy (Clause **6.1.4**) and select the best collective approach for meeting or exceeding the targets by engaging with other members of the value chain;

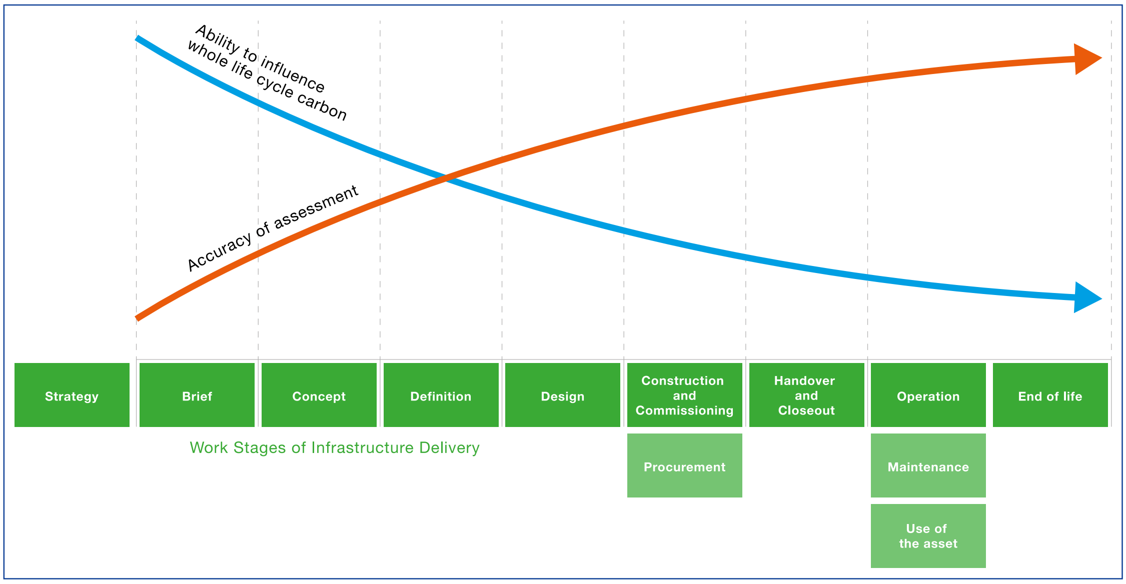
d) Communicate and share the proposed carbon reduction actions they have identified with other value chain members;

e) Encourage other value chain members to choose products/materials and adopt approaches which provide the lowest whole life carbon solution; and

f) Adopt an approach to carbon management that defines and implements measures that achieve whole life carbon reductions against a baseline.

***NOTE*** *Without regular and in-depth engagement with other value chain members, unintentional decisions on options/products/materials can be made which lead to short term carbon reductions but over a whole life perspective can lead to greater carbon emissions. For example, more frequent replacement/refurbishment requirements due to reduced durability or more substantial replacement costs due to greater difficulty in expanding service capacity.*

**Figure 4** – Conceptual diagram to showing ability to influence carbon reduction across the different work stages of infrastructure delivery




***NOTE 1 Figure 4** is a conceptual representation of how ability to influence whole life cycle carbon and accuracy of assessment develop across the infrastructure delivery work stages. The figure highlights that action to reduce carbon needs to be taken early in the work stages before accurate information may be available. This figure has been adapted from Chart 1.C. in the Infrastructure Carbon Review.*

***NOTE 2 Figure 4** introduces the infrastructure delivery work stages from Brief through to Operation as presented in PAS 1192:2. For the purposes of the requirements of this PAS and carbon management in infrastructure an additional 'End of life' work stage has been included.*

***NOTE** Value chain members should recognise that one of the main challenges for managing and reducing carbon during infrastructure delivery is that the scope for reducing whole life cycle carbon emissions is greater during the initial work stages (stages Brief to Definition) than in the later work stages (stages Design to End of life). On the other hand, the degree of knowledge of the types of assets required to deliver the desired outcomes is smaller at these initial work stages and increases over time. Accuracy requirements for the assessment (or quantification) of whole life cycle carbon emissions would also vary in different work stages (e.g. for data and modelling assumptions that are needed for assessing whole life carbon emissions). The degree of accuracy becomes important only when it affects decisions in each work stage to select the lowest whole life carbon option. Refer to Clause **7** for quantification specific requirements.*

### 6.1.3 Carbon emission priorities

All value chain members shall manage whole life carbon as set out in **Figure 7** and place priority on managing carbon emissions that are under their control and on carbon emissions over which they have a direct influence.

In defining the scope of activities for which the value chain member has control, direct influence and influence, all value chain members shall consider how whole life carbon is managed in sector-specific infrastructure assets and programmes of work and the delivery infrastructure services.

***NOTE** The "Guidance Document for PAS2080" provides further explanation and examples of control and direct influence.*

#### 6.1.4 Carbon emissions reduction hierarchy

All value chain members shall engage with other value chain members as early as possible in any collaborative working to identify whole life low carbon solutions, including the selection of relevant low carbon materials and products, innovative design solutions and construction methods. Value chain members shall follow the following carbon emissions reduction hierarchy (in the order of priority shown) when identifying potential opportunities to reduce carbon:

a) Build nothing: they shall evaluate the basic need for an asset and/or programme of works and shall explore alternative approaches to achieve outcomes set by the asset owner/manager;

b) Build less: they shall evaluate the potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required;

c) Build clever: they shall consider the use of low carbon solutions (including technologies materials and products) to minimise resource consumption during the construction, operation and user's use stages of the asset or programme of work;

d) Build efficiently: they shall use techniques (e.g. construction, operational) that reduce resource consumption during the construction and operation phases of an asset or programme of work; or

where this carbon emissions reduction hierarchy is not applied the value chain member shall provide documented justification for not doing so.

## 6.2 Asset owner/manager requirements

#### 6.2.1 Carbon management process

In addition to Clause **6.1** asset owners/managers shall:

a) Develop a carbon management process that incorporates the following components:
   1) Quantification of GHG emissions
   2) Target setting, baselines and monitoring
   3) Reporting
   4) Continual improvement;

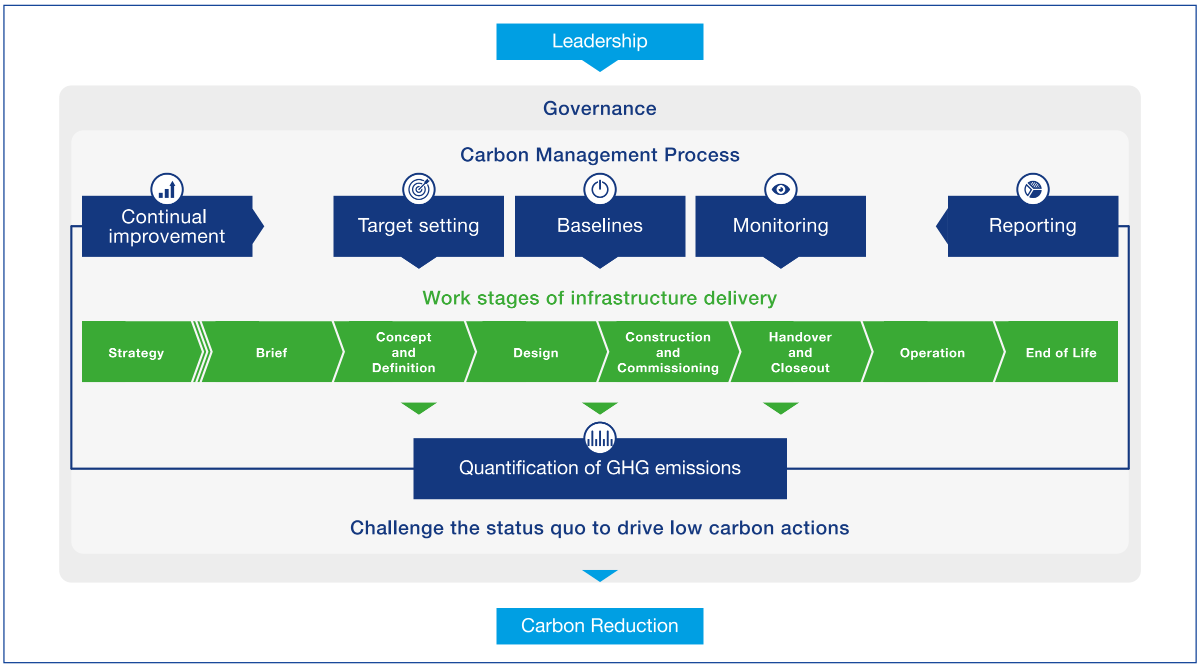
b) Unambiguously identify the assets or programmes of work to which the carbon management process is to be applied;

c) Allocate and communicate unambiguous responsibilities for each aspect of the carbon management process to value chain members involved in the delivery of identified assets or programmes of work;

d) Develop a collaborative environment for all value chain members involved in the implementation of the carbon management process during the delivery of assets and programmes of work.

***NOTE** Standards such as BS 11000 Collaborative Business Relationships provide further detail on how to develop and implement collaborative environments which will benefit all aspects of infrastructure delivery. Asset owners/managers can use such a framework to define roles, responsibilities and processes which include all value chain members.*

**Figure 5** – Carbon management process




### 6.2.2 Work stages of infrastructure delivery

Asset owners/managers shall apply the carbon management process to the work stages of infrastructure delivery as defined by:

- Strategy
- Brief
- Concept
- Definition
- Design
- Construction and commissioning
- Handover and closeout
- Operation
- End of life

As illustrated in **Figure 5.**

Asset owner/managers shall define the components of the carbon management process during the initial Strategy phase. The latter shall be driven by the organization's leadership and governance (Clause **5**).

***NOTE*** *The work stages set out above have been adopted from PAS 1192-2:2013 for information management in construction. PAS 1192-2 refers to the work stages as 'information processes'. This framework is adopted because it represents current good practice in infrastructure information management (including information to inform carbon management), over the asset life cycle.*

## 6.3 Designer requirements

In addition to Clause **6.1** designers shall:

a) Unambiguously identify the part of their organization, as demonstrated through work on selected assets and/or programmes of work, to define the scope of activity to which the carbon management process is to be applied;

b) Share details of their own carbon management process (Clause **6.1.1**) with the asset owner/manager and other relevant value chain members.

c) Where the designer believes that improvements can be made to the asset owners/managers approach to carbon management, designers shall propose such improvements to the asset owners/manager and encourage their use in the delivery of assets and programme of work;

d) Where carbon management improvement proposals are made by designers, they shall be documented in evidence of their submission to the asset owner/manager, supported by the anticipated benefits to the carbon management process and record of the outcome'

## 6.4 Constructor requirements

In addition to Clause **6.1** constructors shall:

a) Unambiguously identify the part of their organization, as demonstrated through work on selected assets and/or programmes of work, to demonstrate the scope of activity to which the carbon management process is to be applied.

b) Share details of their own carbon management process (Clause **6.1.1**) with the asset owner/manager and other relevant value chain members.

c) Where the constructor believes that improvements can be made to the asset owners/managers approach to carbon management, constructors shall propose such improvements to the asset owners/manager and encourage their use in the delivery of assets and programme of work.

d) Where carbon management improvement proposals are made by constructors, they shall be documented in evidence of their submission to the asset owner/manager, supported by the anticipated benefits to the carbon management process and record of the outcome'

## 6.5 Product/material supplier requirements

In addition to Clause **6.1**. product/material suppliers shall:

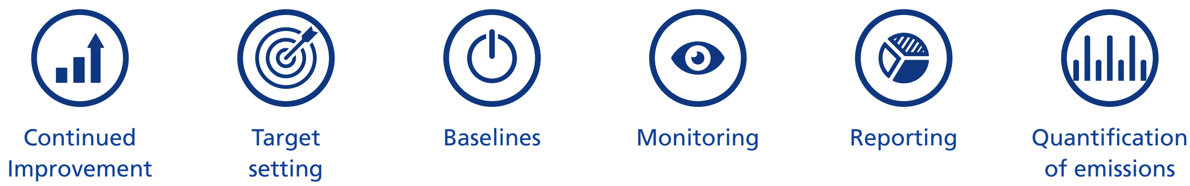
a) Unambiguously identify the part of their organization, as demonstrated through work on selected assets and/or programmes of work, to demonstrate the scope of activity to which the carbon management process is to be applied.

b) Share details of their own carbon management process (Clause **6.1.1**) with the asset owner/manager and other relevant value chain members.

c) Where the product/material supplier believes that improvements can be made to the asset owners/managers approach to carbon management, product/material suppliers shall propose such improvements to the asset owners/manager and encourage their use in the delivery of assets and programme of work.

d) Where carbon management improvement proposals are made by product/ material suppliers, they shall be documented in evidence of their submission to the asset owner/manager, supported by the anticipated benefits to the carbon management process and record of the outcome'

***NOTE** THE CARBON MANAGEMENT PROCESS: Throughout this PAS and the guidance document that supports it, the various components of the Carbon Management Process are flagged by a set of icons intended to assist component recognition, as follows:*




Throughout this document, 'component icons' are each hyper linked to the next instance of use.

# 7 Quantification of GHG emissions

**The quantification of GHG emissions allows carbon hotspots to be identified and informs carbon reduction strategies. A robust methodology gives confidence that all value chain members are following consistent practice. This, in combination with the principle of transparency, will enable results to be compared or for variations to be accounted for by highlighting differences in methodologies.**

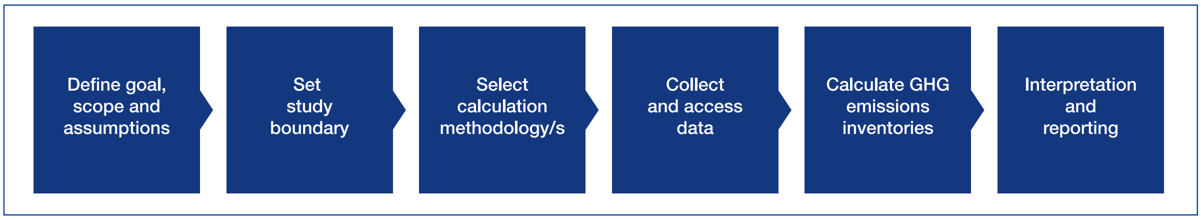
## 7.1 Requirements for all value chain members

All value chain members shall:

a) Put systems in place within their organizations to ensure they are capable of quantifying GHG emissions for assets and programme of works based on the steps shown in **Figure 6**;

b) Challenge other value chain members to strengthen the robustness of GHG emission quantification studies undertaken to achieve greater consistency and accuracy. Challenge includes providing advice on the ambition of study objectives, the quantification methodology applied, tool options, and data quality.

**Figure 6** – Principal steps of GHG emissions quantification




### 7.1.1 Define study goal and scope

The practitioner shall define and document the goal and scope of the GHG quantification to ensure that it is consistent with the intended audience and the intended use of results. The study goal and scope shall describe:

a) The goal of the GHG emissions quantification;

b) The system that is the subject of a quantification;

c) The function of the system (i.e. its performance characteristics);

d) The functional unit (see Clause **7.1.2** where relevant);

e) The system boundary (see Clause **7.1.3**);

f) Allocation procedures (where relevant);

g) The quantification methodology to be applied (see Clause **7.1.4**);

h) How GHG emissions information will be interpreted and used in decision-making;

i) Data quality requirements appropriate to the study goal and the life cycle stage at which an assessment has been made (see Clause **7.1.5.3)**;

j) Assumptions, limitations and constraints;

k) The study review process, ensuring it is appropriate and proportionate to the intended use of the assessment and size of the asset or programme of works.

### 7.1.2 Function and functional equivalence of studied systems

Where relevant to the GHG emissions quantification, the practitioner shall use a functional unit that describes the performance characteristics of the system. The functional unit shall:

a) Be relevant to the asset or programme of works being studied and take account of function, a quantity, a duration, and a quality of the infrastructure asset or programme of work being assessed;

b) Allow the performance characteristics of the studied system to be compared.

***NOTE 1*** *A functional unit can assist in defining baselines and comparing options for infrastructure delivery. For example, when comparing the GHG emissions outcomes of two separate assessments where the studied systems serve the same purpose, then functional unit can aid in decision making, particularly when study boundaries, input inventories, and other relevant aspects are not always directly equivalent. Organizations may choose to quantify the performance of options using more than one functional unit.*

***NOTE 2*** *NThe inherent nature of infrastructure means that on occasion it may provide additional functions beyond those originally envisioned by the asset owner/manager and as defined by the functional unit. Where relevant the associated benefits or loads – on a GHG emissions basis – of this additional functionality might be included in a quantification study. Where a practitioner chooses to include so called additional infrastructure benefits or loads, they should be reported in module D (**Figure 7**).*

### 7.1.3 Study boundaries

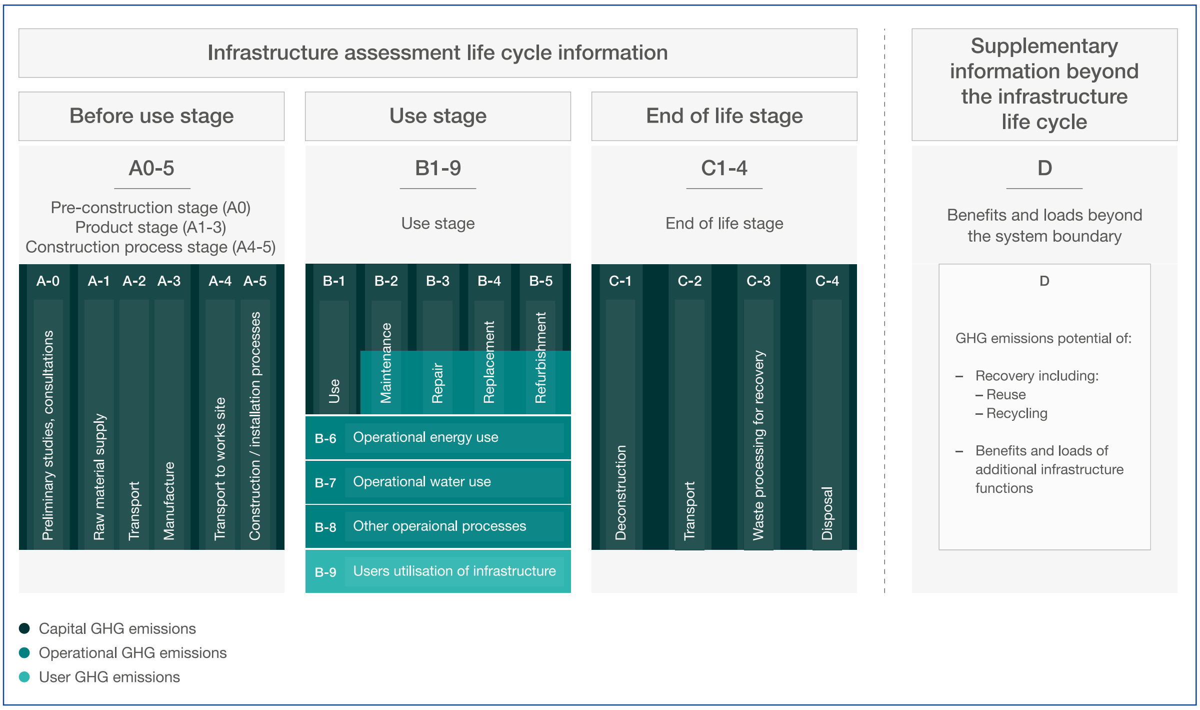
#### 7.1.3.1 Boundary application principles

The practitioner shall apply system boundaries, use data that is consistent with, and report, using the modular approach presented in **Figure 7.**

A GHG emissions quantification shall cover all life cycle modules including A, B and C with module D seen as optional (Clause **7.1.3.3** and **Annex A**).

***NOTE*** *A whole life cycle based approach to GHG emissions quantification avoids un-intended consequences, helping to ensure a balanced perspective by showing the gross size/scale of emissions and when they occur. In this way informed decisions can be made supporting optimum low carbon outcomes.*

**Figure 7** – Modular approach showing the life cycle stages and individual modules for infrastructure GHG emissions quantification




***NOTE 1 Figure 7*** *provides a framework for the quantification of GHG emissions for an infrastructure asset or programme of works and corresponds to the modular structure for information reporting used for Environmental Product Declarations (EPD) for construction products, processes and services following a structure consistent with the principles set out in BS EN 15978:2011 and BS EN 15804:2012.*

***NOTE 2 Figure 7*** *is taken from BS EN 15978:2011 and has been adapted for PAS 2080 and infrastructure.*

***NOTE 3 Figure 7*** *is to be read in conjunction with Annex A and the Guidance Document to PAS 2080 which provides descriptions and worked examples of the modular life cycle boundaries.*

#### 7.1.3.2 Inclusions

The practitioner shall:

a) Apply a study boundary that reflects the system under study including:
   - The physical scope of the activities taking place (physical characteristics);
   - The life cycle stages relevant to the goal of the assessment;

b) Ensure that all activities controlled by the asset owner/manager are included in the system boundary;

c) Ensure that all activities over which the asset owner/manager has influence are included in the system boundary;

d) Clearly document the study system boundary.

***NOTE*** *The principal elements of a system boundary are defined by the different infrastructure life cycle stages shown in **Figure 7**.*

#### 7.1.3.3 Cut off rules

The practitioner shall:

a) Include in the system boundary all the activities leading to GHG emissions relevant to the system being assessed as outlined in Clause **7.1.3**;

b) exclude only activities that do not significantly change the result of the quantification, using sensitivity analysis to demonstrate that such exclusions are not significant.

c) Apply the following provisions to any exclusion of inputs or outputs to the study system:
   - All inputs and outputs to any process for which data are available are always included;
   - Data gaps may be filled by conservative assumptions using generic data (subject to data quality requirements, Clause **7.1.5.3**);
   - The total excluded input or output flows per module shall be a maximum of 5% of energy usage and mass;

   Expert judgement by the practitioner shall be used to determine compliance with these criteria;

d) Justify and document any exclusions applied to the study system including any assumptions and criteria used to decide them.

#### 7.1.3.4 Study period

The practitioner shall carry out the quantification on the basis of a chosen reference study period:

a) The default value for the reference study period shall be the required service life of the infrastructure asset;

b) Where infrastructure industry standards on deriving the required service life exist, these shall have priority in informing the choice of the value used by the study.

***NOTE 1*** *The reference study period may differ from the required service life. This may be the case for example if an elemental component of infrastructure is being studied which has a shorter life (i.e. a reference study period is 30 years) than a broader infrastructure asset or system into which it is being incorporated (i.e. the asset has a required service life of 120 years).*

***NOTE 2*** *.Guidance given in standards ISO 15686-1, -2, -7 and -8 may be useful in assigning appropriate reference study periods and required service life values.*

### 7.1.4 GHG emissions quantification methodology

The practitioner shall:

a) Select and use GHG emission quantification methodologies that assess and reasonably minimize uncertainty and yield accurate, consistent and reproducible results;

b) Where it is available, and there is confidence in its accuracy, use directly measured data.

***NOTE*** *Quantification methodologies can be commonly classified into the following types:*

*1. Calculation based;*

*2. Measurement based;*

*3. A combination of calculation and measurement based.*

### 7.1.5 Collect and access study inventory data

#### 7.1.5.1 Data collection

The practitioner shall use study data in the quantification of GHG emissions that are consistent with the stated study goal, scope, and study boundaries. The practitioner shall record whether actual or forecast data are used in the quantification.

***NOTE 1*** *To undertake a GHG emissions quantification for an asset or programme of works, data for the study system will be required. This will include data on the activities occurring and GHG emissions factors for these activities. Depending on the work stage at which a quantification is made, either part or all of the quantification may be based on data which is predictive in nature (i.e. something that is forecast or planned to occur), or is based on actual activity data (e.g. recorded amounts of consumption).*

#### 7.1.5.2 GHG emission factor data

The practitioner shall present emission factors in carbon dioxide equivalents ($CO_2e$) which cover all relevant GHGs within the system.

***NOTE 1*** GHG *emission factors are a value for 'GHG emissions per unit of activity'. GHG emission factors may be representative of a single process or multiple processes spanning multiple life cycle stages.*

***NOTE 2*** *It may be necessary to apply multiple GHG emission factors for the same activity when assessing infrastructure assets over long study periods. This may be appropriate when future GHG emissions for that activity are expected to reduce. Examples where this might be appropriate include:*

– *Accounting for the GHG emission reduction of an energy grid and the outcome of this on any demand side functions (i.e. highway lighting, electric trains, water pump energy loads, etc.).*

– *The shift in fuel mix of a vehicle fleet or construction plant over time.*

#### 7.1.5.3 Data quality rules

The practitioner shall:

a) Use the most representative, accurate and plausible data in the study;

b) First define, and then apply, data quality requirements in terms of the following criteria:
   - Age (age of data, and the period over which they have been collected);
   - Geography (the region or country from where the data have originated);
   - Technology (whether the data are specific to a particular technology or mix of many);
   - Methodology (the approach applied to gather or calculate the data);
   - Competency (proficiency of entity that developed the data).

#### 7.1.5.4 Types of data for GHG emissions quantification

The practitioner shall:

a) Use activity data that are specific to the system under study to quantify the GHG emissions of an asset or programme of work;

b) Combine activity data with GHG emission factors to determine the GHG emissions associated with the asset or programme of works;

c) Use **Table 2** to guide the selection of data and its appropriateness for use in infrastructure GHG emissions quantification across work stages.

**Table 2** – Types of data for GHG emissions quantification

| Preferred data | Selected work stages | | | | |
|---|---|---|---|---|---|
| | Strategy, Brief and Concept | Design | Construction and commissioning | Operation | End of life |
| **Generic:** data typical of the type of component, product and/or material to be used | X | X | O | O | O |
| **Specific:** data specific to a manufacturers particular component, product and/or material | O | X | X | X | X |
| **Average:** data averaged across different manufacturers or production sites /lines for the same product and/or material | X | X | X | X | X |
| **Collective:** data created according to BS EN 15804 representing a category of products | O | X | X | X | X |
| **Measured:** data gathered from direct measurement for a component, product and/or material | | | X | X | X |
| **Other** | O | O | O | O | O |
| *NOTE Cross (X) represents the preferred use of data; Circle (O) represents alternative sources if available.* | | | | | |

***NOTE 1*** *Derived from BS EN 15978:2011 and adapted for PAS 2080.*

### 7.1.6 Study uncertainty

The practitioner shall:

a) Evaluate the uncertainty of any GHG emissions study findings taking account of the methodology applied (i.e. Clause **7.1.4**);

b) Consider whether the level of uncertainty might significantly affect the outcome of the study and if so, take additional steps to either reduce uncertainty or increase confidence in results.

***NOTE 1*** *Uncertainty may arise from the quality of data, emission factors, selection of study period and the scope and boundaries selected.*

***NOTE 2*** *It is unlikely that all sources of uncertainty can be eliminated from a quantification, and the approach to minimising uncertainty should be proportionate to the analysis being undertaken. The uncertainty may be reduced by, for example, testing the upper and lower limits of certain input parameters, testing for inclusions and exclusions or modifying the study period, and noting whether this would change the outcome of any decision which may be made, or how results may be interpreted when reported.*

### 7.1.7 Quantification of GHG emissions

The practitioner shall:

a) Apply the following logic in the quantification of GHG emissions and removal:

b) Sum individual calculations to form a GHG emissions inventory for the quantification as a whole; and where relevant, determine GHG emissions on the basis of functional unit, and against baseline or target value.

***NOTE** Emission factors may already be expressed in $CO_2$ equivalents. In these cases, it should be understood which global warming potentials were applied. Care should be taken to make sure that factors are as consistent as possible and where differences exist they should be documented.*

### 7.1.8 GHG emission quantification tools

Where value chain members use GHG emission calculators/tools, they shall be consistent with the requirements of Clause **7**.

***NOTE** The "Guidance Document for PAS2080" sets out considerations for selecting and using software tools in GHG emissions quantification.*

## 7.2 Asset owner/manager requirements

The asset owner/manager shall:

a) Put systems and processes in place for the GHG emissions quantification of assets and programmes of work;

b) Identify which value chain member is responsible for GHG emissions quantification at each work stage of infrastructure delivery;

c) Set out the requirements of each value chain member and the roles and responsibilities they must fulfil as part of supporting the GHG emissions quantification process shown in **Figure 6**;

d) Set out the objective of the GHG emissions quantification including identifying the intended audience and what results will be used for;

e) Set out the overarching principles for the GHG emissions quantification relating to study goal and scope, study boundaries, inclusions, quantification methodology, study uncertainty, data quality, and quantification tools as required by Clause **7.1**;

f) Set out the frequency of GHG emissions quantifications during the delivery of assets and programmes of work, to ensure that GHG quantification sufficiently informs decision-making in reducing whole life carbon emissions.

## 7.3 Designer requirements

Designers shall:

a) Quantify GHG emissions of design options using an approach that is consistent with the requirements of Clauses **7.1** and **7.2b)** through to **7.2 f)** (inclusive) as defined by the asset owner/manager;

b) Where opportunity for improvement to the asset owner/manager's approach to GHG emissions quantification is identified, to recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work.

c) Where GHG emissions improvement proposals are made by designers, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome.

d) Report GHG emissions of design options to other value chain members showing where the greatest emissions occur;

e) Where appropriate agree the use of software tools for the quantification of GHG emissions.

## 7.4 Constructor requirements

Constructors shall:

a) Quantify the GHG emissions of construction work activities using an approach that is consistent with the requirements of Clauses **7.1** and **7.2 b)** through to **7.2 f)** (inclusive) as defined by the asset owner/manager;

b) Where opportunity for improvement to the asset owner/manager's approach to GHG emissions quantification is identified, to recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work.

c) Where GHG emissions improvement proposals are made by constructors, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome

d) Report GHG emissions of construction works to other value chain members showing where the greatest emissions occur;

e) Quantify and report as-built capital carbon emissions to help improve baseline data;

f) Work with product and material suppliers to collect and use inventory data (Clause **7.1.5)** to inform GHG emissions quantification studies.

## 7.5 Product/material supplier requirements

Product/material suppliers shall:

a) Use the framework presented in **Figure 7**, to quantify the GHG emissions of their activities and subsequent products/materials (including their direct operations and those of their supply chain) for inclusion in GHG quantification studies by other value chain members;

b) Establish systems to gather specific inventory data from their operations, relevant to the supply of their products/materials and their GHG emissions;

c) When requested support the GHG emissions quantification of their products/materials with third party accreditation;

d) Periodically review GHG emissions quantification methodologies they apply to ensure they reflect current good practice;

e) Proactively share GHG emissions quantification information of their products/materials with the asset owner/manager.

# 8 Target setting, Baselines and Monitoring

**Setting carbon reduction targets provides clear direction and communicates intent for carbon reduction. Targets should be set against clear baselines so that performance against them can be determined. This should be underpinned by robust monitoring at frequent intervals during infrastructure delivery to highlight progress of carbon reductions against set targets.**

## 8.1 Requirements for all value chain members

### 8.1.1 Carbon reduction targets

All value chain members shall:

a) Adopt the carbon reduction targets set by the asset owner/manager as a minimum (Clause **8.2.1**);

b) Communicate and share carbon targets with other value chain members.

### 8.1.2 Baselines

All value chain members shall:

a) Collect data relevant to their activities and roles within infrastructure delivery for asset and/or programmes of works carbon baselines;

b) Take into account limitations in the accuracy of baselines when making comparisons against their activities during infrastructure delivery and transparently report these against any claims of reductions achieved.

## 8.2 Asset owner/manager requirements

### 8.2.1 Carbon reduction targets

In addition to Clause **8.1** the asset owner/manager shall set carbon reduction targets (i.e. capital, operational and/or whole life carbon) that:

a) Relate to a defined outcome (based on the functional unit set for the asset or programme of works defined in Clause **7.1.2**);

b) Will be achieved within a fixed timescale by which the desired outcome is achieved;

c) Where appropriate, align with sector-level or wider national/international carbon reduction targets.

***NOTE*** *Targets may be set to apply to the whole asset or programmes of work, or parts therein. Where targets are set for individual elements of work or for specific work stages, the asset owner/manager should, in line with Clause **8.1.1**, communicate these specific targets to the relevant parts of the value chain.*

### 8.2.2 Baselines

In addition to Clause **8.1** asset owners/managers shall set baselines which:

a) Create a reference level against which future performance can be compared with respect to the desired outcome;

b) Assist with finding carbon emissions hotspots, on which to focus efforts to reduce emissions;

c) Transparently state any assumptions used to fill data gaps and the limitations this may have on the relevance of the baseline;

d) Follow the principles of GHG emissions quantification (Clause **7**);

e) Follow a process of continual improvement to ensure future baselines reflect current good practice in GHG emissions quantification.

*NOTE There may be limitations when setting baselines for the first time where there is not enough existing data within an organization, or relevant secondary data to produce baselines which follow the principles for GHG emissions quantification (Clause 7). In such instances the best available data is chosen to allow the most valid comparisons against the design. It is critical however that mechanisms are put in place that require the collection of relevant data from the value chain during infrastructure delivery so improved baselines can be created for future assets and programmes of works.*

#### 8.2.3 Monitoring

In addition to Clause **8.1** asset owners/managers shall:

a) Develop appropriate KPIs to monitor carbon emissions, which are:
   - Developed with the same functional unit as used in baseline and target setting;
   - Incorporated into a governance system which makes the collection and reporting of KPI data a pro-active process;
   - Not overly burdensome to particular value chain members, with data gathering and reporting requirements shared across the value chain;

b) Set and communicate to all value chain members the monitoring regime and frequency of reporting during the delivery of assets or programmes of work;

c) As a minimum, monitor carbon emissions during all infrastructure work stages or at key points where decisions are made that influence whole life carbon reduction;

d) Report and review KPIs regularly to identify any further actions required to meet targets.

*NOTE Asset owners/managers can decide the frequency of quantification and monitoring of GHG emissions against the baseline. This will depend on the nature of the asset or programme of work being delivered. For example, for an asset with significant construction duration (e.g.>2 years) asset owners/managers may choose to quantify and monitor progress of capital carbon during construction in order to ensure a capital carbon target is being met.*

### 8.3 Designer requirements

#### 8.3.1 Carbon reduction targets

In addition to Clause **8.1** designers shall:

a) Where opportunity for improvement to the asset owner/manager's approach to setting carbon reduction targets is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work.

b) Where carbon reduction target improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the carbon reduction target and record of the outcome.

#### 8.3.2 Baselines

In addition to Clause **8.1** designers shall:

a) Help setting baselines, where requested by the asset owner/manager, by providing relevant activity data to support their development;

b) Where opportunity for improvement to the asset owner/manager's approach to setting baselines is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where baseline improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome;

d) Collect relevant data during the design of assets or programmes of work and communicate such data to the asset owner/manager so it can be used in future baselines.

### 8.3.3 Monitoring

In addition to Clause **8.1** designers shall:

a) Monitor the predicted carbon emissions of the elements of design for which they are responsible at appropriate, agreed infrastructure work stages and report these against the asset owner/manager's carbon reduction targets at the required frequency;

b) Where opportunity for improvement to the asset owner/manager's approach to monitoring is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where monitoring improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome;

d) Identify carbon hotspots in the design of the asset or programme of work and report these to the asset owner/manager and other value chain members on regular intervals.

## 8.4 Constructor requirements

### 8.4.1 Carbon reduction targets

In addition to Clause **8.1** constructors shall:

a) Where opportunity for improvement to the asset owner/manager's approach to setting carbon reduction targets is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work.

b) Where carbon reduction target improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the carbon reduction target and record of the outcome

### 8.4.2 Baselines

In addition to Clause **8.1** constructors shall:

a) Assist asset owners/managers set baselines, where requested by the asset owner/manager, by providing relevant activity data to support their development;

b) Where opportunity for improvement to the asset owner/manager's approach to setting baselines is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where baseline improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome;

d) Collect relevant data during the construction of assets or programmes of works and communicate these to the asset owner/manager so these can be used in future baselines.

### 8.4.3 Monitoring

In addition to Clause **8.1** constructors shall:

a) Monitor carbon emissions of construction and where appropriate commissioning activities, during the relevant infrastructure work stage for the purpose of affecting performance against the carbon realigning target;

b) Where opportunity for improvement to the asset owner/manager's approach to monitoring is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where monitoring improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome;

d) Identify and report where the greatest carbon emissions have occurred and where future reductions can be made.

## 8.5 Product/material supplier requirements

### 8.5.1 Carbon reduction targets

In addition to Clause **8.1** product/material suppliers shall:

a) Where opportunity for improvement to the asset owner/manager's approach to setting carbon reduction targets is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work.

b) Where carbon reduction target improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the carbon reduction target and record of the outcome

### 8.5.2 Baselines

In addition to Clause **8.1** product/material suppliers shall:

a) Assist asset owners/managers set baselines, where requested by the asset owner/manager, by providing relevant activity data to support their development.

b) Where opportunity for improvement to the asset owner/manager's approach to setting baselines is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where baseline improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome;

d) Ensure that, when claims are made that a product or material will reduce carbon compared to another product or material, these claims align with the baselines specified by the asset owner/manager.

### 8.5.3 Monitoring

In addition to Clause **8.1** product/material suppliers shall:

a) Put systems in place in their own organization to monitor carbon emissions of their own product/material development processes

# 9 Reporting

**Reports should make carbon reduction performance visible at different infrastructure work stages and inform decision-making in managing whole life carbon. This should be done with sufficient frequency to enable progress monitoring against targets and continuous improvement over the duration of the project or programme.**

## 9.1 Requirements for all value chain members

There are no common requirements to all value chain members.

## 9.2 Asset owner/manager requirements

Asset owners/managers shall:

a) Report whole life carbon emissions during the delivery of assets or programmes of work, relevant to the objective of the carbon emissions quantification;

b) Set out and communicate to all value chain members the reporting requirements for the infrastructure asset or programme of work, using the modular structure for information reporting (**Figure 7**);

c) Set out the requirements of each value chain member and the roles and responsibilities they must fulfil as part of the asset and programme of work reporting process;

d) Set out the frequency of reporting during the delivery of assets and programmes of work;

e) Disseminate the reporting requirements to all value chain members;

f) Report results of carbon emissions quantification to relevant stakeholders at a frequency sufficient to allow carbon reductions to be implemented and inform the continual improvement process (see Clause **10**).

***NOTE 1*** *The Guidance Document provides details of the appropriate content of reports prepared in accordance with the PAS*

***NOTE 2*** *'relevant stakeholders' refers to those involved in the delivery or maintenance of infrastructure assets who have an interest in or influence on GHG emissions falling within the boundary defined for the assessment or carbon management process.*

## 9.3 Designer requirements

Designers shall:

a) Report, carbon emissions according to requirements and frequency defined by the asset owner/manager during the delivery of assets or programmes of work;

b) Where opportunity for improvement to the asset owner/manager's approach to reporting is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where reporting improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome.

## 9.4 Constructor requirements

Constructors shall:

a) Report, carbon emissions according to the requirements and frequency defined by the asset owner/manager during the delivery of assets or programmes of work.

b) Where opportunity for improvement to the asset owner/manager's approach to reporting is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where reporting improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome.

## 9.5 Product/material supplier requirements

Product/material suppliers shall:

a) Report, carbon emissions according to the requirements and frequency defined by the asset owner/manager during the delivery of assets or programmes of work;

b) Where opportunity for improvement to the asset owner/manager's approach to reporting is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where reporting improvement proposals are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the quantification and record of the outcome.

# 10 Continual Improvement

**Continual improvement is a core part of the carbon management process and allows lessons learned from applying the carbon management process components to improve the delivery of future assets and programmes of work. Continual improvement also allows organizations to embark on the low carbon journey without having comprehensive carbon data or low carbon solutions at the outset and allows them to gradually improve their carbon management maturity.**

## 10.1 Requirements for all value chain members

All value chain members shall:

a) Establish a process of continual improvement and embed in the relevant carbon management process components (Clause **6.2.1**);

b) Seek the input of all value chain members to the process of continual improvement of their own activities during infrastructure delivery;

c) Capture carbon emissions information and share with other value chain members in order to facilitate benchmarking and continual improvement in future carbon management between organizations within infrastructure sectors;

d) Capture carbon reduction solutions and share learning with other value chain members to inform future current good practice

***NOTE 1*** *Organizations within the infrastructure value chain may already use approaches to continual improvement at an asset or programme level (e.g. ISO 14001 or ISO 9001). These are generally based on a 'process approach' using the Plan Do Check Act (PDCA) method. This Clause is designed to be compatible with these existing approaches to continual improvement.*

***NOTE 2*** *Where existing management systems are in place, it may be appropriate for the carbon management process to form part of an existing system or to align closely with it (e.g. as part of an ISO14001-compliant Environmental Management System).*

## 10.2 Asset owner/manager requirements

### 10.2.1 Continual improvement of Baselines and Quantification

In addition to Clause **10.1** asset owners/managers shall:

a) Adapt their GHG quantification methodology, as data availability improves, to minimise uncertainty and produce accurate, consistent and reproducible quantification results (Clause **7.1.4**)

b) Build up an inventory of the most relevant data to use when developing baselines and quantify carbon emissions at different infrastructure work stages.

c) Update the asset or programme of work baselines at appropriate points during infrastructure delivery to ensure that carbon reductions cannot be claimed when they are based on outdated and/or inappropriate baselines.

### 10.2.2 Continual improvement of Targets

Asset owner/managers shall periodically review their targets to ensure they are challenging and promote innovate lower carbon solutions whilst still aligned to their defined outcomes.

## 10.3 Designer requirements for continual improvement of Baselines and Quantification

In addition to Clause **10.1** designers shall:

a) Provide input to the processes of continual improvement of the carbon management process for the delivery of assets and programmes of work.

b) Where opportunity for improvement to the asset owner/manager's approach to continual improvement of baselines and quantification is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where proposals for improvement to the asset owner/ manager's approach to continual improvement are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the continual improvement of baselines and quantification and record of the outcome.

## 10.4 Constructor requirements for continual improvement of Baselines and Quantification

In addition to Clause **10.1** constructors shall:

a) Provide input to the processes of continual improvement of the carbon management process for the delivery of assets and programmes of work;

b) Where opportunity for improvement to the asset owner/manager's approach to continual improvement of baselines and quantification is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where proposals for improvement to the asset owner/ manager's approach to continual improvement are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the continual improvement of baselines and quantification and record of the outcome.

## 10.5 Product/material supplier requirements for continual improvement of Baselines and Quantification

In addition to Clause **10.1** product/material suppliers shall:

a) Provide input to the processes of continual improvement of the carbon management process for the delivery of assets and programmes of work.

b) Where opportunity for improvement to the asset owner/manager's approach to continual improvement of baselines and quantification is identified, recommend and where accepted, assist in its implementation in the delivery of assets and programmes of work;

c) Where proposals for improvement to the asset owner/ manager's approach to continual improvement are made, they shall be documented in evidence of their submission to the asset owner/ manager, supported by identification of the anticipated benefits to the continual improvement of baselines and quantification and record of the outcome.

# 11 Assessment of carbon reductions

## 11.1 Requirements for all value chain members

All value chain members shall:

a) Assess and record any carbon emission reductions planned and/or achieved for the asset and/or programme of work at the earliest opportunity

b) Demonstrate how the carbon emissions reduction hierarchy (Clause **6.1.4**) has been considered and document relevant evidence to substantiate any claimed reductions

c) Document at which work stages carbon reductions have been achieved and whether the reductions are forecast or have been delivered

d) Use the documented evidence to share current good practice at organizational and sector level

e) Put systems in place that ensure that any carbon reduction claims are consistent with the requirements of Clause **9** on reporting and Clause **12** on claims of conformity to PAS 2080

f) ensure that the quantification of any carbon emission reductions is not founded on changes to the GHG emissions quantification methodology used (Clause **7**)

***NOTE*** *Where it is possible to demonstrate GHG emissions reduction through the use of low carbon materials or similar, then it is justifiable to make an emissions reduction claim based on using updated GHG emission factor data that is specific to the asset or programme of works under study. A claim will not be valid if the carbon reduction is based on switching to a different source of generic, average or collective data (see Clause* ***7.1.5.4****).*

## 11.2 Asset owner/manager requirements

No further requirements

## 11.3 Designer requirements

No further requirements

## 11.4 Constructor requirements

No further requirements

## 11.5 Product/material supplier requirements

No further requirements

# 12 Claims of conformity

## 12.1 General

Where claims of conformity to PAS 2080 are made, the provisions in Clause **12.2** and Clause **12.3** shall apply. These provisions include identification of the type of certification/verification undertaken (Clause **12.2**) and requirements for how the claim shall be expressed (Clause **12.3**).

## 12.2 Basis of claim

### 12.2.1 General

The claim shall identify the type of conformity assessment undertaken as one of the following:

a) independent third-party certification in accordance with Clause **12.2.2**;

b) other-party validation in accordance with Clause **12.2.3;** or

c) self-validation in accordance with Clause **12.2.4**.

### 12.2.2 Independent third-party certification

Infrastructure asset owners/managers seeking to demonstrate that their carbon management process has been independently verified as being in accordance with this PAS shall undergo assessment by an independent third party certification body accredited to provide assessment and certification to this PAS.

### 12.2.3 Other-party validation

Organizations using an alternative method of validation involving parties other than those qualifying as accredited independent third-parties shall satisfy themselves that any such party is able to demonstrate compliance with recognised standards setting out requirements for bodies providing certification services.

***NOTE 1*** *Other-party validation bodies are those undertaking assessment services without having achieved accreditation from the authorized accreditation service (e.g. UKAS in the UK). Such bodies could include those which, although independent of the organization undertaking the assessment of GHG emissions, cannot demonstrate complete independence, e.g. a trade body providing assessment services for its members or a consultant employed for such a purpose).*

***NOTE 2*** *Examples of such recognised standards include BS EN ISO/IEC 17065.*

### 12.2.4 Self-validation

Organizations shall be able to demonstrate that their carbon management process has been established in accordance with this PAS, and make supporting documentation available on request.

***NOTE 1*** *The appropriate method for self-validation and for presentation of the results can be determined by reference to BS EN ISO 14064-3 and BS EN ISO 14021.*

***NOTE 2*** *Organizations for whom neither independent third-party certification nor other-party verification is a realistic option, may rely on self-verification. In so doing, organizations should be aware that independent verification could be required in the event of a challenge and that stakeholders could have less confidence in this option*

## 12.3 Permitted forms of disclosure

### 12.3.1 Asset owners/managers

Claims of conformity shall use the appropriate form of disclosure, as follows:

a) For claims of conformity based on independent third-party certification in accordance with Clause **12.2.2**:

"Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as Asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with Clause **12.2.3:**

"Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as Asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with Clause **12.2.4:**

"Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as Asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated"

### 12.3.2 Designers

Claims of conformity shall use the appropriate form of disclosure, as follows:

a) For claims of conformity based on independent third-party certification in accordance with Clause **12.2.2**:

"Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with Clause **12.2.3:**

"Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with Clause **12.2.4:**

"Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

### 12.3.3 Constructors

Claims of conformity shall use the appropriate form of disclosure, as follows:

a) For claims of conformity based on independent third-party certification in accordance with Clause **12.2.2**:

"Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with Clause **12.2.3**:

"Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with Clause **12.2.4:**

"Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

### 12.3.4 Product/material suppliers

Claims of conformity shall use the appropriate form of disclosure, as follows:

a) For claims of conformity based on independent third-party certification in accordance with Clause **12.2.2**:

“Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified.”

b) For claims of conformity based on other-party validation in accordance with Clause **12.2.3**:

“Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated.”

c) For claims of conformity based on self-validation in accordance with Clause **12.2.4:**

“Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as Product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated.”

# Annex A (Normative) Categories of carbon emissions in different infrastructure sectors

## A1 Introduction

In this PAS, capital, operational and user carbon are assigned based on the principles of where they arise during the infrastructure life cycle; and on who exerts control/influence on the infrastructure as it is designed/built, operates and is used (**Figure 7**).

They have further been guided by the expenditure categories widely applied across infrastructure management including capital expenditure (CAPEX) and operational expenditure (OPEX). They are broadly consistent with this terminology, but may vary based on the precise interpretations that different organisations and sectors apply.

Practitioners shall work within the frameworks set out in this annex but may choose to deviate in their interpretations of which activities are allocated to which carbon emission modules. Where they do so justification must be made and supported with documentation of any assumptions and criteria used to guide the working approach.

## A2 Capital carbon

PAS2080 defines capital carbon as GHG emissions that can be associated with the creation, refurbishment and end of life treatment of an asset.

This follows for all infrastructure sectors which have similar sources of capital carbon. This includes the emissions associated with the use of materials, such as concrete and steel, the use of construction plant, such as excavators or tunnel boring machines, and the transport of materials and plant to construction sites.

This will occur for all construction activities be they directed to new build, maintenance or refurbishment.

Capital carbon emissions also arise at end of life and are associated with demolition, waste processing and any final treatment/disposal. Carbon emissions from transportation which occurs as part of any of these activities is considered to be capital carbon.

## A3 Operational carbon

PAS 2080 defines operational carbon as GHG emissions associated with the operation of an asset.

Given the different functions of separate infrastructure sectors, it follows that the origins of operational carbon emissions may vary between sectors. All sectors consume energy, either through direct fuel combustion or from supplied electricity or heat. Direct and indirect carbon emissions associated with this energy are considered as operational energy.

In the water or waste sector, operational carbon emissions may also occur through the use of particular products, technologies or certain chemicals during the use of the asset. In the energy/power sector, fugitive emissions from gas networks, and transmission losses are further examples. In the waste sector, fugitive emissions may occur during the waste treatment or final disposal processes and these are considered as operational carbon.

## A4 User carbon

PAS 2080 defines user carbon as GHG emissions associated with the users' utilisation of infrastructure (i.e. emissions arising from the user utilising infrastructure services).

An example of user carbon emissions can be provided for the roads and highways where emissions arising from vehicles utilising road infrastructure are categorised under user carbon emissions as they represent the user utilising the infrastructure service provided.

The boundary on where to draw this distinction between operational and user carbon is not always clear, for example in the waste sector emissions arising from final disposal of goods could be argued to be both operational or user emissions as the user is utilising the infrastructure but the waste operator is also operating the infrastructure. To differentiate between these, PAS 2080 has used the principle of control and influence. Therefore, asset owner/managers who have a significant level of influence to reduce user emissions through their organizational activities will be allocated the emissions (and hence they shall be termed operational emissions). For example, in the waste sector, the waste collection, disposal and treatment operators do have a level of control over how the waste is disposed of therefore the emissions arising from final disposal are categorised as the waste sectors operational emissions.

## A5 Applying carbon emission categories

**Table A 1** sets out for all infrastructure sectors the categories of capital, operational and user carbon. This framework shall be used for describing and reporting sources of carbon emissions. Practitioners may choose to deviate from the framework of definitions for capital, operational and user carbon. Where they do so justification must be made and supported with documentation, of any assumptions and criteria used to guide the working approach.

Emissions due to land use change are not included in **Table A 1**.  Depending on whether changes in land use lead to emissions or removals, these could be classed as capital or operational carbon.

Operational and user carbon emissions occur only during the use stage of the infrastructure life cycle (**Figure 7**). The assignment of whether an emission is operational or user shall be established based on the principle of control and influence (Clause **3** Terms and definitions).

This is applied by considering which actors in the use stage of the infrastructure life cycle have the ability through their actions to control or directly influence carbon emissions.

If the infrastructure asset owner/manager is the main controlling and influencing, force then the carbon emission is assigned as operational carbon.

If the infrastructure user is the main controlling and influencing force then the carbon emission is assigned as user carbon.

**Table A 1** – Summary of infrastructure sector-specific descriptions of capital, operational and user carbon; this summary is high level and should be read in conjunction with Figure 7 and the specific descriptions documented in Annex A.

| Infrastructure Sector | Capital carbon[4] | Operational carbon[5] | User carbon[6] |
|---|---|---|---|
| Energy | Infrastructure which generates, transmits, distributes and stores energy | Energy consumption of the infrastructure itself (auxiliary loads)<br>All energy sector conversion, transmission and distribution losses<br>Any emissions from chemicals used in processes | Emissions associated with the use of energy at the point of energy consumption |
| Water | Infrastructure including:<br>• Water resources assets:<br>– Rivers, reservoirs and dams<br>• Portable water supply:<br>– Distribution systems, pumping stations and treatment works<br>• Collection and treatment of sewage:<br>– Sewers, pumping stations and treatment works<br>• Distribution:<br>– Pipelines and pumping stations<br>• Flood and coastal defences | Conveyance of water<br>Direct treatment process emissions<br>Energy use for the operation of water assets<br>Chemicals for treatment of water | Energy use for the heating of water in buildings and conveyance of water inside buildings<br>(NOTE: if the product sold is hot water, then energy use associated with the heating of water would instead be classed as operational carbon) |
| Transport | Infrastructure covering all road, rail, aviation, and marine /inland water modes | Energy for street and public realm lighting<br>Energy for pumps, control and automation systems, signage, signalling etc.<br>Other energy related emissions and operational processes necessary for the operation and management of transport assets<br>Energy and fuel use by vehicles (road, aviation, water and rail) that are owned and operated by asset owners/managers and/or operators providing transport services on the infrastructure | Energy and fuel use by user owned vehicles (road, aviation, water and rail) |

**Table A 1** – Summary of infrastructure sector-specific descriptions of capital, operational and user carbon; this summary is high level and should be read in conjunction with Figure 7 and the specific descriptions documented in Annex A. *(continued)*

| Infrastructure Sector | Capital carbon[4] | Operational carbon[5] | User carbon[6] |
|---|---|---|---|
| Waste | Infrastructure used for processing, treatment, reuse, recycling and final disposal of waste | Energy used to power waste handling, processing and treatment equipment (to end-of-waste point)<br>Direct emissions arising from any chemicals or other agents used to process and treat waste<br>Transport of waste from point arising to point of recycling/reuse (i.e. to end-of-waste point), and final disposal<br>Direct emissions arising from any process to treat and dispose of waste at point of final disposal | |
| Communications | Infrastructure for:<br>Voice and data networks (fixed and mobile)<br>Satellite networks<br>TV and radio broadcast networks | Electricity consumption of the networks and data centres<br>Energy and fuel use by vehicles (that are owned and operated by asset owners/managers and/or operators providing services on the infrastructure | End-user device electricity consumption (and any end-user data centres) |

4) Refer to Figure 7 for details of capital carbon in the different life cycle modules (e.g. Before use stage: A0, A1, A2, A3, A4, A5; Use stage: B1, B2, B3, B4, B5; End of life stage: C1, C2, C3 and C4)

5) Refer to Figure 7 for details of operational carbon in the different life cycle modules (e.g. Use stage: B2, B3, B4, B5, B6, B7 and B8)

6) Refer to Figure 7 for details of user carbon in the different life cycle modules (e.g. Use stage: B9)

## A6 Carbon emissions over the infrastructure life cycle

**Figure 7** illustrates the relationship of capital, operational and user carbon with the detailed life cycle modules. To bring further description to these life cycle modules the tables below provide a more detailed summary on each. Further more detailed guidance is provided in BS EN 15978:2011.

Practitioners may choose to deviate from the modular framework set out in this Annex with the exception that carbon emission benefits and loads as defined by module D shall not be aggregated with other life cycle stage modules. Where practitioners do deviate justification must be made and supported with documentation of any assumptions and criteria used to guide the working approach.

### Table A 2 – Before use stage

| Boundary stage | Description |
|---|---|
| Boundary of pre-construction stage (module A0) | Represents preliminary studies and works; for example strategy and brief development, architecture, design efforts, EIA and cost planning.<br>Most if not all these functions will be largely office based functions contributions from across the value chain.<br>In this case carbon emissions might normally be associated with energy use and transportation demands. |
| Boundary of product stage (modules A1 – A3) | Represents raw material extraction, precursor product processing, and final product manufacture, its energy use, and waste management within these processes. It will include any use of recycled or reuse materials and the process associated with making them ready for incorporation in infrastructure (but not processes that are part of the waste processing of the previous product system).<br>Transportation will include all movement of materials and goods within the supply chain up to the point of final factory gate. Manufacture includes the final product used in the infrastructure but also any pre-product elements it might demand. Packaging and other material demands that may be necessary should also be included. |
| Boundary of construction process stage (module A4) | Represents transportation (including intermediate storage and distribution) of products/materials and construction equipment (e.g. an asphalt paving machine or a crane) to the infrastructure construction site from point of production (or point of storage in the case of plant and machinery) to site works.<br>This category might also record any carbon emissions associated with environmental conditions required to keep materials in a required state.<br>If waste occurs due to spillage or damage during transport then waste processing of this and provision of new material and subsequent carbon emissions would be recognised here. |
| Boundary of construction process stage (module A5) | Represents construction site works activities including:<br>• temporary works, ground works, and landscaping<br>• materials storage and any energy or otherwise need to maintain necessary environmental conditions<br>• transport of materials and equipment on site<br>• installation of materials and products into the infrastructure asset<br>• emissions associated with site water demand<br>• waste management activities (transport, processing, final disposal) associated with waste arising from the construction site<br>• production, transportation, and waste management of materials/products lost during works. |

**Table A 3** – Use stage

| Boundary stage | Description |
|---|---|
| Boundary of use stage – installed products and materials (module B1) | Called 'Use' this represents the carbon emitted directly from the fabric of products and materials once they have been installed as part of infrastructure and it is in normal use. |
| Boundary of use stage (modules B2 – B5) | Represents the works activities and new materials for the maintenance, repair, replacement and refurbishment of the infrastructure during the use stage / operation of infrastructure.<br>This is notionally described as capital carbon. However, depending on organisational interpretation, and the way that such activities are delivered through capital and/or operational expenditure budgets, they might alternatively be described as operational carbon emissions. |
| Boundary of use stage – operational energy (modules B6) | Represents the carbon emissions resulting from the energy used by infrastructure-integrated technical systems to enable it to deliver its service during operation. This might be to provide heating and cooling, ventilation, lighting, auxiliary energy for pumps, control and automation.<br>Both direct and indirect energy sources might be used for such systems including the combustion of fuels in plant and equipment and the consumption of electricity from energy grids.<br>In the case that hot water or steam is purchased to enable infrastructure operation, it should also be included in this module. |
| Boundary of use stage – operational water (modules B7) | This represents the carbon emissions resulting from the consumption of water required by infrastructure to enable it to operate and deliver its service. It will include all water used and its treatment (pre- and post-use) during the normal operation of the infrastructure.<br>For transport this might include aspects such as water for washing and cleaning trains; or in the case of highways water used for cleaning road surfaces by street cleaning plant.<br>Energy usage associated with providing water to and from infrastructure shall be included in the module B6. |
| Boundary of use stage – other operational processes (module B8) | Represents other process carbon emissions arising from infrastructure to enable it to operate and deliver its service including management of operational waste.<br>An example is chemicals used in the treatment of water and wastewater or emissions arising from chemical reactions during the wastewater treatment process. |
| Boundary of use stage – user's utilisation (module B9) | Represents the activities associated with user's utilisation of the infrastructure during the use stage.<br>This is defined by the principle of control and influence where by which the carbon emissions are B9 (user's utilisation) when they arise from an activity that the user has control over. An example is highway vehicle carbon emissions where the user makes the decision as to which type of vehicle they purchase (petrol, diesel, electric etc.), the route they travel, and the load they carry. |

**Table A 4** – End of life stage

| Boundary stage | Description |
|---|---|
| Boundary of end of life stage – deconstruction (module C1) | Represents the on-site activities of deconstructing, dismantling and demolishing the infrastructure.<br>For example, emissions arising through the use of plant and transport on site. |
| Boundary of end of life stage – transport (module C2) | This represents all carbon emissions due to transport to disposal and/or until the end-of-waste state of waste materials arising. |
| Boundary of end of life stage – waste processing for recovery (modules C3) | Represents the activities associated with treatment and processing for recovery, reuse and recycling of waste materials arising from infrastructure.<br>This includes use of all waste material outputs from dismantling, deconstruction or demolition of the infrastructure and covers all debris, all construction products, materials or construction elements, etc. arising from the infrastructure.<br>All waste processing carbon emission shall be accounted for up until the material reaches the end-of-waste state as defined in BS EN 15978:2011. |
| Boundary of end of life stage – disposal (module C4) | The boundary includes the carbon emissions resulting from final disposal of demolition materials (neutralisation, incineration with or without utilisation of energy, landfilling with or without utilisation of landfill gases, etc.). Any carbon emission benefits from exported energy (i.e. through substitution) shall be reported into module D. This category also includes any possible post-transportation treatment that is necessary before final disposal. |

**Table A 5** – Supplementary information beyond the infrastructure life cycle

| Boundary stage | Description |
|---|---|
| Boundary of benefits and loads beyond the infrastructure life cycle (module D) | Includes avoided carbon emissions associated with the infrastructure asset including potential for re-use, recovery and recycling of materials and/or energy and associated carbon emissions beyond the system boundary. Where relevant module D might also be used to record benefits or loads arising from additional functions of infrastructure. |

The modularised approach presented in **Figure 7** also sets out the boundary condition of module D. Module D is for the representation of carbon emissions or removals (i.e. climate change benefits and loads) that occur outside the infrastructure life cycle. Therefore, when undertaking a carbon emissions quantification study module D can be used to present:

- avoided carbon emissions associated with the infrastructure asset including the potential for re-use, recovery and recycling of materials; and/or
- aspects such as energy and related benefits (and carbon emissions associated with this) that occur beyond the infrastructure system ;boundary under study;
- benefits or loads arising from additional functions that infrastructure might provide.

Carbon emissions reported in module D shall be reported separately when presenting data by carbon life cycle stage; i.e. it shall not be aggregated with other modules. Carbon emissions reported in module D are not defined as capital, operational and user carbon.

# Annex B (Informative)
# Applying the carbon management process

## B1 Applying the carbon management process to infrastructure delivery

**Annex B** summarises how the different carbon management process requirements relate to the infrastructure work stages when delivering assets or programmes of work. It provides an example on how leadership and the other carbon management process requirements could be applied in the delivery of an infrastructure asset or programme of work.

This Annex is informative only in recognition of the fact that processes and commercial arrangements used in the delivery of assets or programmes of work can vary between projects sectors and organizations. Further guidance on how each value chain member can contribute in each infrastructure work stage is provided in the Guidance Document for PAS2080.

**Table B1** provides additional guidance, for all value chain members, on applying the requirements of the carbon management process to infrastructure assets or programmes of work. The relevant carbon management process requirements are presented in a timeline using the infrastructure work stages presented in this PAS.

**Table B 1** – Carbon management process responsibilities as they could be applied to an infrastructure asset and/or programme of work

| | Strategy | Brief | Concept | Definition | Design | Construction I Commissioning | Handover I Closeout | Operation I Use | End of life |
|---|---|---|---|---|---|---|---|---|---|
| **Leadership and Governance** | Set objectives for carbon management (in organization and/or asset or programme of work), aligned with business goals. Define roles and responsibilities. Establish robust governance framework for infrastructure delivery | Communicate governance framework throughout value chain. Communicate objectives and carbon reduction targets, internally and externally. Set incentives, where appropriate, to encourage desired behaviours. Assign staff to roles. Delegate internally/externally to deliver carbon management process requirements, as appropriate. | | Ensure sufficient (and trained) resources to deliver the carbon management process requirements.<br>Apply governance framework to ensure challenge at each work stage and throughout value chain, to achieve or exceed carbon reduction targets and to promote sharing of current good practice.<br>Recognise and reward innovative behaviours. | | | Review carbon reduction performance, act on feedback and drive continuous improvement through better data collection, capturing current good practice in carbon reduction, etc. | | |
| **Target setting I Baselines I Monitoring** | Set measurable targets to achieve objectives.<br>Determine responsibility for carbon baselines. | Challenge carbon targets where there is potential for improvement<br>Develop appropriate and realistic baselines | | | | Capture construction data and feedback to help improve baselines | | Capture operational data and feedback to improve baselines. | |
| **Carbon reduction hierarchy** | **Build nothing:** Challenge the need for an asset and explore alternative approaches to achieve outcomes that minimise whole life carbon. | | **Build less:** Maximise use of existing assets. Optimise operational efficiency to reduce construction and whole life carbon | | **Build clever:** Use low carbon materials/ products to minimise resource use and select technologies for efficient operation | **Build efficiently**: Embrace construction techniques that reduce resource consumption. | | Operate, maintain (and decommission) efficiently. | |
| | Identify carbon hotspots in existing asset operation and opportunities for reduction. | Identify carbon hotspots in proposed solutions and opportunities/approaches for reduction. Assess opportunity to reduce capital, operational and user carbon. | | Ensure impacts of design on the carbon emissions of construction, future operation and use are minimised. | | Minimise material use, transport to site, construction waste and maximise opportunities for reuse/recycling/ recovery. | | Minimise operational use of energy, transport, chemicals and other consumables in new or existing assets. | |
| | | Share/develop/deploy low carbon solutions technologies, materials, products or methods to be incorporated into solutions | | | | | | | |
| **Quantification** | Set and communicate functional unit(s) for measuring performance. Define and communicate quantification requirements.<br>Identify appropriate data sources.<br>Review suitability of existing tools. | Develop and apply appropriate tools to aid quantification (asset owner/manager could delegate this responsibility). | | | | | | | |
| | | Define goal, scope and assumptions. Establish scope & boundaries of GHG assessment.<br>Select calculation methodology. | Collect and assess data.<br>Calculate GHG emissions.<br>Ensure options are assessed within consistent boundaries.<br>Take account of forecast emissions in operation and use. | | Undertake more detailed quantification of forecast GHG emissions, as required. | Assess **actual** GHG emissions from construction up to handover | | Assess actual GHG emissions of operation (from actual activity data). | |
| | | Share existing information on GHG emissions quantification of technologies, products and materials considered or used. | | | Quantify GHG emissions of materials/products supplied, as required | | | | |
| **Reporting** | Define reporting requirements and communicate throughout value chain. | | Capture data on innovative approaches, technologies, materials and products to be used.<br>Report forecast emissions and performance against targets, in accordance with general principles and reporting requirements. | | | Capture data on innovative construction techniques, materials and products used.<br>Report actual emissions and performance against targets, in accordance with general principles and reporting requirements. | | Report actual emissions and performance against targets, in accordance with general principles. | |
| | | Provide reporting on the performance of technologies, materials and products (to be) used. | | | | | | | |
| **Opportunity to reduce carbon** | Highest → | | | | | | | | Lowest |

| Key to table | Asset owner/manager | Designer | Constructor | Supplier | All parties |
|---|---|---|---|---|---|

# Annex C (Informative) Bibliography

## C1 Introduction

This Annex provides reference to a range of external standards and other documents from which asset owners/managers and infrastructure value chain partners seeking to comply with PAS 2080, will be able to select approaches and methodologies that will assist them in doing so. It is recommended that those intending to reference these publications check to ensure that they are consulting the most recent edition.

## C2 ISO standards published by BSI and CEN

BS EN ISO 9001: Quality management systems – Requirements.

BS EN ISO 14001: Environmental management systems. Requirements with guidance for use.

BS EN ISO 14021:Environmental labels and declarations. Self-declared environmental claims (Type II environmental labelling).

BS EN ISO 14040: Environmental management – life cycle assessment – Principles and framework (Incorporating corrigendum No. 1)

BS EN ISO 14044: Environmental management – life cycle assessment – Requirements and guidelines (Incorporating corrigendum No. 1)

BS EN ISO 14064-1: Greenhouse gases. Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removal.

BS EN ISO 14064-2: Greenhouse gases. Specification with guidance at the product level for quantification and reporting of greenhouse gas emissions and removal.

BS EN ISO 14064-3: Greenhouse gases. Specification with guidance for the validation and verification of greenhouse gas assertions

PD CEN ISO/TS 14067: Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification and communication.

BS ISO 15686-1: Buildings and constructed assets - Service life planning - General principles and framework.

BS ISO 15686-2: Buildings and constructed assets - Service life planning - Service life prediction procedures.

BS ISO 15686-7: Buildings and constructed assets - Service life planning - Performance evaluation for feedback of service life data from practice.

BS ISO 15686-8: Buildings and constructed assets - Service-life planning - Reference service life and service-life estimation.

BS EN 15978: Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method (Incorporating corrigendum November 2011)

BS EN ISO/IEC 17021-1: Conformity assessment. Requirements for bodies providing audit and certification of management systems. Requirements.

BS EN ISO/IEC 17065: Conformity assessment. Requirements for bodies certifying products, processes and services.

## C3 ISO standards published by BSI

BS ISO 21930: Sustainability in building construction – Environmental declaration of building products.

BS ISO 55000: Asset management - Overview, principles and terminology.

## C4 EN standards published by BSI

BS EN 15804: Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products

BS EN 15978:2011 Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method.

## C5 BSI publications

BS 11000-1: Collaborative business relationships. A framework specification

PAS 1192-2: Specification for information management for the capital/ delivery phase of construction projects using building information modelling

PAS 2050: Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.

## C6 Other significant documents

Greenhouse Gas Protocol: 2009

HM Treasury UK National Infrastructure Plan 2014

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## Appendix CL2.12

## PAS 2080:2023 Carbon management in buildings and infrastructure

# PAS 2080:2023

# Carbon management in buildings and infrastructure

Construction Leadership Council

The Green Construction Board

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# Foreword

The revision of this PAS was commissioned by the Green Construction Board Infrastructure Working Group as part of the Construction Leadership Council. Its development was sponsored by the Institution of Civil Engineers and funded by:

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This PAS is not to be regarded as a British Standard. It will be withdrawn in the event it is superseded by a British Standard.

The PAS process enables a standard to be rapidly developed in order to fulfil an immediate stakeholder need. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

## Supersession

PAS 2080:2023 supersedes PAS 2080:2016, which is withdrawn.

## Information about this document

This is a full revision of the PAS, and introduces the following principal changes.

- Expanded scope to include all the built environment (buildings and infrastructure), with a focus on behaviours and good practice principles intended to complement existing standards/guidance.
- Clarifications to the role of value chain members with control of and influence on whole life carbon in the context of a net zero transition and systems-level change.
- Increased emphasis on a whole life carbon, aligned with a 1.5 °C global warming, circular economy principles, and the urgent need to decarbonize systems, networks and assets, while balancing capital carbon investment with operational and user benefit.
- Inclusion of requirements specific to procurement and to aid decision-making in projects and programmes of work.
- Consideration of other demands and co-benefits when managing carbon, such as climate adaptation and biodiversity net gain.
- More emphasis on the importance of leadership, governance and collaboration across the value chain and beyond, including guidance for government, regulators and financiers.
- Features to encourage consistent approaches across the built environment industry to collectively manage whole life carbon and support the net zero transition, while not conflicting with other existing standards, accreditation schemes, procurement notices, or similar.

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*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. "organization" rather than "organisation").

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# Executive summary

At a time of a global climate emergency and with an international agreement to transition to a net zero carbon economy by or before 2050, PAS 2080 outlines a carbon management process that is applicable across both infrastructure and buildings, recognizing that they have key commonalities and are part of an interconnected system – the built environment. By following the PAS 2080 approach, value chain members across the built environment can work collaboratively towards the common goal of net zero carbon transition and achieve the following outcomes:

- align buildings and infrastructure projects and/or programmes of work, at the asset, network or system level, to the net zero transition by or before 2050, and therefore contribute to limiting global warming to 1.5 °C, as per Paris Climate Agreement 2015;
- reduce carbon and increase value across the whole life of buildings and infrastructure; and
- remove silos and create collaborative ways of working that promote innovation, encourage positive change for society and support economic development.

The 2013 *Infrastructure carbon review* [1] recognized the opportunity to create wider benefits through managing carbon in a consistent manner across the value chain. PAS 2080 was first published in 2016 and outlines a practical process to realize low-carbon outcomes. Its principles and claims of conformity have been adopted by several infrastructure organizations and, increasingly, developers and local authorities.

Targeted at leaders and all members of value chain organizations (asset owners/managers, designers, constructors and product/material suppliers) responsible for delivering built assets and networks, PAS 2080 provides a common process for the built environment value chain on how to manage whole life carbon in projects and programmes of work. PAS 2080 promotes reduced carbon, increased value delivery, more collaborative ways of working, and a culture of challenging convention and traditional practice for decarbonization.

PAS 2080 includes requirements for all value chain members to show leadership and establish effective governance mechanisms for reducing whole life carbon through a common management process. The individual value chain requirements are structured around:

- effective leadership;
- maximizing opportunities for whole life carbon reductions at all stages of the delivery process;
- selecting appropriate carbon emissions assessment methodologies;
- setting appropriate carbon reduction targets;
- determining baselines against which to assess carbon reductions;
- establishing metrics (e.g. key performance indicators – KPIs) for credible carbon emissions monitoring and reporting;
- integrating carbon management into procurement; and
- continual improvement of carbon management and performance.

PAS 2080 also sets out guidance for other value chain members – government, regulators and financiers – to illustrate the key roles these organizations play in the net zero transition, particularly to change behaviours. These are presented in Annex C.

The PAS is supplemented by the *Guidance document for PAS 2080*, which provides further practical guidance on how to implement the different requirements of this PAS and addresses current good practice through worked examples and case studies.

# 0 Introduction

## 0.1 The aim of PAS 2080

PAS 2080 is a specification for whole life carbon management when delivering projects and programmes in the built environment. The PAS supports the transition to a net zero carbon economy by 2050 and requires close collaboration across value chain members. It defines their contribution towards the net zero transition by developing and implementing, in a collaborative manner, the PAS 2080 carbon management process.

## 0.2 Buildings, infrastructure, and greenhouse gas emissions

Recently, there has been a step change in political and public perception of the impacts from climate change and environmental degradation. The urgency for action has been universally agreed with the COP21 Paris Agreement. At the time of writing (2023), national governments and the private sector are gearing up for transitioning to a net zero carbon world by or before 2050 that is also resilient to the unavoidable changing climate and enhances biodiversity net gain.

Consequently, the challenge for buildings and infrastructure (also referred to as "built environment" in this document) has shifted: work on every existing and new asset needs to contribute towards the urgent transition to net zero carbon. This requires a step-change transformation at the system level, driven collaboratively by all value chain members.

To date, carbon management in buildings and infrastructure has been largely managed separately. There are industry differences in terminology used to describe emissions sources (e.g., capital vs embodied carbon) and their materiality; there are different standards that buildings and infrastructure professionals use to assess whole life carbon; and different definitions for the stages of delivering projects and programmes work, among other differences. There has also been limited understanding of the carbon implications of land use change, circular economy principles, and the loss of ecosystems and biodiverse habitats. While PAS 2080 recognizes such differences in infrastructure and buildings, as the World Green Building Council points out, "infrastructure and buildings share key commonalities and are interdependent in use – it is important that we consider them together as part of a system" [2]. Accordingly, decarbonization should be carried out in alignment with net zero transition.

To better align the way decarbonization is managed in buildings and infrastructure, PAS 2080 sets some overarching principles to drive whole life carbon reduction, focusing on behaviours and good practices instead of specifics covered elsewhere. Some terms that are used to describe sources of emissions, for example, might more be familiar to buildings practitioners, while other terms might be more familiar to infrastructure practitioners. To provide clarity and avoid duplication, the terms and definitions use in this PAS are defined in Clause **3**.

The *Infrastructure carbon review* [1] and PAS 2080:2016 focused on the whole life carbon of all economic infrastructure and differentiated between carbon in the control and influence of asset owners/managers. Since then, the decarbonization principles have continued to mature.

The review of the UK's progress on decarbonization, published almost eight years after the *Infrastructure carbon review* [1], accentuated the need for the following actions (which have directly informed the scope of PAS 2080:2023):

- focusing on whole life carbon both within the control and influence of asset owners/managers, not just in creating assets, but also in their future operation and use;
- considering assets as part of complex, interconnected networks and systems;
- taking into account and integrating the carbon implications of climate resilience, environmental regeneration and biodiversity; and
- recognizing that most of the built environment expected to exist in 2050 is already built and has locked in high carbon behaviours, hence the need for retrofitting to decarbonize established built environment systems.

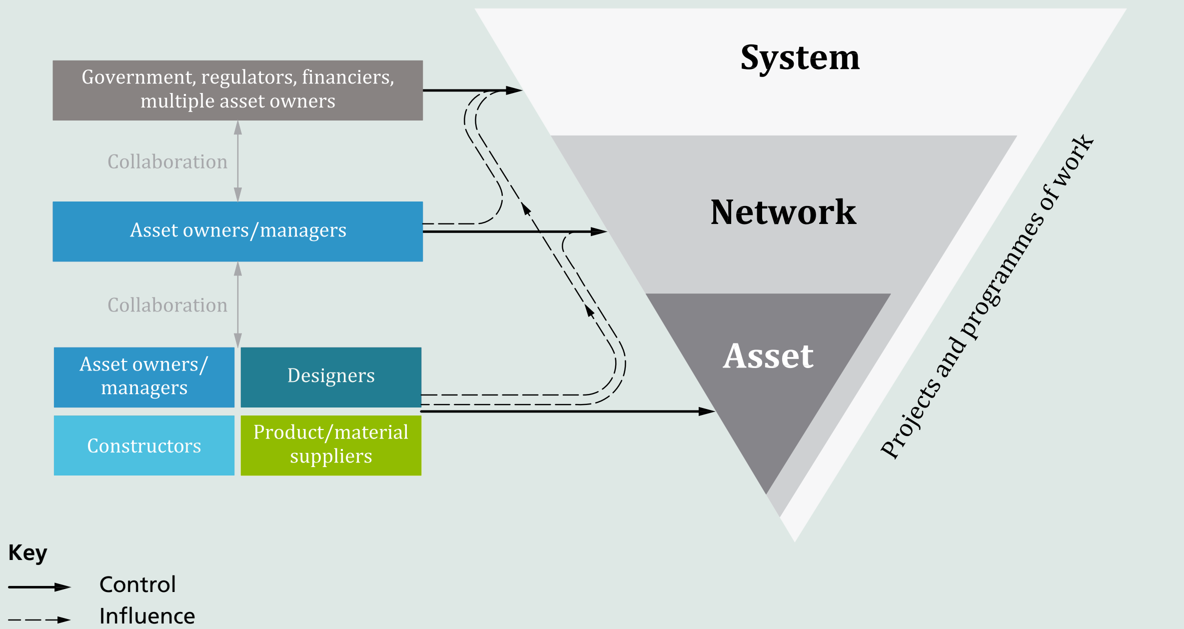
## 0.3 From assets to networks and systems

In the context of a net zero transition, it is essential that decarbonization is addressed from the system level downwards and through close collaboration across the value chain. PAS 2080 acknowledges this systems approach when setting out carbon management requirements and recognizes it is typically governments and regulators who have the greatest control at the system level – and, in some specific cases, major asset owners/managers.

Figure 1 graphically outlines the nested relationship of an asset within a network and a wider system, and the level of control and influence each member of the value chain has to drive whole life carbon reductions, recognizing that projects and programmes of work can be undertaken at each level.

PAS 2080 also recognizes that whole life carbon assessment is an essential part of managing to reduce carbon. Clarification is provided in Clause **4** and worked examples in the *Guidance document for PAS 2080* to drive the right behaviours and principles for decarbonization by all value chain members.

**Figure 1** – Relationships between value chain members across assets, networks and systems




*NOTE A building or infrastructure asset is part of a network, which in turn is part of a system. The control of decision-making sits with different members of the value chain, but some of them often have greater ability to influence decarbonization, depending on the level at which they are operating.*

## 0.4 Decarbonization, resilience and environmental restoration

In striving for net zero, it is important that the value chain, especially asset owners/managers, recognize the complex interdependencies and synergies between decarbonization, other emergencies (e.g., climate adaptation, biodiversity loss), as well as the social and economic priorities in each context.

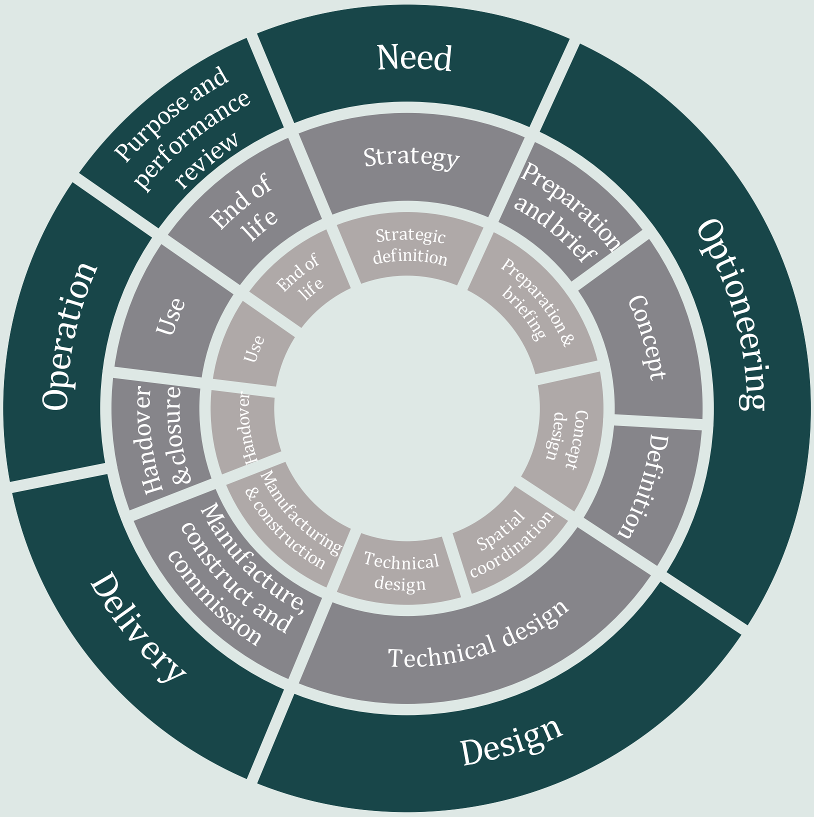
It is important that projects and programmes of work in the built environment address these challenges in a holistic way. The carbon management process outlined in PAS 2080 provides a systematic way to allow value chain members to place the relevant criteria (for the future benefit of our planet and society) at the centre of decision-making.

Further clarification on how to consider these aspects as part of the carbon management process is included in Clause **4** and Clause **6**, and in worked examples provided in *Guidance document for PAS 2080*.

## 0.5 Consistency in the built environment

Adopting consistent language across different sectors will help with resonating the principles of the carbon management process with all value chain members and stakeholders. Figure 2 proposes a unifying approach to compare well-established work stages in infrastructure and buildings, and indicates the terminology used in this document.

**Figure 2** – Unifying work stages for projects and programmes of work




**Key**

- PAS 2080:2023
- BS 8536:2022
- RIBA Plan of Work

***NOTE*** *This figure introduces work stages in PAS 2080 that are similar to those of the Value Toolkit (developed by the Construction Innovation Hub) [4]. For the purposes of this document, these stages map to the work stages of infrastructure (adapted from BS 8536:2022, with an additional "end-of-life" stage) and the work stages of the built environment (Plan of Work [5] developed by the Royal Institute of British Architects), as shown. There are other sector-specific definitions of work stages that differ from those shown in Figure 2, but this is not enough to hinder value chain members from implementing a carbon management process.*

# 1 Scope

This PAS specifies requirements for the management of whole life carbon in buildings and infrastructure – in the provision, operation, use and end of life of new projects and/or programmes of work, as well as the management or retrofit of existing assets and networks.

PAS 2080 is a specification to:

a) align the built environment with the transition to a net zero carbon economy by 2050;
b) encourage wider uptake of carbon management across the built environment;
c) promote close collaboration between all members of the value chain;
d) recognize the importance of systems in transitioning to net zero, clarifying the role of each value chain member to control and influence decision-making;
e) streamline consideration of influencing carbon beyond the project/programme boundaries;
f) emphasize the importance of the carbon reduction hierarchy for whole life carbon reduction;
g) take into account whole life carbon and circular economy principles when delivering/operating new or maintaining/repurposing/retrofitting existing assets/networks; and
h) integrate co-benefits and other emergencies/priorities as part of the carbon management and decision-making processes.

The scope of the PAS is summarized in Table 1.

**Table 1** – PAS 2080 scope

| PAS 2080 is about | PAS 2080 is not about |
|---|---|
| Managing carbon to reduce whole life emissions in the built environment, aligned with the net zero carbon transition and recognizing the importance of balancing climate adaptation and circular economy principles to bring wider co-benefits. | How to conduct a detailed appraisal of wider sustainability or environmental aspects[1)]. |
| Consistency in the process of carbon management, including target setting, opportunities identification, assessment, use of data, procurement, continuous improvement, monitoring, reporting, leadership, governance and collaboration for decarbonization. | Prescriptive greenhouse gas (GHG) quantification/assessment methodologies and data gathering, as this is already addressed in other standards/specifications. |
| Consistency in framing whole life carbon reduction, both within the control and influence of the value chain. | GHG reporting against national accounts or a compliance methodology. |
| Decarbonization for increasing value: driving whole life carbon reduction that is compatible with the net zero carbon transition. | Whole life cost management or prescriptive guidance on how to manage decarbonization at national level. |
| Demonstrating capability for integrating carbon in decision-making when delivering projects and/or programmes of work, whether at asset, network or system level. | Organizational or corporate ESG (environmental, social and governance) certification. |

[1)] While this standard is not about environmental or sustainability appraisals, it is important that the carbon implications of climate adaptation, biodiversity net gain and nature-based solutions are fully taken into account in the delivery, operation, use and end of life of projects and/or programmes of work. Failing to evaluate them together might risk conflict and unintended consequences across the systems.

## Table 1 – PAS 2080 scope

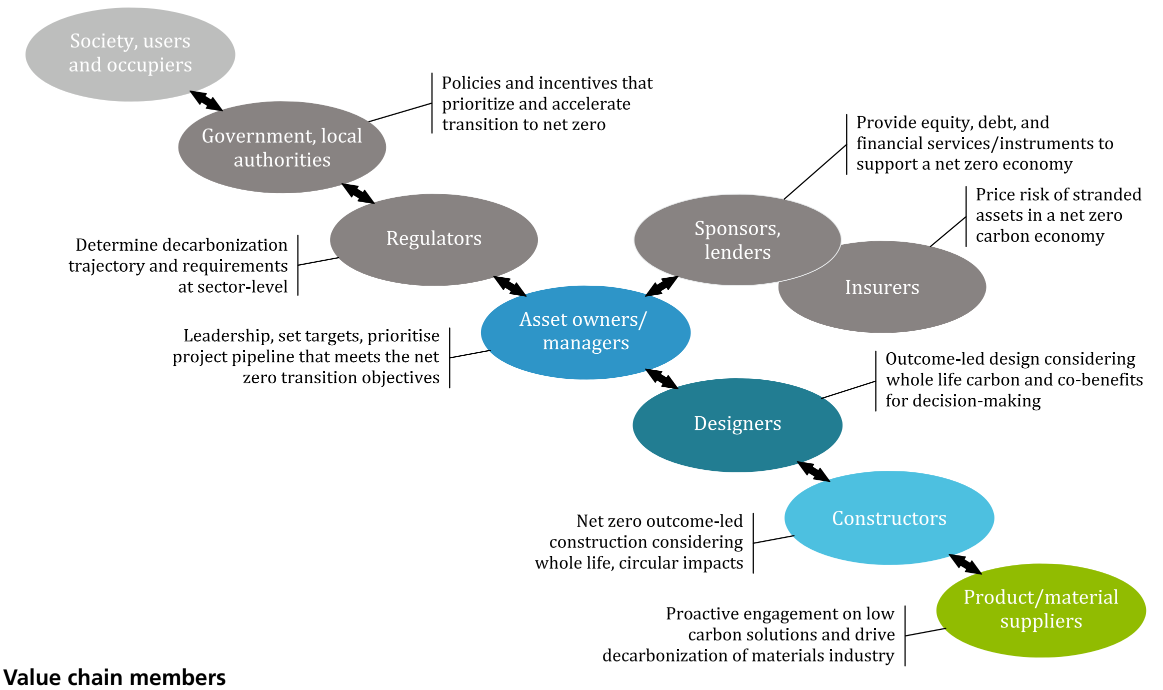
| PAS 2080 is about | PAS 2080 is not about |
|---|---|
| Highlighting the importance of government, regulators and financiers in implementing decarbonization in projects and/or programmes of work. | Setting prescriptive regulatory or investor requirements and KPIs. |

The concepts of systems thinking and co-benefits (e.g., climate adaptation, nature-based solutions) are being continually refined and applied. Although PAS 2080 is focused on carbon management, it recognizes the importance (for all value chain members) of addressing these concepts in the context of a project or programme of work and the associated risks or co-benefits of any intervention (see Clause **4** for further context and *Guidance document for PAS 2080* for worked examples).

Although asset owners/managers have the primary responsibility for implementing a carbon management process, all value chain members share responsibility for the management of the associated carbon emissions and removals during the delivery of projects and/or programmes of work. Asset owners/managers can only realize the intended reductions within a fully integrated value chain involving designers, constructors and product/material suppliers, together with regulators and financiers who influence climate-related policy, planning and regulation.

Figure 3 reflects the relationships across the value chain in the built environment and their roles in carbon management. While PAS 2080 does not set requirements for government, regulators and financiers, this revision acknowledges their importance in influencing decision-making in the built environment by providing additional guidance, in Annex C, on the role they can play in the net zero transition.

## Figure 3 – Value chain members in the built environment and their roles in carbon management




**Value chain members**

- Subject to PAS 2080 scope of requirements
- Not subject to PAS 2080 scope of requirements but guidance given in Annex C
- Not subject to PAS 2080 scope of requirements

***NOTE*** *Other stakeholders who have influence on carbon reduction but are not subject to the requirements of the PAS include, among others, letting agencies, academia and quantity surveyors.*

To help each value chain member contribute effectively, the responsibilities set out in each clause of this PAS are arranged under the following headings.

1) Requirements for all value chain members.
2) Asset owner/manager requirements.
3) Designer requirements.
4) Constructor requirements.
5) Product/material supplier requirements.

Practitioner roles in each value chain member include strategic planning, procurement, design, construction, operation, maintenance, use and end of life.

The PAS includes requirements for developing a carbon management process built around the following components.

i) Decarbonization principles (Clause **4**).
ii) Leadership (Clause **5**).
iii) Integrating carbon management into decision-making (Clause **6**).
iv) Whole life carbon assessment principles to support decision-making (Clause **7**).
v) Target setting and baselines (Clause **8**).
vi) Monitoring and reporting (Clause **9**).
vii) Procurement (Clause **10**).
viii) Continual improvement (Clause **11**).
ix) Claims of conformity (Clause **12**).

In addition to the clauses of this PAS, the informative annexes include guidelines on the following topics.

- Categories of emissions and removals to aid decision-making for reducing whole life carbon (Annex A).
- Applying the carbon management process (Annex B).
- Guidance for government, regulators and financiers (Annex C).

To successfully claim conformity with the requirements of this PAS, each value chain member is required to declare the role(s) they undertake (from the above responsibilities list). They can then demonstrate conformity with the clauses under the "requirements for all value chain members" heading and those under other headings pertaining to their role(s) – refer to Clause **12** for further details.

To achieve conformity, value chain members are to evidence relevant organizational capability appropriate to the point(s) of delivery at which they are involved. This includes alignment with the principles outlined in Clause **4** and demonstrating their capability to deliver decarbonization in the built environment.

***NOTE*** *Value chain members can claim conformity with PAS 2080 as:*

- *an asset owner/manager;*
- *a designer;*
- *a constructor; or*
- *a product/material supplier*

# 2 Normative references

There are no normative references in this document.

# 3 Terms and definitions

For the purposes of this PAS, the following terms and definitions apply.

## 3.1 activity

set of actions that consume time and resources and whose performance is necessary to achieve, or contribute to, the realization of one or more outcomes

[SOURCE: PD ISO/IEC TR 24766:2009, **3.1**]

## 3.2 activity data

data based on a unit quantity of input or output of the studied system or a process within it

***NOTE*** *Activity data can be a physical quantity such as mass (kg), a unit of cost (£), or a unit of energy (kWh).*

## 3.3 asset

physical entity forming part of a network and/or system that has potential or actual value to an organization and its stakeholders

***NOTE*** *For the purpose of this document, buildings are regarded as assets. They are serviced by infrastructure networks, which combined form different systems as part of the built environment.*

## 3.4 asset owner/manager

organization that manages and is responsible for providing, operating and maintaining a buildings and infrastructure network or asset(s)

***NOTE*** *Typically the asset owner/manager is the asset owner, but on occasion an asset owner/manager might also be the organization charged with operating buildings or infrastructure, a project sponsor, a service provider, a developer, a financier, the entity undertaking project works, or the organization charged with providing services from buildings and infrastructure.*

## 3.5 baseline

scenario for what carbon emissions and removals would have been in the absence of planned measures aiming to reduce emissions

***NOTE*** *Emissions and removals are separate parts of the baseline and calculation of emissions reduction only refers to the baseline emissions.*

## 3.6 building

structure, usually enclosed by walls and a roof, constructed to provide support or shelter for intended occupancy

[SOURCE: BS ISO 19880-1:2020, **3.7**]

## 3.7 built environment

collection of human-made or induced physical objects located in a particular area or region

***NOTE*** *When treated as a whole, the built environment typically is taken to include buildings, external works (landscaped areas), infrastructure, and the products of construction works within the area under consideration.*

[SOURCE: BS ISO 15392:2019, **3.5**]

## 3.8 capital carbon

GHG emissions and removals associated with the creation and end-of-life treatment of an asset, network or system, and optionally with its maintenance and refurbishment

***NOTE 1*** *GHG emissions associated with maintenance and refurbishment are included as "optional" under the capital carbon definition because they could also be defined as "operational carbon" emissions, depending on the chosen assessment methodology. The selected terminology is to be clarified as part of the assessment methodology process (see Clause* ***7****).*

***NOTE 2*** *PAS 2080 recognizes the use of the established terms "embodied carbon" and "upfront carbon" by parts of the industry (in accordance with existing life cycle assessments standards and guidance) to refer to similar stages of a whole life carbon assessment. For the purpose of PAS 2080, "capital carbon" is the selected terminology to allow comparison/alignment with the cost management/expenditure profile of projects and/or programmes of work (see Note 3). The selected terminology is to be clarified by the practitioner (as described in Clause* ***7****) and considered in the context of the PAS 2080 whole life carbon framework for decision-making in Clause* ***4****.*

***NOTE 3*** *As defined in the* Infrastructure carbon review *[1], capital carbon can be alternatively defined as the GHG emissions associated with the scope of capital expenditure defined in accordance with the asset owner's preference.*

## 3.9 carbon budget

estimated amount of whole life carbon a system can emit

***NOTE*** *Carbon budgets are usually set at the system level and are aligned to national or international net zero targets or other decarbonization trajectories defined at the system level.*

## 3.10 carbon dioxide equivalent ($CO_2$e)

unit for comparing the radiative forcing of greenhouse gases (GHGs) to carbon dioxide

***NOTE*** *The carbon dioxide equivalent is calculated using the mass of a given GHG multiplied by its global warming potential (see* ***3.25****).*

[SOURCE: BS ISO 14064-1:2006, **2.19** modified – note 2 deleted]

## 3.11 carbon management

assessment, reduction and removal of greenhouse gas emissions during the planning, optioneering, design, delivery, operation, use, end of life (and beyond) of new, or the management of existing, assets, networks and/or systems

## 3.12 carbon offset

discrete reduction in greenhouse gas emissions not arising from the defined subject, made available in the form of a carbon credit meeting a defined set of requirements (as per PAS 2060:2014) and used to counteract emissions from the defined subject

***NOTE*** *Offsets can be generated via a variety of activities, including those that avoid or reduce emissions and those that remove carbon from the atmosphere. Additional information on offset categories is available in the* Oxford principles for net zero aligned carbon offsetting *(2020) [6].*

[SOURCE: PAS 2060:2014, **3.7** modified – original note removed, new note added]

## 3.13 carbon reduction

process of minimizing greenhouse gas emissions in the development of new, or the refurbishment of existing, assets or networks

***NOTE*** *The outcome of carbon reduction process is a quantified reduction in existing sources of GHG emissions or the avoidance of GHG emissions.*

### 3.14 circular economy

economy that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles

***NOTE** Circular economy principles can be applied across all work stages of projects and/or programmes of work to assess materials/products in terms of reuse and recycling potential after end of life, as well as their flexibility in being repurposed or retrofitted whilst satisfying the whole life performance required from their respective assets and networks.*

[SOURCE: BS ISO 20400:2017, **3.1**]

### 3.15 co-benefits

added benefits of decarbonization, above and beyond the direct benefits of reducing greenhouse gas emissions

***NOTE** Examples of co-benefits include, but are not limited to, reduced air pollution, increased resilience, reduced cost and risks, employment possibilities, security, social justice, nature restoration and regeneration, and biodiversity net gain.*

### 3.16 constructor

entity that undertakes work to construct, build, maintain, repair, replace, disassemble or demolish an asset or network

***NOTE** A constructor can be an asset owner/manager or a product/material supplier.*

### 3.17 control

ability of value chain member to make decisions about activities that leverage carbon emissions and removals

***NOTE 1** This could include either operational decision-making power and/or financial decision-making power.*

***NOTE 2** Details of which value chain members, including regulators and financiers, have control or influence when working on an asset, network or system level are provided in Annex C.*

### 3.18 decarbonization

process by which organizations, sectors or other entities aim to achieve zero fossil carbon emissions, typically referring to a reduction of the carbon emissions associated with key sectors, such as electricity, industry and transport

### 3.19 designer

entity that creates, prepares or specifies the design of an asset or network that is to be constructed, maintained, repaired or refurbished

***NOTE** A designer can be an asset owner/manager, consultant, constructor or product/material supplier.*

### 3.20 emissions factor

amount of greenhouse gases emitted, expressed as carbon dioxide equivalent ($CO_2e$) and relative to a unit of activity

[SOURCE: PAS 2060:2014, **3.7** modified – note removed]

### 3.21 emissions reduction

quantified decrease in greenhouse gas emissions specifically related to or arising from an activity between two points in time or relative to a baseline

## 3.22 end of life

stage which begins when the asset has reached the end of its design life and is ready for refurbishment, retrofit, disposal, dismantling, etc., and ends when the asset is recycled, reused, recovered or returned to nature (combustion, deterioration)

***NOTE*** *The process for setting study boundaries and assessing end-of-life emissions follows an appropriate standard or methodology, as described in Clause* ***7****.*

## 3.23 financier

investor (individual or organization holding equity or debt categorized as financial assets, including but not limited to asset owners, asset managers and banks) and lender (individual or organization that loans money to a borrower to finance consumption or investment, on the expectation of repayment on contractual terms, usually within a stated period and with interest payment)

[SOURCE: ISO 14097:2021, **3.7** modified – to include separate definitions for investor and lender from same source]

## 3.24 functional unit

quantified performance of a product or system for use as a reference unit

***NOTE*** *The functional unit takes into account a function, a quantity, a duration, and a quality of the asset, network or system being assessed. Refer to the* Guidance document for PAS 2080 *for further explanation and examples of functional units.*

[SOURCE: BS EN ISO 14044:2006, **3.20** modified – note added]

## 3.25 global warming potential (GWP)

factor describing the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of $CO_2$ over a given period of time

[SOURCE: BS ISO 14064-1:2006, **2.18** modified – note deleted]

## 3.26 greenhouse gases (GHGs)

gaseous constituents of the atmosphere, natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds

***NOTE 1*** *Throughout PAS 2080, the term "carbon" is often used (e.g., capital carbon, user carbon, operational carbon). This is applied as shorthand for "GHGs" (or the equivalent $CO_2e$) as defined by the UNFCC Kyoto Protocol [7].*

***NOTE 2*** *The UNFCC Kyoto Protocol [7] (and Doha Amendment) seven main greenhouse gases include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride ($SF_6$) and nitrogen trifluoride ($NF_3$).*

[SOURCE: BS ISO 14064-1:2006, **2.1** modified – original notes deleted and new notes added]

## 3.27 greenhouse gas (GHG) assessment

process of calculating the total amount of GHG emissions and removals due to the delivery, use, operation, maintenance, demolition and/or reuse of assets and/or networks

***NOTE*** *The principles of quantification and reporting GHG emissions in the built environment differ from Scopes 1, 2 and 3 defined by the* Greenhouse Gas Protocol *[8], and adopted by the Science Based Targets initiative (SBTi) [9], typically used in the corporate sector (e.g. companies' sector, organizations, institutions). Although there are commonalities in certain terminologies and principles, a whole life carbon approach is used for the purpose of carbon management and driving decarbonization in the built environment (buildings and infrastructure).*

### 3.28 greenhouse gas (GHG) emission

total mass of GHG released to the atmosphere over a specified period of time

[SOURCE: BS ISO 14064-1:2006, **2.5**]

### 3.29 influence

ability of value chain member to support other value chain members to make low-carbon decisions

### 3.30 infrastructure

basic physical and organizational structures, facilities, equipment and services needed for the operation of a society or organization, or the services and facilities necessary for an economy to function

***NOTE*** *Assets (infrastructure assets and buildings) are part of networks (e.g. municipal pipes and manholes are part of a water network). The combination and interaction between networks (e.g. transport, drainage, water, energy, telecommunications) form built environment "systems" (see **3.49**).*

[SOURCE: ISO/TR 19231:2014, **3.5** modified – expanded to cover equipment, note added]

### 3.31 leadership

ability of an individual, group or organization to lead, influence or guide other individuals, teams or entire organizations

### 3.32 life cycle

consecutive and interlinked stages of a product, equipment or service, from raw material acquisition or generation from natural resources to design, production, transportation/delivery, use, end-of-life treatment and final disposal

***NOTE*** *A whole life cycle carbon assessment is only one of the components of the carbon management process. As further described in Clause **7**, existing standards for life cycle assessment do not cover all elements of the PAS 2080 whole life carbon framework for decision-making (Clause **4**), hence value chain members are to assess carbon influenced outside the direct project/programme boundary to inform decision-making (i.e. emissions/removals within the study boundary [see **3.48**]).*

[SOURCE: BS ISO 37100:2016, **3.1.12** modified – expanded to cover equipment, note added]

### 3.33 nature-based solutions

actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits

***NOTE*** *Nature-based contributions to decarbonization could be by: 1) providing infrastructure services (e.g. flood protection, urban cooling) and avoiding the need for capital and operational carbon from the equivalent grey/hard infrastructure (e.g. flood defences, air conditioning); 2) actively removing carbon from the atmosphere by enhancing natural ecosystem diversity and re-instating the natural carbon cycle, hence increasing carbon sequestration in the above ground vegetation (e.g. trees) and the soil that supports it. Worked examples are provided in the* Guidance document for PAS 2080*.*

[SOURCE: Cohen-Shachman et al. [10]]

### 3.34 network

combination of interconnected assets (buildings and infrastructure) that provide services (e.g. water, power, transport) to society as part of a wider system

***NOTE*** *Asset owners/managers are typically responsible for a network and have control over its delivery, operation, use and end of life.*

### 3.35 net zero

reduction of anthropogenic greenhouse gas emissions to zero or to a residual level that is consistent with reaching net zero emissions in eligible 1.5 °C pathways (hence time-bound) and neutralizing the impact of residual emissions (if any) by removing an equivalent volume of carbon

***NOTE 1** A net zero target is normally set at the system level reflecting national and/or international decarbonization trajectories to align to an eligible 1.5 °C pathway.*

***NOTE 2** Net zero differs from carbon neutrality (as defined in PAS 2060:2014), as net zero is focused on reducing whole life emissions and using removals to balance out residual emissions within a certain timeframe, whereas carbon neutrality relies on carbon offsets and does not necessarily support whole life carbon reduction. PAS 2080 has been developed to bring together value chain members across the built environment to work collaboratively towards the common goal of net zero carbon transition by 2050, hence does not include carbon neutrality as part of its scope.*

### 3.36 operational carbon

greenhouse gas emissions and removals associated with the operation of an asset, network and/or system required to enable it to operate and deliver its service

### 3.37 organization

company, corporation, firm, enterprise, authority or institution, or part or combination thereof, public or private, that has its own function and administration

### 3.38 practitioner

member of the value chain responsible for contributing to the successful implementation of a PAS 2080-compliant carbon management process, including strategic planning, procurement, programme manager, operator, designer/technical advisor, construction manager, material/product developer, environmental or sustainability manager

### 3.39 product/material supplier

organization that extracts, manufactures and/or produces materials or products for incorporation into works to construct, build, maintain or operate an asset or network

### 3.40 programme of works

defined set of projects related to the construction, maintenance, operation and/or end of life of an asset, network or system

***NOTE** A programme of works is a combination of two or more projects.*

### 3.41 project

unique process, consisting of a set of coordinated activities and controlled resources undertaken to achieve certain objectives that can take place at the asset, network or system level

[SOURCE: BS ISO 21931-2:2019, **3.22** modified – expanded to include resources]

### 3.42 project/programme boundary

physical, process, temporal and geographical limits of a project or programme of work

***NOTE 1** The "project/programme boundary" in PAS 2080 is typically referred to as "system boundary" in life cycle assessment standards. PAS 2080 does not use the same terminology, as existing standards do not address the systemic thinking required when making decisions from carbon reduction in projects and/or programmes of work in the built environment [see "system" definition (**3.49**) and Clause **4** for further details].*

*__NOTE 2__ For emissions beyond the project/programme boundary and its life cycle, refer to definition of "study boundary" (__3.48__).*

## 3.43 regulator

government or authority (e.g. country, state, city council, planning authority, highway authority, government department) which owns the regulatory applications of a specific sector or area, which serve as principles, policies or rules governing or prescribing the behaviour of users as well as the provisioning of goods, services and/or rights interchanged

*__NOTE__ Regulators are responsible for setting targets at a system level (as per Clause __8__). Asset owners/managers are expected to engage with regulators and other relevant asset owners/managers to influence policy-making as part of the carbon management process. Refer to Clause __4__ and Annex C for further information.*

## 3.44 removal

withdrawal of a greenhouse gas from the atmosphere and stored as a result of deliberate human activities

*__NOTE__ Removals are arbitrarily used to refer to either natural processes or technological solutions.*

[SOURCE: IWA 42:2022, **3.3.3** modified – original notes removed and new note added]

## 3.45 residual level

greenhouse gas emissions from a project or programme of work that remain unabated in a specific year after carbon reduction measures have taken place

*__NOTE__ As described in Clause __4__, it is important that carbon reduction targets (as defined in __3.50__) are consistent with the level of residual emissions in the year of national or sector-specific net zero in 1.5 °C-aligned mitigation pathways.*

## 3.46 resources

something that lies ready for use or that can be drawn upon (material and non-material) for aid or to take care of a need

## 3.47 sector

collection of organizations involved in the delivery and operation of assets for the purpose of providing a service (e.g. energy, water, telecommunications)

## 3.48 study boundary

physical, process, temporal and geographical limits of activities to assess GHG emissions and removals

*__NOTE 1__ A project or programme of works falls within the study boundary, however the study boundary can be equal to or greater than the project/programme boundary. The assessment of GHG emissions and removals at a wider study area helps with understanding the project or programme of works' impact on the wider network or system.*

*__NOTE 2__ Throughout PAS 2080, the term "boundary" is often used as a shorthand for "study boundary" unless specified.*

### 3.49 system

collection and interconnection of all physical facilities and human interactions that are operated in a coordinated way to provide a particular service

***NOTE 1*** *The built environment is heavily networked and interconnected, composed of "systems-of-systems", hence the importance of considering a systems-thinking approach in the context of carbon management and reduction of greenhouse gas emissions.*

***NOTE 2*** *Refer to definitions of asset (**3.3**), infrastructure (**3.30**) and **4.2** for further details of interdependencies and synergies between assets, networks and systems for the purpose of carbon management.*

### 3.50 target

desired quantity of carbon emissions (defined as an absolute value or as a reduction amount/percentage against a baseline value) that a project or programme of works is to achieve within a temporal extent

***NOTE*** *A target is specific and appropriate to a project or programme of works. It is measurable within a specified study boundary and is time-bound. It is important that a target is referenced to a baseline. This might implicitly determine a carbon budget.*

### 3.51 user carbon

greenhouse gas emissions associated with users' utilization of an asset, network and/or system, and the service it provides during operation

***NOTE 1*** *Refer to Annex A for further definition.*

***NOTE 2*** *Although user carbon is not directly controlled by asset owners/managers, they might have a direct influence on user carbon emissions, particularly through collaboration with relevant stakeholders. Refer to Annex A for further guidance and examples of user carbon in different sectors.*

### 3.52 value chain

organizations and stakeholders involved in creating, operating and managing assets and/or networks

***NOTE*** *These include asset owners/managers, designers, constructors and product/material suppliers, but also regulators and financiers.*

### 3.53 whole life carbon

sum of greenhouse gas emissions and removals from all work stages of a project and/or programme of works within the specified boundaries

***NOTE 1*** *This includes GHG emissions and removals within the project/programme boundary, as well as emissions/removals between the project/programme and study boundary.*

***NOTE 2*** *Not to be confused with "design life", which is the life expectancy of the material/product/asset, as defined by its designers within its specified parameters [see "end of life" (**3.22**)]. Typically, whole life is longer than design life.*

***NOTE 3*** *Whole life carbon considerations for a project and programme of works are wider than the typical life cycle (see Note 2) assessments account for, particularly when considering carbon emissions/removals in their influence at a system level (see Clause **4**).*

# 4 Decarbonization principles

*COMMENTARY ON CLAUSE **4***

*This clause sets out the fundamental principles underpinning the carbon management process presented in this PAS. Their application allows practitioners to demonstrate that a true and fair approach has been adopted when undertaking carbon management activities.*

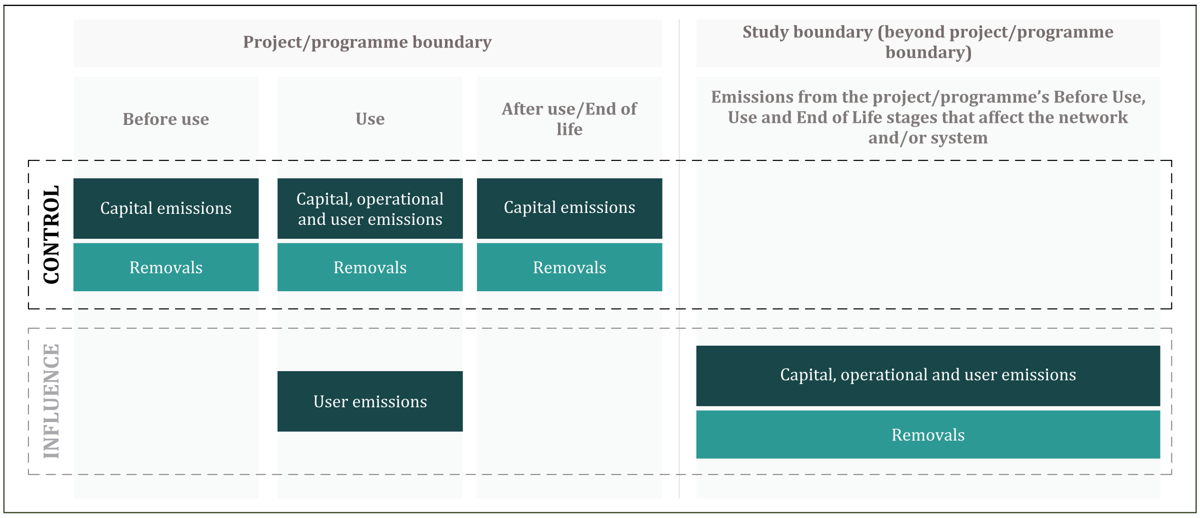
*The carbon management principles apply to projects and programmes comprising buildings and infrastructure. At the core of the principles is the fact that no asset of the built environment can function in isolation from its surrounds: its construction, operation and use impacts on and is impacted by the functions of networks and systems of which it is part. Likewise, the decarbonization principles apply to all value chain members to a greater or lesser extent. More specific details are given in Clause **5** and Clause **6**.*

## 4.1 Managing whole life carbon under the control and influence

All value chain members shall:

a) identify all activities that result in carbon emissions or removals they control and influence, at the asset, network and system level, as set out in Figure 4;

**Figure 4** – PAS 2080 whole life carbon framework for decision-making




***NOTE 1*** *This framework is to identify a comprehensive list of emissions and removals to be assessed, but also to manage the reduction of those emissions. Current practices and standards typically take into account the assessment of emissions at an asset or network level, but given the complexity, scale and impact of the built environment, a holistic framework for both assessing to inform decision-making and managing whole life carbon emissions (including emissions relating to both control and influence) is required.*

***NOTE 2*** *This framework has been developed to provide a systematic guide to help practitioners identify all relevant emissions (examples provided in Table A.1 and Table A.2), assess their magnitude to inform decision-making for reducing those emissions at every work stage of a project or programme and, in turn, so that the decarbonization of the built environment contributes towards the regional, national and international transition to net zero carbon. The framework is not focusing on how accurate any assessments of whole life emissions need to be in different stages of the delivery process. Accuracy, data sources and detailed assessment methodologies are provided in existing standards and guidance. The framework is referenced in Clause **7**, when practitioners are assessing emissions and in Clause **6**, when practitioners follow the implementation of the PAS 2080 carbon management process to systematically manage emissions.*

b) identify interdependencies, synergies and relationships between their own project and/or programme of works and the network and system, and engage with relevant stakeholders to identify carbon reduction opportunities and risks at an asset, network and system level;

*NOTE 3 Examples of these interdependencies and synergies can be found in Annex A.*

*NOTE 4 Decision-making at the system level might mean, for example, that sacrifice/investment in capital carbon is required for operational savings or vice-versa, hence the importance of considering any project or programme of works from a whole life carbon perspective. Similarly, the selection of a low-carbon material feedstock or component in one territory might have a negative impact on emissions elsewhere. Further explanation of this decision-making process is provided in the* Guidance document for PAS 2080*.*

c) prioritize nature-based solutions for reduced whole life carbon emissions and potential for carbon removal, as well as the associated co-benefits;

*NOTE 5 Co-benefits include those that positively address other* environmental *emergencies (e.g., climate adaptation and biodiversity loss) as well as social and economic priorities. Although this PAS is about carbon management, it is important that decision-making in the built environment considers these other aspects to determine the optimal solution/approach for the context of each project of programme of work.*

d) engage with other value chain members or other stakeholders (such as planning authorities, financiers, government and regulators, among others) to align approaches to carbon reduction and maximize decarbonization opportunities for the project and/or programme of work and, where possible, an economic sector or geographical region;

*NOTE 6 All value chain members have a role to play in decarbonizing the built environment, but the government (including local authorities), regulators and financiers typically have the greatest opportunity to set the direction of a project and/or programme of works due to their strategic role on setting policies, objectives, requirements and outcomes. In the absence of requirements for these members in this PAS Annex C provides some context of their role and responsibility to implement carbon management at all levels.*

e) identify the work stages within which they have control or influence in terms of identifying, managing or delivering low-carbon solutions. Where opportunities or risks to influence system-wide decarbonization exist and are significant, these shall be prioritized;

f) assess emissions and removals in accordance with the whole life carbon framework for decision-making in Figure 4 and the assessment principles in Clause **7**;

g) demonstrate that the level of accuracy appropriate for informing decision-making at the stage of the project or programme has been taken into account(as per Clause **7**); and

h) integrate whole life carbon reduction in their decision-making processes in accordance with Clause **6**.

*NOTE 7* Guidance document for PAS 2080 *provides further explanation of what control and influence mean for each value chain member, and includes worked examples.*

In addition, asset owners/managers and designers shall:

1) identify the carbon implications of climate resilience, or lack of, at the asset, network or system level, and integrate them in the whole life carbon framework for decision-making; and

2) collaboratively engage with other value chain members and relevant stakeholders for solutions that deliver the required level of climate change resilience for the lowest whole life carbon, including carbon avoided in recovering from future events.

## 4.2 Aligning to net zero carbon transition

Asset owners/managers shall prioritize target-setting and carbon reduction measures for the project and/or programme of work that align to and support the transition to net zero carbon as set out at the system, network or national level (see Clause **8** for further details).

Where national or sector carbon budgets do not exist, or where downscaling of such budgets at the project/programme level has not been set due to lack of policy or regulation, asset owners/managers shall engage with other asset owners/managers and regulators/government in their network or system to assess how the project or programme of work aligns with wider decarbonization goals.

***NOTE 1*** *Due to lack or inadequacy of policies and regulation, many sectors are still not regulated for net zero, hence do not have carbon targets or budgets set at a system, sector or national level. As indicated in Annex C, it is important that government and regulators act urgently to avoid unintended consequences, such as determining mechanisms of how increases in whole life carbon emissions from a project and/or programme of works are addressed in other parts of the system, sector or national level when considering limited carbon budgets.*

***NOTE 2*** *Further clarification is provided in* Guidance document for PAS 2080 *for asset owners/managers to interpret the relationship and differences between net zero targets for projects and/or programmes of work and science-based targets for their organizations.*

## 4.3 Managing whole life emissions by applying the carbon reduction hierarchy

All value chain members shall:

a) follow the carbon reduction hierarchy as presented in Figure 5 (in the order of priority shown) when identifying potential opportunities to reduce whole life carbon emissions.

   ***NOTE 1*** *The carbon reduction hierarchy is to be applied to all emissions – capital, operational and user emissions (as defined in Clause **3**).*

   ***NOTE 2*** *The greatest ability to influence whole life carbon reduction is at the "need" stage, where objectives and outcomes of projects/programmes are still being developed and assessed, hence the importance of value chain members following a carbon management process right from the start of the delivery process. This is also reflected in Clause **6**.*

b) in applying the carbon reduction hierarchy, demonstrate they have taken into account the following:

   1) avoid: align the outcomes of the project and/or programme of work with the net zero transition at the system level and evaluate the basic need at the asset and/or network level;

      ***NOTE 3*** *This may include exploring alternative means for satisfying the need for whole life performance while not constructing a new asset/network or reusing/retrofitting/repurposing existing ones.*

   2) switch: assess alternative solutions and then adopt one that reduces whole life emissions through alternative scope, design approach, materials, technologies for operational carbon reduction, among others, while satisfying the whole life performance requirements;

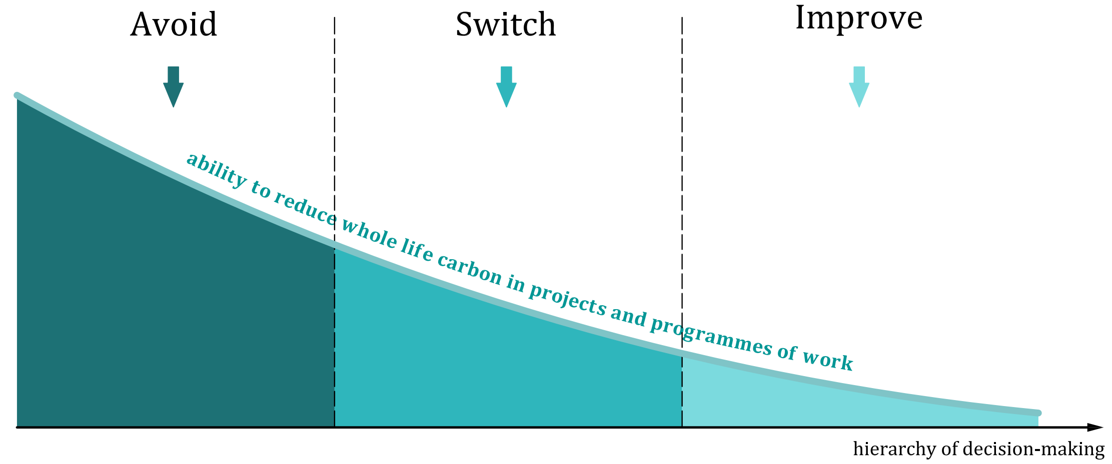
      ***NOTE 4*** *This may also include employing innovative models that optimize the balance between capital, resource use, operational and user efficiency of an asset/network.*

   3) improve: identify and adopt solutions and techniques that improve the use of resources and design life of an asset/network, including applying circular economy principles to assess materials/products in terms of their potential for reuse or recycling after end of life.

      ***NOTE 5*** *This includes efficiency measures for the use stage of an asset/network, and is not limited to material resources and other design and construction efficiencies.*

      ***NOTE 6*** *In identifying appropriate low-carbon solutions, priority should be given to solutions that promote network and system decarbonization as far as possible.*

**Figure 5** – Carbon reduction hierarchy




***NOTE*** *This figure represents a simplified and streamlined version of the carbon reduction hierarchy presented in PAS 2080:2016 and the* Infrastructure carbon review *[1]. It has been updated to clarify its applicability and relevance to a wider range of projects and programmes within the built environment (i.e. to clarify that the carbon reduction hierarchy is not solely about new builds).*

## 4.4 Implementing appropriate governance

All value chain members shall form and implement governance structures to:

a) align whole life carbon impacts of any decisions made with the decarbonization principles in Clauses **4.1** to **4.3**;

b) make carbon management underpin all projects and/or programmes of work (as per the requirements in Clause **6**), regardless of their scale or work stage;

c) embed whole life carbon into business and management processes, forming part of decision-making alongside cost, time and risk;

d) define and establish roles and responsibilities for carbon management to promote the outcomes and behaviours required for decarbonization;

e) put in place roles and responsibilities for engagement with other value chain members and stakeholders so that system-wide opportunities and risks are identified and managed;

f) allocate resources (human and financial) to support the delivery of carbon management processes;

g) put processes in place to assess GHG emissions, identify carbon reduction opportunities, and implement them in projects and programmes;

h) support the implementation of low-carbon solutions;

i) collaborate across the value chain, sharing expertise, knowledge and data to drive decarbonization across the industry;

j) improve business processes based on feedback from other value chain members;

k) allocate senior management support to all decision-making that has a significant effect on carbon management; and

l) keep records in support of carbon management monitoring and reporting practices (as per Clause **9**).

# 5 Leadership

*COMMENTARY ON CLAUSE **5***

*Leadership is recognized as a key enabler of carbon management. It provides the vision to drive carbon reductions across all levels of an organization and allows the right capabilities to exist across the value chain to plan for and drive decarbonization. Leadership is expected from all levels of the value chain in implementing the requirements in this clause.*

## 5.1 Requirements for all value chain members

All value chain members shall:

a) set an organizational policy and strategy for carbon management, with clear roles and responsibilities, and align commercial/business goals with this strategy/structure;

b) assign responsibilities to practitioners of all the disciplines within the organization that are relevant for the development and implementation of the carbon management process;

c) communicate consistently and regularly to staff at all levels within their own organization on the importance of carbon management;

d) have training programmes in place to fill gaps in knowledge and skills;

e) make adequate and competent human resources available for the development and implementation of the carbon management process;

f) demonstrate a commitment to continuous improvement through the sharing of current good practice (internally and externally);

g) promote a culture that rewards efforts to drive down carbon emissions in their own organization, as well as other organizations in the value chain;

h) make the requirements of their carbon management strategy compatible and integrated with other business processes (e.g. asset management, risks management, procurement, health and safety, cost management, quality, delivery programme, sustainability, environmental management);

i) communicate consistently with other value chain members and system stakeholders to develop collaborative relationships with the goal of reducing whole life carbon at the system level;

j) when delivering projects and/or programmes of work, where possible, involve relevant value chain members and stakeholders (e.g. government, regulators, local authorities and financiers) in strategic discussions related to the delivery process to assess how to best drive decarbonization at the asset, network and system level; and

k) proactively collaborate with members of the value chain to promote and implement decarbonization solutions within their control and influence (see Clause **4**).

## 5.2 Asset owner/manager requirements

In addition to **5.1**, asset owners'/managers' leadership shall:

a) clearly document and communicate the desired carbon management outcomes, roles, responsibilities and requirements (as per Clause **6** to Clause **11**) to their value chain when delivering projects and/or programmes of work at the asset, network or system level;

b) support value chain and stakeholder communication to discourage silos, develop collaborative behaviours and enable system optimization;

c) encourage value chain members to challenge current practices and solutions by having whole life carbon reduction as a key objective/outcome for delivery and applying the carbon reduction hierarchy across work stages (as per Clause **4**);

d) identify appropriate mechanisms to recognize and, where possible, reward performance in the value chain to drive low-carbon solutions (including relevant KPIs and financial incentives as set out in Clause **10**);
e) be accountable for meeting reduction targets in projects and/or programmes of work at the asset and/or network level; and
f) clearly identify the whole life carbon implications in their control and influence at the network and system level, and communicate these across the value chain.

***NOTE*** *The importance of embedding these requirements into contracts and procurement processes should be reflected throughout all leadership activities as per Clause **10**.*

## 5.3 Designer requirements

In addition to **5.1**, designers' leadership shall:

a) support asset owners/managers in identifying and implementing whole life carbon reduction opportunities in the control and influence (see Clause **4**) of the asset owner/manager, including brokering collaborations with relevant stakeholders, where appropriate;
b) challenge existing standards, guidance and requirements, or equivalent, where relevant, to drive low-carbon solutions;
c) set clear requirements and guidance for their own suppliers working on projects and programmes to help prioritize whole life carbon reduction outcomes;
d) enable/encourage cross-discipline coordination to drive low-carbon solutions throughout design development; and
e) develop a culture to encourage design and technological innovation that drive decarbonization.

## 5.4 Constructor requirements

In addition to **5.1**, constructors' leadership shall:

a) promote early involvement in the delivery of projects and programmes, and put mechanisms in place to enable collaboration with asset owners/managers, designers and material/product suppliers;
b) challenge their clients, designers and suppliers to provide low-carbon solutions;
c) support supply chain partners that can demonstrate their own carbon reduction commitment; and
d) integrate resource efficiency and circular economy principles into construction business models.

## 5.5 Product/material suppliers

In addition to **5.1**, product/material suppliers' leadership shall:

a) communicate and promote low-carbon solutions to all value chain members during early work stages;
b) encourage carbon management processes and low-carbon technologies within their supply chain and among their industry peers;
c) proactively communicate clear, complete and transparent carbon information to other value chain members; and
d) challenge their clients, designers and constructors to provide low-carbon solutions.

# 6 Integrating carbon management into decision-making

*COMMENTARY ON CLAUSE **6***

*Integrating whole life carbon into decision-making requires the development and implementation of a carbon management process. The intention of a carbon management process is to drive the right behaviours at each work stage (both for infrastructure and buildings) to reduce whole life carbon in a project or programme of work. This process is to be developed and implemented by asset owners/managers. All value chain members, however, are responsible for specific requirements within the carbon management process.*

## 6.1 Requirements for all value chain members

### 6.1.1 Identify control and influence in whole life carbon reduction

All value chain members shall identify:

a) the level of control and influence they have during the work stages for delivering projects and/or programmes of work (as discussed in Clause **4**);

b) the necessary collaborations with other stakeholders that will enable whole life carbon reductions under their control and influence; and

c) the network(s) and system(s) with which the project or programme of work interacts, and the nature of those interactions.

***NOTE*** *Further guidance is given in Annex A and Annex B.*

### 6.1.2 Establish and implement a carbon management process

At each work stage, participating value chain members shall:

a) understand and prioritize the requirements of the carbon management process (see Figure 6) for delivering the project and/or programme of work as established by the asset owner/manager;

b) identify whole life carbon reduction opportunities over which they have control and/or influence, according to the carbon reduction hierarchy (see Clause **4**), and take early action to reduce carbon emissions where the opportunity is greatest;

c) prioritize the implementation of solutions that best support system-wide decarbonization;

d) challenge current practices to enable whole life carbon reduction, including scope, strategy and intended outcomes, standards and prescriptive specifications, design approach, programme or cost;

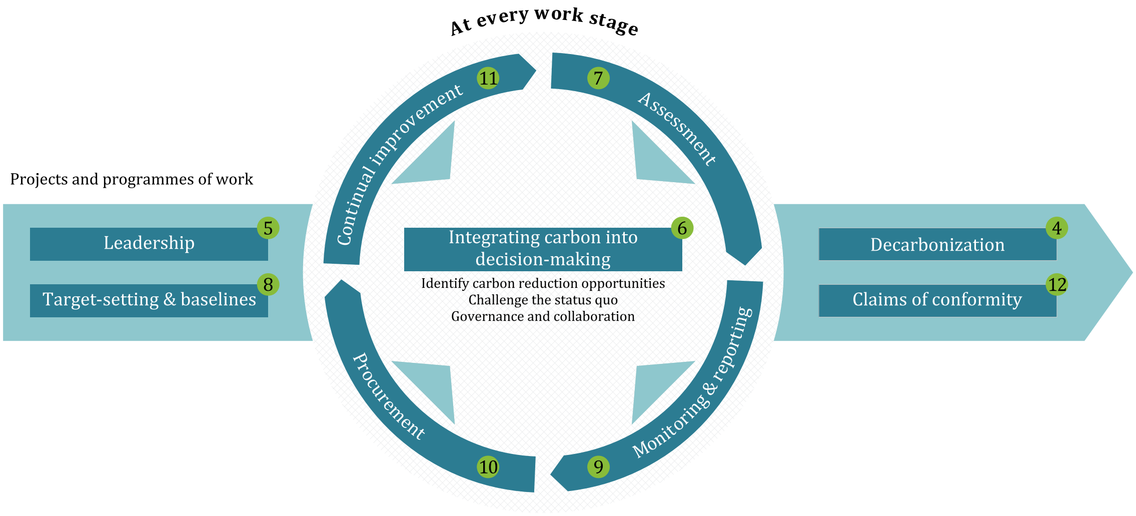
e) collaborate with other stakeholders and value chain members to implement solutions that minimize whole life carbon;

f) assess whole life carbon emissions and removals in their control and influence (as per Clause **7** and the PAS 2080 whole life carbon framework for decision-making in Clause **4**) and record reductions (as per Clause **9**) with reference to the baseline(s) and target(s) set (as per Clause **8**);

g) identify low-carbon alternatives appropriate at each stage of the carbon reduction hierarchy (as per Clause **4**), including nature-based solutions and circular economy opportunities in the project or programme, where appropriate; and

h) where carbon removal activities are planned or undertaken, report them separately from carbon emissions and emissions reductions.

**Figure 6** – The PAS 2080 carbon management process




**Key**

X PAS 2080 clause number

*NOTE The circled numbers are cross-references to the relevant clauses in this PAS.*

## 6.2 Asset owner/manager requirements

### 6.2.1 Requirements for all work stages

In addition to meeting the requirements of **6.1**, asset owners/managers shall:

a) develop and implement a carbon management process (see Figure 6) when suited to their project(s) and/or programme(s) of work at the asset, network or system level;

b) allocate and communicate unambiguous responsibilities for each aspect of the carbon management process to value chain members involved in the delivery of project(s) and/or programme(s) of work for each work stage;

c) make decarbonization and alignment with the net zero carbon transition central to the scope and requirements of the project(s) and/or programme(s) of works;

d) align with and support sector, regional or national decarbonization ambition, or clearly explain why such alignment has not been achieved;

e) align in-house asset standards and guidance with the decarbonization principles (see Clause **4**);

f) set appropriate governance structures as per the governance principles in **4.4**;

*NOTE 1 This involves setting clear roles and responsibilities in the organization to manage whole life carbon when delivering projects and programmes of work, as well as setting up key decision-making milestones in each work stage to challenge every project on the basis of whole life carbon reduction.*

g) define and communicate to the rest of the value chain the assessment requirements for the project(s) and/or programme(s) of work (including impacts to the network and system as per Clause **7**) for achieving consistency when developing and sharing tools or data;

h) set out the objective and frequency of GHG emissions assessments (as per Clause **7**) and reporting (as per Clause **9**) during the delivery of projects and programmes, so that assessments sufficiently inform decision-making;

i) set out procurement mechanisms that enable the delivery of low-carbon solutions (as per Clause **10**); and

j) develop a collaborative environment for all value chain members involved in the implementation of the carbon management process during the delivery of systems/networks/assets and the project(s) and/or programme(s) of work.

***NOTE 2** Standards such as BS ISO 37000, BS ISO 44001 and BS 11000 provide further detail on how to develop and implement appropriate governance structures and collaborative environments that benefit all aspects of built environment delivery. Asset owners/managers can use these to define roles, responsibilities and processes that include all value chain members (see also Clause **10**).*

**6.2.2 Requirements for the need and optioneering stages**

In addition to meeting the requirements of **6.1** and **6.2.1**, asset owners/managers shall:

a) demonstrate that the ability of a project or programme to enable and support the net zero carbon transition of its network and/or system has been taken into account when assessing the need for a new project or programme;

   ***NOTE** Collaboration with other members of the value chain might be required to define this compatibility.*

b) identify the required projects and/or programmes that constitute the organization's contribution to the net zero carbon transition (of the network and system of which their assets are a part) and define a clear implementation strategy that is time-bound and in line with or beyond the set targets;

c) identify the carbon impacts associated with meeting the climate resilience needs for asset, network and/or system climate resilience;

d) review opportunities for the project(s) and/or programme(s) to alter land use or deploy nature-based solutions, and prioritize opportunities for these to help decarbonize the network and/or system;

e) identify activities that fall within the study boundary in line with the requirements of Clause **4** and Clause **7**, including impacts on the network and system;

f) assess carbon impacts in accordance with Clause **7**, prioritizing assessment of emissions and removals that might help identify the lowest carbon outcome;

g) compare the whole life carbon of all options considered using a time horizon that reflects the life of the outcome rather than the life of an asset;

h) clearly define baselines and time-bound targets at project or programme level (as per Clause **8**);

i) demonstrate that they have taken into account alternative approaches that minimize whole life carbon; and

j) demonstrate that they have taken into account options that maximize the use of existing assets where this delivers the lowest whole life carbon outcome.

**6.2.3 Requirements for the design and delivery stages**

In addition to meeting the requirements of **6.1** and **6.2.1**, asset owners/managers shall:

a) set clear design requirements for the project or programme of work to align with the net zero transition;

b) procure design and delivery services based on whole life decarbonization (as per Clause **10**);

   ***NOTE 1** This includes not just capital or operational carbon, but also user carbon.*

   ***NOTE 2** Decarbonization requirements are complemented by the commercial and programme requirements and are not in conflict with them.*

c) select a study boundary that covers all relevant sources of whole life carbon for the project or programme, including user carbon where relevant, noting that the study boundary might be wider than the project/programme boundary;

d) align standards and guidance with whole life decarbonization requirements;

e) use appropriate assessment methodologies for whole life carbon emissions and removals within both the control and the influence of the organization, in accordance with the requirements of Clause **7**;

f) demonstrate that they have assessed options that maximize the use of existing assets where this delivers the lowest whole life carbon outcome; and

g) put in place a system to implement circular economy principles within the planning, design, construction, and operational and end-of-life management, of assets, including collaboration with stakeholders for the useful exchange of resources.

   ***NOTE 3** It might be necessary to revisit decisions made in previous stages to check whether carbon at system and/or network level is still being reduced, and whether opportunities/alternatives to reduce carbon at system and/or network level are being considered and implemented.*

#### 6.2.4 Operational and end-of-life requirements

In addition to meeting the requirements of **6.1** and **6.2.1**, asset owners/managers shall:

a) optimize the operational performance of assets, networks and/or systems, identify any need for retrofitting and/or operational efficiency, and specify the timescales over which they shall be addressed;

b) procure asset management services based on the whole life carbon that the project(s) and/or programme(s) influence, as well as that which they control (as per Clause **10**);

c) capture operational data and feedback to improve baselines; and

d) assess and report actual emissions and performance against targets, in accordance with reporting principles.

### 6.3 Designer requirements

In addition to meeting the requirements of **6.1**, designers shall:

a) challenge the standards and prescriptive requirements that have an impact on whole life carbon;

b) integrate whole life carbon reduction opportunities in the design of the project or programme;

c) have governance structures in place, as per Clause **4**, that promote whole life carbon reduction opportunities;

d) comply with targets defined by the asset owner/manager for the project or programme of work and challenge targets where there is potential for improvement;

e) set targets that are aligned with net zero at the network or system level, to the extent that this is possible, where the asset owner/manager has not set any targets;

f) assess whole life carbon emissions of design options using an approach that is consistent with the requirements of Clause **7**;

g) demonstrate that they have followed the carbon reduction hierarchy as per Clause **4**, including, among other things, how they have assessed how to reuse materials, specified low-carbon materials, specified energy efficient and/or renewable energy generation, and otherwise minimized resource use;

h) demonstrate that they have assessed future adaptability and material recovery; and

i) submit carbon reduction proposals to the asset owner/manager or other value chain members, if appropriate, supported by the anticipated benefits and outcomes of the carbon management process.

### 6.4 Constructor requirements

In addition to meeting the requirements of **6.1**, constructors shall:

a) have governance structures in place, as per Clause **4**;

b) comply with targets defined by the asset owner/manager and challenge targets where there is potential for improvement;

c) set targets that are aligned with net zero at the network or system level, to the extent that this is possible, where the asset owner/manager has not set any targets;

d) assess whole life emissions of construction works using an approach that is consistent with the requirements of Clause **7**;

   ***NOTE*** *For complex construction works (particularly major infrastructure projects), where data and/or tools are not available to fully assess carbon during construction, assess as a minimum the carbon impact of the most significant activities/practices and have a plan on capturing data to improve future benchmarks (see also continual improvement principles in Clause **11**).*

e) minimize use of resources (e.g. materials, water, energy), transport to site and construction waste, and maximize opportunities for reuse/recycling/recovery;

f) capture data and share knowledge on innovative construction techniques, materials and product use; and

g) submit carbon reduction proposals to other value chain members as appropriate, supported by the anticipated benefits and outcomes of the carbon management process.

## 6.5 Product/material supplier requirements

In addition to meeting the requirements of **6.1**, product/material suppliers shall:

a) have governance structures in place, as per Clause **4**;

b) develop and deploy low-carbon solutions, technologies, materials, products and/or methods;

c) make carbon data of existing and developing products easily accessible, allowing other members of the value chain to identify products that produce the best low-carbon outcomes;

d) assess and report to all members of the value chain the whole life carbon emissions of materials/products supplied (including direct operations and those of their supply chain) in a transparent manner;

e) demonstrate efforts towards achieving compliance with an appropriate product level life cycle assessment standard; and

***NOTE*** *This PAS recognizes that smaller organizations might not have environmental product declarations (EPDs) for new and innovative products/materials, e.g. in cases where there may be a backlog of EPD certification. EPD certification could include BS EN 15804 and ISO 21930, among others. PAS 2080 intends to encourage progress for product/material suppliers to become verified under PAS 2080. This PAS, therefore, focuses on product/material suppliers sharing relevant whole life carbon emissions information using appropriate methodologies in a transparent manner.*

f) submit carbon reduction proposals to other value chain members as appropriate, supported by the anticipated benefits and outcomes of the carbon management process.

# 7 Whole life carbon assessment principles to support decision-making

*COMMENTARY ON CLAUSE **7***

*The purpose of Clause **7** is to ensure that whole life carbon assessment is fit for integrating carbon reduction into decision-making in projects and programmes, in accordance with Clause **6**.*

*This clause establishes key principles for consistency in the assessment approach throughout the value chain, encourages a level of detail commensurate with the decision-making at the stage considered, recognizes that the accuracy of assessment improves as the project/programme develops, and emphasizes the importance of assessing whole life carbon, even in the absence of detailed data during the early optioneering stage of the delivery process to drive low-carbon behaviours and decisions.*

*This clause references the whole life carbon framework (introduced in Clause **4**) that for the assessment of emissions and removals within and beyond a project/programme boundary. The framework can be applied to projects and/or programmes of work at the asset, network or system level. The framework builds on life cycle assessment principles of existing standards and does not intend to replace those, while enabling a common carbon management language across different asset/network/system typologies.*

*The framework allows carbon hotspots both in the control and influence of the value chain to be identified and, in turn, support whole life carbon reductions. Central to the PAS 2080 whole life carbon framework is the importance of systems thinking for achieving decarbonization.*

## 7.1 Requirements for all value chain members

### 7.1.1 Assessing GHG emissions over the whole life to inform decision-making at the asset, network and system level

All value chain members shall:

a) establish a comprehensive study boundary that takes into account all emission sources and removals included in the whole life carbon framework for decision-making (see Clause **4**). The study boundary shall be greater than the project/programme boundary to account for impacts on the wider network and system;

*NOTE 1 Examples of relevant emission sources and removals are provided in Table A.1 and Table A.2.*

b) assess emissions and removals for all sources within the control and influence of the value chain member (as per the whole life carbon framework for decision-making in Clause **4**) during all stages of the delivery process;

c) assess the impact of all emissions or removals to a level of detail that supports decision-making at each work stage, such that:

1) at the need and optioneering stages, an appropriate methodology (see **7.1.3**) is used to prioritize assessment of emissions and removals that might affect which option is identified as the lowest carbon outcome (including impacts to the network and system, even when outside the project boundary), working with benchmarks or initial quantities where needed; and

*NOTE 2 An option may involve the creation of new assets and/or the repurposing of existing assets.*

2) at the design, delivery and operation stages, an appropriate methodology (see **7.1.3**) is used to assess to an appropriate degree of detail all relevant sources of emissions and removals attributable to the project or programme.

*NOTE 3 This should include impacts on the network and system, except in cases where it can be demonstrated that this is no longer relevant for decision-making.*

*NOTE 4 Refer to Figure 7 for the level of detail that supports decision-making at different stages of the delivery process.*

d) assess and record emissions and removals associated with land use change (including nature-based and climate resilience solutions) as part of the decision-making process; and

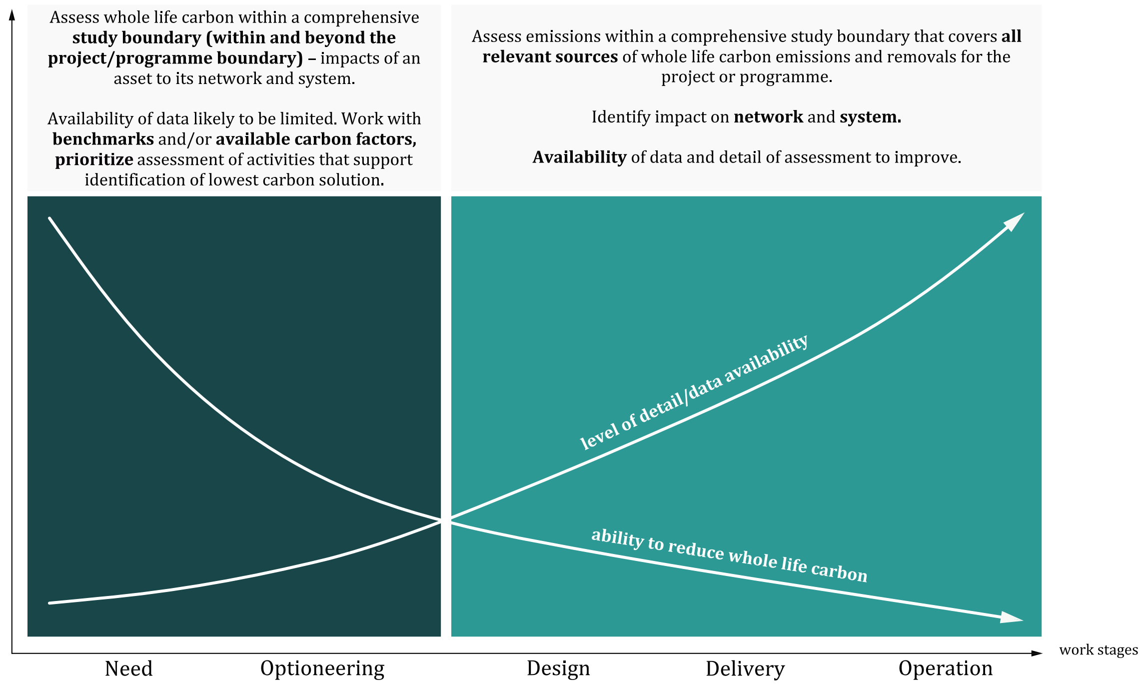
e) not include market-based offsets within the assessment boundary.

### 7.1.2 Selecting an appropriate level of accuracy and detail

Value chain members shall adopt the whole life carbon framework for decision-making, introduced in Clause **4**, to support and inform the decision-making process (see also Clause **6**) for meeting any carbon reduction targets (as per Clause **8**).

***NOTE 1*** *Value chain members should recognize that the accuracy of any GHG assessment, particularly the availability of carbon and/or asset data, improves over the delivery process, and accept that the accuracy of any assessment might be lower at the initial option selection stages. See Figure 7 for an illustration of this.*

**Figure 7** – Degree of accuracy and data availability in whole life carbon assessments across work stages




***NOTE*** *This figure illustrates how the assessment approach changes across project stages to support the decision-making process most effectively.*

Value chain members shall seek to improve the accuracy of their assessment(s), to neither overestimate nor underestimate actual emissions, and to reduce uncertainty as much as practicable.

***NOTE 2*** *Text on accuracy has been adapted from the* Greenhouse Gas Protocol *[8].*

### 7.1.3 Selecting a GHG assessment methodology

All value chain members shall:

a) assess whole life GHG emissions using appropriate GHG assessment methodologies from existing lifecycle analysis standards and/or other recognized sources;

b) identify the limitations in existing methods and address these to meet the assessment requirements in **7.1.1** and **7.1.2** that focus on assessing whole life carbon to inform decision-making at the asset, network or system level; and

c) compare the whole life carbon impact of options using the same GHG assessment methodology for consistency.

***NOTE*** *This PAS recognizes that there are existing national and international lifecycle standards for assessment of GHGs in buildings and other civil works (such as BS EN 15978, BS EN 17472 and BS EN 15804) that could be used to assess GHG emission sources.*

# 8 Target setting and baselines

*COMMENTARY ON CLAUSE **8***

*Setting carbon reduction targets provides clear direction and communicates intent for carbon reduction. It is important that targets are set against clear baselines so that performance against them can be determined. This clause focuses on target setting and baselines throughout the whole life of projects and/or programmes of work at the asset or network level. This PAS recognizes that net zero targets should be set at the system level and ideally all networks and assets should have targets that are aligned with the system net zero target. This PAS also recognizes the importance of asset owners/managers setting carbon targets against clear baselines at project and programme level so that the value chain can focus their efforts in delivering those targets.*

*The purpose of asset-level targets is to deliver the required pace and scale of carbon reduction to support and enable a system-level net zero target. An isolated "net zero" target at asset level might cause unintended consequences of increased carbon elsewhere in the system and shift focus to offsetting carbon rather than whole life carbon reductions or activities that could result in significant carbon reductions at the network or system level. Asset-level targets should be ambitious and align to a system-level net zero target. Further context is provided in **4.1** and **4.2**.*

*At the need stage through to construction, a whole life carbon target should be met which might then evolve to an operational emissions target from handover.*

## 8.1 Requirements for all value chain members

### 8.1.1 Carbon reduction targets

All value chain members shall:

a) adopt the carbon reduction targets set by the asset owner/manager as a minimum (see **8.2.1**); and

b) communicate and share carbon targets with other value chain members.

### 8.1.2 Baselines

All value chain members shall:

a) collect and report asset and whole life carbon data relevant to their activities when delivering projects and/or programmes of work to inform future baselines; and

b) identify limitations in the accuracy of setting baselines when making comparisons against their activities during the delivery of projects and/or programmes of work, and transparently report any uncertainties at appropriate stages of infrastructure and buildings delivery.

   ***NOTE*** *This is similar to cost assessments.*

## 8.2 Asset owner/manager requirements

### 8.2.1 Carbon reduction targets

In addition to meeting the requirements of **8.1**, the asset owner/manager shall develop whole life carbon reduction targets that:

a) are set for projects and programmes at the asset or network level and align with the relevant system-level net zero carbon targets;

   ***NOTE 1*** *Where system-level target is not set, engage with their peers and/or other value chain members not covered under the scope of this PAS (e.g., regulators/government) to influence the setting of the net zero carbon target at the system level.*

b) relate to a defined outcome based on the functional unit set for the project or programme of works at the asset or network level (in line with Clause **7**);

c) are appropriate in scope to the work stage to which they are relevant; and

d) are time-bound.

*NOTE 2 An asset owner/manager could set a net zero target at the network level, where appropriate. For example, in the absence of system-level net zero target in an infrastructure or buildings sector, an asset owner/manager might choose to set a net zero target at the network level covering their entire portfolio.*

#### 8.2.2 Baselines

In addition to meeting the requirements of **8.1**, asset owners/managers shall set baselines that:

a) are set for projects and programmes at the asset or network level;

b) follow the assessment principles presented in Clause **7**, and which align to the boundary used for setting whole life carbon targets;

c) create a reference level against which future performance can be compared relative to targets set;

d) reflect good industry practice;

*NOTE 1 Baselines should, across the industry, improve over time to mirror improvements in practices. They should reflect the latest good practices for design and activity data (such as for materials and design choices) and reputable sources of emissions factors. Therefore, the practitioner is expected to take into account these aspects when developing a baseline so it becomes a mutually agreed starting point from which all value chain members should work to improve.*

e) provide sufficient detail to assist with identifying carbon emissions hotspots, on which to focus efforts to reduce emissions;

f) state any assumptions used to fill data gaps and the limitations this might have on the relevance of the baseline;

g) describe inclusions and exclusions;

h) set out the circumstances in which the baseline might be updated;

i) where gaps exist within the baseline, identify any uncertainty in the assessment; and

j) follow a continual improvement process to make good practices in current GHG assessments contribute to future baselines.

*NOTE 2 There might be limitations when setting baselines for the first time where there is not enough existing data within an organization, or relevant secondary data to produce baselines which follow the principles for GHG emissions assessment (Clause 7). In such instances, the best available data is chosen to allow the most valid comparisons against a design. It is critical, however, that mechanisms are put in place that require the collection of relevant data from the value chain during delivery so improved baselines can be created for future projects and/or programmes of works.*

## 8.3 Designer requirements

#### 8.3.1 Carbon reduction targets

In addition to meeting the requirements of **8.1**, designers shall:

a) work towards meeting the asset owner's/manager's carbon reduction targets;

b) challenge the asset owner/manager to mutually agree a target where the asset owner/manager has not set a whole life carbon reduction target; and

c) recommend and record improvements to the asset owner's/manager's approach to target setting, where appropriate.

#### 8.3.2 Baselines

In addition to meeting the requirements of **8.1** and **8.3.1**, designers shall:

a) support asset owners/managers to set baselines, where requested by the asset owner/manager, by providing relevant activity data;

b) recommend and record improvements to the asset owner's/manager's approach to setting baselines, where appropriate; and

c) collect and share relevant data for improving future baselines and communicate to the asset owner/manager.

## 8.4 Constructor requirements

### 8.4.1 Carbon reduction targets

In addition to meeting the requirements of **8.1**, constructors shall:

a) work towards meeting the asset owner's/manager's carbon reduction targets;

b) challenge the asset owner/manager to mutually agree a target where the asset owner/manager has not set a whole life carbon reduction target; and

c) recommend and record improvements to the asset owner's/manager's approach to target setting, where appropriate.

### 8.4.2 Baselines

In addition to meeting the requirements of **8.1** and **8.4.1**, constructors shall:

a) support asset owners/managers to set baselines, where requested by the asset owner/manager, by providing relevant activity data to support their development;

b) recommend and record improvements to the asset owner's/manager's approach to setting baselines; and

c) collect relevant data for improving future baselines and communicate to the asset owner/manager.

## 8.5 Product/material supplier requirements

### 8.5.1 Carbon reduction targets

In addition to meeting the requirements of **8.1**, product/material suppliers shall recommend and record improvements to the asset owner's/manager's approach to target setting.

***NOTE*** *This can be, for example, the availability of a sector target for specific materials (such as concrete), which could inform the target-setting approach of the asset owner.*

### 8.5.2 Baselines

In addition to meeting the requirements of **8.1** and **8.5.1**, product/material suppliers shall:

a) support asset owners/managers to set baselines, where requested by the asset owner/manager, by providing relevant environmental impact information of the product or material (as per Clause **6** and Clause **7**) to support their development;

b) recommend and record improvements to the asset owner's/manager's approach to setting baselines; and

c) when making claims that a product or material reduces carbon compared to another product or material (as per Clause **6** and Clause **7**), align these claims with the baseline assumptions specified by the asset owner/manager.

   ***NOTE*** *This is to avoid product/material suppliers making further claims of carbon reductions already captured in the target-setting and baseline process.*

# 9 Monitoring and reporting

*COMMENTARY ON CLAUSE **9***

*A carbon management process should have robust monitoring and transparent reporting at frequent intervals during the delivery of projects and/or programmes of work to highlight the progress of carbon reductions against targets. Reports should inform decision-making in managing whole life carbon, as well as provide information for future continuous improvement.*

## 9.1 Requirements for all value chain members

All value chain members shall:

a) identify roles and responsibilities at each work stage for monitoring and reporting, and for submitting monitoring reports to the relevant stakeholders;

b) report whole life carbon emissions at each work stage defined in Clause **6**, in line with the assessment principles detailed in Clause **7**;

c) report progress made against targets set at an asset or network level, as appropriate;

d) keep records on low-carbon options and the extent to which they can improve performance over a baseline; and

e) share good practice outcomes, including non-carbon impacts and benefits of opportunities, where relevant, with other value chain members to drive low-carbon solutions in similar projects and/or programmes of work.

## 9.2 Asset owner/manager requirements

In addition to meeting the requirements of **9.1**, asset owners/managers shall:

a) report whole life carbon emissions during the delivery work stages, in line with the assessment principles (Clause **7**);

b) develop KPIs to monitor and report carbon emissions, which are:

   1) developed with the same functional unit as used in baseline and target setting;

   2) incorporated into a governance system which makes the collection and reporting of KPI data a proactive process; and

   3) not overly burdensome to particular value chain members, with data gathering and reporting requirements shared across the value chain.

c) as a minimum, monitor and report carbon emissions during all work stages or at key points where decisions are made that influence whole life carbon reduction;

d) follow relevant requirements for reporting to government and other system-level stakeholders; in the absence of such requirements, identify how reporting practices can support system-level stakeholders in facilitating decarbonization;

e) review KPIs and project/programme carbon risks regularly to identify any further actions required to meet targets; and

f) publish summary information on the performance of assets, networks and/or systems against carbon targets.

***NOTE*** *Asset owners/managers can decide the frequency of monitoring of GHG emissions against the baseline. This will depend on the nature of the project or programme of work being delivered.*

## 9.3 Designer requirements

In addition to meeting the requirements of **9.1**, designers shall:

a) monitor and report the predicted carbon emissions of the elements of design for which they are responsible at appropriate and agreed delivery work stages, and report these against the asset owner's/manager's carbon reduction targets at the required frequency;

b) where an opportunity for improvement to the asset owner's/manager's approach to monitoring and reporting is identified, recommend and, where accepted, assist in its implementation in the delivery of projects and/or programmes of work; and

c) identify carbon hotspots in the design of the project or programme of work, and report these to the asset owner/manager and other value chain members at regular intervals.

## 9.4 Constructor requirements

In addition to meeting the requirements of **9.1**, constructors shall:

a) monitor and report carbon emissions in construction and, where appropriate, commissioning and decommissioning activities, during the relevant delivery stages;

b) where an opportunity for improvement to the asset owner's/manager's approach to monitoring is identified, recommend and, where accepted, assist in its implementation in the delivery of assets and programmes of work; and

c) identify and report where the greatest carbon emissions are expected to occur or have occurred, and where future reductions can be made.

## 9.5 Product/material supplier requirements

In addition to meeting the requirements of **9.1**, product/material suppliers shall put systems in place in their own organization to monitor and share carbon emissions of their own product/material carbon data so that such data is made available to other users.

# 10 Procurement

*COMMENTARY ON CLAUSE **10***

*The procurement process is critical to accelerate whole life carbon reductions in the value chain when delivering projects and/or programmes of work. This PAS recognizes that procurement is not solely the development of a contract; it's a mechanism that will incentivize the right behaviours.*

*Organizations might want to consider the guidance of ISO 20400 and include carbon as part of a holistic approach to the integration of sustainability in all aspects of procurement activity.*

## 10.1 Asset owner/manager requirements

### 10.1.1 Contracts

Asset owner/managers shall:

a) assess how requirements in contracts for designers, constructors or product/material suppliers or within the delivery model could support the asset owner's/manager's alignment with the decarbonization principles (Clause **4**) and the requirements in the carbon management process;

b) prioritize whole life carbon as a performance drive, avoiding prescriptive specification;

c) make requirements proportionate and relevant to each work stage;

d) provide regular updates of the contract's performance against the agreed carbon reduction targets and other requirements to the contracted entity, and review and/or re-incentivize performance against these targets on par with performance against cost and programme;

e) where appropriate, include data management/information exchange requirements in contracts to support monitoring and reporting (see Clause **9** and Clause **11**);

f) where appropriate, identify incentive mechanisms that reward whole life carbon performance;

g) where appropriate, allow for challenges to asset standards that enable low-carbon performance;

h) support appropriate risk allocation mechanisms that promote the inclusion of low whole life carbon solutions which might be novel and not proven in previous projects and/or programmes of work; and

i) incentivize collaborative contractual arrangements across the value chain that maximize carbon reduction opportunities.

   ***NOTE*** *To support the inclusion of numerical carbon targets in contracts, the asset owner/manager might also need to specify a baseline performance level with reference to **8.2.2**.*

### 10.1.2 Sourcing

Asset owner/managers shall:

a) periodically review the procurement categories that support the delivery of their projects and/or programme of works and identify those with a material carbon impact;

b) develop proportionate criteria for inclusion in tenders that support the selection of suppliers who can efficiently enable delivery of low-carbon outcomes;

c) review and update asset standards and specifications to promote the integration of low whole life carbon solutions; and

d) provide timely and actionable feedback to suppliers on how they performed in tenders, including carbon-focused selection criteria.

***NOTE*** *The importance of carbon should be explicit and aligned with other procurement priorities, such as commercial outcomes, programme and risk. ISO 20400 also provides guidance on approaches to considering a range of sustainability aspects within a broader procurement framework.*

#### 10.1.3 Engagement

Asset owner/managers shall:

a) communicate project and/or programme and carbon targets to the contracted entity;

b) communicate the role the value chain has in achieving the asset owner's/manager's carbon targets;

c) periodically engage with their value chain to identify potential low-carbon techniques or products that can support their projects and/or programmes of work, following the requirements of Clause **6**; and

d) identify opportunities to collaborate with the value chain to develop low-carbon skills and capability.

### 10.2 Designer requirements

#### 10.2.1 Contracts

Designers shall:

a) support appropriate risk allocation approaches set in contracts by the asset owner/manager that promote low-carbon solutions;

b) engage with the asset owner and/or other value chain members involved in the contract to agree on a solution that is acceptable to all relevant parties, where the risk allocation approach needs to be challenged;

c) in responding to tenders for projects and/or programmes of work, demonstrate the approach they will take to identify low-carbon options of relevance to the specific objectives for the project;

d) provide regular updates to the asset owner/manager of the contract's performance against the agreed carbon reduction targets, and review performance against these targets on par with performance against cost and programme; and

e) demonstrate how they will meet the requirements of the asset owner's/manager's carbon management process.

#### 10.2.2 Engagement

Designers shall:

a) promote their low-carbon solutions within the value chain;

b) engage with the value chain to identify ways in which incentives within their design contracts encourage the implementation of low-carbon solutions;

c) identify opportunities to collaborate with the value chain to develop low-carbon skills and capability; and

d) where opportunities exist, actively collaborate with the value chain to develop and integrate capability.

***NOTE*** *As set out in Clause* ***5****, designers should collaborate with other members of the value chain in order to understand the low-carbon solutions they are able to offer.*

### 10.3 Constructor requirements

#### 10.3.1 Contracts

Constructors shall:

a) support appropriate risk allocation approaches set in contracts that promote low-carbon solutions;

b) engage with the asset owner and/or other value chain members involved in the contract to agree on a solution that is acceptable to all relevant parties, where the asset owner's/manager's risk allocation approach needs to be challenged;

c) in responding to tenders for projects and/or programmes of work, demonstrate the approach they will take to identify low-carbon options of relevance to the specific objectives for the project or programme of work;

d) where appropriate, identify any carbon reduction measures included within their tender response;

e) assess how requirements in sub-contracts could support the constructor's project/programme carbon targets and/or support the identification of low-carbon solutions, in line with the asset owner's/manager's carbon management process;

f) provide regular updates to the asset owner/manager of the contract's performance against the agreed carbon reduction targets, and review performance against these targets on par with performance against cost and programme; and
g) demonstrate how they will meet the requirements of the asset owner's/manager's carbon management process.

#### 10.3.2 Sourcing

Constructors shall:

a) periodically review the procurement categories that support the delivery of their activities and identify those with a material carbon impact;
b) develop proportionate criteria for inclusion in tenders that support the selection of suppliers who can deliver low-carbon solutions; and
c) where required, identify and integrate low-carbon solutions within their proposed responses to tenders.

#### 10.3.3 Engagement

Constructors shall:

a) promote their low-carbon solutions across the value chain;
b) communicate carbon targets to the value chain;
c) communicate the role the value chain has in achieving their carbon targets;
d) periodically engage with their value chain to identify potential low-carbon techniques or products that can support their projects and/or programmes of work; and
e) identify opportunities to collaborate with the value chain to develop low-carbon skills and capability.

***NOTE*** *As set out in Clause* ***5****, constructors should collaborate with other members of the value chain in order to understand the low-carbon solutions they are able to offer.*

## 10.4 Product/material supplier requirements

Product/material suppliers shall:

a) engage with other members of the value chain to identify commercial models that can support the uptake of low-carbon solutions;
b) identify opportunities to collaborate with the value chain to develop low-carbon skills and capability; and
c) regularly communicate innovative, low-carbon solutions to other value chain members.

# 11 Continual improvement

*COMMENTARY ON CLAUSE **11***

*Continual improvement is a core part of the carbon management process that allows lessons learned to improve the delivery of current and future projects and/or programmes of work; this should be targeted towards the end goal of decarbonization. Continual improvement also allows organizations to mature their carbon management experience and learn from each other about effective decarbonization approaches, including innovations.*

## 11.1 Requirements for all value chain members

All value chain members shall:

a) establish a process of continual improvement and innovation that targets the development of low-carbon solutions, organizational capability to deliver low-carbon, and improvements in procurement processes and the relevant carbon management process components (Clause **6**);

b) capture carbon emissions information and share it with other value chain members in order to facilitate continual improvement in future carbon management between organizations within the infrastructure and building sectors;

c) capture carbon reduction solutions and share learning with other value chain members to inform good practice; and

d) maintain ongoing engagement across the value chain – asset owners/managers, designers, constructors and product/material suppliers – to build learning on industry innovations to further drive whole life carbon reductions at the asset, network and system level.

***NOTE** Organizations within the infrastructure and building value chains might already use approaches to continual improvement at a project or programme level (e.g. BS ISO 14001 or BS EN ISO 9001).*

## 11.2 Asset owner/manager requirements

Asset owners/managers shall:

a) annually review the effectiveness of their carbon management process and governance structures in place and make improvements where they do not result in low-carbon solutions;

b) regularly review their procurement process and, where necessary, make improvements to put appropriate incentives and/or requirements in place to help value chain members deliver whole life carbon reduction in projects and/or programmes of work;

c) adapt their GHG assessment methodology, as data availability improves, to minimize uncertainty and produce accurate, consistent and reproducible results (Clause **7**);

d) build up an inventory of the most relevant data to use when developing baselines and assessing carbon emissions at different infrastructure and building work stages; and

e) assess the need to update the project or programme of work baselines in delivery work stages to prevent carbon reductions from being claimed that are based on outdated and/or inappropriate baselines.

## 11.3 Designer requirements

Designers shall:

a) provide input to asset owner/manager continual improvement requirements and share improved carbon data to inform future delivery of projects and/or programmes of work; and

b) put in place a process to assess the skills and capability within their organizations and, where necessary, provide further training and/or guidance in relation to GHG assessment, baselines, targets, identifying and promoting whole life carbon reduction, and delivering low-carbon solutions.

## 11.4 Constructor requirements

Constructors shall:

a) provide input to asset owner/manager continual improvement requirements and share improved carbon data to inform future delivery of projects and/or programmes of work;

b) put in place a process to assess their procurement process, establishing appropriate incentives and/or requirements for value chain members to deliver whole life carbon reduction in projects and/or programmes of work;

c) capture as-built data and feedback to help improve baselines; and

d) evaluate the skills and capability within their organizations and, where necessary, provide further training and/or guidance in relation to GHG assessment, baselines, targets, low-carbon solutions, low-carbon procurement, monitoring and reporting.

## 11.5 Product/material supplier requirements

Product/material suppliers shall:

a) engage with other value chain members to share the latest low-carbon innovations and assess their applicability to projects and/or programmes of work; and

b) evaluate the skills and capability within their organizations and, where necessary, provide further training and/or guidance in relation to GHG assessment, baselines, targets, low-carbon solutions and low-carbon procurement.

# 12 Claims of conformity

## 12.1 General

Where claims of conformity to PAS 2080 are made, the provisions in **12.2** and **12.3** shall apply. These provisions include identification of the type of certification or verification undertaken (see **12.2**) and requirements for how the claim shall be expressed (see **12.3**).

## 12.2 Basis of claim

### 12.2.1 General

The claim shall identify the type of conformity assessment undertaken as one of the following:

a) independent third-party certification in accordance with **12.2.2**;

b) other-party validation in accordance with **12.2.3**; or

c) self-validation in accordance with **12.2.4**.

The claim shall be explicit in terms of the scope of the conformity (organization, programme or project) and the specific clauses to which conformity is claimed.

### 12.2.2 Independent third-party certification

Buildings and infrastructure asset owners/managers seeking to demonstrate that their carbon management process has been independently verified as being in accordance with this PAS shall undergo an assessment by an independent third-party certification body accredited to provide assessment and certification to this PAS.

### 12.2.3 Other-party validation

Organizations using an alternative method of validation involving parties other than those qualifying as accredited independent third parties shall satisfy themselves that any such party is able to demonstrate compliance with recognized standards setting out requirements for bodies providing certification services.

***NOTE 1*** *Other-party validation bodies are those undertaking assessment services without having achieved accreditation from the authorized accreditation service (e.g. UKAS in the UK). Such bodies could include those which, although independent of the organization undertaking the assessment of GHG emissions, cannot demonstrate complete independence, e.g. a trade body providing assessment services for its members or a consultant employed for such a purpose.*

***NOTE 2*** *Examples of such recognized standards include BS EN ISO/IEC 17065.*

### 12.2.4 Self-validation

Organizations shall be able to demonstrate that their carbon management process has been established in accordance with this PAS and publish supporting documentation on a website and make information available upon request. The supporting document shall detail:

a) the scope of the claim, in terms of the organizational entity, programme or project which is claiming conformity;

b) summary evidence for each clause which demonstrates that the relevant requirements have been met;

c) any limitations of the claim due to data quality or data gaps;

d) the key stakeholders/roles involved in the carbon management process; and

e) summary of actions for the further improvement of the carbon management process.

***NOTE 1*** *The appropriate method for self-validation and presentation of the results can be determined by reference to BS EN ISO 14064-3 and BS EN ISO 14021.*

***NOTE 2*** *Organizations for whom neither independent third-party certification nor other-party verification is a realistic option may rely on self-verification. In so doing, organizations should be aware that independent verification could be required in the event of a challenge and that stakeholders might have less confidence in this option.*

*NOTE 3 Guidance on what represents suitable evidence is set out in the* Guidance document to PAS 2080*.*

## 12.3 Permitted forms of disclosure

### 12.3.1 Asset owners/managers

Claims of conformity shall use the appropriate form of disclosure, as follows.

a) For claims of conformity based on independent third-party certification in accordance with **12.2.2**: "Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with **12.2.3**: "Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with **12.2.4**: "Carbon management process for [insert unambiguous identification of asset or programme of work] implemented as asset owner/manager by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

### 12.3.2 Designers

Claims of conformity shall use the appropriate form of disclosure.

a) For claims of conformity based on independent third-party certification in accordance with **12.2.2**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with **12.2.3**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with **12.2.4**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as designer by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

### 12.3.3 Constructors

Claims of conformity shall use the appropriate form of disclosure.

a) For claims of conformity based on independent third-party certification in accordance with **12.2.2**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with **12.2.3**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with **12.2.4**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as constructor by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

### 12.3.4 Product/material suppliers

Claims of conformity shall use the appropriate form of disclosure, as follows:

a) For claims of conformity based on independent third-party certification in accordance with **12.2.2**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the certification body] certified."

b) For claims of conformity based on other-party validation in accordance with **12.2.3**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, [insert unambiguous identification of the validation body] validated."

c) For claims of conformity based on self-validation in accordance with **12.2.4**: "Carbon management process for work undertaken on [insert unambiguous identification of asset or programme of work] implemented as product/material supplier by [insert unambiguous identification of the claimant] in accordance with PAS 2080, self-validated."

# Annex A (informative)
# Categories of emissions and removals to aid decision-making for reducing whole life carbon

## A.1 Whole life carbon emission sources and removals

Table A.1 sets out a list of emissions sources and removals for different sectors of the built environment at various stages: before use, during operation and use, and end-of-life. The emissions sources and removals are categorized as per the whole life carbon framework for decision-making introduced in Clause **4**. This framework should be used for identifying relevant sources of carbon emissions and removals to aid in decision-making for reducing whole life carbon at the asset, network and system level. Once identified, all emission sources and removals should be assessed as per Clause **7**, and action taken to reduce them as per all relevant clauses of PAS 2080.

Because decision-making should be geared towards reducing carbon across the whole system, value chain members should consider how to reduce all carbon over which they have control and influence, including capital (or embodied/upfront), operational and user carbon, as well as impacts on natural systems. While the scope of PAS 2080 relates to reducing carbon, value chain members should also take into account how the decisions made in built environment delivery cause other impacts (both benefits and dis-benefits) on the environment and/or wider sustainability goals.

Table A.1 is not exhaustive and can be used as a starting point. Each value chain member should identify all the relevant sources of emissions and removals for their particular circumstance and/or the standard they are using.

Beyond the project/programme boundary assessments should reflect the potential benefits or dis-benefits conferred from one network or system in the built environment to another. Table A.2 sets out a non-exhaustive set of examples of potential benefits or dis-benefits that may result from activity in different networks or systems. Value chain members need to consider which benefits or dis-benefits are material (i.e. non-marginal) to the decisions being made and therefore worthy of assessment. This will avoid time-consuming effort on trivial beyond-the-boundary components.

**Table A.1** – Typical emissions and removal sources in buildings and infrastructure to take into account when managing whole life carbon at the asset, network and system level

| | Before use | Use | End-of-life |
|---|---|---|---|
| Buildings | Site preparation.<br>Planning, design and construction or substantial retrofit/ refurbishment of existing buildings, including substructure, superstructure, facades and fit out. | Energy and materials involved in the maintenance and upkeep of buildings.<br>Use of energy and water by the building, including both regulated and unregulated energy sources. | Reuse, repurposing or removal of buildings. |

**Table A.1** – Typical emissions and removal sources in buildings and infrastructure to take into account when managing whole life carbon at the asset, network and system level *(continued)*

| | Before use | Use | End-of-life |
|---|---|---|---|
| Energy infrastructure | Site preparation.<br>Planning, design and construction or substantial retrofit/ refurbishment of infrastructure that generates, transmits, distributes or stores energy. | Energy (including fuel user for transport) and materials involved in maintenance and upkeep of energy infrastructure.<br>Energy consumption of the infrastructure itself (auxiliary loads).<br>All energy sector conversion, transmission and distribution losses.<br>Any emissions from chemicals used in processes, including refrigerants, $SF_6$ or similar insulating gases.<br>Emissions associated with the use of energy at the point of energy consumption. | Reuse, repurposing or removal of energy infrastructure. |
| Water infrastructure | Site preparation.<br>Planning, design and construction or substantial retrofit/ refurbishment of infrastructure:<br>• water resources assets – boreholes, reservoirs and dams<br>• potable water supply – distribution systems, pumping stations and treatment works<br>• collection and treatment of sewage – sewers, pumping stations and treatment works<br>• distribution – pipelines and pumping stations; and<br>• flood and coastal defences. | Energy (including fuels used for transport) and materials involved in maintenance of water infrastructure.<br>Energy used in conveyance of water.<br>Direct treatment process emissions.<br>Energy use (including fuel used for transport) for the operation of water assets.<br>Chemicals for treatment of water.<br>Energy use for the heating of water and conveyance of water at the point of use. | Reuse, repurposing or removal of waste infrastructure. |

**Table A.1** – Typical emissions and removal sources in buildings and infrastructure to take into account when managing whole life carbon at the asset, network and system level *(continued)*

| | Before use | Use | End-of-life |
|---|---|---|---|
| Transport infrastructure | Site preparation.<br>Planning, design and construction or substantial retrofit/ refurbishment of infrastructure covering all road, rail, aviation and marine/inland water modes. | Energy (including fuel used for transport) and materials involved in the maintenance and upkeep of transport infrastructure.<br>Energy for street and public realm lighting.<br>Energy for pumps, control and automation systems, signage, signalling etc.<br>Other energy-related emissions and operational processes necessary for the operation and management of transport assets.<br>Energy and fuel use by vehicles (road, aviation, water and rail) that are owned and operated by asset owners/managers and/or operators providing transport services on the infrastructure.<br>Energy and fuel use by user-owned vehicles (road, aviation, rail, maritime). | Reuse, repurposing or removal of transport infrastructure. |
| Waste infrastructure | Site preparation.<br>Planning, design and construction or substantial retrofit/ refurbishment of infrastructure used for processing, treatment, reuse, recycling and final disposal of waste. | Energy and materials involved in the maintenance and upkeep of waste infrastructure.<br>Energy used to power waste handling, processing and treatment equipment (to end-of-waste point).<br>Emissions arising from any chemicals or other agents used to process and treat waste.<br>Biogenic fugitive emissions from the storage or processing of waste.<br>Transport of waste from point arising to point of recycling/reuse (i.e. to end-of-waste point) and final disposal.<br>Direct emissions arising from any process to treat and dispose of waste at point of final disposal. | Reuse, repurposing or removal of waste infrastructure. |

**Table A.1** – Typical emissions and removal sources in buildings and infrastructure to take into account when managing whole life carbon at the asset, network and system level *(continued)*

| | Before use | Use | End-of-life |
|---|---|---|---|
| Communications infrastructure | Site preparation.<br>Planning, design and construction or substantial retrofit/ refurbishment of infrastructure for:<br>• voice and data networks (fixed and mobile);<br>• satellite networks; and<br>• TV and radio broadcast networks. | Energy and materials involved in the maintenance and upkeep of communications infrastructure.<br>Electricity consumption of networks and data centres.<br>Energy and fuel use by vehicles that are owned and operated by asset owners/managers and/or operators providing services on the infrastructure.<br>End-user device electricity consumption and any end-user data centres. | Reuse, repurposing or removal of communications infrastructure. |
| All sectors | Land use change as part of the project or programme. Either:<br>• degradation/net carbon emissions from, for example, conversion from a green field to a building/infrastructure grey asset; or<br>• regeneration/net carbon removal from, for example, an upgrade to a biodiverse natural habitat within the project boundary.<br>Planning, design and construction or substantial retrofit/ refurbishment of protection from increased flooding and/or heat induced from climate change.<br>Planning design and construction or retrofit of carbon capture, utilization and storage (CCUS) plant as part of the project or programme. | Land use change as part of the project or programme. Either:<br>• degradation/net carbon emissions; or<br>• regeneration/net carbon removal from, for example, an upgrade to a biodiverse natural habitat within the project boundary.<br>Additional operational energy to protect from extreme flood and/or heat events induced from climate change.<br>Repair and/or replacement of assets and systems following damage from extreme weather events.<br>Energy for the operation of CCUS on the project or programme (leading to abated emissions). | Land use change as part of the project or programme. Either:<br>• degradation/net carbon emissions from the project or programme, for example, reuse, repurposing or removal of assets; or<br>• regeneration/net carbon removal from, for example, an upgrade to a biodiverse natural habitat within the project boundary. |

**Table A.2** – Typical emissions and removal categories to support decision-making for managing whole life carbon beyond the project/programme boundary at the network or system level

| | Consequence for energy | Consequence for water | Consequence for transport | Consequence for waste | Consequence for communications | Consequence for buildings |
|---|---|---|---|---|---|---|
| Activity in all sectors | Reuse and redeployment potential | | | | | |
| Activity in buildings | Changes in types of energy and energy infrastructure needed for building heat, e.g. electricity networks, hydrogen, district heat networks.<br>Excess energy generated and exported to the grid. | Reduced need for clean water and drainage infrastructure through efficiency and reduced demand. | New transport infrastructure requirements to support sustainable urban developments.<br>Reduced need for transport infrastructure through mixed-use, digitally enabled buildings and neighbourhoods. | Changes to waste streams and waste processing requirements from use of different building materials, e.g. timber, recycled concrete. | Integration of communications infrastructure when delivering new buildings, reducing the need for additional construction. | Alleviation of pressure for new supply from other less sustainable locations. |
| Activity in energy | Displacement of higher carbon electricity, heat or fuels.<br>Impacts on power transmission and distribution infrastructure and grid system requirements.<br>Risk of locking-in carbon-emitting infrastructure and supply chains. | Water consumption, e.g. for hydrogen production and thermal power plants. | Provision of low-carbon energy for vehicles/vessels, e.g. electricity for electric vehicles (EVs), trains. | Demand for waste as energy from waste (EfW) feedstock.<br>Decommissioning of energy waste, e.g. radioactive waste.<br>Increased replacement and end-of-life waste, e.g. photovoltaic panels and wind power blades, which have a defined design life. | Integration of communications infrastructure when delivering energy infrastructure.<br>Provision of energy for energy- intensive infrastructure, e.g. data centres. | Provision of power for electrification of heat and transport.<br>Provision of hydrogen and other low-carbon fuels for heat in buildings (including via district heat networks). |

**Table A.2** – Typical emissions and removal categories to support decision-making for managing whole life carbon beyond the project/programme boundary at the network or system level *(continued)*

| | Consequence for energy | Consequence for water | Consequence for transport | Consequence for waste | Consequence for communications | Consequence for buildings |
|---|---|---|---|---|---|---|
| Activity in water | Demand for energy, e.g. extraction of potable water, wastewater treatment, desalination.<br>Excess energy generated and exported to power and gas grids.<br>Provision of water for cooling.<br>Risk of flooding disruption to generation, transmission and distribution plants. | Wastewater to potable water recycling.<br>Risk of flooding/ contamination of potable water supplies. | Facilitates production of low-carbon fuels, e.g. hydrogen, biofuels<br>Risk of disruption/ impact from flood damage. | Changes in amount of waste to be treated. | Provision of water for cooling. | Integration of water efficiency measures in buildings and cities.<br>Risk of flood damage. |
| Activity in transport | Increased demand for low-carbon energy from vehicles/vessels, such as electricity for EVs and electric heating, resulting in need for more electricity generation, transmission and distribution networks, and the associated capital and operational carbon implications.<br>Supports distribution of low-carbon fuels, e.g. biomass, waste | Impact (reduction or increase) track and road surface water runoff into wastewater and associated capital and operation carbon water implications.<br>Increased demand for water from production of batteries and low-carbon fuels. | Modal shift between different transport networks.<br>Alleviation of congestion on other parts of network. | Increased demand for battery waste processing and recycling.<br>Capacity to process and recycle waste from low-carbon transport systems, e.g., EVs. | Integration of communications infrastructure when delivering transport infrastructure reducing the need for additional construction. | Support for high- density, low car- use sustainable urban development. |

**Table A.2** – Typical emissions and removal categories to support decision-making for managing whole life carbon beyond the project/programme boundary at the network or system level *(continued)*

| | Consequence for energy | Consequence for water | Consequence for transport | Consequence for waste | Consequence for communications | Consequence for buildings |
|---|---|---|---|---|---|---|
| Activity in waste | Supply of feedstock for EfW plants.<br>Excess energy generated and exported to power and gas grids.<br>Capacity to process operational and end-of-life waste from low-carbon energy assets. | Reduced pollution of water bodies.<br>Impacting need for water treatment. | Freight user carbon generated from traffic to and from waste treatment plants. | Waste reduction from demand-side measures or increased circularity.<br>Changes in waste composition, e.g. to biogenic content, calorific values. | Capacity to process and recycle waste from communications infrastructure. | Integration of waste processing measures into buildings and cities.<br>Recovery or recycling of building materials for reuse. |
| Activity in communications | Enabling smart, flexible energy systems that are more efficient and have higher levels of low-carbon energy supply.<br>Increased energy demand, e.g. data centres. | Efficiency in processing through digital connectivity and automation. | Reduced need to travel through better digital connectivity.<br>Facilitating shared mobility systems, e.g. e-scooters<br>More efficient asset utilization and operation.<br>Better integrated multi-model transport systems. | Efficiency in processing through digital connectivity, logistics and automation. | — | Enabling smarter, more efficient building (with impacts for energy and water use).<br>Efficiency in construction processes through digital connectivity, logistics and automation. |

# Annex B (informative)
# Applying the carbon management process

Table B.1 summarizes the different carbon management process requirements in each work stage when delivering projects and/or programmes of work.

The purpose of this annex is to summarize at a high level how the PAS 2080 carbon management process can be implemented (by all value chain members) during the different work delivery stages. Table B.1 provides this summary; however, it does not specify which value chain member needs to implement the relevant requirements. Value chain members should refer to the individual clauses in this PAS for the specific value chain responsibilities and requirements.

Further guidance on the roles and responsibilities value chain members have for each work stage, as well as a number of practical examples and case studies, are provided in the *Guidance document for PAS 2080*.

The guidance outlined in Table B.1 is applicable to all value chain members unless stated otherwise.

**Table B.1** – Carbon management process applied to a project or programme of work across work stages

| | Need | Optioneering | Design | Delivery | Operation | Purpose/performance review |
|---|---|---|---|---|---|---|
| Opportunity to reduce whole life carbon | **Highest** ◄——————————————————————————————► **Lowest** | | | | | |
| Leadership<br>(Clause **5**) | Asset owners/managers set objectives, targets and outcomes for the project/programme of works aligned with the decarbonization principles (Clause **4**).<br>Map key collaborators/stakeholders for enabling whole life carbon management. Set governance structure and principles. | | Make competent resources available. Align carbon management with other business processes (e.g. risk/cost management). Communicate and collaborate consistently with the relevant value chain members and stakeholders. Shape the incentives and culture. Recognize and reward innovation. Support development of skills and capability.<br>Challenge the status quo and drive continual improvement through the assets, networks and systems. Support other value chain members to perform their role in decarbonization. Share current good practice with other value chain members. | | | |
| Integration into decision-making<br>(Clause **6**) | Asset owners/managers make alignment with net zero transition central to the scope and requirements of work.<br>Identify activities and associated emissions/removals within control and influence across all work stages (as per Clause **4**), and the necessary collaborations with value chain members and stakeholders that will enable whole life carbon reductions, and the network(s) and system(s) with which the project or programme of works interfaces.<br>Integrate carbon management into the delivery processes to support system-level low-carbon outcomes. Prioritize implementation of carbon reduction opportunities within control and influence.<br>Integrate the carbon implications of climate resilience (or lack of) in the carbon management at all levels. Prioritize nature-based solutions for reduced carbon and increased sequestration.<br>Follow the carbon reduction hierarchy (Clause **4**) across all work stages to identify potential opportunities to reduce whole life carbon emissions: Avoid – Switch – Improve. | | | | | |
| | Asset owners/managers consider the life of the solution, addressing the need for the asset to determine the lowest carbon outcome.<br>Consider options that maximize the use of existing assets, future adaptability and material recovery. | | Align standards and guidance with whole life decarbonization requirements.<br>Demonstrate that proposed solutions are supportive of a net zero transition and whole life performance.<br>Manage resources following circular economy principles. | | Operate and maintain assets/networks in a way which supports the envisaged whole life carbon performance as a minimum, following circular economy principles. | |
| Assessment<br>(Clause **7**) | Establish a comprehensive study boundary to understand emissions impacts and reduction opportunities of the project in the wider system.<br>Map emissions and removals using the PAS 2080 whole life carbon framework for decision-making (Clause **4**).<br>Select an appropriate assessment methodology using existing standards or other recognized sources.<br>Select data sets to be used and understand data quality and uncertainties involved.<br>Work with benchmarks and available carbon factors if detailed information is not available. | | Follow an assessment methodology using recognized sources and/or existing standards so that all relevant sources of emissions and removals attributable to the project or programme of works are assessed and uncertainty is acknowledged.<br>Include impacts to the network and system relevant for decision-making.<br>Improve degree of accuracy in any assessment undertaken to provide the right insights to help decision-making.<br>The primary focus of any assessment is to help decisions that promote low-carbon solutions.<br>Assess whole life carbon emissions during design and construction to monitor progress against any targets set. | | Capture assessment data in suitable format (i.e. by selecting appropriate functional units) and record for the development of future benchmarks and GHG assessments. | Select an appropriate methodology for assessing end-of-life emissions, particularly to consider and prioritize circular economy principles. |
| | Assess GHG emissions and removals associated with land use change, including nature-based solutions and climate resilience solutions.<br>Report removal activities separately to prioritize GHG reduction efforts. | | | | | |
| | Select an appropriate level of accuracy and detail.<br>Collaborate with the value chain and share data that supports the GHG assessment process.<br>Adopt tools and data that increase consistency and accuracy of any assessment. | | | | | |

**Table B.1** – Carbon management process applied to a project or programme of work across work stages *(continued)*

<table>
<tr><th></th><th>Need</th><th>Optioneering</th><th>Design</th><th>Delivery</th><th>Operation</th><th>Purpose/performance review</th></tr>
<tr><td>Opportunity to reduce whole life carbon</td><td colspan="6">Highest ← → Lowest</td></tr>
<tr><td>Baselines and targets<br>(Clause 8)</td><td colspan="2">Set whole life carbon reduction targets that are aligned with targets set in the network or system.<br>Any targets set need to demonstrate, as far as possible, that they are aligned to a net zero transition.<br>Where network or system level targets do not exist, further engagement and challenge needs to take place with different stakeholders to identify ways of closing any gaps, if possible.<br>Work towards consistent targets set for the project and/or programme of works.<br>Develop the project/programme baseline and transparently describe assumptions, limitations and uncertainties.<br>Use existing benchmarks where available. Where not, use first principles to develop a baseline and record uncertainties for improvement over time.<br>Select appropriate functional units to develop the baseline.</td><td colspan="2">Capture and communicate uncertainties in baselines as the project progresses.<br>Challenge carbon targets where there is the potential for improvement. Set appropriate targets for different stages of delivery to drive the right behaviours.<br>A project level whole life carbon target may need to be broken down into capital, operational targets for selective work packages that different value chain members may be leading.<br>Capture design and construction GHG data using appropriate functional units to improve future baselines.</td><td colspan="2">Capture operational data to inform future baselines and targets.<br>Communicate and share improvements in benchmarks/ factors based on project/programme operation, use and end of life.</td></tr>
<tr><td rowspan="2">Monitoring and reporting<br>(Clause 9)</td><td>Asset owners/managers to define monitoring and reporting requirements and communicate.</td><td colspan="3">Report to government and system-level stakeholders.<br>Repeatedly review performance against targets throughout development.<br>Use captured data to improve performance over the baseline.<br>Share good practice outcomes, including non-carbon impacts and co-benefits.</td><td colspan="2">Report actual emissions and performance against targets.</td></tr>
<tr><td colspan="6">Identify roles and responsibilities and stakeholders to report to.<br>Report carbon progress against the set targets and record identified carbon reduction opportunities throughout all stages of development.<br>Share good practice outcomes and carbon data regularly with the value chain to enable wider decarbonization.</td></tr>
<tr><td rowspan="2">Procurement<br>(Clause 10)</td><td rowspan="2">Include carbon management process requirements (including objectives, targets and project outcomes) in contracts.<br>Avoid prescriptive specifications and focus on outcomes.<br>Consider types of incentives to include in contracts.<br>Cascade requirements in sub-contracts. Identify and implement delivery models that support low-carbon outcomes and that promote collaboration.</td><td colspan="5">Review performance against the agreed targets as well as cost and programme.<br>Promote risk allocation approaches that support innovation and low-carbon outcomes.<br>Where appropriate, include data management/information exchange requirements in contracts.<br>Incentivize collaborative contractual arrangements that allow and encourage the successful implementation of the carbon management process.</td></tr>
<tr><td colspan="2">Promote, engage and communicate low-carbon solutions through the value chain.<br>Identify areas of innovation when responding to tenders.<br>Allow for challenge to asset standards and identify incentive mechanisms to reward whole life carbon reduction.</td><td colspan="3">Establish procurement processes that reward suppliers at lower tiers of the value chain that deliver low-carbon solutions.<br>Establish procurement mechanisms that promote innovation that follow the carbon reduction hierarchy of avoid, switch, improve, promoting repurposing and reusing existing assets.</td></tr>
</table>

# Annex C (informative)
# Guidance for government, regulators and financiers

## C.1 Their role of control and influence in the value chain

The *Infrastructure carbon review* [1] set out the whole value chain comprising of multiple stakeholders who have varying levels of control and influence of carbon reduction, at different stages of the lifecycle of a project or programme of works. These stakeholders and their potential roles are shown in Figure 2. At the top of the value chain are government, regulators and financiers (sponsors, lenders, insurers), who arguably have the greatest influence across networks and systems of the built environment.

Although asset owners/managers have the primary responsibility for delivering and managing buildings and infrastructure assets and have the ability to integrate the work under a common carbon management process, all value chain members should share responsibility for the management of the associated carbon emissions and can greatly influence projects and/or programmes of work to be compatible with a net zero carbon transition. Asset owners/managers can only realize carbon reductions within a fully integrated value chain involving not only designers, constructors and product/material suppliers, but also regulators and financiers that determine climate-related policy, planning and KPIs.

Although recognized to be at the top of the value chain, government, regulators and financiers were beyond the scope of the *Infrastructure carbon review* [1] and, as such, there are no normative clauses in PAS 2080 for their role in driving carbon reduction. This informative annex sets out guidance for government, regulators and financiers in enabling decarbonization of the built environment by following PAS 2080 principles.

## C.2 Government and regulators

Government, through legislation and regulation, can shape the policy agenda within which the built environment operates. Policy establishes the direction of development in line with social and economic drivers; net zero carbon transition is part of national and regional policy, which includes built environment systems across buildings and infrastructure. Currently, many governments, whether national, regional or local, make decisions for the development of projects and/or programmes of work. However, alignment with net zero transition is typically not taken into account.

Ideally, whole life carbon management principles should be applied at the start of the decision-making process, when policy responses are being decided, with decarbonization measures forming a key part of the decision-making process, and with PAS 2080 helping to inform that. This is not yet the case. In the meantime, some local governments are early adopters of a hybrid approach that combines PAS 2080 considerations within national appraisal and evaluation processes, which includes the value of whole life decarbonization in the selection of projects and programmes. Further explanation and worked examples are provided in the *Guidance document for PAS 2080*.

Not all regulators currently have a mandate focused on ensuring the economic sectors they regulate transition to net zero carbon. The guidance in Table C.1 sets out how, in line with the PAS 2080 principles, government and regulators can support the economic sectors they oversee to deliver on net zero.

**Table C.1** – Key areas for support from government and regulators

| PAS 2080 clauses | Actions aligned with carbon management principles |
|---|---|
| Leadership | • Be clear on targets and actions required from asset owners/managers for net zero carbon to be achieved and provide support accordingly.<br>• Support the development of collaborative forums focused on facilitating cross-sector problem solving and knowledge sharing.<br>• Encourage training and skills development across their sectors for the delivery of net zero. |
| Integrating carbon into decision-making | • Set specific requirements for asset owners/managers that promote decarbonization when delivering projects and/or programmes of work.<br>• Require information on the carbon associated with a project or programme of work when considering regulatory submissions or business cases. |
| Assessment | • Encourage the adoption of robust and validated methodologies for the reporting of carbon emissions in their control and influence.<br>• Develop robust methodologies tailored to the government or regulator, where required.<br>• Incentivize greater data sharing and collaboration within the value chain, allowing improvements in maturity of their sector. |
| Target setting and baselines | • Be clear on the system-level targets/budgets that can be adopted by the value chain.<br>• Encourage the sharing of information on the baseline position of networks (or information that could be used to develop baselines), including future trends that should be taken into account. |
| Procurement | • Develop and promote delivery models that share risk and reward for low-carbon solutions. |
| Monitoring and reporting | • Require asset owners/managers to publish carbon information associated with the whole life of their assets and networks.<br>• Be clear on the decarbonization targets for key sectors to allow timely progress in reaching net zero.<br>• Require asset owners/managers to follow accountability, transparency, inclusion and verifiable reporting principles as part of the management process. |
| Continual improvement | • Identify key areas of innovation for networks and systems to tackle.<br>• Invite challenge on the approaches to carbon management taken by the sector. |

## C.3 Financiers

Financiers are a highly diverse community and include those who provide equity and debt to built environment companies and assets, or provide other financial services, such as insurance, that support those activities. In some cases, financiers could also be the asset owner/manager.

Aside from compliance, the finance community can use its influence both in terms of the types of projects and/or programmes of work they choose to support, and for those they already are involved in, provide leadership and guidance on how to respond to net zero. This might require a longer-term view on investment, and recognition of the role assets play in wider decarbonization across built environment systems.

Emerging guidance and standards will promote better decision-making and transparency for the finance community. Some of these include regulatory requirements and provide more consistency on net zero, target setting, reporting, etc. for large organizations, such as global investment funds focused on infrastructure and real estate. The main difference between such standards and PAS 2080 is that the former are focused on net zero at the organizational level for large global investment organizations, whereas PAS 2080 focuses on building capability to deliver low-carbon buildings and infrastructure.

The guidance in Table C.2 sets out how, in line with the clauses of PAS 2080, financiers can act and support the value chain in achieving net zero by following carbon management principles.

**Table C.2** – Key areas for support from financiers

| PAS 2080 clauses | Actions aligned with carbon management principles |
|---|---|
| Leadership | • Set the ambition for their (the financier's) investments and projects in achieving net zero carbon.<br>• Influence the assets they are involved with (existing and new) to develop plans to contribute to the net zero transition.<br>• Share lessons and insights on investment profile and asset management/performance to promote investment in low-carbon projects across the industry.<br>• Engage with government and regulators to align decarbonization plans at a network and system level, with appropriate financial and funding mechanisms to execute/deliver them.<br>• Develop finance instruments and packages for accelerating retrofit, refurbishment and alternative solutions. |
| Integrating carbon into decision-making | • Support government and regulators in the identification of risks and opportunities in relation to low-carbon delivery and operation.<br>• Require information on the carbon associated with a project or programme of work when assessing business cases, project finance and funding/insurance agreements.<br>• Take a whole life carbon view when considering payback for any low-carbon investments.<br>• Take into account physical/transition risks, as well as co-benefits, when making decisions on providing investment/insurance to low-carbon projects and/or programmes of work. |
| Assessment | • Contribute to methodologies tailored to their sector and/or provide input data where useful.<br>• Align carbon performance across the project life cycle with the set targets. |
| Target setting and baselines | • Define portfolio targets for investments/insurance and communicate these to the value chain (particularly asset owners/managers) to meet the ambition.<br>• Encourage sharing of information that supports the definition of baselines, including future trends that should be taken into account.<br>• Include performance requirements and targets that encourage decarbonization in funding criteria of projects and/or programmes of work. |
| Procurement | • Promote delivery models that share risk and reward for low-carbon solutions.<br>• Take into the account the inclusion of carbon metrics and performance requirements in financial and project contracts.<br>• Establish project finance structures (or similar) that support collaboration in the value chain. |
| Monitoring and reporting | • Require asset owner/managers to report information on carbon for their assets and networks in alignment with carbon management principles and/or other relevant frameworks (e.g. sustainability disclosure requirements).<br>• Be clear on the decarbonization targets for projects so that timely progress in reaching net zero forms part of asset valuations and investment decisions. |
| Continual improvement | • Identify key areas of innovation for networks and systems to tackle. |

## C.4 Local and regional government

Local and regional government actors (e.g., local authorities) might have control and influence in any or both of the areas set out in **C.2** and **C.3**, either through policy-making, planning or investment activity. In some cases, local and regional government could be asset owners/managers, too.

Given the diversity of roles of local and regional government actors, it is not possible to provide specific guidance. Rather, local and regional government actors should identify the relevant requirements in this PAS and annex and undertake to follow such requirements/guidance to support decarbonization of the built environment within their control and influence.

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[4)] Available at https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2021/04/Infrastructure-Carbon-Review-seven-years-on_March-2021.pdf.
[5)] Available at https://constructioninnovationhub.org.uk/our-projects-and-impact/value-toolkit/
[6)] Available at https://www.architecture.com/knowledge-and-resources/resources-landing-page/riba-plan-of-work
[7)] Available at https://www.smithschool.ox.ac.uk/sites/default/files/2022-01/Oxford-Offsetting-Principles-2020.pdf
[8)] Available at https://unfccc.int/resource/docs/convkp/kpeng.pdf
[9)] Available at https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf
[10)] Available at https://sciencebasedtargets.org/resources/legacy/2017/04/SBTi-manual.pdf.
[11)] Available at https://portals.iucn.org/library/sites/library/files/documents/2016-036.pdf.

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**Appendix CL2.13**

**Institute for Environmental Management and Assessment (IEMA), Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (2017)**

IEMA
Transforming the world to sustainability

ARUP

Environmental Impact Assessment Guide to:

# Assessing Greenhouse Gas Emissions and Evaluating their Significance

# Acknowledgements

## Working Group

This practitioner's guide has been developed by IEMA and EIA professionals working for organisations registered to the EIA Quality Mark (www.iema.net/qmark).

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## About IEMA

The Institute of Environmental Management & Assessment (IEMA) is the professional home of over 15,000 environment and sustainability professionals from around the globe. We support individuals and organisations to set, recognise and achieve global sustainability standards and practice. We are independent and international, enabling us to deliver evidence to Governments, information to business, inspiration to employers and great stories to the media that demonstrate how to transform the world to sustainability.

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The people at Arup are driven to find a better way and to deliver better solutions for our clients.

We shape a better world.

# Contents

# 1 Introduction

## 1.1 The aim of this guidance

The aim of this guidance is to assist practitioners with addressing greenhouse gas (GHG) emissions assessment and mitigation in statutory and non-statutory Environmental Impact Assessment (EIA). It complements IEMA's earlier guide on Climate Change Resilience and Adaptation and builds on the Climate Change Mitigation and EIA overarching principles (see Box 1). The requirement to consider this topic has resulted from the 2014 amendment to the EIA Directive.

Through a working group facilitated by Arup on behalf of IEMA, this guidance has been prepared to assist EIA practitioners to take an informed approach to the treatment of GHG emissions within an EIA. It sets out areas for consideration at all stages of the assessment and offers options that can be explored. It highlights some of the challenges to the assessment such as establishing study boundaries and what constitutes significance. Nevertheless, this guidance is not a prescriptive 'how to' guide and will be updated once the process of incorporating GHG assessment in EIA matures.

### Box 1: IEMA's overarching principles on Climate Change Mitigation & EIA

The GHG emissions from all projects will contribute to climate change; the largest inter-related cumulative environmental effect;

The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive – e.g. population, fauna, soil etc.;

The UK has legally binding GHG reduction targets – EIA must therefore give due consideration to how a project will contribute to the achievement of these targets;

GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant; and

The EIA process should, at an early stage, influence the location and design of projects to optimise GHG performance and limit likely contribution to GHG emissions;

As one of the most challenging environmental issues, the effects of GHG emissions are integral to the understanding of a project's impact and need to be factored into the decision making process accordingly. At the same time **a focus on proportionate assessment is also important in avoiding undue burden** to developers and regulators. It is widely recognised that EIA should focus on a project's significant impacts and this guide is predicated on all assessments being proportional to the scientific evidence available. **A 'good practice' approach is therefore advocated where GHG emissions are always considered and reported but at varying degrees of detail depending on the EIA project.** This is important to build up sufficient knowledge and understanding of how to effectively assess GHG emissions.

The sections which follow cover in two to three pages scoping, baseline, methodology, significance and mitigation for an assessment of greenhouse gas emissions. Finally, section 7 looks at how best to communicate the assessment within an Environmental Statement / EIA Report.

The scope of this guide is presented graphically in Figure 1.

## 1.2 EIA and project linkage

EIA should not be undertaken in a silo to avoid an accounting exercise rather than realising the full potential of GHG emissions reduction opportunity. This can be addressed by delivering EIA in close cooperation with the project design team.

Early stakeholder engagement is key to maximising the mitigation measures that can be implemented to offset the GHG emissions of a proposed project (as shown in Figure 1). Carbon savings are likely to be greater if mitigation is considered from project inception because the potential GHG emissions impact can be investigated at all aspects of the planning, construction and operation stages; enabling mitigation measures to be identified and implemented throughout the life cycle of the project.

The interaction between the design process and EIA process is underpinned by four key principles:

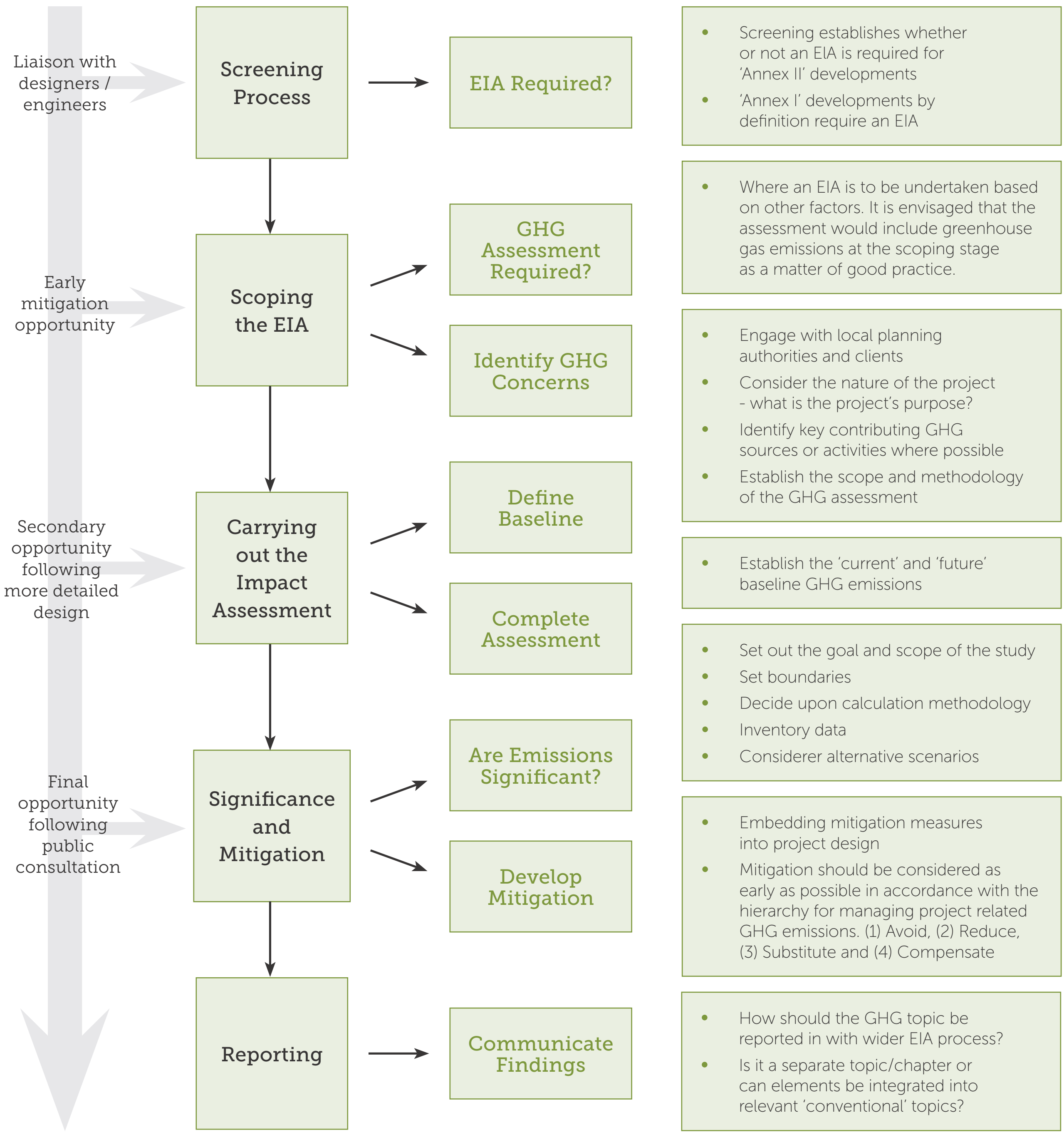
1. Early, effective and ongoing interaction;
2. Appropriate stakeholder engagement;
3. Consenting risk is managed; and
4. A clear narrative.

For further detail on these principles and ensuring that carbon mitigation measures are 'built in' rather than 'bolted on' at a later stage, refer to IEMA's EIA guide on Shaping Quality Development[1].

The need to ensure that carbon mitigation measures are implemented does not end at the pre-application EIA stage, and extends to once consent has been granted for a project. In order to ensure that carbon mitigation measures are carried forward the development of an Environmental Management Plans (EMP) should be seen as the primary mechanism. For further information refer to IEMA's EIA guide to Delivering Quality Development[2].

1. IEMA (2015), Environmental Impact Assessment Guide to Shaping Quality Development.
2. IEMA (2016), Environmental Impact Assessment Guide to Delivering Quality Development.

FIGURE 1: Scope of this guide



# 2 Screening

The purpose of screening is to establish whether or not an EIA is required for 'Annex II' developments (Annex I development by definition requires an EIA). The 2014 amendments to the EIA Directive (2011/92/EU as amended by 2014/52/EU) require specific information such as a description of likely significant effects of the project at the screening stage.

Applying screening criteria (Schedule 3) and taking account of existing environmental conditions and the nature of a proposed project will allow a judgement to be made on whether there is potential for likely significant environmental effects to arise which may trigger the need for an EIA. Occasionally, this may apply to only a very limited number of topics, for example in a sensitive location for a relatively small scale project. Generally however, where an EIA is required it is customary for there to be several topics that require assessment. As the assessment of most topic areas is well established (ecology, water, heritage etc.), it is usually clear cut which topics trigger the need for EIA.

This contrasts with GHG emissions. This is a developing area of impact assessment with limited project examples and experience to draw from. For the purposes of screening it is therefore considered good practice to always consider whether the impact of GHG emissions is likely to be significantly enough to trigger EIA, and to also highlight any proposed mitigation measures that the developer has agreed to.

# 3 Scoping

## 3.1 Introduction

A good practice approach to EIA will see GHG emissions scoped into the assessment and thus estimated, reported and mitigated as part of the project's undertakings. This approach should follow for all projects regardless of whether there is a net increase or decrease in GHG emissions relating to the works.

During scoping it is also important to set out in principle the methodological approach that will be taken to addressing project GHG emissions. This means documenting in outline aspects such as baseline setting, assessment approach, how significance will be determined and strategies for mitigation. These are commonly recorded in a project scoping report and this can form a useful first record of the approach to delivering the GHG emissions assessment. Each of these steps for the EIA are addressed in the following Sections and should be consulted for further detail.

In selecting or developing an approach for project EIA GHG emissions assessment, the aim should be to deliver a robust, appropriate and consistent assessment. Good practice to this starts with a framework of five basic steps that a GHG emissions assessment should always incorporate:

1. Define goal and scope of GHG emissions assessment;
2. Set study boundaries;
3. Decide upon assessment methodology;
4. Collect the necessary calculation data; and
5. Calculate/determine the GHG emission inventory.

Section 5 explores these steps in more detail.

## 3.2 Stakeholder engagement

Stakeholder engagement is an important part of undertaking an EIA, especially during scoping. It will provide useful information and support the goals the GHG emissions assessment.

Stakeholder engagement will provide the practitioner better contextual understanding of the project including on key issues, opportunities, constraints and information pertinent to the assessment. Stakeholders will include clients and statutory consultees[3] who all have an interest and influence on the project.

Box 2 lists a series of questions the practitioner should be seeking to answer during stakeholder engagement as part of project scoping.

3. The UK's Government website includes a sections on Planning practice guidance including a list of statutory consultees: https://goo.gl/9ZvAI3

**Box 2 Questions to consider during stakeholder engagement to support GHG emissions assessment and mitigation**

- Is the client and their delivery team considering GHG emissions as part of the design?
- Has GHG emissions mitigation formed part of the project brief?
- Has a GHG emissions assessment already been done?
- Will the project deliver a net benefit in terms of GHG emissions?
- What project alternatives have been considered to measure against?
- Where are the majority of GHG emissions most likely to arise (site preparation, construction, operating the asset, using the asset, or decommissioning etc.)?
- What is the scale of construction, the size of the supply chain, the energy and GHG emissions profile of the materials that will be used?
- What operational and use profile will the project have regarding materials and energy demand and waste generation?
- What are the international, national and sectorial level legislation, policy or good practice on climate change and GHG emissions relevant to the project?
- Are there relevant sector-specific GHG strategies and targets that should be recognised by the EIA in addressing GHG emissions?

Depending on the project, GHG emissions may be a key topic to be discussed during public consultation. Initial consultation with the project team and wider EIA topic specialists may also reveal parallel activities where input from the GHG assessment would be beneficial. For example, clients may wish to report on the sustainability performance of their projects through the use of assessment schemes such as CEEQUAL or BREEAM. Being able to report on the project's GHG performance will help with such assessments.

Other project management decisions may include the desire to manage the project in an integrated manner, combining 3D models with performance data (including environmental data) such as BIM models.

## 3.3 Benefits and challenges of raising GHG emissions as part of project scoping

By going through the scoping process the GHG practitioner gains an early and informed understanding of the project's impact and potential sources of GHG emissions. This provides an opportunity to influence and even mitigate GHG emissions early in the design process as well as consider emissions from alterative options.

The challenge at scoping is that there is often limited information available from the design team at this early stage resulting in a qualitative-based decision and professional judgment from the practitioner. Nevertheless, the practitioner, by engaging with key stakeholders, should be able to define the boundaries of the GHG assessment (see Section 5.4) as well as start to form a view of where the majority of emissions are likely to arise from and appropriate mitigation strategies.

Where the competent authority (e.g. LPA) provides a scoping opinion, the subsequent Environmental Statement must be 'based on' the expectations set out in the opinion, including any reference to GHG assessment.

# 4 Baseline

## 4.2 Definition and aim

Baseline is the reference point against which the impact of a new project can be compared against, and is sometimes referred to as business as usual (BaU) where assumptions are made on current and future GHG emissions. Baseline can be in the form of:

A. GHG emissions within the agreed physical and temporal boundary of a project but without the proposed project; or

B. GHG emissions arising from an alternative project design and assumptions.

The ultimate goal from establishing a baseline is being able to assess and report the net GHG impact of the proposed project.

## 4.2 Boundary setting

All existing sources and removals of GHG emission prior to project construction and operation (i.e. without development) should be identified and clearly described. The boundary of baseline GHG emissions should consider the physical boundary (e.g. the project boundary line around a site), its geographical location (local, regional or national scale project), and temporal boundary (future baselines associated with operational emissions over an agreed period).

Some projects may lead directly or indirectly to avoided GHG emissions outside the project EIA boundary. In this instance care should be taken to describe the nature of the avoided emissions and potential reliance on any external factors to come to fruition.

For further detail on boundary setting see Section 5.5 in the Assessment Methodology chapter.

### 4.2.1 Current baseline

Current baseline represents existing GHG emissions from the project boundary site prior to construction and operation of the project under consideration. This may include emissions from existing projects (e.g. energy consumption from a building which is scheduled for refurbishment, demolition or replacement) and infrastructure (e.g. current operational and use emissions of a road due to be upgraded).

It may not always be possible to report on current baseline emissions, particularly with projects situated in areas with no physical development or activity. In this instance there would be zero GHG emissions to report, although particular attention should be paid where changes in land use are expected. For example, woodland areas or peat bogs sequester carbon over their lifetime and therefore make a contribution to CC mitigation. Their disturbance or removal through construction will release previously sequestered GHG emissions.

Other approaches to developing the current baseline are emerging that follow a baseline scenario, which is a projection that the project's GHG emissions are compared to. Further information on this approach can be found in the GHG protocol for Projects (see Chapter 6: Selecting a Baseline Procedure - http://ghgprotocol.org/project-protocol). An example of such a GHG baseline can also be found here - https://www.forestry.gov.uk/forestry/infd-8jes7v#what

### 4.2.2 Future baseline

Future baseline should capture both operational and use GHG emissions irrespective of their source (i.e. direct and indirect emissions). The distinction between operation and use GHG emissions is important. For example, an existing motorway will have operational emissions (i.e. lighting, maintenance, upgrades) as well as in-use emissions associated with vehicles travelling along the route. Current baseline travel patterns would have to be assessed as well as how these might change in the near future (changes in mode share, increased efficiency in vehicles and trip numbers for example). With regards to energy supply and demand (e.g. electricity use in a commercial building), future baseline should report on operational GHG emissions and how these may change over time (based on occupancy changes, UK grid decarbonisation projection scenarios or the adoption of renewables for example).

Box 3 lists potential sources of information which can be considered when establishing future baseline emissions.

### 4.2.3 Alternative baselines

Alternative baselines may be based on a different location, design, layout, operation or even size of the proposed project. A detailed GHG assessment of alternative baselines is not an EIA requirement, and in many instances alternatives may not have been considered by the developer. Ideally, alternatives would have been considered earlier in the project life cycle, and the EIA is viewed as the platform for improving the preferred design. Nevertheless, where alternative baselines were considered, even a qualitative assessment of their GHG impact would be acceptable as part of the overall assessment.

**Box 3 Potential sources of information on GHG and energy projections (see Appendix A for further details)**

- Committee on Climate Change (CCC) – The Fifth Carbon Budget[4]
- The Department for Business, Energy & Industrial Strategy (previously DECC)[5/6]
- UK greenhouse gas emissions statistics
- The Department for Transport (DfT) WebTAG (the Transport Analysis Guidance) – Data Book[7]
- The Green Construction Board – Infrastructure Carbon Review, Technical Report[8]

4. https://goo.gl/79MYvQ
5. https://goo.gl/6aNsnv | https://goo.gl/zgQx0D
6. https://goo.gl/jsQKZz
7. https://goo.gl/R1ypT9
8. https://goo.gl/icZxRQ

# 5 GHG emissions assessment methodology

## 5.1 Introduction

There are many different assessment methods available for measuring and quantifying the GHG emissions associated with the built environment. These range from general guidance to formal standards and many will be appropriate for use in EIA depending on the goals and scope of the assessment required. A list of relevant methods can be found in Appendix B. Two key examples particularly suited to EIA include:

- PAS 2080:2016 Carbon management in infrastructure[9] which has been developed to enable a consistent approach to the managed reduction of GHG emissions associated with economic infrastructure by construction industry stakeholders including clients, designers, constructors and material suppliers.
- BS EN 15978:2011 Sustainability of construction works, Assessment of environmental performance of buildings, Calculation method[10] which has been developed by CEN to enable a consistent approach to the environmental assessment of buildings including GHG emissions.

Given the wide variation of working situations and the particular aims and objectives of the EIA process this guidance does not recommend a particular approach, rather it sets out advice for the key common components necessary for undertaking a GHG emissions assessment.

## 5.2 GHG assessment and proportionality

GHG emissions should be assessed and reported as part of a good practice approach to EIA. This aligns with IEMA's overarching-principles[11]; that all GHG emissions will contribute to climate change and thus might be considered significant, irrespective of whether this is an increase or decrease in emissions.

Projects will vary by type and size, and so will GHG emissions. An effective scoping exercise ensures that a balance is struck between the amount of GHG emissions emitted by the project and the effort committed to the actual GHG assessment. For example, if the majority of impacts occur during a project's construction phase and that operational impacts are negligible, then the GHG assessment can reflect this. A high-level or qualitative GHG assessment for certain project elements or activities can be carried out as long as it is justified and agreed during the scoping stage with stakeholders. This will help contribute towards delivering proportional EIAs.

**It should also be recognised that qualitative assessments are acceptable, for example: where data is unavailable or where mitigation measures are agreed early on in the design phase with design and engineering teams.**

9. PAS 2080:2016, Carbon management in infrastructure, BSI
10. BS EN 15978:2011, Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method, BSI
11. IEMA (2010), IEMA Principles Series: Climate Change Mitigation & EIA.

## 5.3 Steps of GHG emissions assessment

In selecting or developing an approach for project EIA GHG emissions assessment, the aim should be to deliver a robust, appropriate and consistent assessment. Good practice to this starts with a framework of five basic steps that a GHG emissions assessment should always incorporate:

1. Define goal and scope of GHG emissions assessment;
2. Set study boundaries;
3. Decide upon assessment methodology;
4. Collect the necessary calculation data; and
5. Calculate/determine the GHG emission inventory.

The following sections explore these aspects in more detail.

## 5.4 Define goal and scope

In the first instance an EIA GHG emissions assessment should set out a study goal and scope. This will normally incorporate a range of different aspects including:

- The goal of the GHG emissions calculation;
- Description of the system (i.e. built environment asset/development etc.) that is the subject of the assessment;
- The function of the system (i.e. its performance characteristics);
- The system boundary to be applied;
- Allocation procedures (where used) for apportioning GHG emissions;
- The calculation methodology to be applied;

How GHG emissions information will be interpreted and used in decision-making including how it should be used to inform;

- Mitigation response;
- Significance of impact of emissions;
- Communicating and reporting GHG emission impact within EIA;
- Data quality requirements;
- Assumptions, limitations and constraints; and
- The study review process, ensuring it is appropriate and proportionate to the intended use of the study.

### 5.4.1 Scoping the boundaries of the GHG emissions assessment

It should be understood that scoping in the context of undertaking a GHG emissions assessment is the task of identifying what is included and excluded from the study. It is separate and different from the scoping stage of an EIA where the environmental topics are included or excluded from the EIA.

The scoping exercise of the GHG emissions assessment will consider aspects like which life cycle stages to include, whether there should be a focus on asset construction or operation, if there are specific elements of the supply chain that must be included, and what an appropriate boundary condition or cut off point might be to excluding aspects from the assessment.

## 5.5 Study boundaries

EIAs should apply system boundaries, use data that is consistent with, and report, using the modular approach (Figure 3). A detailed and complete GHG emissions assessment typically covers all life cycle modules including A, B and C with module D seen as optional. As described under Section 5.2, projects will vary in size and hence so will the scale of GHG assessments in the spirit of delivering proportionate EIAs. Certain life cycle modules (or stages) can be excluded as long as these exclusions are justified by the practitioner using professional judgement. One would expect that direct GHG emissions from a project's use and/or operation would be reported at a minimum.

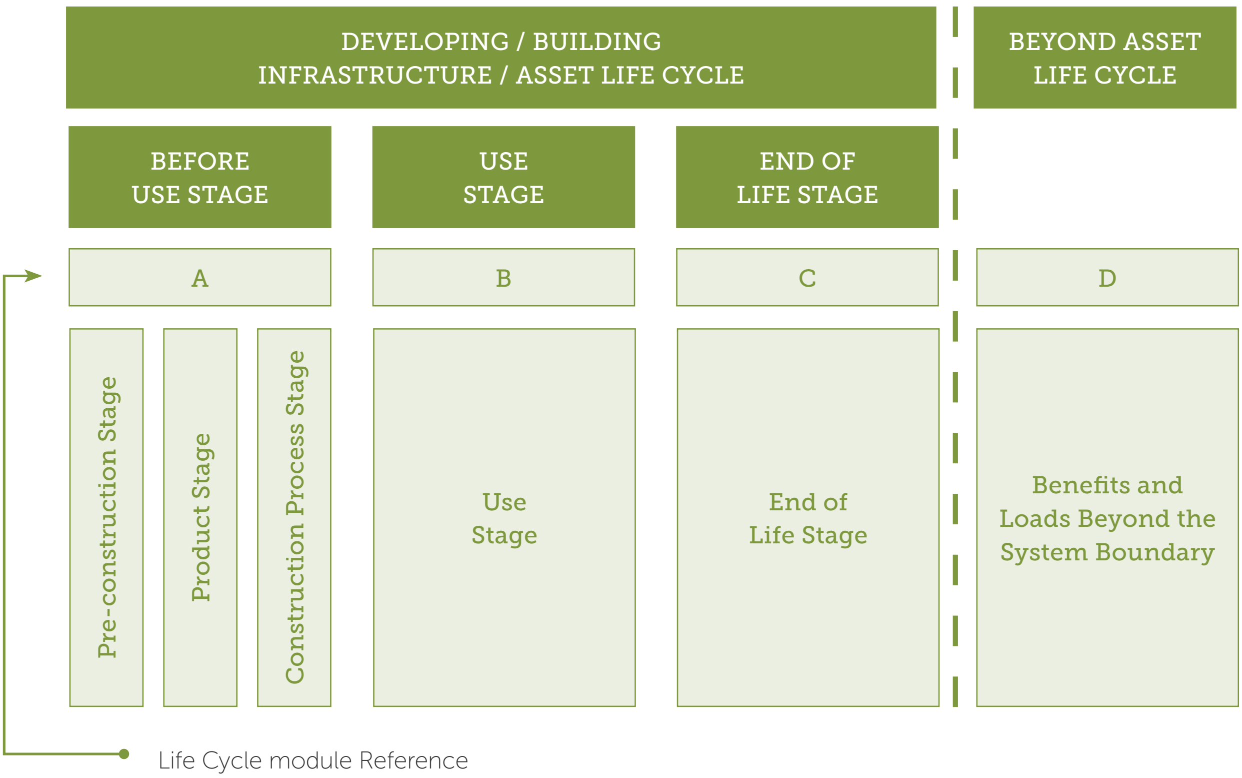



FIGURE 3: Modular approach of life cycle stages and modules for EIA GHG emissions assessment; the module references are widely used in construction GHG emissions assessment and reduction activities.

The figure provides a simplified presentation of the modular approach that can be used for boundary definition and the gathering and reporting of information associated with the assessment. A more detailed presentation of this structure can be found in PAS 2080 and BS EN 15978.

### 5.5.1 Inclusions

The study system boundary should reflect the system under study including its physical scope and life cycle stages relevant to the goal and scope of the assessment.

### 5.5.2 Cut off rules (exclusions)

Activities that do not significantly change the result of the quantification can be excluded however the total excluded input or output flows per module would generally be expected to be a maximum of 5% of energy usage and mass. All inputs and outputs to a process for which data are available should be included.

### 5.5.3 Study period (the life cycle period that should be studied)

A reference study period shall be chosen as the basis for the GHG emissions assessment and this should be based on the expected service life of the construction asset. Guidance is available in ISO 15686-1.

## 5.6 Calculation data

To undertake a calculated GHG emissions assessment for an EIA it will be necessary to gather data on the activities occurring and the GHG emissions factors for these activities, for the system under study. It is important that data for both these aspects, and particularly the activity data, is specific to the system under study.

### 5.6.1 Study system activity data

Activity data consists of information that defines and describes the size, magnitude and physical nature of the system under study. It will take many different forms and can consist of information covering materials quantity, energy and water demand, waste generation, transportation distances and modes, works techniques/technologies, etc.

### 5.6.2 GHG emission factors

GHG emission factors are a value for 'GHG emissions per unit of activity'. Examples of this are:

- HGV: 0.13 kg $CO_2$e / t.km
- UK electricity grid: 0.41 kg $CO_2$e / kWh
- Concrete: X kg $CO_2$e / tonne

GHG emission factors vary in their scope and coverage and will be representative of a single process/activity or multiple of these, sometimes incorporating multiple life cycle stages. Care should be taken to select the right factors for the system under study.

When undertaking a study it is often necessary to apply multiple GHG factors for the same activity particularly when the assessment is studying a life cycle with a long time period. This may be appropriate when future GHG emissions for that activity are expected to change; this might occur for example when accounting for a reduction in GHG emissions associated with a national electricity grid and the benefit this brings to demand side GHG emissions of using electric trains.

For examples of sources of GHG factors refer to Appendix A.

### 5.6.3 Data quality

Data of appropriate quality to satisfy the goal and scope of the EIA should be used and this means defining expectations in terms of:

- Age;
- Geography;
- Technology mix represented by data;
- Methodology applied to gather or calculate the data; and
- Competency of entity that developed the data.

### 5.6.4 Types of data

The type of data used by the GHG practitioner will vary depending on how detailed the project design is. Most EIAs are based on design-stage information, hence activity data specific to the project should in theory be available from the engineering and design teams. If this is not the case, an alternative approach would be to fall back on generic or publically available information that best represents the project and its activities.

## 5.7 GHG emissions calculation method

Quantification of the GHG emissions for an EIA may be associated with either a measured or calculated approach or a combination of both for the emissions associated with the project. It is expected that in almost all cases a calculated approach for quantifying GHG emissions will be taken because an EIA is completed in advance of supply chain mobilisation and associated construction works.

When undertaking a quantification calculation the formula for determining a GHG emission (or removal value), associated with the construction works, should have the following structure:

GHG emission factor × Activity data
= GHG emission or removal

Calculations may be taken at different scales reflecting specific activities, components or elements of construction. Therefore individual calculations should be summed to form a GHG emissions inventory for the quantification as a whole.

## 5.8 Study uncertainty

Uncertainty can arise from quality of data, study boundaries and period of assessment etc. and can never be eliminated from a study. Uncertainty should be considered and if it significantly affects the outcome of the study, additional steps should be taken to reduce it and provide confidence in results.

Uncertainty can be considered by:

- Testing upper and lower limits;
- Testing for different inclusions and exclusions; and
- Modify study period.

If the scale of uncertainty provides findings that are likely to change any decision based on the data then it should be appropriately reduced.

# 6 Significance and Mitigation

## 6.1 All GHG emissions are significant

IEMA principles on climate change mitigation and EIA identify climate change as one of the defining environmental policy drivers of the future and that action to address GHG emissions is essential. Specifically three over-arching principles are particularly relevant to considering the aspect of significance[12]:

"The GHG emissions from all projects will contribute to climate change; the largest inter-related cumulative environmental effect."

"The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive – e.g. Population, Fauna, Soil, etc."

"GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant."[13]

The thread through these principles is that 1) all projects create GHG emissions that contribute to climate change; 2) climate change has the potential to lead to significant environmental effects; and 3) there is a GHG emission budget[14] that defines a level of dangerous climate change whereby any GHG emission within that budget can be considered as significant.

Therefore in the absence of any significance criteria or a defined threshold, it might be considered that all GHG emissions are significant and an EIA should ensure the project addresses their occurrence by taking mitigating action[15].

Whilst there is no single preferred method to evaluate significance, extensive research is being undertaken to explore significance, thresholds for GHG emission assessments, and science-based targets. Box 4 provides further information on recent findings.

12. IEMA (2010) Climate Change Mitigation & EIA
13. The third principle is related to the IPCC carbon budget definition which states that to remain below a 2oC threshold (the level defined as dangerous climate change impacts), global GHG emissions must remain within 1000 billion tonnes.
14. IPCC 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.
15. Notwithstanding this EIA traditionally works on the principle of significance and Appendix C provides guidance on considering the significance of GHG emissions.

### Box 4: Targets based on scientific projections

Science-based targets are defined as GHG reduction targets which have been created based on scientific projections and global carbon budgets. These targets aim to mitigate the greatest effects of climate change by limiting GHG emissions within a certain cumulative threshold. This threshold has been defined by the IPCC, as a carbon budget equivalent to a maximum increase in global temperature of 2°C from pre-industrial levels.

There is currently little evidence of these science-based targets being used in the UK's development consent system, or related EIA process, to assess a project's significance. However, this quantitative approach provides a good indicator of significance and could be used in EIA to calculate a project's carbon budget. This budget can then be compared against an existing carbon budget (global, national, sectoral, regional, or local - as available), to identify the percentage impact the project will contribute to climate change. Consequently, the greater the project's carbon budget, the greater its significance.

A review of the literature has identified a number of different methods which can be used to allocate a project's carbon budget; a list of some of these is provided below:

- Grandfathering;
- Carbon Space;
- Contraction and Convergence;
- Blended sharing; and
- Common but Differentiated Convergence.

Due to the inconsistencies between the different methods and their assumptions for assessment; there is not one single agreed method by which to assess a project's carbon budget. Therefore a review of these methods should be undertaken, to identify which method can best represent a project's potential carbon footprint. The applicability of the method will be dependent on the type and scale of the project. For further detail on significance and project examples refer to Appendix C.

## 6.2 Contextualising a project's carbon footprint

Under the principle that all GHG emissions might be considered significant, and the ongoing research of how to actually measure significance, it is down to the practitioner's professional judgement on how best to contextualise a project's GHG impact.

Generating a project's carbon contribution, will enable the impact of your project, to be contextualised against sectoral, local or national carbon budgets. This will provide the practitioner and the LPA with a sense of scale. For example the Green Construction Board[16] has calculated carbon budgets for each of the UK built environment sectors (non-domestic buildings, domestic buildings, construction and operation). Similarly the Committee on Climate Change[17] (CCC) has determined a UK wide carbon budget broken down by the following key sectors: power generation, industrial production/ manufacturing, buildings, transport, agriculture and land use change.

The good practice approach included in Figure 4 below provides an example of how to contextualise your project's carbon footprint against pre-determined carbon budgets. This guidance does not include an exhaustive list of existing carbon budgets and therefore research should be undertaken to identify the best budget to compare with your project.

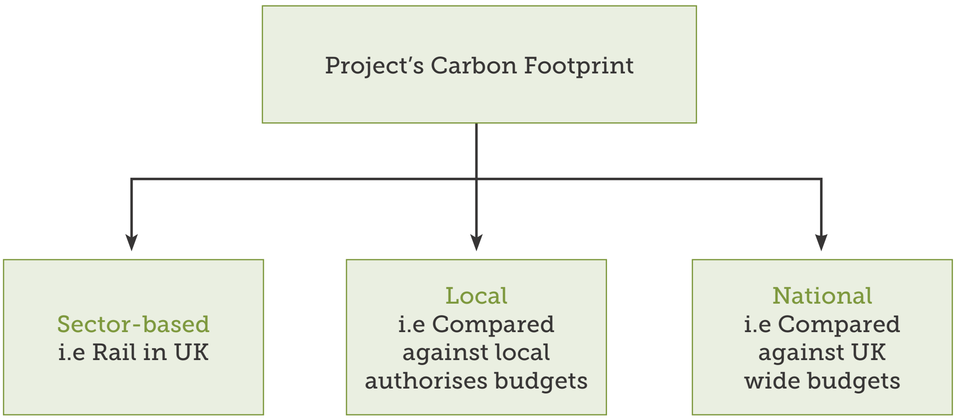



FIGURE 4: Good practice approach for contextualising a project's carbon budget

16. The Green Construction Board – the Low Carbon Routemap for the Built Environment: https://goo.gl/g3lOM6
17. Committee on Climate Change (2015) The Fifth Carbon Budget – The next step towards a low-carbon economy.

## 6.3 Mitigating GHG emissions

Carbon mitigation can best be achieved by taking a planned and focused approach following the principles of a carbon management hierarchy. There are many different variations on this theme covered in literature with the commonality that they set out a graded structure of interventions with more favourable options presented over others. Such structures typically start with first avoiding or reducing emissions where practical, before suggesting offset or sequester strategies beyond this. Depending on the project and contextual setting, the practical outcomes of this can be many and diverse. Although not set out in a hierarchy BS EN 14064: 2012[18] on GHG quantification and reporting provides an example list of carbon mitigation interventions such as;

- Energy demand and use management;
- Energy efficiency;
- Technology or process improvements;
- GHG capture and storage in, typically, a GHG reservoir;
- Management of transport and travel demands;
- Fuel switching or substation; and
- Afforestation.

For EIA GHG emissions mitigation, PAS 2080 also provides a useful structure for working through and identifying potential opportunities and interventions. The IEMA GHG hierarchy[19] provides a similar structure set out as avoid, reduce, substitute and compensate. A variation of these steps is set out below and can be followed by the GHG emissions practitioner in the EIA to identify opportunities that direct GHG mitigation action for a project.

1. **Do not build:** evaluate the basic need for the project and explore alternative approaches to achieve the desired outcome/s.
2. **Build less:** realise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required.
3. **Design clever:** apply low carbon solutions (including technologies, materials and products) to minimise resource consumption during the construction, operation, user's use of the project, and at end-of-life.
4. **Construct efficiently:** use techniques (e.g. during construction and operation) that reduce resource consumption over the life cycle of the project.
5. **Offset and sequester:** as a complimentary strategy to the above, adopt off-site or on-site means to offset and/or sequester GHG emissions to compensate for GHG emissions arising from the project.

18. BS EN ISO 14061-1: 2012 Greenhouse gases – Part 1: specification with guidance at the organizational level for quantification and reporting of greenhouse gas emissions and removals.
19. IEMA (2014) Position Statement on Climate Change and Energy https://goo.gl/P9F14p

# 7 Communication/ Reporting

When reporting on GHG emissions assessment in EIA the text should conform to Schedule 4: Information for inclusion in environmental statements, of the EIA regulations[20] document. The GHG emissions assessment should form part of an integrated assessment on climate change impacts and can be presented as a standalone climate change chapter within an EIA or supporting technical appendix. GHG emissions should not be treated as a sub-category of an EIA's consideration of other environmental effects of climate change if it is to be considered and assessed through the EIA process.

The effects of potential future climate change based on the net GHG impact from a proposed project are likely to be interrelated to other key EIA topics. To ensure consistency is provided throughout the Environmental Statement / EIA Report the GHG team will need to liaise with other key EIA topics including (but not limited to):

- Logistics/Transport (based on TA);
- Waste management (cover construction and demolition);
- Noise/vibration (construction/hours of work/ fuel uses, list of plant/energy use); and
- Air quality (Carbon capture).

Consistent reporting of GHG emissions in EIA will highlight the importance of accounting for carbon emissions from project inception. It will encourage both clients and engineers to consider the impacts of GHG emissions during early design stage. At the same time it is suggested that a brief introduction to climate change and the role of GHG emissions as a contributing factor is included in the GHG assessment EIA chapter. This will help explain the interrelationship between GHG emissions and climate change with other relevant topics to the readers. This may further be supported with relevant links to documents and information on the topic.

When reporting on GHG emissions and mitigation in EIA the following steps should be presented where available:

- Baseline emissions: the existing emissions from the project boundary site prior to construction and operation of the project;
- Alternative emissions: including the future baseline emissions should the project not be developed;
- Net emissions (Year 1 and lifetime): the direct and indirect emissions of the project during the first year of operation and for the full lifetime of the project; and
- Mitigation savings: the amount of carbon saved during all stages of the project.

20. The Town and Country Planning (Environmental Impact Assessment) Regulations (2017) Schedule 4: Information for inclusion in environmental statements.

There are a number of challenges and difficulties when integrating GHG assessment into EIA practice. These challenges and ways to overcome them are presented below.

- The possible effects identified from a GHG emissions assessment can be interlinked with other key EIA topic chapters. There are a number of different ways to report these effects including;
    - Reporting on GHG emissions assessment in a standalone chapter that does not overlap with any of the other EIA chapters; or
    - Providing a GHG emissions assessment in a standalone chapter but also discussing the relevant likely climate change effects in the other EIA chapters.
- Reporting of a GHG emissions assessment, should endeavour to conform to the existing EIA template. However if there is data or information that needs to be included that doesn't fit into the existing EIA template then additional sub-sections should be added in order to present all the data from the GHG emissions assessment; to inform the EIA and account for the possible effects on future climate change.
- There are a lack of thresholds on which to identify the significance of a proposed project with regard to the net change in GHG emissions. The GHG assessment should therefore present assumptions, data collection and methodology to clarify how the significance has been quantified.
- Where GHG assessment is used to inform early design stages it is vital to get stakeholders to understand the importance of minimising the GHG contribution of a project and designing a project that will limit the net change in future GHG emissions.

# Appendix A

## Stakeholder list and data sources

| Source | Description |
|---|---|
| Committee on Climate Change (CCC) – The Fifth Carbon Budget[21] | The CCC reports on UK carbon budgets, by sector, and reductions that need to be achieved of the UK is to meet its carbon reduction target of 80% by 2050.<br><br>This includes historical and projected (up until 2035) GHG emissions by UK industrial sector: power, industry, buildings, transport, agriculture, land use and waste.<br><br>Decarbonisation projections of the UK's electricity and gas network are also reported. |
| The Department for Business, Energy & Industrial Strategy (previously DECC)[22] | The UK Government regularly reports on UK energy and emissions projections by source: agriculture, business, energy supply, industrial processes, land use change, public, residential, transport and waste management.<br><br>Currently, GHG emissions reach back to 1990 and project in to the future up until 2035. |
| The Department for Business, Energy & Industrial Strategy (previously DECC)[23]<br><br>UK greenhouse gas emissions statistics | The UK Government also reports on GHG emissions from a geographical perspective, by UK local authority. Current and historical emissions are available which may be used to establish current baseline emissions. |
| The Department for Transport (DfT) WebTAG (the Transport Analysis Guidance) – Data Book[24] | WebTAG provides UK transport modelling values and information including projections on how the UK's modal mix (diesel, petrol, electric) is expected for change over time, current and future fuel efficiency projections (litres or kWh per kilometre travelled) up to 2035.<br><br>Also reported are carbon dioxide emissions per litre of fuel burnt or kWh used for: petrol, diesel, gas oil and electricity used on road and rail travel. |

21. https://goo.gl/Nvlmbs
22. https://goo.gl/XqmqW1 | https://goo.gl/9s8v6U
23. https://goo.gl/yEGI9t
24. https://goo.gl/4tklQZ.

| Source | Description |
|---|---|
| The Green Construction Board (GCB) – Infrastructure Carbon Review, Technical Report[25] | The GCB has developed a tool that allows stakeholder to model policy changes associated with the built environment and visualise what this means in terms of GHG emissions. Also available is the Low Carbon Routemap report which explores various GHG emissions projections for both building and infrastructure at the UK level. |
| Inventory of Carbon and Energy (ICE) – University of Bath: Sustainable Energy Research Team[26] | The Inventory of Carbon and Energy (also known as the ICE database) is a leading embodied energy and carbon database for building materials. |
| The Department for Business, Energy & Industrial Strategy (previously DECC)[27] - Government emission conversion factors for greenhouse gas company reporting | The Government conversion factors for greenhouse gas reporting are suitable for use by UK based organisations of all sizes, and for international organisations reporting on UK operations. |
| Examples of publicly available carbon assessment tools. The list of carbon tools is non- exhaustive and constantly changing. It is up to the GHG practitioner's professional judgement to decide which tool is most appropriate for the project at hand. Of course it is perfectly appropriate to develop bespoke assessment sheets which may provide more flexibility and transparency. | • Scottish Government Windfarm Carbon Assessment tool<br>• Environment Agency Carbon Planning Tool<br>• RSSB / Network Rail Carbon Tool<br>• Transport Scotland: Carbon Management System (CMS)<br>• asPECT – asphalt pavement embodied carbon tool<br>• Highways Agency DBFO (design, build, finance and operate) carbon calculation sheets |
| National Atmospheric Emissions Inventory [28] | • The UK Inventory contains summaries of information about air quality pollutants and GHGs. There is also access to a wide range of more detailed information about the levels and trends in emissions of these pollutants, and their sources. |

25. https://goo.gl/lNyAru
26. https://goo.gl/ud4lHU
27. https://goo.gl/8B095W
28. http://naei.defra.gov.uk/

# Appendix B

## Methods for GHG emissions assessment

### B1 List of standards

- WRI GHG Protocol - the World Resource Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) partnered to develop internationally recognised guidance and standards on GHG accounting and reporting, and includes advice on:
  - Corporate Standards;
  - Corporate Value Chain (Scope 3);
  - Product Life Cycle assessments;
  - GHG Protocol for Cities; and
  - Agricultural Guidance.
- PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.
- PAS 2060 - a standard for declarations of carbon neutrality
- PAS 2070 - a standard for assessing city-wide GHG emissions.
- PAS 2080 - is the world's first standard for managing infrastructure GHG emissions.
- BS EN ISO 14064-1 - guidance on reporting GHG emissions at an organisational level.
- BS EN ISO 14064-2 - guidance on reporting GHG emissions at the project level.
- BS EN 15686-1: 2011 Buildings and construction assets – service life planning, general principles and framework.
- BS EN 15978:2011 Sustainability of construction works, Assessment of environmental performance of buildings, Calculation method
- BS EN 15804: Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products.
- PD CEN ISO/TS 14067: Greenhouse gases. Carbon footprint of products. Requirements and guidelines for quantification and communication.
- BS EN ISO 14044: Environmental management. Life cycle assessment. Requirements and guidelines
- ENCORD: the European Network for Construction Companies for Research and Development – a network for active members from the construction industry have published a 'Construction $CO_2$e Measurement Protocol'.

### Notes

1. IEMA Members can enjoy a 15% discounts when buying copies of BSi products (ISO / BS EN standards). Simply:
   - - Login to www.iema.net
   - - Visit the myIEMA section
   - - Follow the link to my BSi Shop.
2. PAS2050 and PAS2080 are freely available documents, which can be accessed on-line.

# Appendix C

## Significance of GHG emissions

### C1 Considering the significance of GHG emissions

GENERIC PROCESSES

1. **Sacramento Metropolitan Air Quality Management District**[29]

   Established a significance threshold of 1,100 metric tonnes ($MTCO_2e$ per year). This is based on capturing 90% of the development projects across the state, ensuring that small projects, which generally have low emission levels, would not be considered significant. The small projects will still be required to reduce their GHG emissions because they must comply with state and local regulations that require energy efficiency and transport infrastructure improvements.

2. **California Air Pollution Control Officers Association**[30]

- GHG impacts are considered to be exclusively cumulative impacts because no single project makes a significant contribution to global climate change;
- Assessment of significance is based on whether a project's GHG emissions cumulatively represent a considerable contribution to the global atmosphere.

3. **California Environmental Quality Act (CEQA) guidelines**

According to Appendix G of the CEQA Guidelines, a project would have a significant effect associated with GHGs if it would:

- Generate GHG emissions, either directly or indirectly, that may have a significant and/or cumulative impact on the environment; or
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHG.

4. **IEMA principles on climate change mitigation and EIA**

The IEMA principles document provides a section on how to assess GHG emissions in EIA and states:

- "When evaluating significance, all new GHG emissions contribute to a significant negative environmental effect; however; some projects will replace existing development that have higher GHG profiles. The significance of a project's emissions should therefore be based on its net impact, which may be positive or negative."
- "Where GHG emissions cannot be avoided, the EIA should aim to reduce the residual significance of a project's emissions at all stages."
- "Where GHG emissions remain significant, but cannot be farther reduced... approaches to compensate the project's remaining emissions should be considered."

29. Sacramento Metropolitan Air Quality Management District, 2014. Justification for Greenhouse Gas Emissions Thresholds of Significance.
30. CAPCOA 2008 CEQA and Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act.

CASE STUDIES

## 5. The Park at Granite Bay[31], California, USA

Assessment included quantitative and qualitative methods of GHGs;

- Quantitative: construction and operational emissions were lower than the Sacramento significance threshold;
- Qualitative: project complied with a number of mitigation measures at local and district level including; increased diversity (incorporating recreational use into project design will reduce mobile source emissions), improve destination accessibility, improve pedestrian network, provide traffic calming measures and comply with energy efficiency standards; and
- The project would not substantially contribute to GHG cumulative impacts and therefore impacts would be considered less than significant.

## 6. Wind Energy Ordnance[32]

Guidelines for determination of significance

"For the purpose of the EIR, the County's Interim Approach to Addressing Climate Change on CEQA Documents (County of San Diego 2010) guidelines for determining significance apply the direct and indirect impact analysis, as well as the cumulative impact analysis. A significant impact would result if:

- The project would conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs"
- The impacts from the proposed project (Wind turbine) related to generation of GHG emissions on a cumulative level would be less than significant as they will contribute to emissions reductions targets set out in the Climate Change Action Plan/Goals in AB 32 (for San Diego) and will contribute to the state's goals by facilitating the development if renewable sources of energy in place of fossil fuel based electrical generation.
- Implementation of the proposed project would not result in significant impacts associated with GHG emissions and global climate change. By facilitating the development of a local renewable energy supply, the proposed project could help to reduce impacts related to global climate change in two ways: (1) decrease GHG emissions, and (2) reduce the potential for energy shortages and outages in the inland areas. Therefore, the proposed project would not result in any significant impacts related to GHGs

31. The Park at Granite Bay (December 2015) Draft Environmental Impact Report.
32. Wind Energy Ordnance (2012) Draft Environmental Impact Report

### 7. HS2 Phase One[33]

- GHG emissions associated with the construction of the proposed project are significant. Mostly a result of the construction of tunnels, earthworks, bridges, viaducts and underpasses that have been included to mitigate other significant environmental noise and visual amenity.
- Multiple mitigation measures have been identified, with two described below;
- Secondary carbon benefits: proposed project will increase total carrying capacity of the rail transport system therefore freeing up capacity of existing rail networks which can be used to transfer freight or passenger traffic from higher carbon modes.
- Opportunities will be identified to avoid carbon in the project design; and reduce embedded carbon in construction materials and carbon emissions from construction works.

---

The following two project example are based in New York City. Although they don't specifically focus on significance, both provide mitigation measures based on the following statement:

"Although the contribution of any single project's emissions to climate change is infinitesimal, the combined GHG emissions from all human activity have been found to be significantly impacting global climate... there are no established thresholds for assessing the significance of a project's contribution to climate change. Nonetheless, prudent planning dictates that all sectors address GHG emissions by identifying GHG sources and practicable means to reduce them."

### 8. Vanderbilt Corridor and One Vanderbilt, New York, USA

- Focus on mitigation measures. Don't compare against threshold instead they look at savings between baseline conditions and mitigated conditions example below:
- The proposed One Vanderbilt development is estimated to require 28.5 gigawatt-hours per year (GWh/yr) of electricity for general building use and a total of 17,487 million British thermal units per year (MMBtu/yr) of natural gas for heat and hot water. An option including on-site electricity and heat cogeneration is under consideration, which would provide approximately half of the electricity demand using a natural gas-fired system, requiring 148,268 MMBtu/yr of natural gas.
- Proposed project will include a number of sustainable design features that would reduce GHG emissions (based on LEED certification rather than standard building code), these include;
- Efficient building design;
- Use clean power;
- Transit-oriented development and sustainable transportation;
- Reduce construction operation emissions; and
- Use building materials with low carbon density (i.e. recycled steel).

33. HS2 (2013) London – West Midlands Environmental Statement Volume 3 Route-wide effects https://goo.gl/QkUCtc

## 9. Billie Jean King National Tennis Centre (NTC), New York, USA

- As the proposed project would result in more than 350,000 square feet of development, the sources of GHG emissions and measures that would be implemented to limit those emissions are discussed in this chapter, along with an assessment of the proposed project's consistency with the citywide GHG reduction goal
- The assessment concludes that the project's design includes features aimed at reducing energy consumption and GHG emissions, which is consistent with NYC citywide GHG reduction goal.
- Focus on minimising energy use and GHG emissions during the non-event season. Also aim to improve options for sustainable transport;

The majority of emissions from the proposed project would be associated with its construction rather than the two weeks per year the US Open operates. Therefore, many of the emission reduction measures that would be implemented as part of the proposed project would focus on construction activities

# Notes

# List of abbreviations / glossary

BaU – Business as Usual

BIM – Building Information Modelling

BREEAM – Building Research Establishment Environmental Assessment Method

CEEQUAL – Civil Engineering Environmental Quality assessment scheme

CEMP – Construction Environmental Plan

CEN – European Committee for Standardization

Climate change – changes in general weather conditions over an extended period of time (seasonal averages and extremes)

Climate Change Adaptation – the process that a receptor or project has to go through to ensure it maintains its resilience to climate change

Climate Change Mitigation – This consists primarily of approaches that seek to avoid, reduce or limit the release of GHG emissions that contribute to anthropogenic climate change. It can also include actions that will increase the removal of GHG atmospheric emissions (e.g. carbon sequestration through woodland creation, conservation and wider land management practices). The ideal is to pursue a strategic approach whereby overall emissions are quantified and reduced, assisting a transition towards a low or zero carbon footprint.

Climate Change Resilience – a measure of ability to respond to changes that something experiences. If a receptor or project has a good climate change resilience, it is able to withstand the changes in climate in a way that ensures it retains much of its original function and norm

CCC – Committee on Climate Change

DBEIS – Department for Business, Energy & Industry Strategy

DEFRA – Department for Environment, Food & Rural Affairs

DfT – Department for Transport

EMP – Environmental Management Plan

EPD – Environmental Product Declaration

EIA – Environmental Impact Assessment

ES – Environmental Statement

GHG – Greenhouse Gases

IEMA – The Institute of Environmental Management and Assessment

IA – Impact Assessment

LICR – Large Infrastructure Carbon Rating

LCA – Life Cycle Assessment

LPA – Local Planning Authority

PAS – Publically Available Specification

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# Appendix CL2.14

## Institute for Environmental Management and Assessment (IEMA), Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance – Edition 2 (2022)

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Institute of Environmental Management & Assessment (IEMA) Guide:

# Assessing Greenhouse Gas Emissions and Evaluating their Significance

2nd Edition

February 2022

# Contents

# Acknowledgements


## Working group

This practitioner's guide has been developed by IEMA and EIA professionals working for organisations registered to the EIA Quality Mark (www.iema.net/qmark).

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## About IEMA

The Institute of Environmental Management & Assessment (IEMA) is the professional home of over 18,000 environment and sustainability professionals from around the globe. We support individuals and organisations to set, recognise and achieve global sustainability standards and practice. We are independent and international, enabling us to deliver evidence to governments, information to business, inspiration to employers and great stories to the media that demonstrate how to transform the world to sustainability.

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# List of Abbreviations / Glossary

**BaU** – Business as Usual

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**CEMP** – Construction Environmental Management Plan

**CEN** – European Committee for Standardization

**Climate change** – changes in general weather conditions over 30 years (seasonal averages and extremes)

**Climate Change Adaptation** – the process that a receptor or project must go through to ensure it maintains its resilience to climate change

**Climate Change Resilience** – a measure of ability to respond to changes in climate. If a receptor or project has a good climate change resilience, it is able to respond to the changes in climate in a way that ensures it retains much of its original function and norm

**CCC** – Climate Change Committee

**DBEIS** – Department for Business, Energy & Industrial Strategy

**DEFRA** – Department for Environment, Food & Rural Affairs

**DfT** – Department for Transport

**EIA** – Environmental Impact Assessment

**EMP** – Environmental Management Plan

**EPD** – Environmental Product Declaration

**ES** – Environmental Statement

**F-gases** – a group of greenhouse gases called fluorinated gases, consisting of HFCs, PFCs and SF6

**GHG** – Greenhouse Gases

**GHG practitioner** – an environmental consultant with specific experience and knowledge pertaining to GHG modelling and reporting; not to be confused with EIA practitioners who typical have a wider EIA delivery role overseeing the coordination of all environmental topics in an ES

**IA** – Impact Assessment

**IEMA** – the Institute of Environmental Management and Assessment

**IPCC** – Intergovernmental Panel on Climate Change

**kWh** – kilowatt-hour

**LCA** – Life Cycle Assessment is a cradle-to-grave or cradle-to-cradle analysis technique to assess environmental impacts associated with all the stages of a product's life, which is from raw material extraction through materials processing, manufacture, distribution, and use.

**LICR** – Large Infrastructure Carbon Rating

**LPA** – Local Planning Authority

**LULUCF** – Land Use, Land-Use Change and Forestry

**TCFD** – Task Force on Climate-related Financial Disclosures

**$tCO_2e$** – tonnes of carbon dioxide equivalent

**UK** – United Kingdom

**UNFCCC** – United Nations Framework Convention on Climate Change

**WBCSD** – World Business Council for Sustainable Development

**WRI** – World Resource Institute

# I – Introduction

## 1.1 The aim of this guidance

The aim of this guidance is to assist greenhouse gas (GHG) practitioners (hereinafter referred to as 'practitioners') with addressing GHG emissions assessment, mitigation and reporting[1] in statutory and non-statutory Environmental Impact Assessment (EIA). It is a revision of the 2017 IEMA guidance on Assessing Greenhouse Gas Emissions and Evaluating their Significance[2] (Box 1 lists the key updates from the 2017 version of the guidance). It complements IEMA's latest guide on Climate Change Resilience and Adaptation[3] published in 2020 and builds on the Climate Change Mitigation and EIA overarching principles (as in the previous version of the GHG Guidance). The requirement to consider this topic has resulted from the 2014 amendment to the EIA Directive (2014/52/EU), the Town and Country Planning (Environmental Impact Assessment) Regulations 2017[4] and the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017[5], hereafter referred to as the 'EIA Regulations'.

A lot has changed since 2017. Climate change has moved up the national and international agenda with local authorities across the UK declaring a climate change emergency. The UK's legally binding Climate Change Act 2008[6] was amended in 2019[7] in response to the Paris Agreement, setting a new and challenging target to reduce UK GHG emissions to net zero by 2050, accounting for residual emissions which are offset. Devolved administrations in Scotland and Wales have also set net zero targets. In December 2020, the UK Government's independent advisors, the Climate Change Committee (CCC), set the sixth[8] carbon budget at 965 million $tCO_2e$ from 2033 to 2037, which has since been enshrined in to law. There is a distinct requirement for deeper cuts in emissions across all sectors of the economy to meet the net zero target according to the CCC.

1 Note: Statutory EIA reports are called 'Environmental Statements' in England, Wales and Northern Ireland and 'Environmental Reports' in Scotland.

2 IEMA (2017) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance. Available at: https://www.iema.net/preview-document/assessing-greenhouse-gas-emissions-and-evaluating-their-significance

3 IEMA (2020) Climate Change Resilience and Adaptation. Available at: https://www.iema.net/resources/reading-room/2020/06/26/iema-eia-guide-to-climate-change-resilience-and-adaptation-2020

4 UK Legislation (2017) The Town and Country Planning (Environmental Impact Assessment) Regulations 2017. Available at: https://www.legislation.gov.uk/uksi/2017/571/contents/made

5 UK Legislation (2017) The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Available at: https://www.legislation.gov.uk/uksi/2017/572/contents/made

6 UK Legislation (2008) Climate Change Act 2008. Available at: https://www.legislation.gov.uk/ukpga/2008/27/contents

7 UK Legislation (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019. Available at: https://www.legislation.gov.uk/ukdsi/2019/9780111187654

8 UK Legislation (2021) The Carbon Budget Order 2021. Available at: https://www.legislation.gov.uk/uksi/2021/750/contents/made

**Box 1: Key updates to the 2017 guidance**

Mitigation has taken a much more prominent role within the EIA. It is no longer an element to be considered towards the later stages of the EIA process (after scoping, emissions assessment and significance determination). Instead, mitigation should be considered from the outset and throughout the project's lifetime, whilst also helping to deliver proportionate EIAs. Mitigation is addressed first in the guidance (Section II) but also as part of the GHG Assessment Methodology (Section V).

The guidance presents more nuanced levels of significance. The 2017 guidance stated that "...in the absence of any significance criteria or defined threshold, it might be considered that all GHG emissions are significant...". This update of the guidance does not change IEMA's position (or the science) that all emissions contribute to climate change, however specifically in the EIA context it now provides relative significance descriptions to assist assessments. Section VI describes five distinct levels of significance which are not solely based on whether a project emits GHG emissions alone, but how the project makes a relative contribution towards achieving a science-based 1.5°C aligned transition towards net zero.

In November 2021 Glasgow hosted COP26 – widely regarded as the most important climate summit since the 2015 Paris Agreement and acknowledging the urgency (as evidenced by latest IPCC reports), the Glasgow Climate Pact was agreed. This set the agenda on climate change for the next decade. Pledges made to further cut emissions, and a plan set to reduce the use of coal and phase-out fossil fuel subsidies are some of the commitments made at COP26. The nations present at COP26 collectively agreed to work to reduce the 'emissions gap' and to ensure that the world continues to advance during the present decade, so that the rise in the average temperature is limited to 1.5°C.

With climate change taking centre stage, projects are increasingly scrutinised and challenged for not mitigating GHG emissions in line with the net zero ambition and the associated required pace of reductions[9]. This critical change is known as the transition imperative. EIA Climate chapters are receiving a lot more attention with clients, project developers and stakeholders often asking: '*what do we need to do and how can we be net zero?*'. Addressing significance and contextualising projects' emissions is an increasingly challenging exercise, especially under a tapestry of national and sectoral carbon targets and budgets, regional and local plans and sectors all on different pathways. This guide aims to provide practitioners with the best advice on how to tackle these questions.

Through a working group facilitated by Arup on behalf of IEMA, this guidance helps practitioners take an informed approach to the treatment of GHG emissions within an EIA. It sets out areas for consideration at all stages of the assessment and offers methodological options that can be explored. It highlights some of the challenges to the assessment, such as establishing study boundaries and what constitutes significance. However, this guidance is not a prescriptive 'how to' guide and will be updated as the process of incorporating GHG assessment in EIA continues to mature.

## 1.2 EIA and project linkage

EIAs can often be undertaken in silo, separate from the full design process, resulting in an accounting exercise rather than realising the full potential of the GHG emissions reduction opportunity. This can be addressed by delivering the EIA in close cooperation with the project design team.

9 The pace of reduction should align with a credible 1.5°C transition scenario (for example Science Based Targets Initiative Net Zero or Tyndall Centre aligned carbon budget)

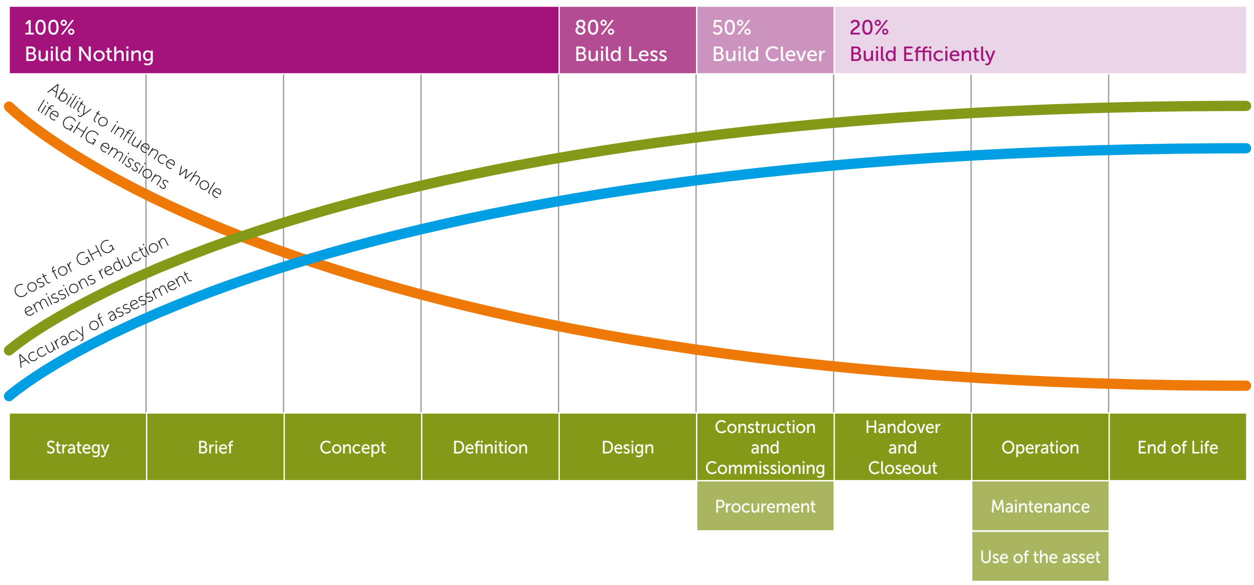


Figure 1: The ability to effect change to achieve GHG emissions reduction for the project reduces over time. This makes it important that the emissions reduction is considered from the outset or at the earliest practical point. (Source: Infrastructure Carbon Review & PAS 2080).

Early stakeholder engagement is fundamental to maximising GHG emissions savings. GHG reductions are likely to be greater if mitigation is considered at project inception and throughout all subsequent work phases: planning, construction and operation stages – enabling mitigation measures to be identified and implemented throughout the life cycle of the proposed project. Examples of stakeholders can be found in Appendix A. Figure 1 illustrates how the potential to achieve GHG emissions reduction declines with time over a project life cycle.

The interaction between the design process and EIA process is underpinned by four key principles:

1. Early, effective and ongoing interaction
2. Appropriate stakeholder engagement
3. Managing consenting risk
4. A clear narrative

For further detail on these principles and ensuring that GHG mitigation measures are built in rather than bolted on at a later stage, refer to IEMA's EIA guide on Shaping Quality Development[10].

The need to ensure that GHG mitigation measures are implemented does not end at the pre-application EIA stage, but extends after consent has been granted to the proposed project. To ensure that GHG mitigation measures are carried forward, the development of Environmental Management Plans (EMP) and Construction Environmental Management Plans (CEMP) are the primary mechanisms. For further information refer to IEMA's EIA guide to Delivering Quality Development[11].

The scope of this document is presented in Figure 2.

10 IEMA (2015) Environmental Impact Assessment Guide to Shaping Quality Development. Available at: https://www.iema.net/download-document/7018

11 IEMA (2016) Environmental Impact Assessment Guide to Delivering Quality Development. Available at: https://www.iema.net/download-document/7014

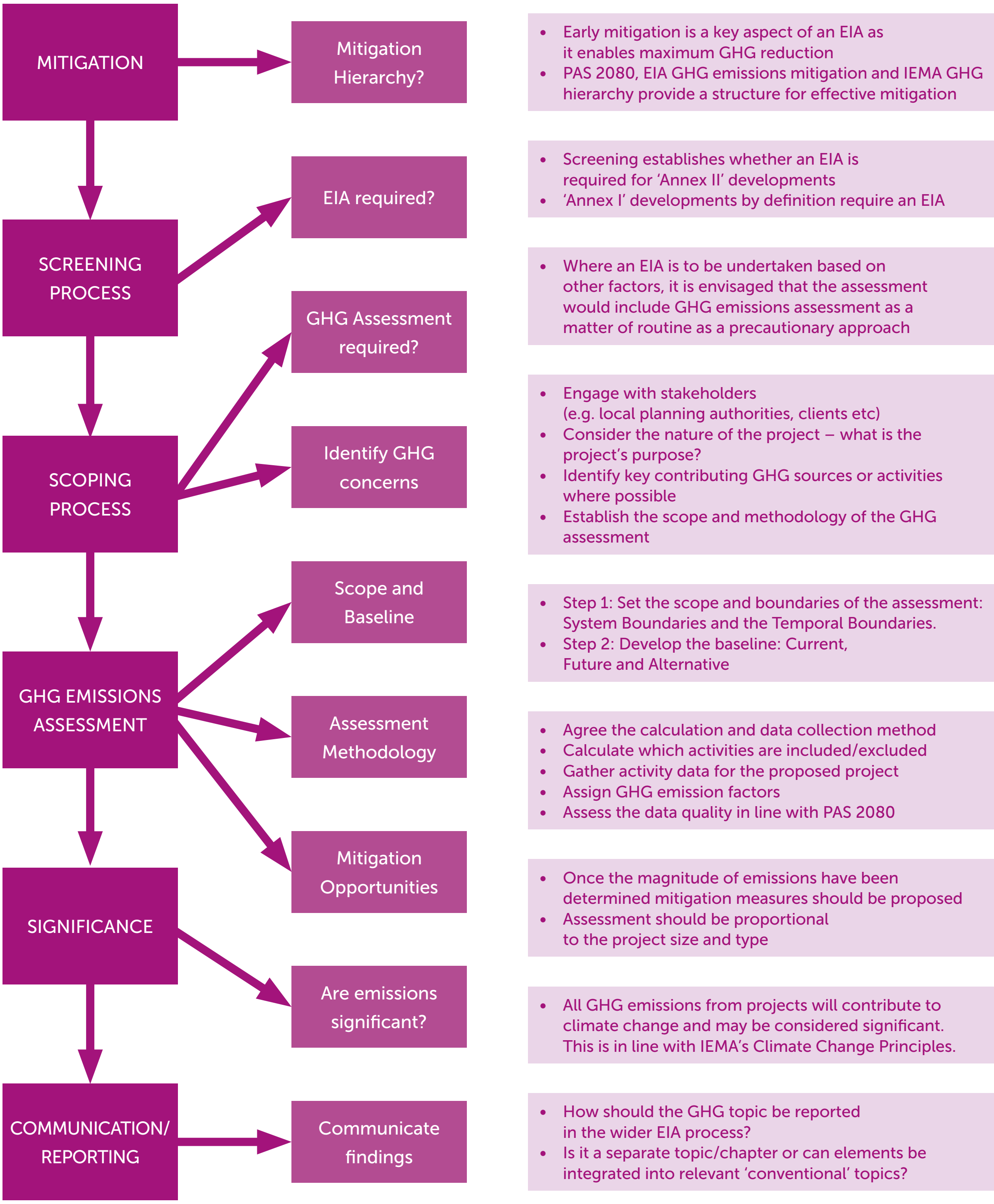


Figure 2: Scope of this guide

# II – Mitigation

## 2.1 Early design mitigation

It is important that project designers incorporate measures to reduce GHG emissions at an early stage. This means evaluating what GHG emissions reduction measures may be appropriate to include in the design. Mitigation should be considered at all stages of design development – from optioneering through to detailed design, not just as a part of the EIA process (see Figure 1). To successfully address GHG emissions at an early stage, it is good practice to ensure there is a 'carbon coordinator' within the design team, who focuses on promoting GHG saving opportunities and ensures GHG reduction is a focus of the design team.

GHG mitigation is best achieved by taking a planned and focused approach following the IEMA GHG management hierarchy principles[12]. There are many different variations on the use of hierarchies in environmental management and assessment, with the commonality that they set out a graded structure of interventions with generally more favourable options presented over others. Such structures typically start with first avoiding or reducing harm, before suggesting compensations. Depending on the proposed project and contextual setting, the practical outcomes of this can be many and diverse. In addition to mitigations listed in IEMA's GHG Management Hierarchy, BS EN ISO 14064-1: 2019[13] on GHG quantification and reporting provides an example list of GHG mitigation interventions such as:

- Energy demand and use management
- Energy efficiency
- Technology or process improvements
- GHG capture and storage in, typically, a GHG reservoir
- Management of transport and travel demands
- Fuel switching or substitution
- Afforestation
- Waste minimisation
- Alternative fuels and raw materials (AFR) use to avoid landfilling or incinerating the wastes
- Refrigerant management

## 2.2 Mitigation hierarchy

For EIA GHG emissions mitigation, PAS 2080 also provides a useful structure for working through and identifying potential opportunities and interventions. The IEMA GHG Management Hierarchy[14] (see Figure 3) provides a similar structure set out as **eliminate**, **reduce**, **substitute** and **compensate**. A variation of these steps is set out below and can be followed by practitioners in the EIA to identify opportunities that direct GHG mitigation action for a project:

- Do not build: evaluate the basic need for the proposed project and explore alternative approaches to achieve the desired outcome/s
- Build less: realise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required
- Design clever: apply low carbon solutions (including technologies, materials and products) to minimise resource consumption and embodied carbon during the construction, operation, user's use of the project, and at end-of-life
- Construct efficiently: use techniques (e.g. during construction and operation) that reduce resource consumption and associated GHG emissions over the life cycle of the project

12 IEMA (2020) Pathways to Net Zero: Using the IEMA GHG Management Hierarchy. https://www.iema.net/document-download/51806

13 BS EN ISO 14064-1: 2019 Greenhouse gases – Part 1: specification with guidance at the organizational level for quantification and reporting of greenhouse gas emissions and removals.

14 IEMA (2014) Position Statement on Climate Change and Energy. Available at: https://www.iema.net/climate-emergency/position-statement

**IEMA Greenhouse Gas Management Hierarchy (updated 2020)**

**Eliminate**
- Influence business decisions/use to prevent GHG emissions across the lifecycle
- Potential exists when organisations change, expand, rationalise or move business
- Transition to new business model, alternative operation or new product/service

**Reduce**
- Real and relative (per unit) reductions in carbon and energy
- Efficiency in operations, processes, fleet and energy management
- Optimise approaches (eg technology) and digital as enablers

**Substitute**
- Adopt renewables/low-carbon technologies (on site, transport etc)
- Reduce carbon (GHG) intensity of energy use and of energy purchased
- Purchase inputs and services with lower embodied/embedded emissions

**Compensate**
- Compensate 'unavoidable' residual emissions (removals, offsets etc)
- Investigate land management, value chain, asset sharing, carbon credits
- Support climate action and developing markets (beyond carbon neutral)

*Updated from original IEMA GHG Management Hierarchy, first published in 2009*

Figure 3: IEMA GHG Management Hierarchy

- **Offset and remove emissions:** as a complementary strategy to the above, adopt off-site or on-site means to offset and/or sequester GHG emissions to compensate for GHG emissions arising from the project

## 2.3 Offsetting residual emissions

Multiple terms are used to describe how offsets are used to mitigate residual emissions, and projects may sometimes be promoted as 'carbon neutral' or 'net zero'. It is important that the EIA is clear in defining any terms used. Figure 3 above sets out the position of carbon offsets (referred to as 'Compensate' in Figure 3) in the mitigation hierarchy. There is a distinction between carbon offsets that provide a financial payment to avoid emissions and offsets that remove and sequester atmospheric GHG emissions, and this should be communicated transparently where offsetting is assessed in an ES chapter.

The October 2021 IEMA's Net Zero Explained report[15] summarises the concept of net zero, its origin and science behind the definition. The report also links to alternative sites providing some clarity behind evolving definitions, such as net zero, carbon neutral and zero carbon. The UNFCCC's Race to Zero Lexicon[16] provides the following definitions:

- Net Zero: "*When anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period.*" Net zero is achieved where emissions are first reduced in line with a 'science-based' trajectory with any residual emissions neutralised through offsets.
- Carbon Neutral: "*When anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period… irrespective of the time period or magnitude of offsets required.*"

15 IEMA (2021) Net Zero explained. Available at: https://s3.eu-west-2.amazonaws.com/iema.net/documents/knowledge/policy/climate-change-energy/Net-Zero-Explained-Oct-2021-4.pdf

16 UNFCCC (2021) Race to Zero Lexicon. Available at: https://racetozero.unfccc.int/wp-content/uploads/2021/04/Race-to-Zero-Lexicon.pdf

- Absolute Zero or Zero Carbon: *"When no GHG emissions are attributed"* to an activity or project without the need for offsets.

After following the mitigation hierarchy, projects can seek to compensate residual emissions by the use of either carbon credits (purchased from credible eligible schemes) or by removals within the organisation or entity itself (e.g. nature based solutions on owned land or land with partners). In order to avoid significant adverse effects, mitigation and compensation (if required) would need to be implemented at a magnitude and in a timescale that is consistent with measures required to achieve a 1.5°C compatible trajectories, as discussed in Section VI on determining significance of effects.

# III – Screening

The purpose of screening is to establish whether or not an EIA is required for 'Schedule 2' developments (Schedule 1 developments by definition require an EIA). The EIA Regulations require specific information at the screening stage. This includes the consideration of likely significant effects of the proposed project on the environment, taking into account the following:

- The magnitude and spatial extent of the impact (e.g. the geographical area and size of the population likely to be affected)
- The nature of the impact
- The transboundary nature of the impact
- The intensity and complexity of the impact
- The probability of the impact
- The expected onset, duration, frequency and reversibility of the impact
- The cumulation of the impact with the impact of other existing and/or approved projects
- The possibility of effectively reducing the impact

Applying screening criteria (Schedule 3) will allow a judgement to be made on whether there is potential for likely significant environmental effects to arise which may trigger the need for an EIA. Occasionally, this may apply to only a very limited number of topics, for example in a sensitive location for a relatively small-scale project. Generally, however, where an EIA is required, it is common for there to be several topics that require assessment. As the assessment of most topic areas is well established (e.g. ecology, water, heritage), it is usually clear cut which topics trigger the need for EIA.

## Sensitivity of receptor(s)

GHG emissions are not geographically limited. They have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The receptor for GHG emissions is the global atmosphere. The receptor has a high sensitivity, given the severe consequences of global climate change and the cumulative contributions of all GHG emission sources.

It is always good practice to consider whether the effects associated with GHG emissions are likely to be significant enough to trigger an EIA. At the screening stage, proposed mitigation measures that the developer has committed to which aim to avoid or prevent significant adverse effects, may be taken into account when determining whether significant effects are likely to occur.

It should be noted that, as with most environmental topics, there are likely to be only limited cases in which GHG emissions alone are the decisive factor in whether an EIA is needed for a particular project, but in almost all cases GHG emissions are likely to be a relevant factor at the screening stage.

For proposed projects where the need for an EIA has been screened out, it is still important that its GHG emissions are minimised wherever possible, as emissions of any scale contribute cumulatively to global climate change. Undertaking a proportionate assessment of GHG emissions on non-EIA projects is therefore good practice to support decisions that reduce GHG emissions.

# IV – Scoping

## 4.1 Introduction

The scoping process should be used to determine the approach to considering GHGs within the ES. The approach should be proportionate[17] to the proposed project and may, in some cases, not require an ES chapter where it can be justified that GHGs can be addressed within upfront sections of the ES (see further detail in Section V: Methodology, Section VI: Significance and Section VII: Communication/ Reporting). Additionally, ES chapters may differ in scope or assessment detail on a project-by-project basis. The scoping process should therefore consider both the scope of the EIA and the scope of the GHG assessment.

The scoping process should provide an explanation of the likely significant effects of a proposed project. Section VI: Significance sets out the principles in determining likely significant GHG effects which should be reviewed at the scoping stage.

The following should be considered when determining a proportionate approach:

- The type, size, location and temporal scale of the proposed project
- Whether other assessment work has already considered life cycle GHG emissions
- Whether mitigation has already been agreed with the design team, particularly if this is beyond minimum policy requirements
- Whether the proposed project has specific goals or aspirations (e.g. achieving BREEAM certification)

In selecting or developing an approach for an EIA GHG emissions assessment, the aim should be to deliver a robust, proportionate, appropriate and consistent assessment.

During scoping, it is also important to set out in principle the methodological approach that will be taken to assessing project GHG emissions. This means documenting in outline aspects such as baseline setting, assessment approach, how significance will be determined and strategies for mitigation. These are commonly recorded in a project scoping report, and this can form a useful first record of the approach to delivering the GHG emissions assessment. Each of these steps for the EIA are addressed in the following sections, which should be consulted for further detail.

## 4.2 Stakeholder engagement

Stakeholder engagement is an important part of undertaking an EIA, especially during the scoping stage. It will provide useful information and support the goals of the GHG emissions assessment.

Stakeholder engagement will provide the practitioner better contextual understanding of the project including on key issues, opportunities, constraints and information pertinent to the assessment. Stakeholders will include clients, project developers and statutory consultees who all have an interest and influence on the project.

Depending on the nature of the proposed project, GHG emissions can be discussed during public consultation. Initial consultation with the project team and wider EIA topic specialists may also reveal parallel activities where input from the GHG assessment would be beneficial. For example, clients may wish to report on the sustainability performance of their projects using assessment schemes such as PAS 2080, CEEQUAL and BREEAM. Being able to report on the proposed project's GHG performance will help with such assessments. It may be sensible that a single GHG assessment is carried out which provides evidence for the EIA's GHG scope as well as CEEQUAL or BREEAM assessment requirements. Depending on contractual agreements there are efficiencies to be gained in minimising effort and avoiding duplication of work.

17 IEMA (2017) Delivering Proportional EIA. Available at: https://www.iema.net/resources/reading-room/2017/07/18/delivering-proportionate-eia

Other project management decisions may include the desire to manage the project in an integrated manner, combining 3D models with performance data (including environmental data) such as BIM (Building Information Modelling).

### 4.3 Benefits and challenges of raising GHG emissions as part of project scoping

By going through the scoping process, the practitioner gains an early and informed understanding of the project's impact and potential sources of GHG emissions. This provides an opportunity to influence and even mitigate GHG emissions early in the design process as well as consider emissions from alternative options.

The challenge at the scoping stage is that there is often limited project information available from the design team at this early stage, resulting in a qualitative-based decision and professional judgement from the practitioner. Nevertheless, by engaging with key stakeholders, the practitioner should be able to define the boundaries of the GHG assessment (see Section 5.3), as well as start to form a view of where the majority of emissions are likely to arise from and appropriate mitigation strategies.

Where the competent authority (e.g. LPA) provides a scoping opinion, the subsequent ES must be 'based on' the expectations set out in the opinion, including any reference to GHG assessment. This underlines the importance of the scoping stage; however, case law has established that the ES can also adapt to development design evolution that occurs post-scoping.

# V – GHG emissions assessment methodology

## 5.1 Introduction

There are many different assessment methods available for measuring and quantifying GHG emissions associated with the built and natural environment. These range from general guidance to formal standards, and many will be appropriate for use in EIA depending on the goals and scope of the assessment required. There is ample GHG quantification guidance in the public domain. However, undertaking an EIA is different to other GHG assessments as the total net impact of the proposed project must be quantified. Therefore, any assessment should follow the principles set out below (see Section 5.2). A list of relevant methods can be found in Appendix B.

Given the wide variation of working situations and the particular aims and objectives of the EIA process, this guidance does not recommend a particular approach. Rather, it sets out advice for the key common components necessary for undertaking a GHG emissions assessment. This guidance does, however, outline a framework of six steps that an assessment should incorporate, which are set out in Section 5.3.

## 5.2 GHG quantification principles

- GHG quantification within EIA should follow the principles outlined in key documents such as the GHG Protocol Corporate Standard, BS EN ISO 14064-2 or PAS 2080 (see Appendix B) – Relevance, Completeness, Consistency, Transparency and Accuracy
- The assessment should seek to quantify the difference in GHG emissions between the proposed project and the baseline scenario (the alternative project/solution in place of the proposed project). Assessment results should reflect the difference in whole life net GHG emissions between the two options
- The assessment must include all material emissions (defined by magnitude, see Section 5.3, Step 3 *for the exclusion threshold*), direct or indirect (based on the point above), during the whole life of the proposed project. The boundary of the assessment should be clearly defined, in alignment with best practice
- The assessment should seek to present a reasonable worst case
- Any exclusions, limitations, assumptions and uncertainties should be justified and reported where appropriate

## 5.3 Six Steps of GHG emissions assessment

In developing the approach, the aim should be to deliver a robust, proportionate, appropriate and consistent assessment. The following six steps outline the framework a GHG emissions assessment should incorporate:

1. Set the scope and boundaries of the GHG assessment
2. Develop the baseline
3. Decide upon the emissions calculation methodologies
4. Data collection
5. Calculate/determine the GHG emissions inventory
6. Consider mitigation opportunities and repeat steps 4 & 5

The following sections explore these aspects in more detail. The contextualisation of emissions and determination of significance is addressed in Section VI: Significance.

## Step 1: Set the scope and boundaries of the GHG assessment

In the first instance the assessment should set out the rationale for the assessment and its scope, as well as provide background and context. This will normally incorporate a description of the proposed project, its purpose and activities, the system boundary to apply and life cycle stages scoped in and out (including justification) of the assessment.

### *System boundaries*

All material existing sources and removals of GHG emissions prior to project construction and operation (i.e. without the project) should be identified and clearly described.

EIAs should use data that is consistent with and report using the modular approach (Figure 4). A detailed and complete GHG emissions assessment typically covers all life cycle modules.

As projects vary in size, so does the scale of GHG assessments in the spirit of delivering proportionate EIAs. Certain life cycle modules (or stages) can be excluded if these exclusions are clearly highlighted and justified by the practitioner using professional judgement and in accordance with the materiality and cut-off guidance.

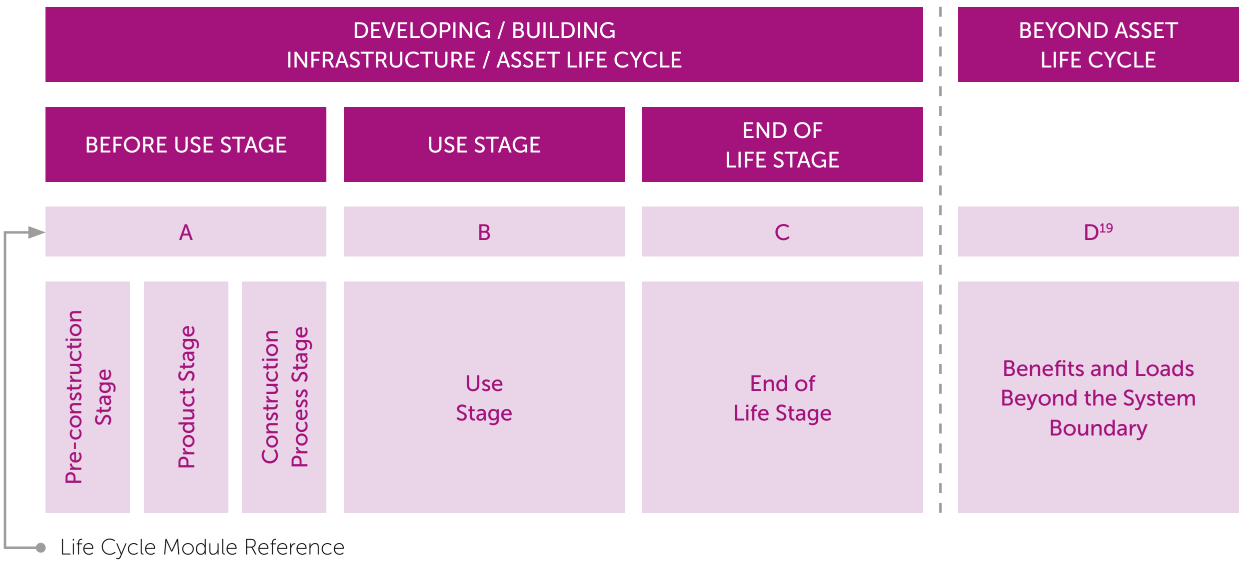


Figure 4: Modular approach of life cycle stages and modules for EIA GHG emissions assessment; the module references are widely used in construction GHG emissions assessment and reduction activities. The figure provides a simplified presentation of the modular approach that can be used for boundary definition and the gathering and reporting of information associated with the assessment. A more detailed presentation of this structure can be found in PAS 2080 and BS EN 15978[20].

18 'For clarity, Module D in Figure 4 (Benefits and Loads Beyond the System Boundary) refers to wider impacts that may not be appropriate to attribute (in part or whole) to the project when calculating net impacts within the study boundary but are nevertheless relevant context to consider. Examples include the benefits of a project sending waste materials for recycling rather than disposal (which is properly attributed to the user of recycled products, but still relevant to acknowledge) or where a major project such as an airport or rail line might affect regional or national travel patterns and emissions (properly attributable to a wider group of transport users, but relevant to acknowledge in the project context).'

19 BS EN 15978:2011 Sustainability of construction works, Assessment of environmental performance of buildings, Calculation method

### *Temporal boundaries*

A reference study period shall be chosen as the basis for the GHG emissions assessment, and this should be based on the expected service life of the construction asset. Additional assistance is available in ISO 15686-1[20], RICS Whole life Carbon Assessment[21] and TAG GHG Assessment guidance[22].

## Step 2: Develop the baseline

A baseline is a reference point against which the impact of a new project can be compared against; sometimes referred to as 'business as usual' (BaU) where assumptions are made on current or future GHG emissions. Baseline can take the form of:

A. GHG emissions within the boundary of the GHG quantification but without the proposed project; or

B. GHG emissions arising from an alternative project design and/or BaU for a project of this type.

The ultimate goal of establishing a baseline is being able to assess and report the net GHG impact of the proposed project.

### *Current baseline*

The current baseline represents existing GHG emissions from the assessment prior to construction and operation of the project under consideration. This may include emissions from existing projects (e.g. energy consumption from a building which is scheduled for refurbishment, demolition or replacement) and infrastructure (e.g. current operational and end-user emissions of a road due to be upgraded).

Depending on the nature of the project, in addition to the project baseline, it may also be necessary to establish a sectoral baseline. For example, baseline emissions from BaU power generation would also be important to consider due to the interconnected nature of the electricity grid. This will equally apply to other project types that have wider interlinkages beyond a site level, e.g. many transport, industrial and waste projects.

It may not always be possible to report on current baseline emissions, particularly with projects situated in areas with no physical development or activity. In this instance there would be zero GHG emissions to report at a site level, although particular attention should be paid where changes in land use are expected. For example, land use and land-use change such as woodland creation can sequester carbon over their lifetime and therefore contribute to climate change mitigation. Their disturbance or removal through construction will release previously sequestered GHG emissions.

20 ISO 15686-1:2011Buildings and constructed assets — Service life planning — Part 1: General principles and framework

21 RICS (2021) Whole Life Carbon Assessment for the Built Environment, 1st edition. Available at: https://www.rics.org/uk/upholding-professional-standards/sector-standards/building-surveying/whole-life-carbon-assessment-for-the-built-environment

22 Department for Transport (2021) TAG unit A3 environmental impact appraisal. Available at: https://www.gov.uk/government/publications/tag-unit-a3-environmental-impact-appraisal

*Future baseline*

Future baseline should capture both operational[23] and user[24] GHG emissions irrespective of their source (i.e. direct and indirect emissions). The distinction between operational and user GHG emissions is important. For example, an existing motorway will have operational emissions (i.e. lighting, maintenance, upgrades) as well as user emissions associated with vehicles travelling along the route. Current baseline travel patterns should be assessed as projected change (e.g. changes in mode share, increased efficiency in vehicles and trip numbers). With regards to energy supply and demand (e.g. electricity use in a commercial building), future baseline should report on operational GHG emissions and how these may change over time (e.g. based on occupancy changes, UK grid decarbonisation projection scenarios or the adoption of renewables).

Box 2 lists potential sources of information which can be considered when establishing future baseline emissions.

Box 2: Potential sources of information on GHG and energy projections (see Appendix A for further details)

- Modelled or projected future scenarios and pathways to net zero published by authoritative bodies such as the CCC[25]
- The Department for Business, Energy & Industrial Strategy (previously DECC)[26]
- The Department for Transport (DfT) TAG (the Transport Analysis Guidance) – Data Book[27]
- BEIS Electricity emissions to 2100 factor projections[28]
- GHG emissions from the operation of existing buildings can be estimated using published benchmarks (e.g. CIBSE Guide F – Energy Efficiency in Buildings (2012) or BSRIA Rules of Thumb Guidelines for Building Services (5th Edition, 2011)) where primary data such as annual metered energy consumption is not available
- GHG emissions associated with other sources or activities such as playing fields may be harder to estimate. It may be appropriate to assume zero baseline GHG emissions in such cases to ensure a reasonable worse-case approach to establishing the net GHG effect of the project. It could in such cases be important to also quantify (estimate) emissions release from the land used change and soil disturbance

23 PAS 2080:2016 Carbon Management in Infrastructure defines operational carbon as GHG emissions associated with the operation of infrastructure required to enable it to operate and deliver its service

24 PAS 2080:2016 Carbon Management in Infrastructure defines user carbon as GHG emissions associated with Users' utilisation of infrastructure and the service it provides during operation

25 Climate Change Committee (2020) The Sixth Carbon Budget. Available at: https://www.theccc.org.uk/publication/sixth-carbon-budget

26 The Department for Business, Energy & Industrial Strategy. Available at: https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy

27 The Department for Transport (2021) Transport Analysis Guidance (TAG). Available at: https://www.gov.uk/guidance/transport-analysis-guidance-tag

28 The Department for Business, Energy & Industrial Strategy (2021) Energy and emissions projections – Net Zero Strategy Baseline. Available at: https://www.gov.uk/government/collections/energy-and-emissions-projections

*Alternative baselines*

Alternative baselines can be used to supplement the analysis and address uncertainty. For example, it may be unclear what baseline to adopt and compare a proposed project against if the site is 'empty' (i.e. the project is not replacing an existing development). For example: different locations, designs or layouts for building developments; or alternative energy generation options in the instance of a wind or solar farm proposal. However, a realistic worse-case baseline should still be used for assigning significance.

In many instances, alternatives may not have been considered by the developer. Ideally, alternatives would have been considered earlier in the project life cycle, and the EIA is viewed as the platform for improving the preferred design. Nevertheless, where alternative baselines were considered, even a qualitative assessment of their GHG impact would be acceptable as part of the overall assessment.

## Step 3: Assessment methodology

Once the scope and baseline is set, the calculation method can be agreed along with data collection. The methodology should result in a relevant, complete, consistent, transparent and accurate assessment of the reasonable worst case. In most cases, the assessment should use activity data and emissions factors. However, where possible, it may be preferable to generate bespoke emissions factors (e.g. through mass balance calculations) or use actual monitored data. The methodology chosen should follow best practice guidance, such as the GHG protocol, and it is not the aim of this guidance to provide this.

*Inclusions & exclusions*

The project boundary should include its spatial extent and life cycle stages relevant to the scope of the assessment.

Activities that do not significantly change the result of the assessment can be excluded where expected emissions are less than 1% of total emissions, and where all such exclusions total a maximum of 5% of total emissions; all exclusions should be clearly stated.

## Step 4: Data collection

*Project activity data*

To calculate GHG emissions of a proposed project it is necessary to gather data on the activities occurring and associated GHG emissions factors. It is important that data for both these aspects, and particularly the activity data, is specific to the proposed project.

Activity data consists of information that defines and describes the size, magnitude and physical nature of the proposed project. It will take many different forms, including material specifications and quantity, energy and water demand, waste generation, transportation distances and modes, and works techniques/technologies.

*GHG emission factors*

GHG emission factors are a value for 'GHG emissions per unit of activity'. Examples of this are:

- HGV: kg $CO_2$e / tonne.km
- UK electricity grid: kg $CO_2$e / kWh
- Concrete: kg $CO_2$e / tonne

GHG emission factors vary in their scope and coverage and will be representative of a single process/activity or multiple of these, sometimes incorporating multiple life cycle stages. Care should be taken to select and reference the right factors for the proposed project.

When undertaking a study, it is often necessary to apply multiple GHG factors for the same activity or material particularly when the assessment is studying a life cycle with a long time period. This may be appropriate when future GHG emissions for that activity are expected to change; this might occur, for example, when accounting for reduced GHG emissions associated with a national electricity grid and the benefit this brings to demand side GHG emissions of using electric trains.

For examples of sources of GHG factors refer to Appendix A.

### *Data quality*

The following aspects, in line with PAS 2080[29], should be considered when collecting assessment data:

- Primary (measured), secondary (estimated) or benchmarks
- Age (age of data, and the period over which they have been collected)
- Geography (the region or country from where the data have originated)
- Technology (whether the data are specific to a particular technology or mix of many)
- Methodology (the approach applied to gather or calculate the data)
- Competency (proficiency of entity that developed the data)

Baseline GHG emissions from the operation of existing buildings can be estimated using published benchmarks (e.g. CIBSE Guide F – Energy Efficiency in Buildings (2012) or BSRIA Rules of Thumb Guidelines for Building Services (5th Edition, 2011)) where primary data (e.g. annual metered energy consumption) is not available.

Baseline GHG emissions associated with other sources or activities such as agricultural fields may be harder to estimate. It may be appropriate to assume zero baseline GHG emissions in such cases to ensure a reasonable worse-case approach to establishing the net GHG effect of project proposals.

### *Types of data*

The type of data used by the practitioner will vary depending on how detailed the project design is. Most assessments are based on design-stage information, hence activity data specific to the project should in theory be available from the engineering and design teams. If this is not the case, an alternative approach would be to fall back on generic or publicly available information that best represents the project and its activities.

Studies undertaken as part of the planning application for the proposed project outside of EIA process can provide a useful source of information for GHG assessments, for example:

- BREEAM Pre-assessment (especially RIBA 2 evidence for Mat 01 Construction Materials LCA)
- Energy Statement
- Whole Life Carbon Assessment (e.g. London Plan)
- Circular Economy Statement (e.g. London Plan)
- Sustainability Statement

## Step 5: Calculate GHG emissions inventory

### *GHG emissions calculation method*

Quantification of the GHG emissions for an EIA may be associated with either a measured or calculated approach or a combination of both for the emissions associated with the project. It is expected that in almost all cases a calculated approach for quantifying GHG emissions will be taken because an EIA is completed in advance of supply chain mobilisation and associated construction works.

29 PAS 2080:2016 Carbon Management in Infrastructure.

When undertaking a quantification calculation the formula for determining a GHG emission (or removal value), associated with the construction works, should have the following structure:

***GHG emission factor × Activity data = GHG emission or removal***

Calculations may be taken at different scales reflecting specific activities, components or elements of construction. Therefore, individual calculations should be summed to form a GHG emissions inventory for the quantification as a whole.

### *Study uncertainty*

Uncertainty can arise from quality of data, study boundaries and period of assessment, and can never be eliminated from a study. Uncertainty should be considered and if it significantly affects the outcome of the study, additional steps should be taken to reduce it and provide confidence in results. As a reminder, a relevant, complete, consistent, transparent and accurate assessment of the reasonable worst case must be undertaken despite uncertainties.

Uncertainty can be considered by:

- Testing upper and lower limits
- Testing for different inclusions and exclusions
- Modifying study period
- RAG (red, amber, green) rating input data based on data quality criteria presented above
- If the scale of uncertainty provides findings that are likely to change any decision based on the data, then it should be appropriately reduced.

### *Cumulative GHG emissions*

The atmospheric concentration of GHGs and resulting effect on climate change is affected by all sources and sinks globally, anthropogenic and otherwise. As GHG emission impacts and resulting effects are global rather than affecting one localised area, the approach to cumulative effects assessment for GHGs differs from that for many EIA topics where only projects within a geographically bounded study area of, for example, 10km would be included.

For example, air pollutant emissions are dispersed and diluted after emission and only the cumulative contributions of other relatively nearby sources contribute materially to the pollutant concentration, and hence effect, at a particular sensitive receptor in the study area. Due to the persistence of GHGs in the atmosphere, that same dispersion effect contributes to the global atmospheric GHG emissions balance. There is no greater local climate change effect from a localised impact of GHG emission sources (or vice versa).

All global cumulative GHG sources are relevant to the effect on climate change, and this should be taken into account in defining the receptor (the atmospheric concentration of GHGs) as being of 'high' sensitivity to further emissions.

Effects of GHG emissions from specific cumulative projects therefore in general should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other.

The contextualisation of GHG emissions, as discussed in Section 6.4, should incorporate by its nature the cumulative contributions of other GHG sources which make up that context. Where the contextualisation is geographically – or sector-bounded (e.g. involves contextualising emissions within a local authority scale carbon budget, or a sector level net zero carbon roadmap), then the consideration of cumulative contributions to that context will be within that boundary.

### Step 6: Mitigation opportunities

Once the magnitude of emissions has been determined (as discussed in Section 5.3, Step 4), mitigation measures (as discussed in Section 2) should be proposed. Any mitigation measures that are committed to need to be included within the assessment. This means recollecting new activity data where this has changed due to mitigation measures, and new emissions calculations need to be undertaken. Steps 4 & 5 should be repeated as necessary.

## 5.4 GHG assessment and proportionality

GHG emissions should be assessed and reported as part of a good practice approach to EIA.

Projects will vary by type and size, and so will GHG emissions. An effective scoping exercise ensures that a balance is struck between the amount of GHG emissions emitted or saved by the project and the effort committed to the actual GHG assessment. For example, if most impacts occur during a project's construction phase and operational impacts are negligible, then the GHG assessment can reflect this. A high-level or qualitative GHG assessment for certain project elements or activities can be carried out as long as it is justified and agreed during the scoping stage with stakeholders. This will help contribute towards delivering a proportionate assessment.

It should also be recognised that qualitative assessments are acceptable, for example: where data is unavailable or where mitigation measures are agreed early in the design phase with design and engineering teams.

# VI – Significance

## 6.1 Introduction

IEMA's 2010 principles on climate change mitigation and EIA identify climate change as one of the defining environmental policy drivers and that action to reduce GHG emissions is essential. Specifically, three overarching principles are particularly relevant in considering the aspect of significance[30]:

1. The GHG emissions from all projects will contribute to climate change, the largest interrelated cumulative environmental effect
2. The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive (e.g. human health, biodiversity, water, land use, air quality)
3. GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit[31]; as such any GHG emissions or reductions from a project might be considered to be significant[32]

This document builds on those principles as follows:

- When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its life time, which may be positive, negative or negligible
- Where GHG emissions cannot be avoided, the goal of the EIA process should be to reduce the project's residual emissions at all stages
- Where GHG emissions remain significant, but cannot be further reduced, approaches to compensate the project's remaining emissions should be considered

The guidance in this document provides further detail of how those principles can be applied, particularly how the net effect of a project and its beneficial or adverse effects can be evaluated in the context of emission reductions on a trajectory towards net zero.

## 6.2 Background to significance

The goal of the Paris Agreement is to limit global temperature rise to well below 2°C, aiming for 1.5°C, compared with pre-industrial levels, in order to stand a greater chance of avoiding severe adverse effects from climate change.

The UK has set a legally binding GHG reduction target for 2050 with interim five-yearly carbon budgets which define a trajectory towards net zero. The 2050 target (and interim budgets set to date) are, according to the CCC, compatible with the required magnitude and rate of GHG emissions reductions required in the UK to meet the goals of the Paris Agreement, thereby limiting severe adverse effects. Further budgets are set by the devolved administrations in Wales and Scotland, which are also in line with advice from the CCC. Carbon budgets allow for continuing economic activity, including projects in the built environment, in a controlled manner.

To meet the 2050 target and interim budgets, action is required to reduce GHG emissions from all sectors, including projects in the built and natural environment. EIA for any proposed project must therefore give proportionate consideration to whether and how that project will contribute to or jeopardise the achievement of these targets.

30 IEMA (2010) Climate Change Mitigation & EIA. Available at: https://www.iema.net/document-download/33006

31 There is a global GHG emission budget that defines a level of dangerous climate change, and any GHG emission that contributes to exceedance of that budget or threatens efforts to stay within it can be considered as significant.

32 The third principle is related to the IPCC carbon budget definition. The IPCC's Sixth Assessment Report (WG1: The Physical Science Basis, Table SPM.2) indicates that the remaining global carbon budget from 2020 that provides a two-thirds likelihood of not exceeding 1.5°C heating is 400 $GtCO_2$; for an 87% likelihood it is 300 $GtCO_2$.

However, it is important to note that:

(a) The UK's and devolved administrations' GHG targets incorporate a staged set of reductions between the present day and 2045 or 2050, defined by five-yearly carbon budgets. A continuing, but, over time, reduced level of GHG emissions is compatible with national and international climate change commitments. Going above and beyond these commitments and achieving net zero at an earlier date is strongly desirable and a high priority.

(b) The necessary level and rate of GHG emission reductions will be unevenly distributed across different economic sectors, activities and types of projects. Net zero for the UK in 2050 (and in the interim) will include some activities with net negative emissions and some with residual emissions greater than zero.

A key goal of EIA is to inform the decision maker about the relative severity of environmental effects such that they can be weighed in a planning balance. Therefore, it is essential to provide context for the magnitude of GHG emissions reported in the EIA in a way that aids evaluation of these effects by the decision maker.

**The crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050[33].**

Often a project will cause a change in GHG emissions compared to the baseline which should be assessed, as discussed in Sections 5.3. When setting this impact into context to determine significance, it is important to consider the net zero trajectory in line with the Paris Agreement's 1.5°C pathway[34].

The timing of reductions is critical due to the cumulative effect of GHG emissions in the atmosphere. Achieving net zero or very low emissions by 2025 instead of 2040 would avoid 15 years of cumulative heating.

The specific context for an individual project and the contribution it makes must be established through the professional judgement of an appropriately qualified practitioner, drawing on the available guidance, policy and scientific evidence[35].

The following principles are a guide to determining significance.

### 6.3 Significance principles and criteria

Figure 5 illustrates how to determine significance depending on the project's whole life GHG emissions and how these align with the UK's net zero compatible trajectory. The following section provides further explanation on the different levels of significance and should be read in conjunction with Figure 5.

33 (or other date as defined in targets for devolved administrations or as may be defined for the UK or specific economic sectors in future).

34 IEMA (2021) Net Zero explained. Available at: https://s3.eu-west-2.amazonaws.com/iema.net/documents/knowledge/policy/climate-change-energy/Net-Zero-Explained-Oct-2021-4.pdf

35 At the time of publication, the applicable evidence is that provided by the IPCC and UNFCCC, supporting the commitments defined in the Paris Agreement, and in the UK that provided by the CCC with regard to GHG budgets and policies that are compatible with the UK's Paris Agreement commitments. Evidence will continue to be developed, for example, through the IPCC's Sixth Assessment Report, future international treaty negotiations and further advice of the CCC or other expert bodies, and the practitioner must evaluate the prevailing evidence at the time.

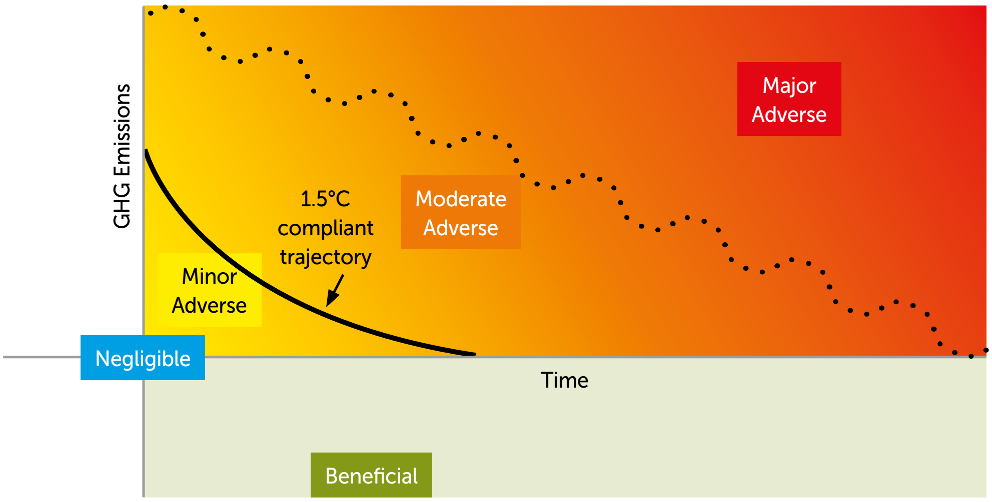


Figure 5: Different levels of significance plotted against the UK's net zero compatible trajectory[36]

A project that follows a 'business-as-usual' or 'do minimum' approach and is not compatible with the UK's net zero trajectory, or accepted aligned practice or area-based transition targets, results in a **significant adverse** effect. It is down to the practitioner to differentiate between the 'level' of significant adverse effects e.g. '**moderate**' or '**major**' adverse effects (see Box 3 for an example of such a differentiation).

A project that is compatible with the budgeted, science-based 1.5°C trajectory (in terms of rate of emissions reduction) and which complies with up-to-date policy and 'good practice' reduction measures to achieve that has a **minor adverse** effect that is **not significant**. It may have residual emissions but is doing enough to align with and contribute to the relevant transition scenario, keeping the UK on track towards net zero by 2050 with at least a 78% reduction by 2035[37] and thereby potentially avoiding significant adverse effects.

A project that achieves emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory, and has minimal residual emissions, is assessed as having a **negligible** effect that is **not significant**. This project is playing a part in achieving the rate of transition required by nationally set policy commitments.

A project that causes GHG emissions to be avoided or removed from the atmosphere has a **beneficial** effect that is **significant**. Only projects that actively reverse (rather than only reduce) the risk of severe climate change can be judged as having a beneficial effect.

36 Ideally, the curve will be quantitative, derived from a set of carbon budgets that show the rate of reduction to be achieved; but where this is not available, it will need to be evaluated qualitatively based on policy goals and advice of expert guidance bodies on the actions needed to achieve the necessary rate of reductions.

37 or other science-based 1.5°C compatible trajectory as may be defined for a specific sector or local area, as applicable

For the avoidance of doubt, a 'minor adverse' or 'negligible' non-significant effect conclusion does not necessarily refer to the *magnitude* of GHG emissions being carbon neutral (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change, aligning project emissions with a science-based 1.5°C compatible trajectory, and achieving net zero by 2050[38]. A project's impact can shift from significant adverse to non-significant effects by incorporating mitigation measures that substantially improve on business-as-usual and meet or exceed the science-based emissions trajectory of ongoing but declining emissions towards net zero.

A 'minor adverse' effect or better is therefore a high bar and indicates exemplary performance where a project meets or exceeds measures to achieve net zero earlier than 2050. However, in the context of the severe threat of climate change, such an effect cannot be judged as significant beneficial – this category is reserved for projects with effects that directly or indirectly remove or avoid GHG emissions in the without-project baseline.

An example of how these principles may be applied in practice is given in Box 3.

**Box 3: Examples of significance criteria**

For the avoidance of doubt IEMA's position that all emissions contribute to climate change has not changed. This Box 3 provides practitioners with examples of how to distinguish different levels of significance. Major or moderate adverse effects and beneficial effects are **considered to be significant**. Minor adverse and negligible effects are **not considered to be significant.**

**Major adverse:** the project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.

**Moderate adverse:** the project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.

**Minor adverse:** the project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.

**Negligible:** the project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.

**Beneficial:** the project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.

38 or other date as defined in targets for devolved administrations or as may be defined for the UK or specific economic sectors in future.

A modification to this approach is required for the very largest-scale developments, those that in themselves have magnitudes of GHG emissions that materially affect the UK's or a devolved administration's total carbon budget. An indicative threshold of 5% of the UK or devolved administration carbon budget in the applicable time period is proposed, at which the magnitude of GHG emissions irrespective of any reductions is likely to be significant. A project that meets this threshold can in itself materially affect achievement of the carbon budget.

Practitioners should note that existing policy and regulation may in some cases lag behind the necessary levels of GHG emission reductions (or types of actions to achieve those) that are compatible with the UK's or devolved administrations' targets and with a science-based 1.5°C compatible trajectory towards net zero. Meeting the minimum standards set through existing policy or regulation cannot necessarily be taken as evidence of avoiding a significant adverse effect, and it is recommended that practitioners consider and have reference also to emerging policy/standards and the guidance of expert bodies such as the CCC on necessary policy developments, particularly for multi-phased projects with long timescales. This must be evaluated by the practitioner as part of the evidence base used in the assessment of effects. References to 'existing' and 'emerging' policy in the principles of significance and example criteria above must be interpreted with this in mind.

In following this guidance, the practitioner is contextualising the project to understand whether committed mitigation represents best endeavours, to avoid significant adverse effects in line with the principles and example criteria defined above.

The assessment process for GHG emissions will therefore require a review of the current and emerging policy/regulatory position together with a review of expert scientific advice from bodies such as the CCC or IPCC about where existing policy or regulation is insufficient or not, relative to the science.

It bears reiterating that an ES should inform decision makers about both adverse and beneficial effects, so that all significant effects can be weighed in decisions. Where the fundamental reason for a proposed project is to combat climate change (e.g. a wind farm or carbon capture and storage project) and this beneficial effect drives the project need, then it is likely to be significant.

### 6.4 Contextualising a project's carbon footprint

The context of a project's carbon footprint determines whether it supports or undermines a trajectory towards net zero. Determining that trajectory and the position of a project within it, however, is the challenge for practitioners.

It is down to the practitioner's professional judgement on how best to contextualise a project's GHG impact.

The UK has a defined national carbon budget and budgets set by devolved administrations which have been determined as being compatible with net zero and international climate commitments. The starting point for context is therefore the percentage contribution to the national or devolved administration carbon budget as advised by the CCC. However, the contribution of most indivdual projects to national-level budgets will be small and so this context will have limited value.

The available contextual information base is rapidly developing and will continue to grow in the coming years as developments such as sector initiatives, locally set carbon budgets and the Task Force on Climate-Related Financial Disclosures (TCFD) and transition risk scenario analysis progress.

Existing government policy will in many cases define goals and necessary action for GHG emissions reduction that is compatible with national climate commitments. However, it is also essential to evaluate this in the context of expert advice/commentary on policy gaps and emerging policy recommendations.

Industry bodies for many sectors crucial to reducing GHG emissions have published analyses, strategies and net zero compatible reduction trajectories for their sectors. This can provide useful and highly specific evidence of what constitutes the necessary type and rate of GHG reduction actions for a particular project type.

For example, the Green Construction Board[39] has calculated carbon budgets for each of the UK built environment sectors. Similarly, the CCC[40] has determined a UK wide carbon budget broken down into the following key sectors: surface transport, buildings, manufacturing and construction, electricity generation, fuel supply, agriculture and land use, land-use change and forestry (LULUCF), aviation, shipping, waste, F-gases, and greenhouse gas removals. Researchers at the Tyndall Centre at the University of Manchester have proposed local authority scale carbon budgets that are compatible with the UK's commitments under the Paris Agreement[41]. Further examples of sectoral strategies and budgets are given in Figure 6 below.

The good practice approach included in Figure 6 below provides an example of how to contextualise your project's carbon footprint against pre-determined carbon budgets or against emerging policy and performance standards where a budget is not available.

Where quantified carbon budgets or a net zero trajectory is lacking, a more qualitative or policy-based approach to contextualising emissions to evaluate significance may be necessary. In these instances, uncertainty and the likelihood of effect should be discussed.

It is good practice to draw on multiple sources of evidence when evaluating the context of GHG emissions associated with a project. The practitioner should be aware that sources of evidence are still emerging, subject to revision as understanding develops and innovation occurs, and in some cases will be contested and conflicted. Professional judgement will therefore be vital in integrating these sources of evidence and evaluating them. Table 1 sets out further sources of contextual information against which the GHG emissions and reduction actions of project can be evaluated.

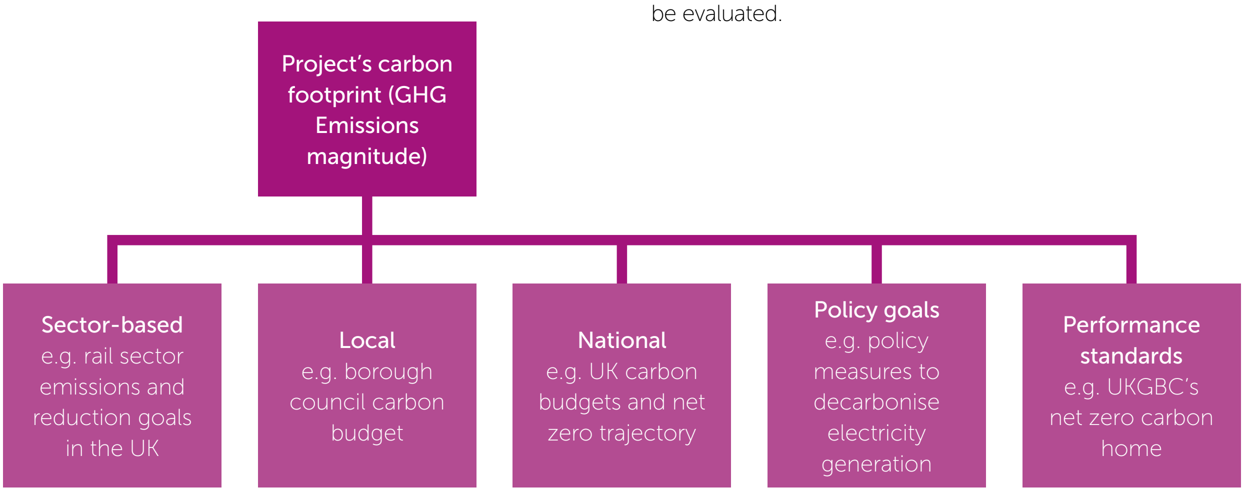


Figure 6: Good practice approaches for contextualising a project's GHG emissions

39 The Green Construction Board (2015) Green Construction Board Low Carbon Routemap for the Built Environment. Available at: http://www.hwa.uk.com/site/wp-content/uploads/2020/10/CD-17.13-Low-Carbon-Routemap-for-the-Built-Environment-Technical-Report-Green-Construction-Board-2015.pdf

40 Climate Change Committee (2020) The Sixth Carbon Budget: The UK's path to Net Zero. Available at: https://www.theccc.org.uk/publication/sixth-carbon-budget

41 Tyndall Centre for Climate Change Research (2022) Quantifying the implications of the United Nations Paris Agreement for local areas. Available at https://carbonbudget.manchester.ac.uk

Table 1: Sources of contextual information against which projects can be evaluated.

| Context | Advantages | Limitations |
|---|---|---|
| National or devolved administration carbon budget and NDC | • Clearly defined and based on robust scientific evidence | • Too high level for most individual projects |
| Local or regional carbon budgets developed by local authorities and researchers (e.g. the Tyndall Centre at the University of Manchester[42]) | • A more pertinent scale for individual projects and local decision-making<br>• Will reflect regional factors such as concentration of industry | • Effects of GHG emissions are not geographically circumscribed, so a geographic budget (below a national budget defined based on negotiated NDCs to commitments to a global budget agreed through the UNFCCC) is not very meaningful<br>• Displacing GHG emissions from one local authority or region to another within the UK has no benefit<br>• It's unclear whether emerging local authority or regional budgets will add up coherently to the UK budget |
| Sectoral budgets or reduction strategies | • These are available for many crucial sectors (e.g. the Energy Transitions Commission[43] presents net zero strategies for a wide range of sectors)<br>• They often contain detailed, staged measures (and several scenarios) for GHG reductions with interim targets, providing a clearly defined trajectory | • There is a risk that some sectoral strategies represent a lobbying position rather than science-based target setting |
| Current and future GHG emissions intensity of an activity | • This provides useful context in cases where a project is meeting an established demand, such as for electricity generation, and may have a GHG benefit by displacing a legacy source (e.g. renewable generators displacing gas-fired baseload) | • This would not be applicable context for absolute emissions changes, (e.g. construction emissions or land-use change at a site level), so would need to be combined with other sources of information |
| Existing and emerging national and local policy or regulation | • This is extensive, providing context for all development types<br>• It will often provide relatively detailed and specific goals and implementation measures<br>• Policy should be compatible with the UK's national GHG commitments and actions to achieve those | • There can be significant policy gaps or policy lag<br>• It will not always be clear that compliance with policy measures, or a subset of them, amounts to a net zero carbon compatible trajectory |
| Expert advice of guidance bodies<br>Voluntary performance standards (e.g. the UK Green Building Council's 'Net Zero Carbon Building' framework[44]) | • Extensive publications and strategies are available, providing context for all development types<br>• Considerable reliance can be placed on the advice of the CCC, which has the statutory duty of advising the government on policy that is necessary to achieve national climate commitments<br>• Expert advice of guidance bodies can identify existing policy/regulatory gaps<br>• Expert advice of guidance bodies can be used as a source to define what constitutes achievable best practice for many development types<br>• Voluntary performance standards provide a framework for evaluating what constitutes best practice for emissions performance, and the means to predict and then monitor this | • Guidance and advice may be contested or conflicting<br>• There is a risk that some guidance represents a lobbying position rather than science-based GHG reductions |
| Company-specific TCFD reporting, transition risk assessments or Science-Based Targets | • This can provide context that is highly specific to the project in question, where the developer has already set science-based targets and/or undertaken climate risk assessments with scenario analysis that includes a best practice measures / minimum climate risk scenario | • This may not be available for the majority of projects |

42 Tyndall Centre for Climate Change Research (2022) Quantifying the implications of the United Nations Paris Agreement for local areas. Available at: https://carbonbudget.manchester.ac.uk

43 Energy Transitions Commission (2022) A global coalition of leaders from across the energy landscape committed to achieving net zero emissions by mid-century. Available at: https://www.energy-transitions.org

44 UKGBC (2019) Net Zero Carbon Buildings: A Framework Definition. Available at: https://ukgbc.s3.eu-west-2.amazonaws.com/wp-content/uploads/2019/04/05150856/Net-Zero-Carbon-Buildings-A-framework-definition.pdf

### 6.5 Embedded or committed mitigation

When determining significance, any embedded/committed mitigation measures that form part of the design should be considered.

It is valuable and strongly encouraged for GHG emissions mitigation to be considered and embedded at the earliest stages of design, where the greatest influence can be achieved, as discussed in Section II and in IEMA's 'Pathways to Net Zero: GHG Management Hierarchy' guidance[45].

Where embedded/committed mitigation is relied upon in the assessment of effects, the practitioner must form a clear judgement that this mitigation is:

1. Evidenced in the design for the project
2. A committed goal that is secured, e.g. forming part of the description of development, a specific planning condition/requirement, or a legal agreement
3. Realistic and achievable to deliver

In some cases, mitigation commitments (especially in the form of targets or commitments to actions at a later design stage) may not offer sufficient certainty at the time of undertaking the assessment that the practitioner can rely upon in judging the significance of effects.

In this case, the significance of effects should initially be stated without this mitigation, and it should then fall into the assessment of additional mitigation and residual effects.

### 6.6 Additional mitigation and residual effects

Where the initial assessment identifies significant adverse effects, additional mitigation should be considered to reduce these effects to an acceptable and non-significant level where feasible.

As a matter of good practice, available mitigation to reduce non-significant effects or further enhance beneficial effects should also be considered where possible.

As noted above, where there is embedded mitigation in the form of project commitments to GHG emission reductions but the details of this are not secured within the project design at the time of assessment, further detail of the potential mitigation measures to achieve that commitment can also be considered within the additional mitigation section and assessment of residual effects.

The assessment of potential residual effects, with incorporation of additional mitigation, must be expressed in conditional terms. The residual effects would depend on the additional mitigation recommendations being accepted, secured and delivered in practice. An example of appropriate wording would be:

*"Residual effects: with the implementation of [the additional mitigation measures as set out above] and the achievement of [measurable GHG emissions goal] the residual effect could be [reduced to not significant / negligible / beneficial]".*

45 IEMA (2020) Pathways to Net Zero: Using the IEMA GHG Management Hierarchy November 2020. Available at: https://www.iema.net/resources/reading-room/2020/11/26/pathways-to-net-zero-using-the-iema-ghg-management-hierarchy-november-2020

# VII – Communication / Reporting

When reporting on GHG emissions assessment in EIA, the text should conform to Schedule 4: Information for inclusion in environmental statements, of the EIA Regulations document.

### 7.1 Where should GHG emissions be reported within an ES chapter?

There are three main ways in which GHG emissions can be reported on within an ES chapter. These are as follows:

- Within a GHG emissions ES chapter that focuses on the effects of the proposed project on climate change only
- Within an integrated climate change ES chapter that focuses on both the effects of the proposed development on climate change and of the effects of climate change on the proposed development (i.e. climate change resilience and adaptation)
- It may be proportionate for a section in the project description or an appendix to provide information on GHG emissions to support a conclusion about whether these are significant, without a full ES chapter

Regardless of where GHG emissions are reported within the ES chapter, it is crucial that the assessment is transparent and a conclusion on the significance of effects is reached and clearly stated.

### 7.2 How does reporting on GHG emissions fit with related EIA topics?

The effects of potential future climate change based on the net GHG impact from a project are likely to be interrelated with other key EIA topics. To ensure consistency is provided throughout the ES, the GHG team will need to liaise with other key EIA topics including (but not limited to):

- Logistics/Transport (Transport Assessment)
- Resources and waste management (construction and demolition)
- Noise/vibration and air quality (construction activities, hours of work, fuel uses, list of plant and energy use)
- Ecology, landscaping and Sustainable Urban Drainage Systems (green infrastructure and land-use change)

### 7.3 What should be included when reporting on GHG emissions within an ES chapter?

Consistent reporting of GHG emissions in EIA will highlight the importance of accounting for GHG emissions from project inception. It will encourage clients, project developers and engineering design teams to consider the impacts of GHG emissions during early design stages. It is suggested that a brief introduction to climate change and the role of GHG emissions as a contributing factor is included where the effects of GHG emissions are reported within the ES chapter. This will help explain the interrelationship between GHG emissions and climate change with other relevant topics to the readers. This may further be supported with relevant links to documents and information on the topic.

When reporting on GHG emissions and mitigation in EIA, the following steps should be presented where available:

- Baseline emissions: the existing and future emissions within the assessment boundary without construction and operation of the project
- Net emissions (Year 1 and lifetime): the direct and indirect emissions of the project during the first year of operation and for the full lifetime of the project expressed as a change compared to the current and/or future baseline
- Significance: a significance value should be assigned to effects based on the criteria set out
- Further mitigation: the GHG reductions that could be achieved through the application of further mitigation (this will be expressed conditionally and may be quantitative or qualitative)
- Residual effects: a new significance value is assigned to effects taking account the further mitigation measures that have been outlined

### 7.4 What are the challenges associated with reporting on GHG emissions in EIA?

There are a number of challenges, difficulties and opportunities associated with integrating GHG assessment into EIA practice. These challenges and ways to overcome them are presented below:

- The possible effects identified from a GHG emissions assessment can be interlinked with other EIA topic chapters. Therefore, it is important to liaise with other EIA topic specialists where necessary (e.g. transport, waste management, air quality) – and indeed with practitioners providing assessments such as energy modelling and BREEAM/CEEQUAL. This also needs to be considered when reporting on significant effects within the ES.
- GHG emissions associated with a proposed project are often reported as a whole life figure that takes account of both construction and operation. This whole life approach is often at odds with the sub-headings set out in ES chapter templates provided by EIA co-ordinators. However, due to the nature of GHG emissions, it is good practice to include a section that reports on the whole life GHG emissions associated with the proposed project, alongside the sections that assess construction and operation effects in isolation. Additionally, if there is other data or information that needs to be included that doesn't fit into the provided ES chapter template, then additional sub-sections should be added in order to present all the data from the GHG emissions assessment; to inform the EIA and account for the possible effects on future climate change.
- It is challenging to identify fixed numerical thresholds against which to identify the significance of a proposed project regarding the net change in GHG emissions. The GHG assessment should therefore present context for the GHG emissions as discussed in Section VI: Significance.
- Where GHG assessment is used to inform early design stages, it is vital to get stakeholders to understand the importance of minimising the GHG contribution of a project and designing a project that will limit the net change in future GHG emissions.

# Appendix A – Potential Stakeholders and Sources of GHG Information

### A1 Potential stakeholders, sources of environmental information and carbon tools

| Source | Description |
|---|---|
| Climate Change Committee (CCC) – The Sixth Carbon Budget[46] | The CCC reports on UK carbon budgets, by sector, and reductions that need to be achieved if the UK is to achieve its carbon reduction target of net zero by 2050. This includes reports for GHG emissions by UK industrial sector: surface transport, buildings, manufacturing and construction, agriculture & LULUCF, aviation, shipping, waste, F-gases and GHG removals. Reports for the UK's electricity and fuel supply are also reported. |
| The Department for Business, Energy & Industrial Strategy (previously DECC)[47] | The UK Government regularly reports on UK energy and emissions projections by source: agriculture, business, energy supply, industrial processes, land-use change, public, residential, transport and waste management. Currently, GHG emissions reach back to 1990 and project into the future up until 2035 and 2040 (for the 2019 projections). |
| The Department for Business, Energy & Industrial Strategy (previously DECC)[48] UK greenhouse gas emissions statistics | The UK Government also reports on GHG emissions from a geographical perspective, by UK local authority. Current and historical emissions are available which may be used to establish current baseline emissions. |
| The Department for Transport (DfT) TAG (the Transport Analysis Guidance) – Data Book[49] | TAG provides UK transport modelling values and information including projections on how the UK's modal mix (diesel, petrol, electric) is expected for change over time, current and future fuel efficiency projections (litres or kWh per kilometre travelled) up to 2050. Also reported are carbon dioxide emissions per litre of fuel burnt or kWh used for: petrol, diesel, gas oil and electricity used on road and rail travel. |

46 Climate Change Committee (2020) Sixth Carbon Budget. Available at: https://www.theccc.org.uk/publication/sixth-carbon-budget

47 Department for Business, Energy & Industrial Strategy (2021) Energy and emissions projections. Available at: https://www.gov.uk/government/collections/energy-and-emissions-projections

48 Department for Business, Energy & Industrial Strategy (2018) UK greenhouse gas emissions statistics. Available at: https://www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics

49 Department for Transport (2021) TAG data book. Available at: https://www.gov.uk/government/publications/tag-data-book

| Source | Description |
|---|---|
| The Green Construction Board – Infrastructure Carbon Review, Technical Report[50] | The GCB has developed a tool that allows stakeholders to model policy changes associated with the built environment and visualise what this means in terms of GHG emissions.<br>Also available is the Low Carbon Routemap report[51] which explores various GHG emissions projections for both building and infrastructure at the UK level. |
| Inventory of Carbon and Energy (ICE) – University of Bath: Sustainable Energy Research Team[52] | The Inventory of Carbon and Energy (ICE) database is a leading embodied energy and carbon database for building materials. |
| The Department for Business, Energy & Industrial Strategy (previously DECC)[53] – Government emission conversion factors for greenhouse gas company reporting | The Government conversion factors for greenhouse gas reporting are suitable for use by UK based organisations of all sizes, and for international organisations reporting on UK operations. |
| Examples of publicly available carbon assessment tools. The list of carbon tools is non – exhaustive and constantly changing. It is up to the practitioner's professional judgement to decide which tool is most appropriate for the project at hand. It is perfectly appropriate to develop bespoke assessment sheets which may provide more flexibility and transparency. | • Scottish Government Windfarm Carbon Assessment tool[54]<br>• Environment Agency Carbon Planning Tool[55]<br>• RSSB Carbon Tool[56]<br>• National Highways Carbon Tool[57]<br>• MacKay Carbon Calculator[58]<br>• Transport Scotland: Carbon Management System (CMS) |

50 The Green Construction Board (2013) Infrastructure Carbon Review Technical Report. Available at: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2019/06/Infrastructure-Carbon-Review-Technical-Report-25-11-13.pdf

51 Institution of Civil Engineers (nd.) Low Carbon Concrete Routemap. Available at: https://www.ice.org.uk/getattachment/knowledge-and-resources/briefing-sheet/low-carbon-concrete-routemap/low-carbon-concrete-roadmap.pdf.aspx

52 Circular Ecology (2019) Embodied Carbon – The ICE Database. Available at: https://circularecology.com/embodied-carbon-footprint-database.html#.WMO7PYXXLD4

53 Department for Business, Energy & Industrial Strategy (2021) Government conversion factors for company reporting of greenhouse gas emissions. Available at: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

54 Scottish Government (2018) Carbon calculator for wind farms on Scottish peatlands: factsheet. Available at: https://www.gov.scot/publications/carbon-calculator-for-wind-farms-on-scottish-peatlands-factsheet

55 Environment Agency (2016) Carbon planning tool. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/571707/LIT_7067.pdf

56 RSSB (2021) Rail Carbon Tool. Available at: https://www.rssb.co.uk/sustainability/Rail-Carbon-Tool

57 National Highways (2021) Carbon emissions calculation tool. Available at: https://nationalhighways.co.uk/industry/carbon-emissions-calculation-tool

58 Department for Business, Energy & Industrial Strategy (2020) Carbon calculator. Available at: https://www.gov.uk/guidance/carbon-calculator

# Appendix B – List of Standards*

- BRE IMPACT LCA standard – allows the embodied carbon, life cycle environmental (LCA) and life cycle cost (LCC) performance of buildings to be measured and compared in a standardised way.
- BS EN 15686-1:2011 – Buildings and construction assets – service life planning, general principles and framework.
- BS EN 15804:2012 – Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products.
- BS EN 15978:2011 – Sustainability of construction works, Assessment of environmental performance of buildings, Calculation method.
- BS EN ISO 14021:2016 – Environmental labels and declarations. Self-declared environmental claims (Type II environmental labelling).
- BS EN ISO 14025:2006 – Environmental Labels and Declarations. Quantified environmental performance declarations (Type III Environmental Labelling) – guiding principles and procedures.
- BS EN ISO 14044:2006 – Environmental Management. Life cycle assessment. Requirements and guidelines.
- BS EN ISO 14064-1:2018 – guidance on reporting GHG emissions at an organisational level.
- BS EN ISO 14065:2020 – guidance on principles and requirements for bodies performing validation and verification of environmental information statements.
- BS EN ISO 14604-2:2018 – guidance on reporting GHG emissions at the project level.
- ENCORD: the European Network for Construction Companies for Research and Development – a network for active members from the construction industry who have published a 'Construction $CO_2$e Measurement Protocol'.
- Greater London Authority – draft Whole Life-Cycle Carbon Assessments Guidance.
- PAS 2050:2011 – Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.
- PAS 2070:2013 – Specification for the assessment of greenhouse gas emissions of a city.
- PAS 2080:2016 – Carbon Management in Infrastructure – the world's first standard for managing infrastructure GHG emissions.
- PD CEN ISO/TS 14067:2018 – Greenhouse gases. Carbon footprint of products. Requirements and guidelines for quantification and communication.
- RICS (2021) Whole Life Carbon Assessment for the Built Environment, 1st edition.
- UK Green Building Council – Net Zero Carbon Buildings: A Framework Definition.
- WRI GHG Protocol – the World Resource Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) partnered to develop internationally recognised guidance and standards on GHG accounting and reporting, and includes advice on:
  - Corporate Standards;
  - Corporate Value Chain (Scope 3);
  - Product Life Cycle assessments;
  - Project Protocol (The GHG Protocol for Project Accounting);
  - GHG Protocol for Cities; and
  - Agricultural Guidance.

*Please note this list is not exhaustive, and subject to updates

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