

High Value Manufacturing Catapult

Summer 2022

Embodied Emissions and Net Zero

A Review of Standards and
Recommendations for Consistent
Greenhouse Gas Emissions
Accounting in the UK



Executive Summary

The manufacturing sector accounts for more than 40% of the UK's consumption-based carbon emissions. Recent work carried out on behalf of the Catapult Network by University of Leeds showed that whilst consumption emissions have flatlined as a share of total UK emissions in the last 30 years, the territorial share of those emissions has halved in the same timeframe. This shows we urgently need to act, to better understand our upstream supply chain emissions and avoid continuing the trend of offshoring manufacturing as a shortcut to reducing our carbon emissions.

To do this, it is important to have a robust, unified, measurement and reporting framework in place for carbon emissions, underpinned by consistent carbon accounting standards. At present, many different accounting standards can be used by organisations to report at a corporate or product level. In addition to this, there are sector level standards for carbon reporting, as well as standards which enable corporate reporting of carbon emissions alongside other environmental, social, and governance (ESG) reporting.

This report contains a review of the key cross-sector standards that are in use to account for carbon emissions at the corporate and product level. This review is an output of an HVMC Project on Embodied Emissions and Net Zero and it aligns with a parallel assessment of carbon accounting tools and datasets, A review of carbon accounting tools and databases for consistent emissions accounting in the UK [1]. The output from this review will be used to inform the next stages of the HVMC's work on embodied emissions during 2022 and 2023.

The review has highlighted methodological differences between the standards, as well as differences in scope, emissions covered, structure and terminology. Several key challenges have been identified, firstly that cross-sector standards allow a high level of flexibility in terms of the scope and boundaries for calculations. However, this flexibility leads to differences of application which hampers the ability to create carbon footprints that are comparable with each other. Another challenge highlighted is the lack of detailed guidance on upstream Scope 3 carbon emissions quantification and reporting. The Catapult Network study identified that between 60% and 90% of manufacturing emissions occur in the early materials extraction and materials processing stages of the manufacturing value chain, the majority of manufacturing emissions thereby being incurred in 'upstream' activities. Understanding these emissions is fundamental to the UK's progression towards net zero. Current reporting is inconsistent and uses varying terminology and reporting formats. This must change to improve comparability and ensure robustness in the accounting approach.

“ Standardised measurement and reporting frameworks are critical requirements for the effective management and reduction of carbon emissions.

The four key recommendations arising from this review are: -

1. A common framework for measuring and reporting embodied carbon emissions should be identified, and the manufacturing industry must be assisted with its implementation

This framework of support could either be developed by the HVMC or in conjunction with the Department for Business, Energy and Industrial Strategy (BEIS) to support implementation across the UK industrial base, as well as with the British Standards Institution (BSI) in relation to standardisation of a consistent approach.

2. Tighter guidance for upstream Scope 3 emissions must be created, to help manufacturing industries report in a consistent and more comparable way

There is a role for HVMC in working with the manufacturing industry and BSI to develop this guidance as well as assisting in its implementation.

3. Agreement must be reached on which metrics to use and how these are appropriately contextualised

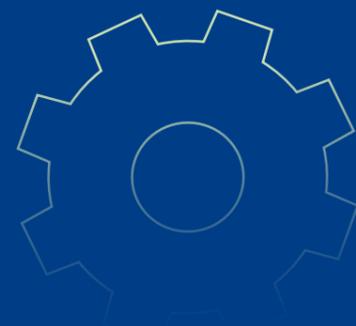
At the UK level there is a role for HVMC to work with government departments such as BEIS, DEFRA and HM Treasury, alongside industry bodies, to facilitate this consensus.

4. A robust reporting and monitoring system should be implemented – overseen by an economy-wide carbon regulator



Contents

Executive Summary	2
Glossary	5
1. Introduction	8
2. Standards for Corporate Level Carbon Accounting	10
2.1 Structure	12
2.2 Application	13
2.3 Audience	14
2.4 Accounting and Reporting Principles	14
2.5 Scope	14
2.6 System Boundaries	15
2.7 Emissions Covered	16
2.8 Treatment of Data	16
2.9 Allocation	17
2.10 Target Setting and Tracking Progress	17
2.11 Reporting	17
2.12 Validation and Review Requirements	17
2.13 Guidance for SMEs	18
3. Standards for Product Level Carbon Accounting	19
3.1 Structure	21
3.2 Application	21
3.3 Audience	22
3.4 System Boundary	22
3.5 Emissions Covered	22
3.6 Treatment of Data	23
3.7 Allocation	23
3.8 Treatment of Land Use, Biogenic Carbon and Other Impact Categories	24
3.9 Treatment of Offsetting	25
3.10 Validation and Review Requirements	25
3.11 Reporting	25
3.12 Treatment of Product Categories	26
3.13 Interpretation and Uncertainty	26
4. Challenges Identified	27
5. Recommendations	30
References	32



Glossary

Activity data	Quantitative measure of a given activity that causes GHG emissions.
Allocation	Partitioning of the input or output flows of a process or system between the system under study and one or more other systems.
Background data	Data for energy and materials flows which are delivered to the foreground system, for which individual plants or operations cannot be identified.
Base year	A reference point in the past with which current emissions can be compared.
Biogenic carbon	Carbon that is derived from biomass such as soil, trees and plants. Non-biogenic carbon is found in all other sources such as fossil fuels.
Business-to-Business (B2B)	The exchange of products, services or information between companies, such as one involving a manufacturer and wholesaler, or a wholesaler and a retailer, rather than between a company and individual consumer.
Business-to-Consumer (B2C)	The process of selling products and services directly between a business and consumers who are the end-users of its products or services.
Carbon accounting	An accounting method used to measure, create an inventory, track and report the GHG emissions of an organisation, city, project or product. Typically used interchangeably with 'GHG accounting'.
Carbon footprint (CF)	The total GHG emissions caused by a product, organisation, person, place, etc., that is expressed as carbon dioxide equivalents.
CO2 equivalent (CO2e)	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.
Consumption-based emissions	A calculation of all GHG emissions associated with the production, transport, use and end of life treatment of products and services consumed by a defined entity over a time period.
Cut-off criteria	Specification of the amount of material or energy flow / the level of environmental significance associated with unit processes or product systems to be excluded from a study.
Direct GHG emission	A GHG emission from stationary or mobile sources directly owned or controlled by an organisation.
Embodied emissions	The total greenhouse gas emissions associated with a product or service over all life cycle stages including raw material extraction, manufacturing, use and end of life.
Emissions factor	A coefficient factor which is used to convert activity data (e.g., tonnes of fuel consumed, tonnes of product produced) into GHG emissions. It is the average emission rate of a given source, relative to units of activity or process/processes.
Foreground data	Data for energy and materials flows which are under the control of the person conducting the study.
Functional unit	Reference unit for the product system under investigation.
Greenhouse Gas (GHG)	Atmospheric gases which can be natural or anthropogenic and absorb or emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, atmosphere or clouds. Water vapour (H2O), carbon dioxide (CO2), nitrogen oxide (N2O), methane (CH4) and ozone (O3) are the greenhouse gases naturally present in the Earth's atmosphere.

Greenhouse Gas (GHG)	The Montreal Protocol lists many other greenhouse gases of human origin, such as halocarbons and other compounds containing chlorine or bromine. The Kyoto Protocol covers CO2, nitrous oxide (N2O), CH4, super hexafluoride (SF6), nitrogen trifluoride (NF3), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).
GHG inventory	A list of emission sources and the associated emissions quantified using standardised methods.
GHG sink	A process that removes a GHG from the atmosphere
GWP	Global warming potential
Indirect GHG emission	A GHG emission that is the consequence of an organisation's operations and activities, but that arises from sources not owned or controlled by the organisation. These can occur upstream and downstream in the supply chain.
Life Cycle Assessment (LCA)	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. An attributional LCA estimates what share of the global environmental burdens belongs to a product. A consequential LCA estimates how the global environmental burdens are affected by the production and use of the product.
Materiality	The concept that individual errors or the aggregation of errors, omissions and misrepresentations could affect the carbon footprint and influence decisions made from this information. 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 organisation being verified.
Net zero	Net zero refers to achieving a balance between the amount of greenhouse gas emissions produced and the amount removed from the atmosphere.
Scope 1 emissions	Emissions from the operations that are owned or controlled by the reporting company.
Scope 2 emissions	Emissions from the generation of purchased or acquired electricity, steam, heating or cooling consumed by the reporting company.
Scope 3 emissions	All indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.
Supply chain	A network of organisations involved in the production, delivery and sale of a product to the customer.
System boundary	Set of criteria specifying the unit processes or system elements that are included in the study.
Territorial-based emissions	A calculation of GHG emissions that take place as a result of production activity within a country's territorial boundary, including exports but excluding imports.
Upstream emissions	Indirect GHG emissions from purchased or acquired goods and services.
Value chain emissions	Emissions from upstream and downstream activities associated with the operations of the reporting company, including the use of sold products by consumers and end of life treatment of sold products after consumer use.

1. Introduction

The UK Government's *Industrial Decarbonisation Strategy* [2] sets out a plan for decarbonising the UK in line with net zero ambitions. It recognises the role of investors and consumers in influencing markets for low carbon products, the need for support for low carbon technologies, and requirements for tracking progress against emissions targets. However, these aims cannot be achieved without the comprehensive measurement and detailed understanding of carbon emissions at a national, sectoral, organisational and product level. Underpinning the measurement of carbon emissions are carbon accounting standards.

Carbon accounting involves the calculation and reporting of carbon emissions as well as the measurement and tracking of performance against carbon emission reduction strategies and targets. Carbon accounting standards can be broadly separated into either corporate/organisational standards or product standards and provide a framework against which organisations can work to calculate and report carbon and other greenhouse gas emissions. There is also a range of guidelines and reporting standards for specific sectors, as well as category rules and labelling standards for products.

For organisations, the sheer range of standards available can make it challenging to identify the most appropriate standard to use, and the need to use different standards for the evaluation at an organisational and product level makes it very difficult to directly compare or aggregate emissions data up to a sector or regional level in a consistent manner. The variation in methodological approach for carbon accounting is a major roadblock in tracking performance against net zero policy ambitions. To truly influence investor and consumer markets for low carbon technologies and products, as is called for in the *Industrial Decarbonisation Strategy* [2], a common carbon accounting framework that allows all businesses to work within the same standardised approach would greatly facilitate this transition.

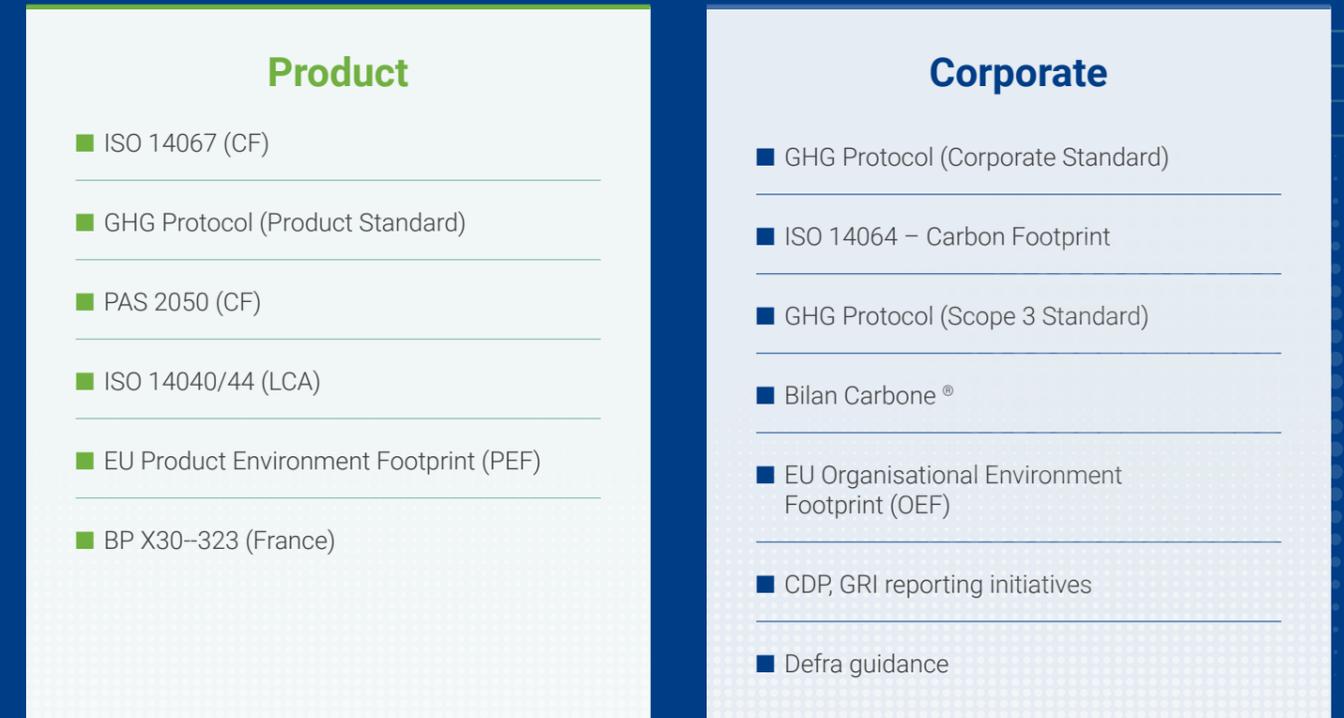
A recent Catapult study [3] conducted with University of Leeds showed that consumption-based carbon emissions from UK manufacturing have flatlined over the last 30 years, whilst the UK-based content of those emissions has halved in the same timeframe. If it is assumed that there is a short-term cost associated with emissions reduction, there is a real risk that the UK's net zero targets could unintentionally accelerate the offshoring of the manufacturing footprint. Conversely, if the correct business environment, including standards and incentives, can be established, then there may be an opportunity to create a 'Green Shoring' destination in the UK, where manufacturing activity is actively located in the UK due to the low emissions footprint. Consistent and common standards for reporting emissions across the whole value chain (embodied emissions) will be key to this ecosystem, as they will:

1. Enable businesses to specify that embodied emissions are reported when procuring goods and services, rewarding those who can evidence low or reduced embodied emissions.
2. Create a market pull for low emissions manufacturing, rewarding investment and innovation in emissions reduction.

This document presents a review of current cross-sector carbon accounting standards, comparing their structure and requirements to understand the source of key differences and similarities. A review of corporate level standards is summarised in Section 2 and product standards in Section 3. The review identifies the key challenges associated with carbon accounting (Section 4) and makes recommendations on how these could be resolved (Section 5). The review of corporate and product carbon standards has been guided by previous work carried out to scope both the EU Organisational and Product Environmental Footprint Guides [4] [5]. Sector specific standards (e.g., infrastructure or construction) are not included in the review, instead, the focus is on the most widely used and established cross sectoral standards.

A summary of the key corporate and product standards reviewed in this document is summarised below in Figure 1.

Figure 1: Principal Carbon Accounting Standards



This review is an output of the HVMC project on embodied emissions and net zero. It aligns with a parallel assessment of carbon accounting tools and datasets presented in the HVMC's report, *A review of carbon accounting tools and databases for consistent emissions accounting in the UK* [1], also an output of the HVMC project on embodied emissions and net zero. Study conclusions will be used by HVMC to inform the next stages of work linked to Embodied Emissions during 2022 and 2023.



2. Standards for Corporate Level Carbon Accounting

The primary standards for corporate and project level carbon accounting are the Greenhouse Gas (GHG) Protocol and the International Organisation for Standardisation (ISO) 14064 series of standards, which are summarised below.

■ ISO 14064 series:

- ISO 14064-1:2019 Greenhouse gases – Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals [6].

This standard specifies principles and requirements for organisational level quantification and reporting of GHG emissions and removals. It includes requirements for the development, management, reporting and verification of a GHG inventory.

- ISO 14064-2:2019 Greenhouse gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements [7].

This standard relates, specifically, to the principles and requirements of project level quantification, monitoring and reporting of GHG emissions. It includes requirements for planning a GHG project, identifying emission sources and sinks relevant to the project and baseline scenario, as well as monitoring, quantifying, documenting and reporting project performance.

- ISO 14064-3:2019 Greenhouse gases – Part 3: Specification with guidance for the verification and validation of greenhouse gas statements [8].

This standard specifies principles and requirements for those conducting or managing the validation or verification of GHG assertions. It can be applied at either the organisational or project level and includes GHG quantification, monitoring and reporting following ISO 14064-1 and ISO 14064-2.

■ GHG Protocol:

- GHG Protocol Corporate Accounting and Reporting Standard [9]

This standard was first developed as a Corporate Reporting Standard by the World Resources Institute (WRI) and the World Business Council on Sustainable Development (WBCSD) in 2001. It is the accounting platform for a significant amount of corporate reporting programmes across the world, with 85% of companies reporting to CDP¹ (the global disclosure system) claiming to use this standard². It guides companies and other types of organisations in recording and reporting GHG emissions, covering the six GHGs covered by the Kyoto Protocol. Note: this is referred to as the GHG Protocol Corporate Standard throughout the remainder of this document.

- GHG Protocol (Scope 3) Accounting and Reporting Standard [10]

This standard was first published in 2011. It supplements the GHG Protocol Corporate Accounting and Reporting Standard and provides additional requirements and guidelines on life cycle accounting and reporting of corporate Scope 3 (value chain) emissions. Note: this is referred to as the GHG Protocol Value Chain Standard throughout the remainder of this document.

Other key corporate accounting standards include the following:

■ Bilan Carbone® [11]

This is an organisational GHG accounting guidance document first published in France in 2004 by Agence d'Environnement et de la Maîtrise de l'Energie (ADEME) and Association Bilan Carbone® (ABC); version 8 was released in 2018 and is still current. The methodology can be used to calculate the GHG emissions of an organisation, an event or a project. Unlike other GHG guidance, it considers all GHGs as opposed to the six Kyoto Protocol gases. It provides calculation templates for emissions factors and output that are relevant to reporting under other schemes.

■ Department for Environment, Food and Rural Affairs (DEFRA) guidance on how to measure and report your greenhouse gas emissions (2009) [12]

This guide supports UK companies of all sizes looking to account for and report their GHG emissions. The guidance is designed to help internal reporting rather than provide a framework for external reporting. The calculations make use of emissions factors that are published by DEFRA for Scope 1 and Scope 2, as well as some for Scope 3; these are updated annually.

■ Global Reporting Initiative (GRI) Standards⁴

The GRI is a large global network for sustainability reporting, made up of different stakeholders who participate in GRI's working groups and governance bodies. The GRI Standards are a suite of interconnected standards, with a structure of general, sector-specific and topic-specific standards. The standards framework, which was developed through contributions from the GRI's network of stakeholders, sets out principles and performance indicators that organisations can use to measure and report their economic, environmental and social sustainability performance. GHG emission reporting requirements are part of a wider standard on emissions which are based on the GHG Protocol (GRI305 Emissions 2016) [13].

■ CDP Guidance⁵

Formerly known as the Carbon Disclosure Project, the CDP is a not-for-profit organisation that runs a global disclosure system for investors, companies, cities, states and regions to manage their environmental impact. Guided by a questionnaire format, the framework has three focus areas: climate, water and forests. Companies reporting to CDP are scored according to reporting criteria, with the results published online. Tabulated submission results to CDP across sectors or regions can be purchased, and CDP publishes several trends reports annually.

³ <https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting>

⁴ <https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/>

⁵ <https://www.cdp.net/en/guidance>

¹ <https://www.cdp.net>

² <https://ghgprotocol.org/blog/looking-back-15-years-greenhouse-gas-accounting>



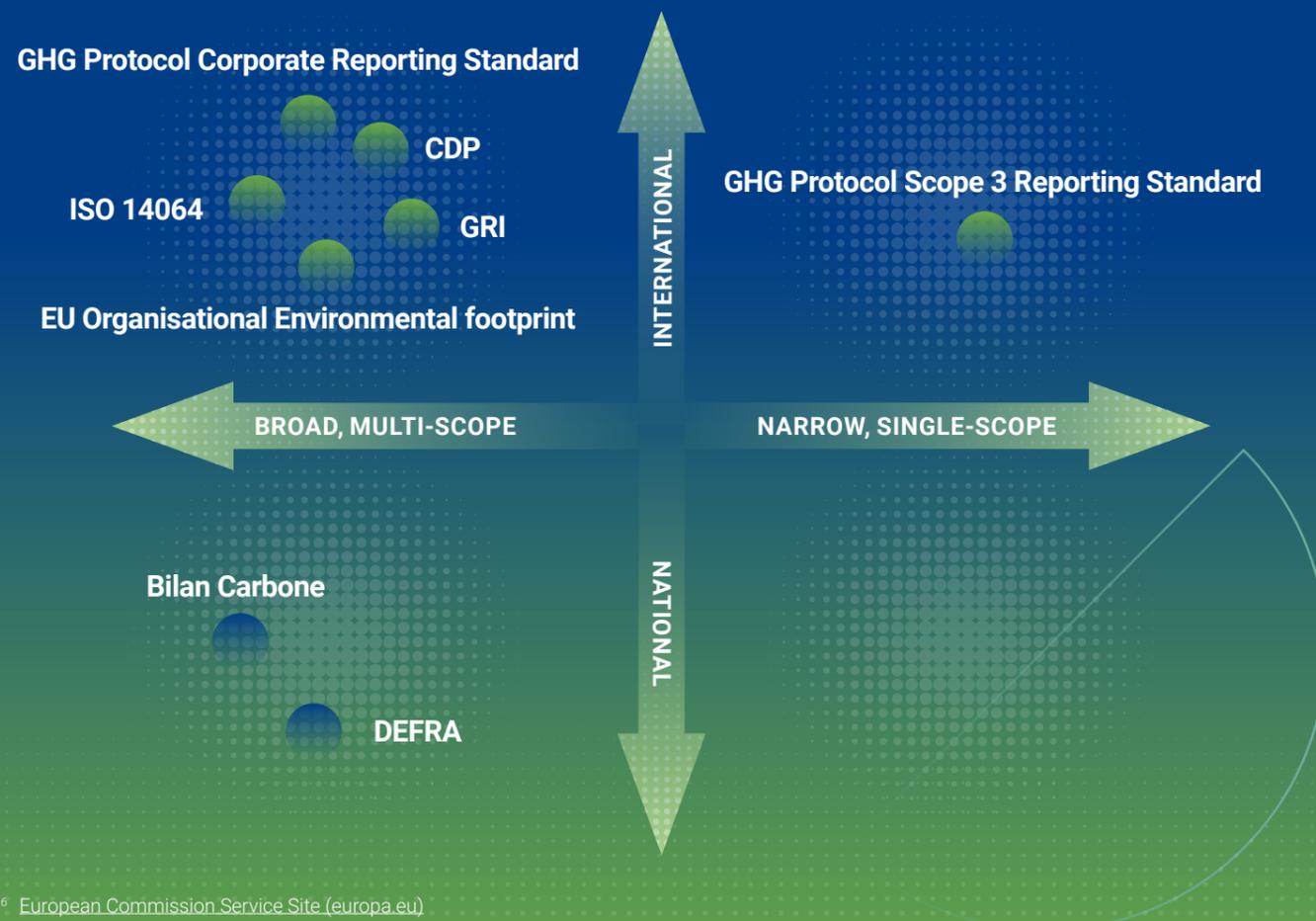
■ *The EU Organisational Environmental Footprint (OEF) method* [5]

An OEF is a multi-criteria measure of the environmental performance of a goods/services-providing organisation from a life cycle perspective; the OEF method is the means of determining that result. The method relates to one of the fundamental parts of the Europe 2020 Strategy, *Roadmap to a Resource Efficient Europe* [14]. In 2010, the European Council invited the Commission and Member States to optimise the use of methods such as Life Cycle Assessment (LCA) of products, taking into account work done by the EU on the International Reference Life Cycle Data System (ILCD)⁶, as well as GRI Standards, the GHG Protocol, CDP Guidelines (for water), ISO 14064 series, DEFRA guidance and Bilan Carbone[®]. The OEF and Product Environmental Footprint (PEF) methods were created (the PEF is discussed in Section 3), to harmonise European methodologies for environmental footprinting. The OEF method also includes Organisational Environmental Footprint Sector Rules (OEFSRs), which aim to help provide focus on the aspects of the OEF method that are most relevant for a particular sector.

Figure 2 below, provides a visual snapshot of these standards for carbon accounting at the organisational level, based on their scope and geographical relevance.

“ Whilst the structure and report-like nature of the GHG Protocol makes it potentially easier to engage with, the precise requirements that are applicable may be less easy to identify.

Figure 2: Visual breakdown of organisational carbon accounting standards reviewed



⁶ European Commission Service Site (europa.eu)

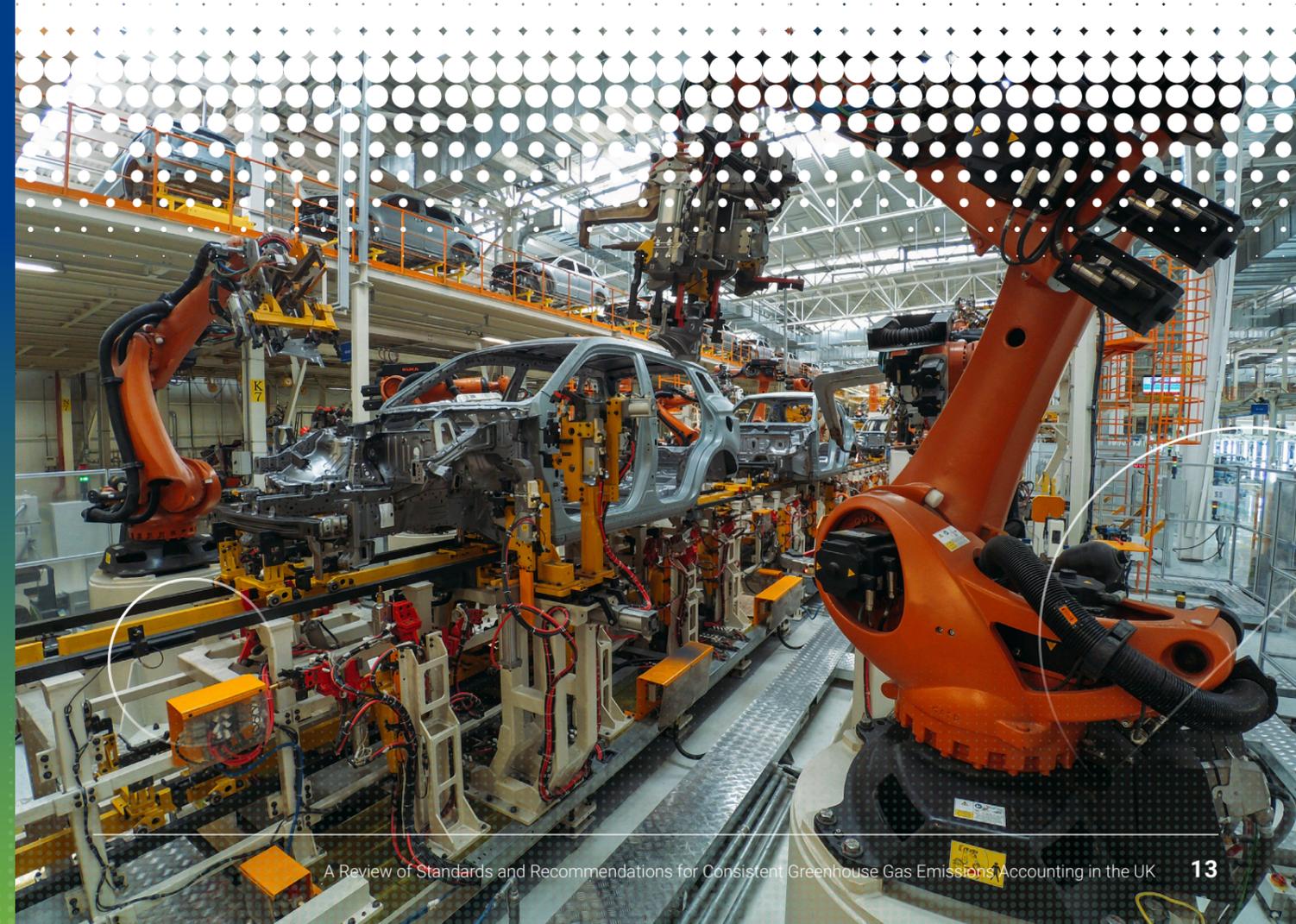
2.1 Structure

The two main standards, ISO 14064 series and the GHG Protocol, both provide a 'standards' part and 'guidance/informative' part. For ISO 14064-1, the guidance appears in an annexe section at the end of the document. The annexe section covers guidance on direct and indirect GHG emissions categorisation; guidance on the selection, collection and use of data; treatment of biogenic GHG emissions; treatment of electricity; GHG emissions reporting; agricultural and forestry guidance; and guidance for identifying significant indirect GHG emissions. The GHG Protocol Corporate Standard and Value Chain Standards both include standards and guidance sections throughout the chapters of the document. Guidance accompanies most standards sections relating to accounting principles, organisational boundary setting, collecting and calculating GHG emissions, and reporting. Standards and guidance sections within chapters are identified. Whilst the structure and report-like nature of the GHG Protocol makes it potentially easier to engage with when compared with a traditional ISO standardised format, the precise requirements that are applicable under the GHG Protocol standard framework may be less easy to identify, particularly for those used to dealing with ISO standards.

Both the GHG Protocol Corporate Standard and ISO 14064-1 contain chapters which detail a sequence of required activities. Bilan Carbone[®] is slightly better defined, in that it orders activities required under the standard in different stages. Inventory analysis under Bilan Carbone[®] is based on the ISO 14064 series and similarly adopts tightly bound phasing to make clear what is required under the approach. DEFRA guidance is designed to be a set of guidelines rather than recommendations, with an emphasis on being easy to follow and geared towards SMEs.

GRI Standards and CDP Guidance are both focused on reporting. GRI Standards are structured with an umbrella document for general disclosure, under which a specific emissions disclosure document sits. This emissions disclosure document outlines requirements and provides guidance. Assessment is conducted using a questionnaire format, asking for a range of information alongside GHG emissions, including climate strategy, buy-in from executive levels of management and target setting.

The OEF method is a 148-page document outlining general considerations, scope and boundary setting, data collection, impact assessment, interpretation, reporting and critical review. Rather than explicitly separating requirements from guidance, it adopts terminology such as 'shall', 'should', and 'may' to distinguish between what is required for adherence to the standard, what is recommended and what is permissible.



2.2 Application

An application typically covers the purpose or intention of reporting, and each standard supports multiple purposes. The ISO 14064 series provides principles and requirements for organisational design, development, management and reporting of GHG emissions.

The GHG Protocol provides slightly more detailed guidance on reporting goals and application, also stressing the importance of alignment with business goals.

The OEF method focuses on enabling comparability through the application of sector rules (OEFs). It, therefore, differs from other corporate or organisational carbon footprinting standards which preference flexibility in their approach.

The Bilan Carbone® and DEFRA guidance were designed to support GHG accounting and disclosure, primarily for business and industrial companies. The GRI standard has a wider sustainability scope and remit.

2.3 Audience

Each accounting standard has a wide range of intended audiences, with both internal and external audiences within the reporting scope covering business to business (B2B) and business to consumer communications (B2C). Bilan Carbone® is the main exception in that internal business reporting was the primary intended audience.

The OEF method can be used for in-house performance tracking and management, external B2B and B2C communication, or performance benchmarking.

2.4 Accounting and Reporting Principles

The majority of carbon accounting standards focus on relevance, completeness, consistency and accuracy as their key principles. These principles underpin the GHG Protocol, Bilan Carbone®, DEFRA guidance and ISO 14064. The ISO 14064 series expands this to include principles for verification and independence, ethical conduct, fair presentation and due professional care. The DEFRA reporting principles also expand to highlight the importance of transparency in all environmental reporting as well as recording data collection methodologies and relevant assumptions.

GRI Standards include principles focused on content around materiality, stakeholder inclusiveness, sustainability context and completeness. For reporting, quality principles relating to balance, comparability, accuracy, timeliness, clarity and reliability are considered. Materiality also forms part of key accounting principles in CDP Guidance.

Principles of relevance, completeness, consistency, accuracy and transparency are core to the OEF method. The standard uses an environmental accounting model rather than a financial accounting model – aiming to minimise the need for using financial information, for

example in the definition of organisational boundaries. In its development, it has considered all major carbon accounting standards – with the focus being on harmonisation of these.

2.5 Scope

The scope of emission coverage is not consistent across all of the standards and a summary of the variation is provided in Table 2. The table summarises emissions by Scopes 1 to 3, however, this same terminology is not used by all standards.

GHG Protocol covers Scopes 1 and 2 in the Corporate Standard, with Scope 3 covered in detail separately in the Value Chain Standard. Under ISO 14064, direct and indirect emissions are referred to rather than Scopes.

The default scope for the OEF is cradle to grave and the terminology used mirrors product footprinting standards (see Section 3). In both the CDP Guidance and GRI Standard, the three scopes are referred to, with the GRI Standard also including reference to direct and indirect emissions.

Scope 1 and 2 emissions are therefore included in the majority of standards, with Scope 3 emissions falling into the optional or 'material' category.

Table 1: Summary of intended audience for each standard

Standard	Internal	B2B	B2C
GHG Protocol	✓	✓	✓
ISO 14064 series	✓	✓	✓
Bilan Carbone®	✓		
DEFRA guidance	✓	✓	✓
OEF method	✓	✓	✓
GRI	✓	✓	✓

Table 2: Summary of Scope Coverage

Standard	Scope 1	Scope 2	Scope 3
GHG Protocol	Corporate	✓	✓
	Value Chain		✓
ISO 14064 series	✓ = 'direct' emissions	✓ = 'indirect' emissions	Optional
Bilan Carbone®	✓	✓	✓
DEFRA guidance	✓		Optional
OEF method	✓	✓	✓

¹ UK to enshrine mandatory climate disclosures for largest companies in law - GOV.UK (www.gov.uk)



2.6 System Boundaries

For the GHG Protocol and ISO 14064, organisational/operational system boundaries are defined based on either equity share or control (operational or financial). Although this allows for various system boundary approaches to be taken, they recommend the use of financially determined boundaries to align with traditional accounting and reporting mechanisms. DEFRA and CDP also allow this choice of approach to boundary setting.

For defining system boundaries, Bilan Carbone® prioritises methods that include all the flows of material and energy that are biophysically relevant, rather than financial methods. It also covers methods for including capital goods in the assessment – guidance which is not provided in ISO 14064.

The OEF method requires a control rather than equity share approach, which can be financial and/or operational. The control approach is based on having an operational or financial stake or the ability to influence environmental decisions.

The GRI approach is based on financial or operational control and equity share, rather than allowing a choice.

2.7 Emissions Covered

All standards, apart from the OEF, focus on GHG emissions (expressed as carbon equivalents). Within the GRI suite of standards, there are additional standards that help to account for a range of environmental, economic

and social indicators. The CDP guidance offers guidelines for reporting on water footprinting alongside GHG emissions. The OEF method includes a default set of 14 environmental impact categories⁸ to be employed. The climate change category is relevant to carbon accounting. The other categories include ozone depletion, ecotoxicity, acidification and resources depletion.

2.8 Treatment of Data

Data Exclusions

In addition to considerations regarding system boundaries, the GHG Protocol recommends against the use of cut-off criteria (that could exclude some emissions data) but indicates that decisions regarding the exclusion of Scope 3 emissions should consider size, influence, risk, stakeholders, etc.

ISO 14064 permits exclusions based on materiality, feasibility and cost effectiveness, although users should include 100% of direct and energy indirect emissions.

The OEF method does not allow cut-off criteria to be used. The OEF allows for both attributional and consequential modelling approaches to be taken. In comparison with the other standards based on modelling direct or indirect emissions, this is a different framing of modelling approaches that uses principles based on an environmental accounting approach rather than mirroring financial accounting.

The use of a cut-off approach is also discouraged in the other standards under review.

Data Quality

Limited guidance on data quality is given under ISO 14064, although it does recommend that emissions factors are derived from a recognised source. It requires organisations to develop and implement a data management system and also requires uncertainty to be documented. ISO 14064-3 provides detail on validation and verification procedures.

In common with DEFRA and Bilan Carbone®, the GHG Protocol provides modelling spreadsheets with embedded default emissions factors. The DEFRA default values are updated annually and the Bilan Carbone® factors are average factors. The GHG Protocol also guides the collection of primary data for Scope 3 activities, encouraging the use of internationally recognised or peer-reviewed sources for any secondary data.

GRI Standards and CDP guidance give very limited, if any, guidance on data sourcing or data quality assessment. The GHG Protocol contains guidance on data quality monitoring and uncertainty assessment.

Data quality requirements under the OEF are to assess data against six criteria – technological, geographical, time-related representativeness, completeness, methodological appropriateness and consistency. This quality assessment is mandatory for studies that are to be presented externally and recommended for internal studies.

2.9 Allocation

The GHG Protocol is guided by the ISO 14044 allocation hierarchy⁹ [15], whereas no guidance is given for ISO 14064, GRI Standards or CDP guidelines. Bilan Carbone® follows the ISO guidance for multi-functional allocation, and when carrying out allocation for recycling specifies an avoided impacts method for open-loop recycling and the stock method for closed-loop recycling. Bilan Carbone® also advises against economic allocation, with the view that it does not provide a foundation for a realistic representation of flows and their associated impacts. The OEF method has a specific hierarchy relating to multi-functional systems, with a preference for system expansion. It also has specific guidance for handling allocation for recycling. The DEFRA guidance document does not cover allocation.



2.10 Target Setting and Tracking Progress

Overall, there is minimal guidance given on target setting and tracking progress. The GHG Protocol and ISO 14064 both specify that justification of the choice of a base year is required as well as justification for any base year recalculations that are carried out. GRI Standards and CDP guidelines refer to the need for selecting a base year but give little guidance on how to select this. The OEF method does not provide any guidance on this aspect. The DEFRA guidance provides steps for setting GHG targets and recalculation of the base year. Bilan Carbone® provides a spreadsheet for the management of reduction targets which should be absolute targets rather than intensity-based targets.

2.11 Reporting

The GHG Protocol Corporate Standard requires reporting of all Scope 1 and Scope 2 emissions. Under the Scope 3 Standard, Scopes 1, 2 and 3 should be reported. A reporting template is provided online¹⁰. The ISO 14064 standard provides recommended report contents, and if an organisation is to claim 14064 it must provide a public report which conforms to the standard and has been verified by a third party. Bilan Carbone® is aligned with ISO 14064, GHG Protocol and CDP guidelines in terms of reporting. DEFRA, GRI Standards and CDP guidelines all provide generic templates for reporting. The OEF method points to ISO 14044 for reporting guidance, and a reporting template is provided.

2.12 Validation and Review Requirements

The GHG Protocol Corporate Standard provides detailed guidance on verification, but this is not set out as a requirement. The other standards, Bilan Carbone®, DEFRA, ISO 14064 and OEF method, whilst recognising the importance of third-party verification for quality purposes and external communication purposes, do not advise that it is mandatory, only 'required' or 'encouraged'.

2.13 Guidance for SMEs

The only standard to provide additional guidance for SMEs is the DEFRA guidance¹¹.

⁷ The related Streamlined Energy and Carbon Reporting (SECR) Guidance recommends Scopes 1 and 2, with Scope 3 emissions voluntary for quoted companies and only reporting of business travel emissions mandatory for large unquoted companies and LLPs. Other Scope 3 emissions are voluntary, but strongly encouraged where this is a material source of emissions.

⁸ The categories are referred to as midpoint indicators which assess the impacts earlier in the cause and effect chain than end point indicators. For example, midpoint indicators refer to Global Warming Potential while the end point indicator is Disability Adjusted Life Year – years of loss of life or quality of life due to climate change.

⁹ The allocation procedure is described in Section 4.3.4.2 of the ISO 14044 Standard. Wherever possible allocation should be avoided, if this is not possible then guidance is provided regarding how to partition impacts between different outputs within a product system, e.g., where more than one product is generated.

¹⁰ [Sample GHG Inventory Reporting Template.docx \(live.com\)](#)

¹¹ [Guidance on how to measure and report your greenhouse gas emissions \(publishing.service.gov.uk\)](#)

3. Standards for Product Level Carbon Accounting

The main standards for product-based carbon footprinting are summarised in the following section.

■ **ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines** [15]

This standard specifies and provides guidance for life cycle assessment, including specifying stages in the LCA process. These stages cover the definition of goal and scope, life cycle inventory analysis (LCI), life cycle impact assessment (LCIA), life cycle interpretation, reporting and critical review. There is an explanation of the relationship between LCA phases, and conditions for use of optional elements. This standard works in conjunction with ISO 14040:2006, *Environmental management – Life cycle assessment- Principles and framework* [16] and introduces the LCA framework and stages. These two standards are part of the Environmental Management suite of standards that are owned and overseen by the Technical Committee ISO/TC 207 SC5.

■ **ISO 14067:2018 Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification** [17]

ISO 14067 is based on the life cycle assessment standards ISO 14040 and ISO 14044, and it specifies principles for the quantification and reporting of the carbon footprint of a product. The standard provides for the adoption of product category rules (PCRs) that are aligned with the labelling requirements of ISO 14025 [18]. It addresses the single impact category of climate change only. The standard is owned and overseen by Technical Committee ISO/TC 207 SC7, Greenhouse Gas Management and Related Activities.

■ **GHG Protocol Product Life Cycle Accounting and Reporting Standard**[19]

The WRI and WBCSD published the GHG Product Life Cycle Accounting and Reporting Standard in 2011, following a 3-year, multi-stakeholder development process. The standard includes requirements and guidelines on product life cycle accounting that are based on a life cycle approach and built on ISO 14040. Note: this is referred to as the GHG Product Standard throughout the remainder of this document.

■ **PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services** [20]

The Publicly Available Specification (PAS) 2050 enables the assessment of the life cycle GHG emissions of goods and services. First published in 2008 and updated in 2011, it mirrors the development timeframe of the GHG Protocol Product Standard. It was originally developed over 18 months via collaboration and consensus-building with a range of international experts and stakeholders, a process which was overseen by an independent steering group and included pilots with companies. The document specifies requirements for the assessment of the life cycle GHG emissions associated with goods and services, based on life cycle techniques and principles that are lifted from ISO 14040 and 14044. It covers the entire life cycle of products, including use-phase and land-use change emissions.

Other product level carbon footprinting standards include:

■ **EU Product Environmental Footprint (PEF) method**[4]

A Product Environmental Footprint (PEF) is a multi-criteria measure of the environmental performance of a product across its life cycle and the PEF method is the means of calculating that result. The method covers the modelling of environmental impacts of the flow of materials and/or energy, emissions and waste streams associated with a product during its life cycle. The method also includes guidance on how to develop product category specific methodological requirements for use in Product Environmental Footprint Category Rules (PEFCRs), which are designed to help shift focus towards the most relevant and important aspects of the PEF method for a particular product type. Having been piloted by a range of sectors over the past few years, the PEF entered a transition phase in 2020, under which implementation is being monitored.

■ **BP X30-323**[21]

This guidance document was published under the French law *Grenelle I Act*¹², which establishes the prospect of regulatory communication of environmental information relating to products. The guidance on product labelling was developed by

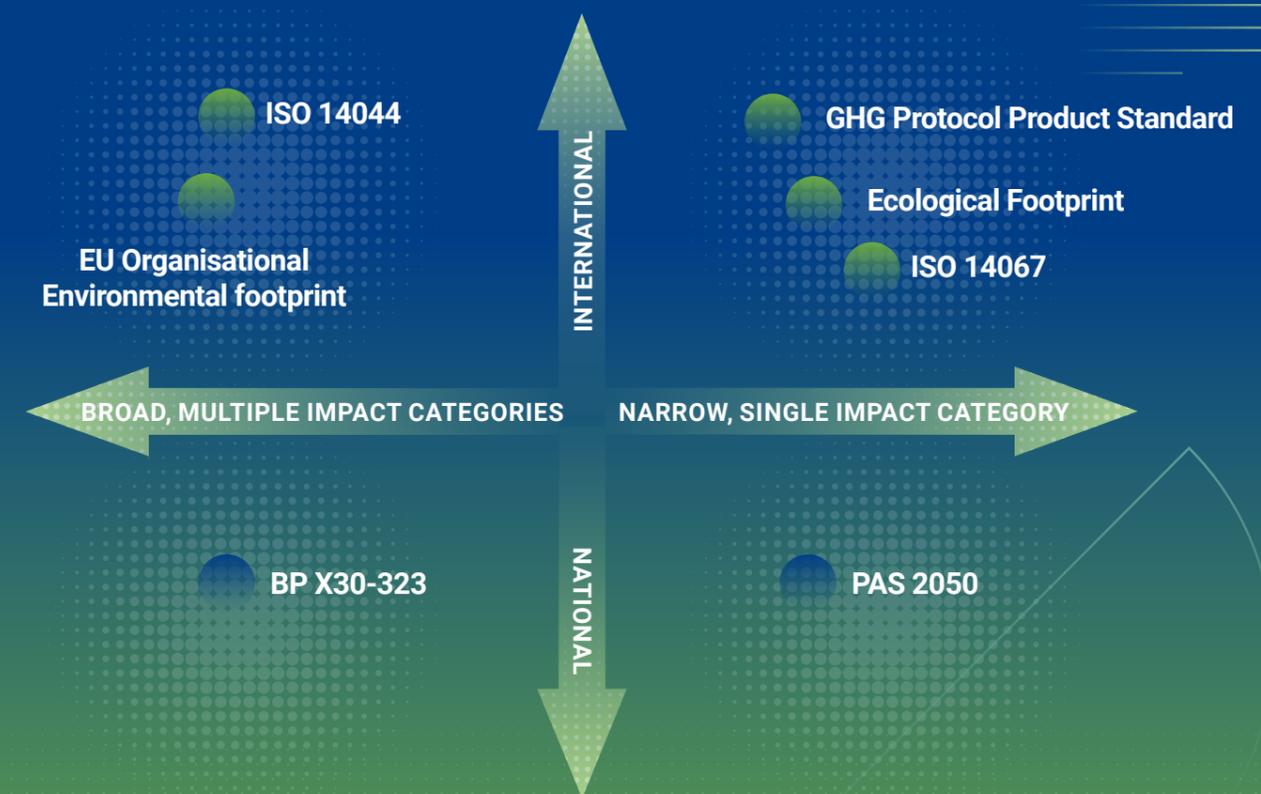
ADEME and the French Association of Normalisation (AFNOR), working together with 300 other organisations and stakeholders. The guidance is in line with ISO 14040 and ISO 14044, giving general principles for the environmental communication of products. The document also defines principles for creating methodological guides for specific product categories. 24 product category reference frameworks have also been developed by ADEME and cover product categories such as food, clothing textiles, furnishings and sports goods. The BP X30-323 guidance was revised in 2014 to align with European requirements on product labelling and a databased *Base Impacts*¹³ was developed to support sectoral calculations, which will expand the range of product categories over time.

■ **Ecological Footprint Standard** [22]

The Ecological Footprint Standard was developed by the Global Footprint Network to evaluate the extent to which human activities exceed biocapacity. This is the only standard to explicitly point to process LCA as well as environmental input-output analysis as mechanisms for assessing ecological impact.

Figure 3 on page 21 provides a visual snapshot of these standards for carbon accounting at the product level, taking into account their impact categories and geographical relevance.

Figure 3. Breakdown of product carbon footprinting standards reviewed



¹² LOI n° 2009-967 du 3 août 2009 de programmation relative à la mise en œuvre du Grenelle de l'environnement (1). There is now a Grenelle 2 Act, Article 228 that was developed as part of advancing French product category labelling requirements.

¹³ Home - Base Impacts® - Home (ademe.fr)



STANDARDS

3.1 Structure

As with the associated Corporate Standards, the GHG Protocol Product Standard combines guidance and requirements within the document – with each section labelled as such. ISO 14040, ISO 14044 and ISO 14067 follow the standard ISO structure, with requirements set out in the main body of the standard and a set of informative annexes at the end. ISO 14044 includes informative sections on data collection, interpretation, and links to ISO 14067 and ISO 14046 for water footprinting. ISO 14067 includes informative annexes on limitations, comparisons, procedures for the treatment of recycling and treatment of agriculture and forestry products. PAS 2050 mirrors the ISO structure and contains informative annexes detailing global warming potentials for various GHGs, guidance on recording supporting information, land-use change figures for various countries, recycling and disposal. The PEF method contains a detailed set of guidance following ‘shall’, ‘should’, and ‘may’ terminology to distinguish between what is required to comply with the standard and what is recommended. The Ecological Footprint standard offers access to footprint data and the BP X30-323 standard combines guidance with methodological examples, e.g., a data tracking sheet.

3.2 Application

All standards broadly focus on identifying opportunities to improve environmental performance and helping to inform decision-makers. In addition to this, ISO 14067 and the GHG Protocol Product Standard also include an element of performance tracking. The GHG Protocol Product Standard does not support carbon footprinting for comparative assertions, whereas ISO 14067 and ISO 14044 do with additional requirements. PAS 2050 does not set requirements for communication but instead points to other standards for this. The application of BP-X30-323 is more consumer-focused, as is the Ecological Footprint standard. The Ecological Footprint standard is different from the other product standards in that it allows for both a national and regional input-output approach as well as a process LCA (PLCA). The PEF method can be used for both in-house footprinting and external communication (B2B or B2C).

3.3 Audience

The GHG Protocol Product Standard, ISO 14067, ISO 14044 and PEF method are all designed for both B2B and B2C communication. PAS 2050 does not specify requirements for communication. BP-X30-323 and the Ecological Footprint are designed for communication to the public/the consumer.

3.4 System Boundary

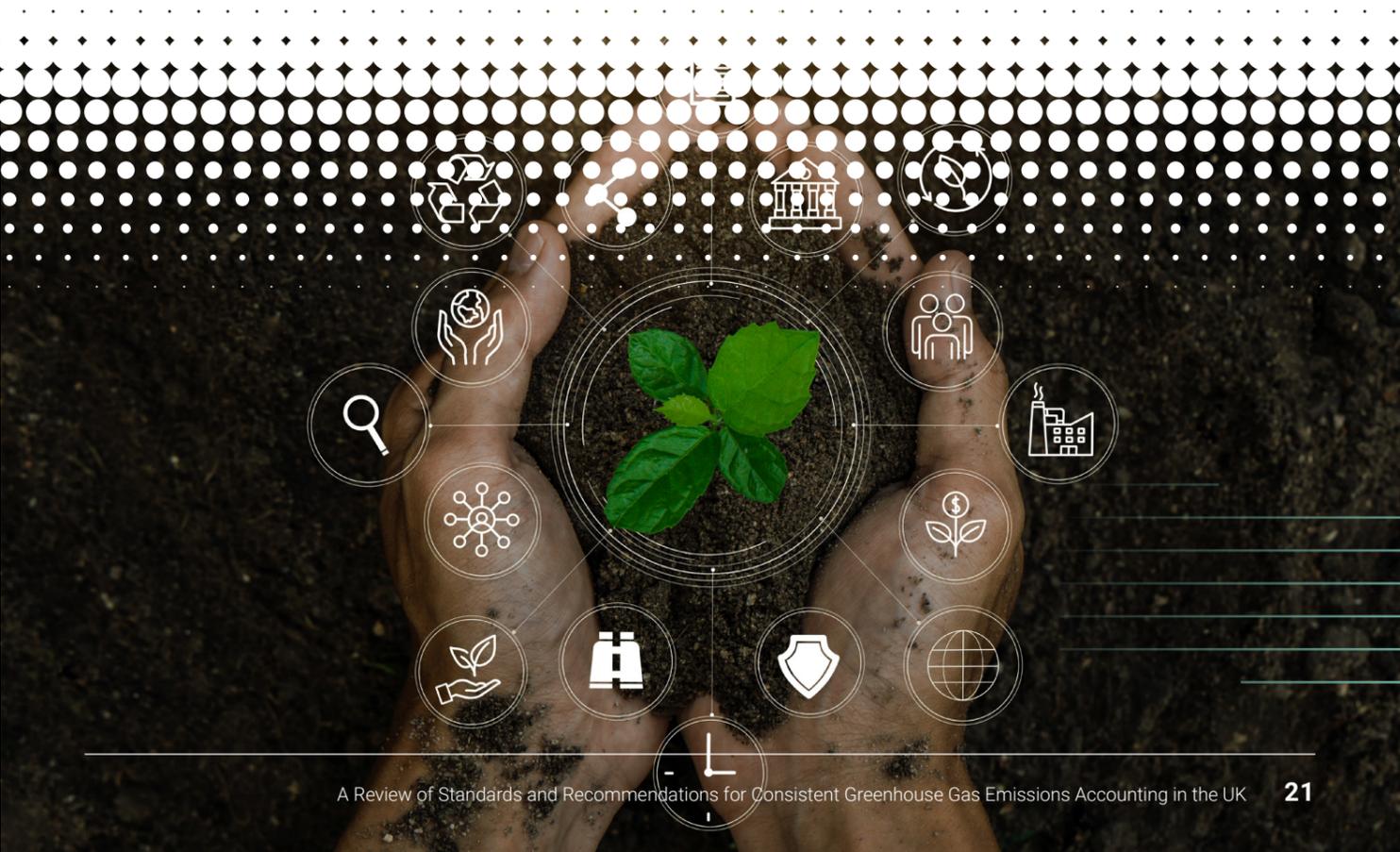
ISO 14044 views the system boundary from the perspective of it being the indicator that determines which unit processes are included within the LCA. It focuses on the process being iterative, starting with initial boundaries based on the goal and scope, and finishing with the boundaries determined by calculations and sensitivity analysis.

The GHG Protocol Product Standard, ISO 14067 and PAS 2050 allow for cradle-to-gate or cradle-to-grave analysis. PAS 2050 stipulates the use of product-specific requirements if relevant, and where none are available, refers to the specification given by ISO 14044. It explicitly excludes capital goods (unless required under product category rules), human energy inputs, transport services provided by animals, transport of the consumer to and from point of retail purchase, and the commuting of employees. BP-X30-323 excludes offsets, R&D, and employee and customer transport. The Ecological Footprint standard does not provide specific rules for system boundary definition but states that all activities included within system boundaries are defined, for example, cradle up to point of purchase, purchase plus disposal, purchase plus consumer use activities, purchase to point of purchase etc. Under the PEF method, the system boundaries should include all processes linked to the product supply chain relative to the unit of analysis, with a default approach of cradle-to-grave. The system boundaries should be divided into foreground processes and background processes.

3.5 Emissions Covered

ISO 14044 covers a range of emission types and environmental impacts relating to emissions including GHG emissions, ozone depletion, acidification, eutrophication photochemical ozone creation and other impacts relating to ecosystems and human health. ISO 14067 covers all GHGs and land-use change, as does PAS 2050. The GHG Protocol Product Standard includes all Kyoto GHGs, also recommending the inclusion of others if applicable to the study. BP-X30-323 covers a range of environmental impact categories similar to ISO 14044, and the Ecological Footprint standard requires impacts to be translated to Ecological Footprint values, typically global hectares, which are defined as using primary conversion factors drawn from the National Footprint and Biocapacity Accounts. The PEF covers 14 mid-point environmental impact categories. Studies should include these unless otherwise specified by a product category rule or other exclusion which is justified based on the PEF Guide.

“ All standards broadly focus on identifying opportunities to improve environmental performance and helping to inform decision-makers.”



¹⁴ https://data.footprintnetwork.org/?_ga=2.55044971.1742774251.1649772051-1399958863.1649772051#/



3.6 Treatment of Data

Data Exclusions

ISO 14044 specifies cut-off approaches based on mass, energy or environmental significance criteria. ISO 14067 does not provide any specific cut-off criteria, and the GHG Protocol Product Standard requires that 100% of system elements should be reported – exclusions can only be made if no data is available (including proxy data). PAS 2050 allows for 5% GWP to be excluded. BP-X30-323 allows for an exclusion of 5% mass/energy/environmental impact. Exclusions are not allowed under the PEF guidance.

ISO 14044 allows for the selection of either an attributional approach (estimating what share of the global environmental burdens belong to a product) or consequential approach (estimating how the global environmental burdens are affected by the production and use of a product) to be taken towards data modelling. The GHG Protocol Product Standard, PAS 2050 and BP-X30-323 are designed to take an attributional approach, with avoided allocation preferred. ISO 14067 also places preference on avoided allocation. The Ecological Footprint allows for process LCA, input-output or hybrid modelling, using an accounting approach similar to attributional modelling. The PEF takes elements of both attributional and consequential modelling approaches.

Data Quality

On data quality analysis, ISO 14067, Environmental Footprint and PAS 2050 both adopt ISO 14044 guidance on data quality assessment, which stimulates assessment of time-related coverage, geographical coverage, technology coverage, precision, completeness, representativeness, consistency, reproducibility, sources of data and uncertainty. For the collection of primary data, ISO 14044 broadly defines this as collected data which is measured, calculated or estimated from production sites associated with the unit process. The GHG Protocol Product Standard requires primary data for all processes under the reporting companies' ownership or control. This is also reflected in PAS 2050. ISO 14067 refers back to ISO 14044 but does not explicitly specify situations when primary data collection should be preferred.

Only PAS 2050 and BP-X30-323 provide a data collection template. PAS 2050 gives more explicit guidance on the treatment of secondary data, in that selection of secondary data sources should follow the ISO 14044 data quality rules and that preference should be given to peer-reviewed sources and other competent sources such as Governments of UN Publications. Data quality requirements under the PEF need to be met for both specific and generic data by any study to be used in external communication.

3.7 Allocation

Where processes in a product life cycle result in the creation of more than one useful product, then a method termed 'allocation' may be required. This requires inputs and outputs to be split between the products.

ISO 14044 specifies that allocation should be avoided by applying process subdivision or system expansion, and indeed the majority of standards link back to ISO 14044 regarding allocation procedures. PAS 2050 states that if using allocation cannot be avoided then it should be guided by product category requirements; if this is not applicable, then economic allocation should be chosen. The Ecological Footprint states that if calculations are being made which disaggregate a product into its primary product equivalents from product LCA data, this approach must comply with ISO 14040 and ISO 14044.

For the treatment of recycling allocation, no specific rule is specified under ISO 14044. The GHG Protocol Product Standard specifies that either closed-loop approximation (a type of system expansion method that accounts for the impact that end-of-life recycling has on the net virgin acquisition of material) or recycled content method (allocates the recycling process emissions and removals to the life cycle that uses the recycled material) should be used. If neither method is appropriate, then another method can be selected as long as it is consistent with ISO 14044. ISO 14067 also links back to the guidance in ISO 14044 and provides example calculations for different open-loop and closed-loop recycling scenarios. PAS 2050 also provides calculations for estimating GHG emissions from reuse and where a product contains recycled or recyclable material. The latter uses different allocation approaches regarding how to take account of the various process emissions (including the recycled content method or closed-loop approximation method). The BP-X30-323 provides similar guidance for different recycling scenarios. The PEF follows the same multi-functional hierarchy as the OEF, with the provision of specific guidance and formula for recycling allocation scenarios.

Allocation is a fairly complex aspect of the analysis that requires detailed explanation even at a practitioner level.

3.8 Treatment of Land Use, Biogenic Carbon and Other Impact Categories

Climate change impacts can be considered from biogenic (from the combustion or degradation of organic material in soil and water and biogenic removals during photosynthesis) and non-biogenic perspectives (the emissions from fossil-based material).

ISO 14044 provides no specific guidance on either biogenic or non-biogenic carbon. Under ISO 14067 it is mandatory to report carbon emissions from biogenic and fossil sources separately. Under PAS 2050, emissions and removals must be considered, with biogenic emissions and removals from food and feed exempt/not mandatory; impact from carbon storage should be recorded separately. The GHG Protocol Product Standard and PEF also require emissions and removals to be included and reported separately.

Land-use change linked to climate change is not dealt with specifically under ISO 14044. Under the GHG Protocol Product Standard, consideration of direct land-use change impact is required where attributable and guidance for calculations is given. Impacts from indirect land-use change are not required to be considered but if impacts can be calculated and are significant then they should be reported separately to the other inventory results. PAS 2050 includes emissions from direct land-use change that occurred within the past 20 years and excludes indirect land-use change. ISO 14067 states that indirect land use should be included once an internationally recognised procedure is developed. Under the PEF, GHG emissions from direct land-use change should be allocated to goods/services for 20 years after the land-use change occurs. For BP X30-323, direct land-use change impacts follow IPCC methodologies.

In terms of the climate change calculation method, all standards use GHG emissions referenced to 100 years, based on IPCC methodology [23]. No method for calculating GHG emissions is specified in ISO 14044. The Ecological Footprint method uses National Footprint Accounts, which include CO₂ only.

Carbon storage should be reported separately under the GHG Protocol Product Standard, ISO 14067, PEF and PAS 2050. For the PEF, this is only allowed if specified within a category rule. Where carbon storage is included, weighting factors for delayed emissions should not be included in the main inventory table and should be reported separately. ISO 14044 and the Ecological Footprint standard do not provide specific guidance on carbon storage. Under BP-X30-323, the decision to apply delayed emissions is optional and dependent on product category rule requirements. Removals can be taken into account for products containing biomass if this biomass is derived from reforestation.

3.9 Treatment of Offsetting

All standards except ISO 14044 state that offsetting should not be considered within the assessment. Only ISO 14044 does not include any guidance on offsetting and therefore does not take it into account in the guidance.

3.10 Validation and Review Requirements

All of the standards propose a level of external assessment or verification, either for the study outputs or the data. ISO 14044 provides requirements for comparative studies, although within the LCA community there lacks clarity over when a critical review is required for non-comparative studies. If the study is to be disclosed to the public then ISO 14044 recommends a critical review. Under the GHG Protocol Product Standard, assurance is required, which can be obtained through first- or third-party verification or critical review. Under ISO 14067, carbon footprints, claims and labels require third-party verification following the relevant standards and the intended study application.

For PAS 2050, the verification requirement depends on the intended communication, for example, if third-party verification is required this must be accredited to provide assessment and certification under PAS 2050. The PEF supports independent review for external communication purposes and specifies minimum requirements for reviewer qualifications.

The BP X30-323 is slightly different in that review is proposed for secondary data sources and at the product category level regular reviews of data are proposed to make sure that it remains up to date over time.

3.11 Reporting

The GHG Protocol Product Standard provides a list of required and optional elements for reporting publicly. ISO 14067 gives much looser guidance for third-party reporting, which is adopted from ISO 14044. PAS 2050, BP-X30-323 and the Ecological Footprint do not provide a template for reporting. Mandatory reporting elements within the PEF mirror those from ISO 14044 and include a Summary, Main report and Annex as minimum requirements. Any PEF study that is for external communication purposes must also include a PEF study report.

Public reporting is required to claim conformance with standards. ISO 14067 refers to relevant declarations, claims and labelling standards. The PAS 2050 standard does not set requirements for communication and is intended for internal assessment and ISO 14044 provides no specific information on communication requirements. BP X30-323 sets out labelling and declaration guidelines that require information to be in line with other relevant product labelling standards.



3.12 Treatment of Product Categories

Specific product category rules are not required for public reporting under the GHG Protocol Product Standard, but it does encourage the use of product rules if they are available. PAS 2050 terms these 'supplementary requirements' rather than product rules. Under PAS 2050, these supplementary requirements must be in line with the overarching PAS standard. The ISO 14067 requires product category rules which should be publicly available. Under ISO 14044, product category rules are not specifically provided for but are referred to in the context of ISO 14025 for Environmental Product Declarations. The Ecological Footprint does not contain product category rules as opposed to BP X30-323, which includes specific product category approaches in the core approach and these are set by sector working groups.,

3.13 Interpretation and Uncertainty

Under ISO 14044, the interpretation phase should cover the identification of significant issues based on the results of the life cycle inventory and life cycle impact assessment phases of the LCA. It should also include an assessment of completeness, sensitivity and consistency, as well as conclusions, limitations and recommendations. ISO 14067 adopts this specification from ISO 14044. The GHG Protocol Product Standard includes interpretation guidance within specific chapters on reporting, performance tracking and uncertainty. The PAS 2050, BPK30-326 and Ecological Footprint standards do not provide detailed guidance on interpretation. The PEF specifies the following steps should be followed: (1) 'assessment of the robustness of the PEF', (2) 'identification of hotspots', (3) 'estimation of uncertainty', and (4) 'conclusions, limitations and recommendations'.

There is limited guidance across the standards for dealing with uncertainty. In ISO 14044, it is listed as a requirement, but no specific guidance is given; this is the same for ISO 14067. The GHG Protocol Product Standard requires qualitative reporting of uncertainty for significant processes. Supplementary information on the GHG Protocol website gives more information on quantitative uncertainty assessment, including a calculation worksheet. Uncertainty is not specifically addressed within PAS 2050, but again further information is provided within a separate guidance document on applying the standard [24]. Although not very detailed, the Ecological Footprint does specify that uncertainty should be considered based on input parameters, assumptions, category errors and incomplete coverage. The PEF requires that at least a qualitative description of uncertainties should be provided. BP X30-323 considers uncertainty and sensitivity as part of the working groups and the approach is based on ISO 14040.

“ There is limited guidance across the standards for dealing with uncertainty.”

¹⁵ [Microsoft Word - Quantitative Uncertainty Guidance_final.docx \(ghgprotocol.org\)](#)

4. Challenges Identified

Both corporate and product level standards have gone through lengthy and detailed development processes, including significant stakeholder engagement and review. Standards such as the OEF and PEF have recently gone through a series of extensive pilots with associated OEF sector rules and PEF category rules, with revisions made based on the pilot scheme findings.

These standards are now in their transition phase, prior to formal adoption of the environmental footprint methods in other EU policies. The OEF and PEF standards commenced the implementation stage of development in 2021, following the Commission's adoption of a recommendation on the use of environmental footprint methods.

Overall, product standards tend to show more common elements than corporate reporting standards, which is likely because the majority of product standards remain guided by ISO 14044. Corporate standards tend to differ from each other in terms of their intended audience, their system boundary setting, their allocation, and review and verification requirements. Product standards differ on specific methodological choices such as inclusion/exclusion of capital goods, cut-off criteria, approach at end-of-life, consideration of uncertainty, and interpretation.

Based on this review, several areas have been identified that require further attention to enable carbon accounting to be conducted robustly and consistently across the UK. These areas are detailed below.

Flexibility versus prescriptiveness

Various standards are available for carbon accounting at both the organisational and product level. A common challenge often identified through the assessment of carbon footprinting standards is the issue of flexibility versus prescriptiveness. Standards are designed to be applicable to the widest possible range of use cases to enable their widespread adoption, but in doing so this means that many methodological choices are left open and for the user of the standard to determine. This ultimately impacts how directly comparable carbon footprints that align themselves to these standards are with each other. This is despite the majority of these standards stating they can be used for public reporting.

The inability to make robust comparative assertions using existing footprinting standards was a key driver in the development of the OEF and PEF methodologies and the underlying basis for their product and sector rules. The objectives of the OEF and PEF are to enable different products and organisations to be compared – thus allowing LCA to be better utilised in policymaking, as well as allowing for harmonisation of existing methods, and creating a credible mechanism for communication that helps build trust and avoids confusion.

The OEF and PEF standards are not without criticism [25]. The methods diverge in language and terminology from ISO 14044; for example, 'unit of analysis' is used instead of 'functional unit', and 'resource use' and 'emissions profile' instead of 'life cycle inventory'. There are also other elements such as approaches to weighting, cut-off, end-of-life and impact category choices, all of which either differ from ISO 14044 or are not extensively tested or used. [26] Analysis of the pilot stages of the PEF has shown that there are significant challenges in trying to achieve true comparability. The development process of the PEF and OEF standards and the pilot stage of PEF category rules highlight how challenging it is to develop a consistent methodology that enables comparability in external reporting. [26][27]

Despite such challenges associated with comparability, this does not specifically point to new standards being needed – rather, tighter methodological framing and product category rules that can be used to improve comparability both at the product and organisational levels.



Accounting for Scope 3

Except for the GHG Protocol Scope 3 Standard, reporting of Scope 3 is typically either completely optional or users are free to determine which indirect emissions from Scope 3 are excluded from their calculations. There is also no mandatory minimum level of reporting when it comes to indirect emissions, with much of the language in the documents being aspirational rather than setting an expected requirement.

The GHG Protocol Corporate Value Chain Standard provides detailed guidance on accounting for Scope 3 (both upstream and downstream indirect emissions). This is the only standard to detail a list of Scope 3 indirect sources of GHG emissions. Other standards point vaguely to sources of indirect emissions but leave these up to the user to determine. Despite the guidance on Scope 3 provided by the GHG Protocol, the openness of methodological choice limits how comparable Scope 3 inventories and results can be between organisations. Going forward, as more organisations look to quantify Scope 3 emissions, a consistent approach to doing so is required to enable direct comparisons to be made.

Use of terminology and metrics

Different terminologies are used to describe carbon emissions accounting and target setting. ISO 14064 refers to direct and indirect emissions, whereas the GHG Protocol refers to these in the context of Scopes 1, 2 and 3. As described above, the PEF and OEF also use terminology which differs from the other standards. In addition to specific standards-related terminology, net zero often features in carbon accounting language but in an inconsistent way – often conflated with schemes like Science-Based Targets (SBTs), carbon neutrality, climate neutrality and absolute zero. There are also sector-specific challenges with regards to how different organisations define specific operations in the value chain or even differences in definition and terminology within companies across different manufacturing sites or facilities.

At a broader level, the role of the different metrics used to communicate the results of carbon accounting needs to be better understood – at the product, corporate, sector and national levels. These might be metrics relating to embodied emissions, operational emissions, emissions linked directly with financial investment or financial income, and displaced emissions. The oversimplification of metrics should be avoided to ensure that the metrics used are appropriate for the evaluation being carried out.

Ensuring confidence in external reporting

Standards used for external reporting need a robust mechanism in place for reviewing and verifying carbon emissions data and underlying assumptions. To avoid inaccurate reporting of emissions data, a thorough auditing and review process for reporting is needed, particularly if the results of corporate or product level carbon footprinting are to be used within a regulatory setting such as defining low carbon product standards. This is linked with wider calls for a clear assurance structure and governance systems on climate change and carbon emissions.

Understanding the impacts of new materials and technologies

The transition to net zero requires new materials and technologies. Existing standards such as ISO 14044 provide the basis for assessing their associated carbon emissions; however, where new products lack supply chain maturity, demonstratable use phase performance or clear routes at end-of-life, the uncertainties introduced by these aspects need to be properly communicated in carbon footprinting studies. This requires improved and more consistent handling of uncertainty (parameter, model, choice) and variability (spatial, temporal). Current standards, including the PEF, specify qualitative assessment of uncertainty only.



5. Recommendations

The HVMC and relevant partners from industry, government, standards bodies and academia have a key role to play in supporting the manufacturing sector to fully embrace carbon accounting and making accounting practice easier to access for all companies across the value chain. The following recommendations are made regarding opportunities for the HVMC and partners to add value to greenhouse gas accounting practice and to address the challenges identified in the previous sections. The HVMC also has a role in guiding and supporting the manufacturing industry with understanding carbon accounting practices and developing common and consistent tools, guidance and procedures that enable comparability and transparency of outputs. Common frameworks should be developed that are applicable at an HVMC, UK and international level, with the initial application at an HVMC level to test and enable scalability.

1. A common framework for measuring and reporting embodied carbon emissions should be identified, and the industry must be assisted with its implementation

A common framework must be adopted for measuring and reporting manufacturing embodied carbon emissions. This will likely be using existing standards (e.g., the GHG Protocol) for which additional guidance may be required. There is a clear role for HVMC to work with the manufacturing industry in developing this, with further involvement in developing training guidelines and tools and identifying and developing additional assistance needed to enable widespread adoption, in particular providing support for SMEs to demystify the carbon accounting landscape. This framework of support could either be developed by the HVMC or in conjunction with BEIS to support implementation across the UK industrial base as well as BSI in relation to standardisation of a consistent approach.

2. Tighter guidance for upstream Scope 3 emissions must be created, to help manufacturing industries report in a consistent and more comparable way

More specific guidance on the measurement of upstream Scope 3 emissions associated with UK manufacturing is needed. This could be strengthening existing Scope 3 guidance (i.e., GHG Protocol Scope 3 Standard) to better enable comparability and maintain consistency in reporting. There is a role for HVMC in working with the manufacturing industry and BSI to develop this guidance as well as assisting in its implementation.

3. Agreement must be reached on which metrics to use and how these are appropriately contextualised

Work is needed to understand the most appropriate metrics to use and how best to contextualise these metrics in a meaningful way in order to show progress against the UK's net zero targets. Internationally, this can be done through programmes like the Science-based Targets initiative (SBTi), whereas this information in a national context – in terms of levels of reduction needed – is currently missing. At the UK level, there is a role for HVMC to work with government departments such as BEIS, DEFRA and HM Treasury alongside industry bodies to facilitate this consensus.

4. A robust reporting and monitoring system should be implemented – overseen by an economy-wide carbon regulator

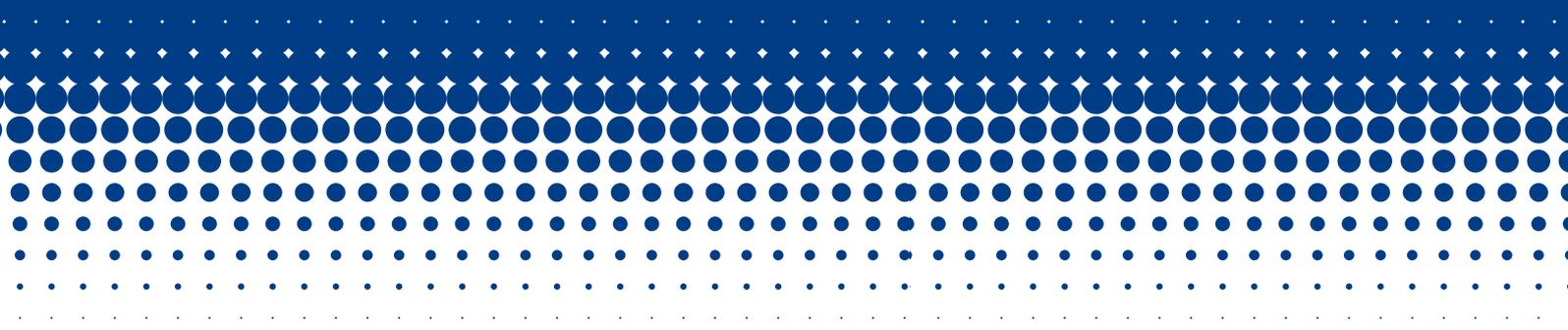
Without a proper auditing and monitoring system in place, there is no way of knowing where the UK manufacturing industry is in terms of working towards and meeting net zero targets. There must be a centrally coordinated system in place to do this, to ensure consistency and transparency. This builds on and reinforces the outcomes from previous Catapult studies and the need for an economy-wide regulator for carbon.

“ Without a proper auditing and monitoring system, there is no way of knowing where the UK manufacturing industry is in terms of working towards and meeting net zero targets. ”



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