Net Zero Carbon Policy

CATAPULT Network

CATAPULT Energy Systems

Carbon Accounting and Standards in Industry:

A Framework for Innovation and Growth

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About Energy Systems Catapult

Energy Systems Catapult was set up to accelerate the transformation of the UK's energy system and ensure UK businesses and consumers capture the opportunities of clean growth. The Catapult is an independent, not-for-profit centre of excellence that bridges the gap between industry, Government, academia, and research. We take a whole systems view of the energy sector, helping us to identify and address innovation priorities and market barriers, in order to decarbonise the energy system at the lowest cost.

Net Zero Carbon Policy

Net Zero Carbon Policy is an Energy Systems Catapult thought leadership project, focusing on how the UK can develop an innovation-friendly, economy-wide policy framework for Net Zero. We are building on the insights from our Rethinking Decarbonisation Incentives project, to develop credible policy options for an efficient and socially beneficial transition.

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Executive Summary

A carbon accounting framework that provides an accurate and quantifiable picture of emissions across industry is essential for revealing opportunities of low carbon innovation and growth. Fundamental to this is the robust monitoring, reporting, and verification (MRV) and accounting of emissions, including consistent regulatory oversight, and standards that guarantees best practice.

The current carbon accounting ecosystem is complex and limited in coordination between existing practices. There is also an absence of regulatory oversight to provide consistent emissions disclosures across approaches. Addressing both is crucial for ensuring the carbon accounting ecosystem matures to the scale, and at the pace, required for Net Zero.

In this report, we consider options for the standardisation of MRV and carbon accounting practices that affect industry. These options reflect the role that emissions reporting plays in meeting Government and industry stakeholders' needs. In doing so, we demonstrate how a carbon accounting framework can support both industry stakeholders and carbon policy development.

We propose a carbon accounting framework that promotes standardisation where it makes sense, and accommodates flexibility where it is necessary.

This includes:

- **Standardisation of emissions disclosures,** with coordination across Government to improve access to emissions data for policymakers, and regulatory oversight to ensure compliance and promote best practice.
- **Distributed digital systems architecture,** with standards to promote the comparability (or interoperability) of emissions data.

Improved data comparability and flexibility across different reporting requirements in a standardised framework can provide a more complete picture of emissions, which:

- for industry can reduce the overall administrative burden via the use of a single point of disclosure; and
- for Government can support the development and implementation of carbon policies.

More broadly, such a framework can support growth and innovation by simultaneously creating a level playing field for competition and encouraging innovation through collaboration.

Finally, **the framework must also consider the international dimension of carbon accounting.** Recognising that it will need to adapt to work with evolving cross-border policies, such as carbon border adjustment mechanisms and product standards.

Recommendations for Policymakers

We recommend that policymakers take the following actions to make such a framework a reality:

1. **Introduce a Carbon Regulator to provide effective coordination and adoption of a carbon accounting framework.** Its independence is crucial to ensure the long-term credibility and cross-sector consistency necessary for industrial decarbonisation and Net Zero. In addition, ensure that data governance is factored into carbon regulation and reporting requirements (e.g. utilise Ofgem's Data Best Practice Guidance to ensure that data is able to be shared cross-sector).
2. **Adopt a "disclose once" principle across a standardised carbon accounting framework.** A single point of disclosure reduces the administrative burden placed on industry and establishes a single source of truth. To allow for flexibility across different reporting requirements, improvements in the comparability of data, and cohesion of carbon policies, this approach needs to be supported by a distributed data system.
3. **Engage with the digital spine programme[1] and embark on the development of a distributed, scalable digital infrastructure to underpin emissions data exchange.**
4. **Fund feasibility studies to better understand how a standardised carbon accounting framework and distributed data system can be implemented across different industrial sectors,** followed by trials in key industrial sectors and their associated supply chains. This should eventually be extended to include other emitting sectors to establish an economy-wide framework.
5. **Work closely with international partners to maintain standardisation of accounting across international boundaries,** including in any future development of policies applied at the border used to mitigate carbon leakage.

[1] DESNZ (2022). Energy System 'Digital Spine' Feasibility Study. https://www.gov.uk/government/publications/energy-system-digital-spine-feasibility-study

1. Introduction

The Innovate UK funded cross-Catapult Carbon Accounting programme is led by High Value Manufacturing Catapult in collaboration with Connected Places Catapult, Digital Catapult, Satellite Applications Catapult, and Energy Systems Catapult.

The programme makes the case for a policy and regulatory environment that:

- Supports creating a comprehensive UK framework for greenhouse gas (GHG) emissions, with agreed standards and tools for accounting, tracking, and reporting GHG emissions through supply chains to accelerate industrial decarbonisation.
- Unlocks investment and creates an environment where UK industry excels on the global stage as a destination for low carbon manufacturing.

As part of this programme, Energy Systems Catapult explored how carbon accounting standards can simultaneously support carbon policy design and the needs of industry.
Industry requires clear and predictable carbon policies in order to make investment decisions for long-dated assets, innovate to reduce its emissions, and know that it is competing on a level playing field both domestically and internationally. This report summarises our work on the role that standardisation of carbon accounting can have in facilitating that policy environment.

We have built on our previous work with the South Wales Industrial Cluster (SWIC) Carbon Accounting in Industry project, which reviewed the carbon accounting mechanisms and methodologies relevant to UK industry and made proposals to move towards a more consistent and coherent approach[2].

In this report, we use the term 'industry' to refer primarily to the foundation industries of metals, ceramics, glass, chemicals, paper, and cement. These are amongst the largest emitting industrial sectors in the UK and vital for the manufacturing and construction sectors.

The report's structure is as follows:

- **Section 1** introduces the carbon accounting programme and the research approach taken.
- **Section 2** provides an overview of standards as a general concept, of carbon accounting, and of carbon accounting standards specifically.
- **Section 3** describes the existing landscape of carbon accounting standards, including formal standards and informal practices of standardisation.

[2] Energy Systems Catapult (2022). Carbon Accounting in Industry: Learning from the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework https://es.catapult.org.uk/report/carbon-accounting-in-industry/

- **Section 4** discusses the considerations and requirements of building a more complete picture of emissions for industry stakeholders and Government
- **Section 5** discusses how carbon accounting standards can support growth and innovation, including through competition and collaboration.
- **Section 6** proposes an approach to carbon accounting that can enable growth and innovation in a low carbon economy.
- **Section 7** makes specific recommendations for policymakers that would progress the necessary carbon accounting framework.

1.1 Research Approach

This project sits within Energy Systems Catapult's wider portfolio of the Net Zero Carbon Policy[3] thought leadership programme, building on a foundation of high impact industrial decarbonisation reports. Throughout our work we promote an economy-wide, whole systems approach to carbon policy design, highlighting opportunities for innovation and low carbon growth, while recognising the specific needs of different sectors and energy consumers.

We adopt the following principles to guide our approach to research, analysis, and the development of policy recommendations:

- Encourage innovation with policies that enable open and competitive markets that reveal the value of clean energy resources and technologies.
- Understand business needs with an emphasis on reducing the administrative burden of carbon policies where possible to ensure industry, particularly small and medium-sized enterprises (SMEs), can thrive in a low carbon economy.
- Adopt a whole systems approach to policy design using industry expertise to support economy-wide decarbonisation, facilitate regional partnerships, promote international best practice, and encourage reshoring of industry (while preventing further offshoring).

[3] Energy Systems Catapult's back catalogue of Net Zero Carbon Policy work can be found here: https://es.catapult.org.uk/project/net-zero-carbon-policy/

We adopt a whole systems approach to our policy thinking, but consider that carbon policy should be tailored to individual sectors[4]. This recognises the unique opportunities and challenges that individual sectors face, and that the starting position varies for each sector.

At the heart of our research, we aim to capture a wide range of stakeholder views. During the development of this report, we conducted in-depth interviews with twenty one stakeholders to establish a baseline understanding of the existing carbon accounting standards landscape. Key themes were expanded in four structured workshops targeting cross-industry, the steel-sector, academia, and Government, to test our developing thoughts and recommendations.

[4] Energy Systems Catapult (2020). Accelerating to Net Zero: A sector led approach to economy-wide carbon policy framework. https://es.catapult.org.uk/report/accelerating-to-net-zero-a-sector-led-approach-to-an-economy-wide-carbon-policy-framework/

2. Standards and Carbon Accounting

This section sets out some of the key concepts with regard to standards, carbon accounting, and standardisation of carbon accounting practices. These concepts are repeated throughout the rest of the report.

2.1 Standards

A standard is a proposed way of doing things, with guidelines, criteria, and assumptions that aim to achieve the greatest degree of order to a given context. The use of standards is widespread in industry, ranging from process requirements to financial record keeping, with all organisations having followed some form of standard with varying characteristics (see Figure 1).

In the UK, most formally agreed standards for industry are set by the British Standards Institution (BSI), with international standards operationalised through the International Standards Organisation (ISO). Formalised standards should go through a rigorous process to establish an agreed consensus amongst stakeholders. There may also be informal practices that encourage standardisation more generally, such as the sharing of best practice, signalling through policy (e.g. business models for low carbon technologies), and sector specific guidelines promoted by industry bodies.

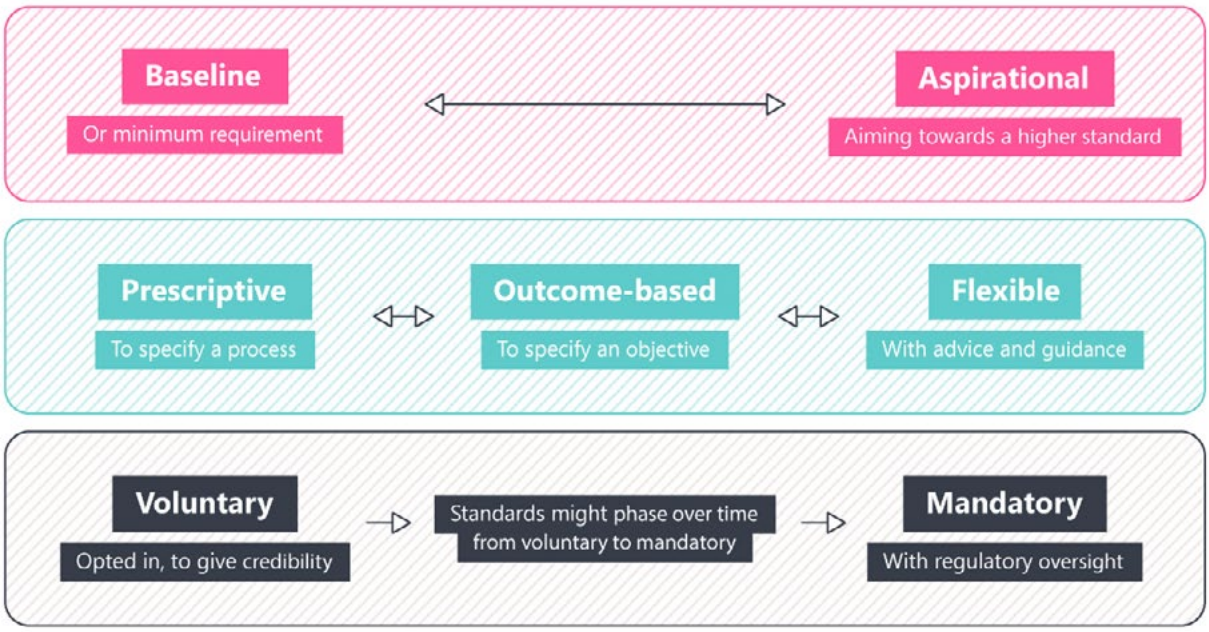


Figure 1. Illustration of the elements that can be used to characterise different standards.

Standards are applied at various stages and scales of operation, from products and organisations to processes. These can be supported through monitoring and reporting, and may be certified or verified by a third party (who could also do this to an agreed standard).

Standardisation can support economic growth by establishing a framework for sharing best practice and giving credibility to organisations. BSI has estimated formal standards increased the UK's annual GDP by £161 billion since 2000. BSI's survey of one thousand companies, suggested that most businesses recognise the benefits of formal standards in improving productivity and promoting competitiveness, especially in export markets[5].

There are also challenges associated with the use of standards. The comprehensive coverage of existing standards can be difficult for businesses to navigate, and new standards can increase the administrative burden. There needs to be clear rationale for introducing new standards, and when introduced, new standards should be cohesive with existing requirements on organisations (or replace outdated requirements), to minimise the administrative burden.

2.2 Carbon Accounting

Carbon accounting refers to the processes used to measure and allocate GHGs emitted within a set of parameters for the purposes of maintaining GHG inventories, producing corporate environmental reports, or calculating the carbon footprint of a product or service. It is also crucial for the operation of many policy mechanisms that incentivise decarbonisation, including market-based mechanisms (e.g. the UK Emissions Trading Scheme (UK ETS)).

Accounting for Greenhouse Gases

Throughout this report, we use the terms carbon accounting as most mechanisms report in terms of carbon dioxide (CO_2) or carbon dioxide equivalent (CO_2e). However, carbon dioxide is just one of the seven main GHGs covered by the Kyoto protocol requiring reduction:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HRC)
- Perfluorocarbons (PFC)
- Sulphur Hexafluoride (SF_6)
- Nitrogen trifluoride (NF_3)

Some of the inconsistencies faced by carbon accounting mechanisms lie in trying to convert GHG emissions into their carbon equivalent. While the focus of this report is on carbon accounting, we do consider and recognise the importance of monitoring and reporting all industry relevant GHGs as part of this process.

[5] Cebr (2022). The Contribution of Standards to the UK Economy. https://www.bsigroup.com/globalassets/documents/about-bsi/nsb/cebr/bsi-uk-final-report-1.2-apr22.pdf

To date, the application of carbon accounting across these uses has not led to the development of consistent definitions, protocols, or approaches. The complexity that exists in carbon accounting results from a range of frameworks and methodologies across different operational levels (e.g. corporate and national) and from a mix of compliance and voluntary based mechanisms.

At a high level, carbon accounting will be essential for:

- **Effectively tracking progress towards Net Zero** – for industrial decarbonisation, it is important to develop a complete and quantifiable picture of GHG emissions that supports decision makers and track progress towards the UK's Carbon Budgets. And to do so in way that is transparent enough to identify feedback and unintended consequences at different levels of the system[6].
- **Creating demand for low carbon products** – accurate emissions data will be an essential component of a low carbon economy, for example, for verification purposes of low carbon products or participation in carbon markets.

We cover these high level aims in more detail in Sections 5 and 6 of this report.

Monitoring, Reporting and Verification (MRV)

At the heart of carbon accounting is the requirement for consistent and coherent MRV to ensure emissions are accurately accounted for.

The terms 'monitoring' and 'reporting' are sometimes used interchangeably in carbon accounting literature. For the purposes of this report, we define monitoring as intentionally selecting, obtaining, and tracking data on specific activities over a set frequency.

Reporting involves presenting data for the requirements of a decarbonisation mechanism. Reporting requirements may influence the emissions data monitored by industry and in some cases, there may be emissions that are monitored, but not transparently reported.

Verification involves validating the emissions reported, ensuring they are accurate and robust, adhering to a set of predetermined principles.

All decarbonisation mechanisms require the amount of carbon to be quantified, though several variations exist in the MRV processes adopted.

[6] Energy Systems Catapult (2022). Carbon accounting is more than just numbers on a spreadsheet. https://es.catapult.org.uk/insight/carbon-accounting-is-more-than-just-numbers-on-a-spreadsheet/

2.3 Carbon Accounting Standards

Formal Standards

A formal standard is a named standard that has been reached through a process of intentional development. The process for formalising practices of standardisation usually involves the convening of relevant stakeholder groups to establish consensus and the publication of clear rules and guidelines for adoption.

Often, standards are developed with the support or direction of National Standards Bodies (NSBs) such as the British Standards Institution (BSI), or other coordinating standards bodies such as the International Organisation for Standardisation (ISO), which is made up of representation from different NSBs. Sector specific standards may also be developed through the coordination of an industry body (e.g. the World Steel Association (WSA)).

Both BSI and ISO have been involved in the development of carbon accounting standards in use by industry today. The majority of formal carbon accounting standards are applicable economy-wide (as well as internationally) and allow for a significant degree of flexibility in the carbon accounting methodologies used and boundaries applied[7].

[7] For a summary of how carbon accounting methodologies vary, see: Energy Systems Catapult (2022). Carbon Accounting in Industry: Learning from the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework. https://es.catapult.org.uk/report/carbon-accounting-in-industry/

Informal Practices of Standardisation

Informal practices of standardisation can occur unintentionally or be developed without an established consensus amongst the user group (i.e. industry).

Policy or market signals can also have a standardising effect, for example:

- Sharing of best practice between industrial stakeholders.
- Government developed business models (e.g. Carbon Capture, Usage and Storage (CCUS) business model).
- Mandatory obligations to report emissions in a certain way to adhere to a policy mechanism within a certain scope or boundary (e.g. the UK ETS and installation level emissions disclosures).

2.4 Section Summary

This section briefly introduced the key concepts of standards and carbon accounting, and their interaction in the form of carbon accounting standards. It is not the intention of this report to seek to introduce a new formal standard or set of standards, thereby adding to an already complex field. Instead, we have explored the wider carbon policy context to understand how the role of standards and practices of standardisation can help ensure decarbonisation of industry and the wider economy.

3. Existing Carbon Accounting Standards

Existing carbon accounting standards and associated guidance are largely designed to support organisational reporting (i.e. attributing emissions within an organisational boundary) or to calculate emission abatement at the project level. Methodologies vary significantly to support the needs of different business models.

Our previous work[8] indicated that the flexibility offered by existing carbon accounting guidance and standards, such as the ISO series and GHG Protocol, limited the transparency and comparability of disclosed emissions. For example, it is not always clear at what stage emissions abatement has been accounted for. While there will be a continued need for some level of variation in accounting practices, there is a role for standards to improve the consistency of emissions disclosures.

A more standardised approach to carbon accounting in industry could:

- Build a more complete picture of emissions that supports industry and Government in tracking progress towards the UK's Net Zero target, as well as improving the measurability of carbon policies.
- Reduce the administrative burden for industry by simplifying the reporting requirements for policy mechanisms such as the UK ETS and Streamlined Energy and Carbon Reporting (SECR).
- Improve the transparency and comparability of emissions data, revealing opportunities for investment in low carbon market growth and areas requiring more targeted policy interventions.

There are also challenges to address, such as how a standardised approach to carbon accounting in the UK would interact with international requirements (or a lack of requirements on some international competitors). Variations in the UK and the global approach could create additional administrative burdens for multinationals and organisations reliant upon international trade.

Additionally, if the incorrect point at which emissions are accounted is used, it risks driving unintended behaviour and could result in minimal effect on emissions reduction (for example, if specific sector processes and complex supply chains are not taken into consideration).

[8] Energy Systems Catapult (2022). Carbon Accounting in Industry: Learning from the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework. https://es.catapult.org.uk/report/carbon-accounting-in-industry/

3.1 Formal Standards for Industry

Accounting for Organisational Emissions

ISO and GHG Protocol emphasise flexibility in methodologies with alignment in principles for emissions accounting more generally. The principles are:

- **Relevant** – Carbon accounting approaches should serve the decision-making needs of stakeholders (e.g. policymakers, investors, industry).
- **Consistent** – Calculations and methodologies used should allow for meaningful comparison over time and geographies to identify trends and to assess performance against targets.
- **Complete** – Includes all relevant GHG emission sources within the defined boundary.
- **Transparent** – Based on a clear audit trail and include the disclosure of assumptions or proxies, potential inaccuracies, and data flows.
- **Empirical Accuracy** – Data should be sufficiently accurate to enable users to make decisions with reasonable assurance that the reported information is credible. Measurement and reporting of emissions data is supported by empirical evidence.

An example of a formal standard for reporting organisation-level emissions is SECR, which aims to encourage energy efficiency and GHG reduction by incorporating flexibility into the standard:

- Disclosure requirements vary for quoted and large companies.
- MRV guidance varies depending on sector, with flexibility to suit business models.
- Methodologies must be disclosed, but do not need independent verification.

Project Planning and Emissions Abatement

At the project level, *ex ante* consequential accounting is more suitable than attributional accounting. Consequential accounting is a decision-making approach used when seeking to predict the impact of an intervention on GHG emissions when compared to a counterfactual baseline. For Industry, this can be used to review the potential impact of industrial processes on emissions reduction investment choices.

The standards used to inform project decisions are not the same as the standards used to attribute emissions resulting from those decisions, and there is no easy way of connecting the two, which may result in confusion. For example, an organisation might conflate the two measures, incorrectly informing business decisions.

Product Standards

Increasingly, industry receives emissions disclosure requests from customers to help inform the carbon intensity of a product further down the supply chain. This may be in the form of a specific request from a customer, but most commonly take the form of an Environmental Product Declaration (EPD) request.

EPDs are a form of Type III environmental label, and aim to quantify the environmental impact of a product and enable comparisons of products that fulfil the same function. EPDs are compiled using Product Category Rules (PCRs) to promote both the standardising of information and the standardising of methodologies used[9]. EPDs are generated based on data obtained through a Life Cycle Assessment (LCA) in line with international standards, including ISO 14025, 14040 and 14044. There is no one centralised body that administers PCRs and LCAs, instead there are organisations who dominate this space. For example, EPD International[10], one of the original developers of EPDs, who adhere to ISO standards for LCAs.

There are also sector specific standards covering EPDs such as ISO 21930 and EN 15804 standards for construction products. The construction sector was most commonly referenced in our stakeholder interviews as increasing demand for EPDs. Raw materials such as steel dominate the EPDs created and stored on international databases such as the EPD System[11].

[9] ASBP. What are Environmental Product Declarations (EPD). https://asbp.org.uk/workstream/environmental-product-declarations

[10] The International EPD System. https://www.environdec.com/

[11] EPD. The International EPD System. https://www.environdec.com/about-us/the-international-epd-system-about-the-system

Industry is highly familiar with EPDs and LCAs as the environmental impact of raw materials is considered and accounted for further down the supply chain by their customers. Some industry stakeholders interviewed suggested that their customers may be more interested in signalling that the environmental impact of a product has been considered by the manufacturer, rather than with the details contained within an EPD. The proliferation of EPDs in recent decades, particularly from the construction sector, has also increased the administrative burden on industry.

Procurement and Design Standards

Standards used in other sectors of the economy can influence the carbon accounting practices applied to industry emissions disclosures. Examples include standards on procurement and design that encourage the adoption of lower carbon processes or materials.

Standards Used in Construction

The sector most extensively covered by existing and emerging standards on emissions for procurement and design is construction. Examples include:

- The UK Net Zero Carbon Buildings Standard[12] is being developed through a consortium of UK built environment stakeholders. It is expected to include MRV throughout the build process, including interim verification of a building at design stage.
- The Construction Playbook[13] sets out policies and guidance for how public works projects and programmes are assessed, procured, and delivered. It was updated in 2022 to include benchmarking of GHG emissions data and the development of a benchmarking data hub from the Infrastructure and Projects Authority.
- The Future Homes Standard is due to be introduced in 2025. The standard was criticised by the Climate Change Committee for not including assessments for emissions from building materials and for compliance concerns around the measurability of operational emissions[14]. Previously, the Code for Sustainable Homes included measures for sustainable design, but this was abandoned in 2015.
- Housing Pattern Books, which standardise housing designs. There is increasing interest in the utilisation of pattern books to support Local Authorities and Housing Associations plan and procure "off the shelf" modular homes. One example is the Advanced Industrialised Methods for the Construction of Homes' (AIMCH) Pattern Book for Affordable Homes project[15], which would facilitate standardised accounting practices for embodied emissions.

[12] UK Net Zero Carbon Buildings Standards. https://www.nzcbuildings.co.uk/

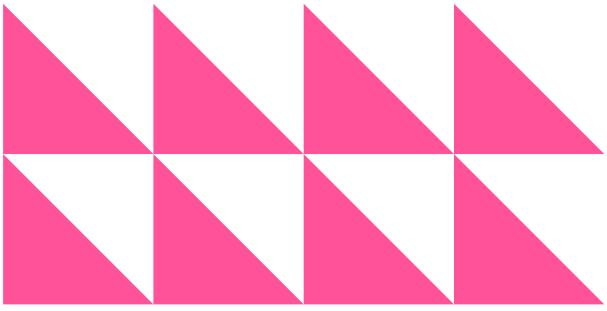
[13] HM Government (2022). The Construction Playbook. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1102386/14.116_CO_Construction_Playbook_Web.pdf

[14] CCC (2020). Letter: Future Homes Standards and Proposals for Tightening Part L in 2020. https://www.theccc.org.uk/publication/letter-future-homes-standard-and-proposals-for-tightening-part-l-in-2020/

[15] AIMCH. Affordable Homes Pattern Book. https://www.aimch.co.uk/outputs/affordable-homes-pattern-book

The economic success of UK-based industries will, in part, depend on how procurement and design standards are set by other sectors of the economy. For example, cement and steel sectors are often in competition in promoting low carbon construction materials. The point at which carbon is accounted for could have a significant impact on how these sectors develop in a low carbon economy.

> *"Procurement, particularly public sector procurement policy, is a key driver for change... There is a lot of development in this area, but I don't think there's enough knowledge about the right solutions [to promote] wider social value and circular economy principles"*
>
> – Industry Stakeholder



Reporting Standards Set by Government

Government requires industry to disclose emissions for participation in various policy mechanisms designed to incentivise decarbonisation. Some of the stakeholders we interviewed suggested Government requirements have a particularly standardising effect on industry, especially for resource limited small and medium-sized enterprises (SMEs). Mandatory Government obligations are the main cause for standardising emissions reporting, but there are also voluntary schemes that industry actively participates in. We covered these policy mechanisms in more detail in our previous report[16] and highlight the main standardising practices below:

- **The UK ETS** is a compliance driven cap and trade carbon market for energy intensive sectors. Monitoring plans are agreed and regulated by the Environment Agency in England and respective counterparts in Wales, Scotland, and Northern Ireland. Emissions are accounted for at the installation level for Scope 1 (direct site emissions) and Scope 2 (indirect energy supply emissions). Proxy measuring is supported using GHG inventory conversion factors for the respective year.[17]

[16] Energy Systems Catapult (2022). Carbon Accounting in Industry: Learning from the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework. https://es.catapult.org.uk/report/carbon-accounting-in-industry/

[17] HM Government. Guidance: Participating in the UK ETS. https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets#permitting-monitoring-reporting-and-verification

- **Streamlined Energy and Carbon Reporting (SECR)** requires the transparent reporting of energy use and emissions from most mid-large companies. Scope 1, 2, and 3 reporting requirements are dependent on company size and energy use. It follows guidelines set out in the GHG Protocol and supports the use of UK Government GHG Inventory conversion factors.[18]
- **Climate Change Agreements (CCAs)** is a voluntary scheme, with participation from most UK industry sectors. CCAs are agreements made between UK industry sector associations and the Environment Agency to reduce emissions for specified industrial processes in return for a reduction in the Climate Change Levy (a consumption tax levied on energy bills). The gross calorific value (GCV) for fossil fuel use on site is calculated and then converted to GHG emissions using 2012 GHG conversion chart to facilitate year on year comparison in emissions reduction.[19]

We have identified areas where the emissions data required for these schemes could be further standardised to limit the administrative burden on industry. We set out initial recommendations to improve the use of digital tools in our previous report and expand on these proposals in Section 6 of this report.

[18] HM Government. Guidance: Streamlined Energy and Carbon Report (SECR). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850130/Env-reporting-guidance_inc_SECR_31March.pdf

[19] Environment Agency (2022). Climate Change Agreements Operations Manual. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1056762/Climate-Change-Agreements-Operations-Manual.pdf

3.2 Informal Practices of Standardisation

Government requirements, such as those set out above, have a standardising effect on industry's engagement in carbon accounting practices. Standardisation can also be encouraged by data constraints, such as the availability and formatting of energy supplier data, and physical constraints, such as geographical boundaries (e.g. industrial clusters or site level emissions).

GHG conversion charts (e.g. the UK GHG Inventory) are often formatted in Microsoft Excel. The popularity of this software has led to stakeholders accounting for emissions across a range of complex spreadsheets – in essence, this is an informal practice of digital standardisation.

Some Government interventions have been designed in a way that limits their standardising effects. For example, the required development of Industrial Cluster Plans have not been designed in a way that encourages a standardised approach to accounting for different clusters' emissions. As a result, cluster members and other industry representatives expressed some frustration in the lack of comparability and accessibility of emissions data for industrial clusters.

> ***"The first question we asked was how do you want [us] to measure greenhouse gases? How do you want [us] to show that we have reached Net Zero by 2040? What are we measuring? And we got nothing back. You have to define that yourself essentially. And the problem that's led to is all the clusters are counting [emissions] in different ways."***
>
> – Cluster stakeholder

Stakeholders from outside of industry (e.g. academia) also expressed frustration in the lack of comparability between clusters and some highlighted the risk of "emissions inflation" that could be used to secure infrastructure investment.

3.3 Section Summary

Currently, the complex landscape of standards and the associated level of flexibility, comes at the expense of harmonisation. Better targeted guidance and standardisation across carbon accounting could go a long way in improving this, without having to develop additional standards.

> ***"There are opportunities to reduce the administrative burden so companies can focus on making the reductions rather than reporting into yet another scheme"***
>
> – Academic stakeholder

Formal and informal practices of standardisation are often developed in isolation, and without consideration of the whole system of emissions disclosures that industry is already engaged in. Over time, this approach has inadvertently increased the administrative burden on industry.

4. Building a More Complete Picture of Emissions

The primary purpose of a carbon accounting activity should determine the approach taken and the standards used for disclosing emissions. For example, holding an organisation accountable for its emissions might require different inventory boundaries and accounting methodologies when compared with calculating the consequential emissions of a new product or process. The purpose of carbon accounting requirements is not always well defined, which can contribute to the confusion and complexity surrounding the existing landscape.

> ***"Different people want different things, so I think the key is when you are collecting your data it should be in a format so that it can be used for different ways of reporting and verification"***
>
> – Industry stakeholder

To better understand opportunities for standards to support a carbon accounting framework, we need to understand the primary goals of emissions disclosures. This is particularly relevant for policymakers; several of the existing formal and informal carbon accounting standards that drive industry's approach to carbon accounting stem from multiple obligations set by Government policy.

By understanding the various existing disclosure requirements, we can start to identify areas where there might be overlap and opportunities for efficiency improvements. Figure 2 highlights the stakeholders that generate and consume emissions data, for example.

This section looks more closely at the reasons behind emissions disclosures, building on insights from our workshops with targeted stakeholder groups. It is not an exhaustive list, but does contain the reasons most relevant to UK industry. We also explore how complete our picture of industry emissions needs to be to satisfy the requirements of specific stakeholders.

4.1 For Industry Stakeholders

Industry is both emission and energy intensive. As such, it is familiar with environmental impact assessments and monitoring of localised emissions to address environmental and public health concerns, such as air quality. GHG emissions have received more targeted scrutiny in recent years, but the rapid pace of development in carbon accounting practices and requirements has led to inconsistent methodologies and guidelines.

Table 1 summarises the reasons that industry discloses emissions in different formats, which we have identified through stakeholder interviews and workshops.

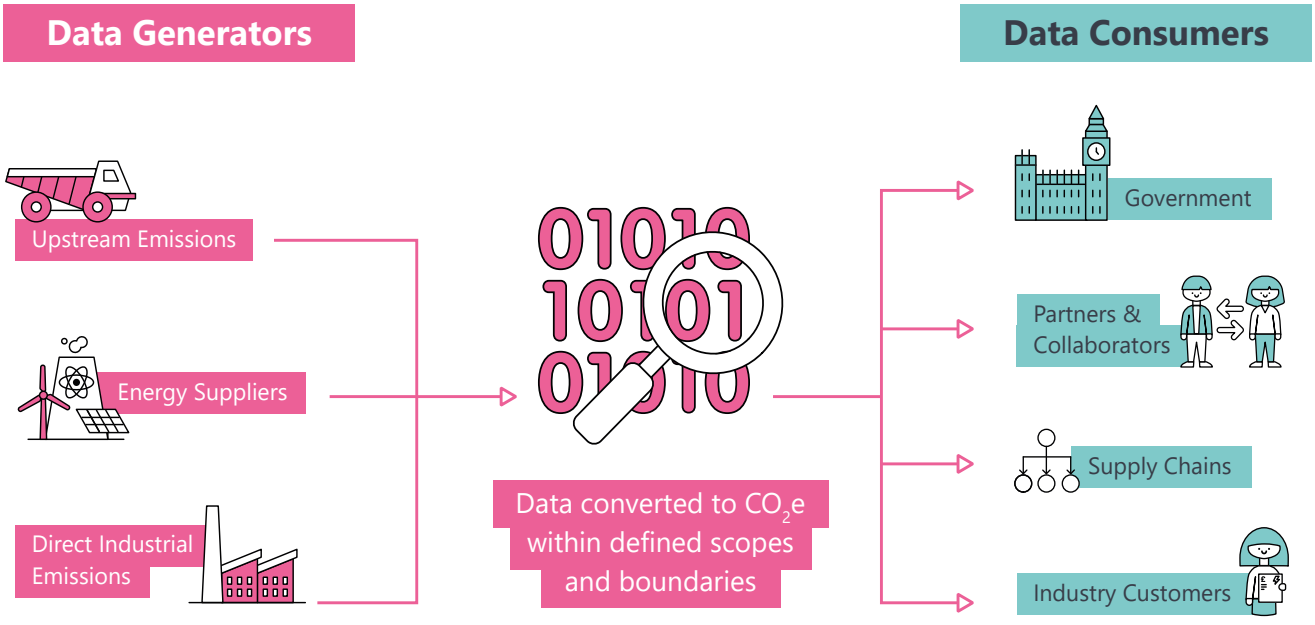


Figure 2. Emissions data generators and consumers.

Our earlier work[20] discussed the administrative burden that arises from the different disclosure formats in more detail; it also highlighted the different types of accounting methodologies, boundaries, and conversion calculations that have been developed to support these requirements.

Table 1. Reasons industry disclose emissions.

Reason	Description	Examples
Complying with Government policy requirements and schemes	Government policy is often the main driver for emissions monitoring and disclosure. This ranges from compliance-based carbon markets to qualifying for Government support.	• UK Emissions Trading Scheme • Climate Change Agreements • Streamlined Energy and Carbon Reporting (SECR) • Potential for a future GGR Marketplace linked to the UK ETS[21]
Benchmarking Net Zero and emission reduction plans	To be able to quantify and track progress for meeting decarbonisation plans, industry must measure and disclose emissions on an ongoing basis against a baseline benchmark.	• Industrial Cluster Plans (e.g. South Wales Industrial Cluster Plan) • Organisation emission reduction targets (e.g. Rockwool[22] and Phillips 66[23])
Demonstrating decarbonisation efforts	Demonstrating to clients/ consumers an organisations Corporate Social Responsibility or green credibility via voluntary schemes.	• Science Based Targets Initiative (SBTi)
Research & Development (R&D)	Disclosing emissions internally or to partners for early-stage R&D purposes and to ensure credibility of low carbon products in development.	• Developing multi component low carbon cements[24] • Developing circular models for steel production, including recyclability[25]

[20] Energy Systems Catapult (2022). Carbon Accounting in Industry: Learning from the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework. https://es.catapult.org.uk/report/carbon-accounting-in-industry/

[21] https://www.gov.uk/government/consultations/greenhouse-gas-removals-ggr-business-models

[22] Rockwool (2020). Rockwool Announces Ambitious Global Decarbonisation Goals. https://www.rockwool.com/group/about-us/news/2020/rockwool-announces-ambitious-global-decarbonisation-goals/

[23] Philips 66. Greenhouse Gas Emissions Reduction Targets. https://www.phillips66.com/sustainability/our-targets/

[24] HM Government. Greenhouse Gas Removals Business Models Consultation. https://cement.mineralproducts.org/Innovation/Development-of-low-carbon-multi-component-cements.aspx

[25] CELSA Group. Circular Economy and Recycling. https://www.celsagroup.com/en/sustainability/circular-economy-and-recycling/

Further down the supply chain, customers of industry, such as automotive manufacturers, are also responding to consumer demands for "greener" products. There are increasing requirements for industry to demonstrate its decarbonisation efforts through EPDs and other forms of emissions disclosures. Industry stakeholders in our workshops suggested that customer demands for emissions data relating to their products are becoming increasingly complex and onerous to produce.

In addition to supporting requests from customers and obligations placed by Government, industry engages in various schemes and initiatives to demonstrate its decarbonisation efforts. Many of these schemes have a carbon accounting element to help quantify intentions and authenticate claims, with examples adhering an agreed standard (e.g. SBTi).

Science Based Targets initiative (SBTi)

Objective: Provide businesses with defined pathways to reduce their GHG emissions by setting targets that are in line with the latest climate science.

Disclosure Requirements: Companies that participate are required to set targets based on emissions reductions in line with a global temperature increase of 1.5°C before 2050 across Scopes 1, 2, and 3. This is split into near- and long-term targets.

MRV Guidance: External verification of corporate Net Zero targets and annual progress reporting, validated against SBTi's own criteria. Sector-specific guidance is being developed for aluminium, buildings, cement, chemicals, forests, land use and agriculture, and steel.

4.1.1 Considerations for Building a More Complete Picture of Emissions for Industry

In building a more complete picture of emissions, it is important for industry that considerations are made that inform both internal business decisions and broader consumer choices. These might include:

- **Levelling the playing field** – Fundamental to trade-exposed industry is ensuring that emissions data captures domestic industry on a level playing field with international competitors to mitigate carbon leakage[26]. It is also relevant to domestic competition, where sectors compete for customers (e.g. in construction, choices between concrete, steel, or timber).
- **Protecting intellectual property** – There can be a tension between reporting emissions and revealing commercially sensitive data. Both must be balanced when building a complete picture of emissions.
- **Reducing administrative burden** – Accounting of emissions can come in many formats, increasing disclosure requirements through policy or social responsibility increases the cost to industry.
- **Informing investment decisions** – A more complete picture can be used to inform business decisions and help identify innovation opportunities.

Currently, emissions data gathering, processing, and disclosure is largely undertaken with spreadsheet-based tools and static databases that require disproportionate resource to maintain. Industry are asked to complete templates that are then aggregated, modelled, and quality controlled through a time consuming, labour-intensive, periodic exercise. This approach is more prone to random errors from manual processing and is not a viable when considering how to scale the approach to more data sources and more frequent data updates.

[26] Carbon leakage can occur if the competitiveness impacts that arise from carbon policies leads to emissions reduction from domestic firms combined with increases in emissions in other jurisdictions where carbon policy is either less ambitious or does not exist. This can lead to a net increase in global emissions.

From our stakeholder interviews, a consistent message has been the need to standardise across the various emissions disclosure requirements on industry. The current disparate landscape of disclosure requirements reduces the overall transparency and comparability of disclosures, and creates significant administrative costs. In Section 6, we highlight the opportunity for Government to support a standardised carbon accounting framework to help mature the carbon accounting ecosystem, while reducing the administrative burden on industry.

> *"The more you standardise things, the more the ecosystem that performs the tasks can mature and bring costs down."*
>
> – Academic stakeholder

Considerations for Commercial Sensitivity

Many stakeholders interviewed highlighted commercial sensitivity as a barrier to more transparency in emissions data. Industry is unlikely to disclose emissions data at more granular level than is mandated. Through our interviews, we have identified the following reasons for this:

- **Risk of exposing their clients' emissions.** Some industry sites may only have one or a few customers purchasing their products. If these organisations are required to disclose more granular emissions data, they are not only disclosing their emissions, but potentially those of their clients. This may be the difference between retaining a customer or not.
- **Concerns about revealing their unique selling point.** For some industrial processes, the transparency of energy input and output risks exposing intellectual property. The possibility of replicating an industrial process more cheaply abroad exacerbates concerns about international competitiveness.
- **Concerns about additional and unwarranted scrutiny.** There are major hurdles to achieving full scale decarbonisation of industry - technologies may still be in their commercial infancy and/or come with a significant associated cost. Some stakeholders admitted industry is behind other sectors of the economy in their decarbonisation efforts, while others suggested the wider role domestic industry has for emissions reduction needs more consideration (for example, the steel needed to support other sectors to decarbonise).

On the contrary, some academia stakeholders suggested "commercial sensitivity concerns" has become a catch-all reason for limiting disclosures and that the concerns expressed by industry stakeholders may not be as warranted. This tension highlights that commercial sensitivity often comes down to a sense of fairness amongst organisations.

Levelling the playing field by standardising emissions reporting could go some way to mitigating many of industry's concerns. However, standardising emissions reporting domestically would not solve international competitiveness concerns; additional policies (e.g. carbon border adjustment mechanism (CBAM) or product standards applies at the border) will also be required.

4.1.2 The Role for Standards and Standardisation in Supporting a More Complete Picture for Industry

Standards already play a role in emissions disclosure for industry, but the variations between them have given rise to complexity when organisations have to adhere to multiple disclosure requirements simultaneously. Standardisation of disclosure, data, and process could go some way to reduce the overall administrative burden, as well as making the data itself more useful for other stakeholders. Options include:

- Where possible, require a single point of disclosure. For example, adopting a "disclose once" principle for industry reporting emissions to Government (this is discussed in more detail in Section 6).
- Establish standard formats for data requests by customers, including standards on proxy measurements. This would need to be sensitive to product and supply chain specific requirements, but could reduce the need for bespoke data requests from customers.
- Build on existing processes used by industry. For example, use of already recorded industrial material inputs and outputs to calculate emissions with standardised conversion practices.

In addition to the above, the international efforts of other jurisdictions require due attention. The European Union's development of a CBAM is likely to impact on the administrative burden of UK industry, regardless of whether it results in an increased carbon price or not for exports.

Where possible, standardisation domestically should not result in conflicting reporting for international requirements. Standardisation across international borders could also better support international supply chains, where data is required between trading partners or cross-border customers.

Sector Specific Considerations

It was made clear through our stakeholder interviews and workshops that the level of standardisation varies between sectors. For example, the steel industry in the UK is well established, with well understood energy inputs and process requirements, which could be used to simplify the emissions MRV process. The chemicals sector, on the other hand, is more complex and varied, covering fertilisers to pharmaceuticals, involving different supply chains, sites, and processes.

There are also variations to the net socio-economic effects of carbon leakage for specific sectors. For example, the steel and cement produced in the UK impacts the types of construction materials available to support new house building, whereas the chemicals industry impacts food production and access to medicines. More work is required to understand the extent to which specific energy intensive sectors of industry need more flexibility in their emission reporting obligations to support wider policy objectives.

Target Setting

Setting decarbonisation targets, either as an organisation or collectively announcing targets as a sector or regional cluster can enable the investment and R&D required to decarbonise. Targets could be technology or process-specific (e.g. to replace a blast furnace with an electric arc furnace by a certain year) or they could be less prescriptive and outcome-based (e.g. blanket emissions reduction target, such as a percentage reduction) that allows for flexibility in how the target is met.

Quantifiable emissions targets, such as Net Zero, need to be developed with consideration of the carbon accounting approach to be taken in order to establish benchmarks and track progress. For example, boundaries for a regional industrial cluster's emissions need to be determined carefully to avoid unintended consequences, such as carbon leakage, and consider supply chains that operate outside the cluster's boundaries.

Industry stakeholders interviewed suggested that while outcome-based targets could provide some flexibility (e.g. to the source of energy supply chosen for the electrification of a process), for many industries, decarbonisation involves the replacement of a key piece of equipment. Asset replacement could reduce a site's emissions significantly, but this reduction would not be represented gradually. A target to reduce emissions by a certain percentage by a certain year would not be suitable in instances where the timing of asset replacement results in a step change of site level emissions.

4.2 For Government

In recent years, as part of commitments in the Industrial Decarbonisation Strategy[27] and Net Zero Strategy[28], the UK Government has developed and consulted on several targeted initiatives and policy measures to further decarbonise industry. These include the development of Industrial Cluster Plans, the planned phasing out of UK ETS Free Allowances, and business models for enabling technologies/vectors such as CCUS and hydrogen. These sit as additional to existing schemes that continue to operate, highlighting an often-fragmented approach to policy development and implementation.

We identified the following reasons Government require industrial emissions data:

- Supporting the *ex-ante* appraisal of emissions for policy design (e.g. application of HM Treasury's Green Book).
- Quantifying the *ex-post* impact of a specific policy or set of polices to understand how effective they have been at achieving an overarching strategy.
- Demonstrating progress to meeting emissions reduction targets (e.g. Carbon Budgets, Net Zero).
- Identifying areas where data is currently missing, to improve Government's overall strategy.
- Informing future strategies and developing sector-specific targets.
- Quantifying risks associated with targeted policies, including risk of carbon leakage.
- Informing purchasing decisions (e.g. through public procurement rules) and setting conditions for funding (e.g. demonstrator funding).
- Distinguishing between different levels of industrial emissions (e.g. project, product, and national), and being able to read across overlapping inventory boundaries to inform Government policy.
- Identifying incidences of greenwashing and enforcing compliance.

[27] DESNZ (2021). Industrial Decarbonisation Strategy. https://www.gov.uk/government/publications/industrial-decarbonisation-strategy

[28] DESNZ (2021). Net Zero Strategy. https://www.gov.uk/government/publications/net-zero-strategy

Requirements of emissions data will vary across Government departments, but there is a need for more coordination and the establishment of high-level principles to support policymakers in their use of emissions data. For example, industry stakeholders raised concerns about existing emissions standards for innovations at a low technology readiness level (TRL) receiving demonstrator funding, suggesting more consideration is needed to recognise the wider potential of these technologies when setting project level emissions targets.

> ***"Government insists that low TRL meets a certain [emissions] standard, whereas [at low TRL] your purpose is not to reduce GHGs... your purpose is to develop a technology that has the potential to reduce GHGs. The actual demonstrator might be quite carbon intense, because you've had to take some shortcuts or you don't need to demonstrate the whole project."***
>
> – Industry stakeholder

4.2.1 Considerations for Building a More Complete Picture of Emissions for Government

Government collects a wealth of emissions data (Figure 3), but it is unclear how effective that data is in supporting the objectives previously listed. This uncertainty is compounded by a lack of clarity around how different data sets relate to each other and the extent to which they are comparable. For example, the level of detail held by various reporting systems (such as the Emissions Trading Scheme Workflow Automation Project) and Government databases (such as the National Atmospheric Emissions Inventory) is not transparent, nor is it clear how these different databases and reporting systems already support and inform one another.

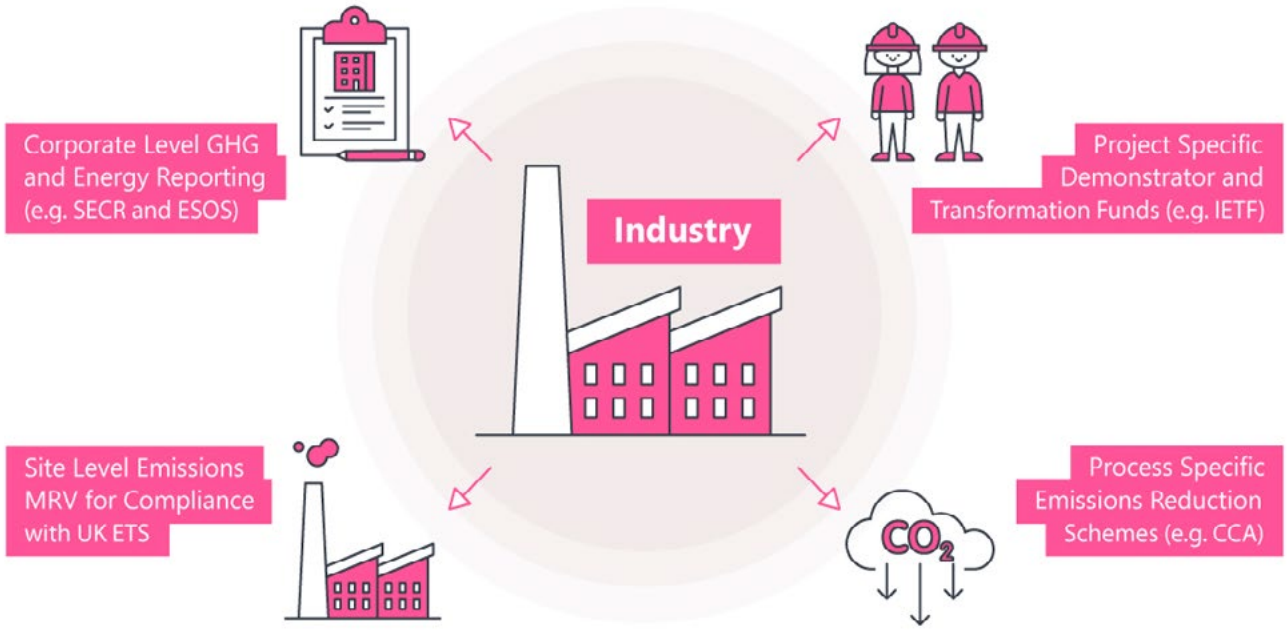


Figure 3. Examples of emissions data already being reported to Government. The level of detail is driven by the requirements of individual schemes.

Using existing emissions data, rather than developing new requirements is particularly important, where data from one Government department could be used by another department, to fulfil requirements. There is also an opportunity for Government to ensure the administrative burden is minimised for industry, for example, by aligning requirements between policies (see below on CCAs, for example).

Climate Change Agreements

Organisations receive a discount on the Climate Change Levy (CCL), a consumption tax added to energy bills, via CCAs, if they can agree a commitment to reduce their energy use and emissions with the Environment Agency.

CCA emission disclosures require reporting emissions with predetermined GHG conversion factors. The factors[29] were locked in at the beginning of the scheme in 2012, which means they are not comparable to disclosures made with more recent GHG conversion charts used for reporting to the UK ETS, for example.

There is an opportunity for data required for both the UK ETS and CCAs to come from a single point of disclosure from industry if different conversation factors are applied by the Government to align with the design of individual policies.

[29] Environment Agency (2013). Climate Change Agreements: Operations Manual. https://www.gov.uk/government/publications/climate-change-agreements-operations-manual--2

4.2.2 Role for Standards and Standardisation in Supporting a More Complete Picture of Emissions for Government

Government is well placed to impose standards, including on industry for carbon accounting purposes. Government can do this in a way that accounts for emissions reporting requirements from across departments as well as other sectors (e.g. customers of industrial products). This would simplify the reporting requirements on industry and increase the overall transparency of emissions data to help inform Government decision making.

Looking ahead, more comprehensive, and economy-wide emissions MRV will be required to support the functioning of a low carbon economy and the policies required to enable it. Improving the coordination of emissions data across Government would also support the development of a carbon accounting framework that is more adaptable to future requirements of emissions data.

In Section 6 we set out our recommendation for a standardised carbon accounting framework for industry, including considerations for the digitalisation of MRV requirements and the regulation required to enable it.

4.3 A Whole Systems Approach

Beyond individual stakeholder requirements, the overall approach to carbon accounting standards, including obtaining emissions data is worth reflection. Energy Systems Catapult advocates taking a whole systems approach, which means considering both the direct and indirect implications of policy design using systems thinking[30]. For example, accurate representation of the carbon intensity of electricity sits outside of industry, but directly impacts reporting of Scope 2 emissions (see below), which has ramifications for investment decisions. Within industry, circular economy considerations require improved

Accurately Tracking Carbon in Electricity Markets

Measuring carbon emissions at the point of generation can be relatively straightforward, and it is a requirement for generators participating in the UK ETS. The challenge is to accurately track the carbon content of electricity from its point of generation to its contracted end user, including its trading and re-trading. Currently, where carbon is tracked and matched with electricity consumption, it is only done on an annual, or at best monthly, basis.

As organisations electrify as part of their decarbonisation efforts, accounting for the carbon content of generation becomes important for accurately reporting industry's Scope 2 emissions. The current Renewable Energy Guarantees of Origin (REGO) does, to some extent, provide transparency about the portion of electricity that suppliers source from renewable energy, but it does not accurately reflect the attributes of a given unit of energy sold to the consumer (e.g. the time of generation does not match the time of consumption).

For industry to be able to account for carbon more accurately, Scope 2 emissions must be more representative of time-related consumption, rather than relying on system averages. However, the mechanisms to do so are not within the remit of industry. This highlights the importance of taking a whole systems approach when policies (e.g. REGOs) and reporting requirements are developed.

[30] Systems thinking is a holistic approach to analysis that focuses on the way that a system's constituent parts interrelate and within the context of a larger system.

[31] Energy Systems Catapult and Elexon (2021). Accurately Tracking Carbon in Electricity Markets. https://es.catapult.org.uk/report/accurately-tracking-carbon-in-electricity-markets/

systems thinking across value chains.

In addition to improving our picture of emissions economy-wide, there must also be consideration of the wider picture of socio-economic co-benefits of industry. This is particularly important if Government's Industrial Decarbonisation Strategy[32] is to effectively align with its wider objectives, such as "levelling up", growth, employment, and controlling inflation. Carbon accounting has implications on an organisation's resource and ability to compete, which can have an indirect impact on the ability to achieve these wider objectives.

4.4 Section Summary

The rapid pace of carbon accounting development has led to a complex and disjointed reporting landscape. Resulting in an increasing administrative burden on industry to disclose emissions in various formats, to support customers and Government, and it remains a significant barrier to innovation and for the growth of SMEs.

Standards and standardisation could help mature the carbon accounting ecosystem and simplify existing emissions requirements. It remains the case that any decisions must be sensitive to sector specific challenges and opportunities – and not to treat industry as one, single sector. In doing so, standards could embed principles of transparency and comparability across emission data sets, with Government having an increased role in ensuring compliance (akin to accounting in the financial sector).

Beyond the considerations for industry and Government, there should also be consideration for the potential use cases by other stakeholders and the broader implications when thinking about standards and standardisation. In our interviews, representatives of academia and think tanks identified challenges in accessing the data needed to scrutinise industrial decarbonisation and make recommendations to support the implementation of Net Zero policies or identify areas to target R&D.

[32] DESNEZ (2021) Industrial Decarbonisation Strategy. https://www.gov.uk/government/publications/industrial-decarbonisation-strategy

5. Supporting Growth and Innovation

Government's industrial decarbonisation policy has so far focused on establishing mechanisms to decarbonise complex industrial sites, often co-located in clusters, and to lower the cost of energy-intensive industrial processes. Stakeholders highlighted this "at source" investment as essential for decarbonising direct industrial emissions. But they also highlighted missed opportunities to harness industry to support economy-wide decarbonisation while promoting growth and innovation, including:

- Attracting new industry and investment to regional industrial clusters.
- Using UK produced materials, such as steel, in the development of renewable energy.
- Attracting new customers with verified low carbon offerings that support customers' Scope 3 pledges.
- Commoditising and exporting industry knowledge and expertise.
- Adopting circular economy principles to co-design low carbon products with supply chain partners.

To truly decouple GHG emissions from economic growth, all sectors will need to incorporate new ways of working and innovating (e.g. cross-sector partnerships to use waste materials). While innovation opportunities remain for industry, carbon accounting practices should be designed in a way that not only adapts to innovation, but creates the enabling conditions to do so. The UK has an opportunity to become a world leading market in low carbon industrial products, but only if it can create an attractive framework for investors with credible emissions accountability.

Implementing a robust carbon accounting framework and the standards to support it, requires an understanding of the growth and innovation areas where standards could be applied. In this section, we highlight opportunities for industry in a low carbon economy, and consider how standardising practices could help industry compete on a level playing field and facilitate the collaboration necessary to innovate.

5.1 Creating a Level Playing Field for Competition

The economy of 2050 will look very different to today but, as long as it relies on the same types of materials (e.g. steel and cement), there would be a role for Government to promote the domestic production of these materials. Doing so is essential to the wider transition and for accessing the co-benefits of industry for local communities.

Creating a level playing field for competition sits at the heart of many industry stakeholders' concerns. Competition can also encourage

innovation in processes, technologies, and products. Policy should seek to access this upside of competition, while mitigating as far as possible the potential negative impacts discussed in this section.

Competition Between Regions

Regionally, UK industry is split into two types – industrial clusters and dispersed sites.

For industrial clusters, stakeholders identified differences in how emissions are being attributed within cluster boundaries. There is a risk this leads to variations in how clusters account for their Scope 1, 2, and 3 emissions. Developing a standardised carbon accounting framework, in particular as the cluster plans are actioned upon, would enable clusters to compete for investment on a level basis. By increasing the level of comparability between clusters, investment decisions can be better directed, while also ensuring progress towards Net Zero.

Some industrial clusters also have a competitive advantage resulting from access to certain infrastructure. For example, investment deriving from a policy focus on large-scale infrastructure projects, such as transport and storage pipelines for CCUS, currently gives a competitive advantage to some industrial clusters located near offshore stores. A standardised carbon accounting framework, which provides a broad picture of emissions, can inform investment decisions, and reveal opportunities for surrounding areas.

For dispersed sites, many rely on the co-location of their supply chain to reduce transportation costs. Approximately half of UK industrial emissions are attributed to dispersed sites located outside of industrial clusters[33]. Additional socio-economic benefits of dispersed sites should also be considered, such as the local communities who rely on them for employment and the wider regions their products serve.

For example, the aggregates sector is particularly dominated by dispersed sites. The high cost of aggregate resource transportation has caused related industrial processes to co-locate close to the point of extraction. For example, in the Peak District, around two thirds of the down-stream supply chain for mineral aggregates is located within the National Park and neighbouring areas[34].

[33] Energy Systems Catapult (2022). Towards Industrial Decarbonisation: The Strategic Role of Industrial Clusters. https://es.catapult.org.uk/report/towards-industrial-decarbonisation-the-strategic-role-of-industrial-clusters/

[34] Genecon (2017). Minerals & Aggregate Extraction in High Peak & Derbyshire Dales: A Sector Benefits Study. https://www.highpeak.gov.uk/media/2674/Minerals--Aggregate-Extraction-in-High-Peak--Derbyshire-Dales---Draft-Report/pdf/Minerals___Aggregate_Extraction_in_High_Peak___Derbyshire_Dales_-_Draft_Report.pdf?m=1514474274637

Should mineral extraction in the Peak District cease, additional transportation costs could have knock-on effects for development projects in surrounding cities.

Additional support may be needed for dispersed sites. For example, one stakeholder suggested dispersed sites may need to be given priority in purchasing negative emission credits. A carbon accounting framework will need to account for these geographical differences if they are to facilitate effective competition and accurately inform associated policy decisions (e.g. GGR Business Models).

Competition Within and Between Sectors

Several stakeholders highlighted that industry sectors often find themselves competing against different materials that provide a similar function (for example, timber, steel, and cement for construction of low carbon homes[35]). A standardised carbon accounting framework should provide more clarity for industry customers when choosing materials that serve a similar function.

> ***"When organisations carry out an LCA, they make assumptions about steel... often taking a European average... organisations like [ours] who are doing quite positive things in terms of decarbonisation overall, lose out, because of how those assumptions are made."***
>
> – Steel sector stakeholder

Industry stakeholders also identified the use of emissions data and formal standards to support their own R&D for low carbon products. This form of carbon accounting is often verified using an existing standardised approach to give new products credibility. However, the current level of granularity required of emissions data to support R&D is resource intensive and requires a level expertise that may only be available to larger organisations, such as multinationals. This places SMEs at a disadvantage.

[35] UK Collaborative Centre for Housing Evidence (2021). Decarbonising through innovation: Summary of stakeholder engagement discussions. https://housingevidence.ac.uk/news/decarbonising-through-innovation-summary-of-stakeholder-engagement-discussions/

International Competition

Carbon leakage can occur if the competitiveness impacts that arise from carbon policies leads to emissions reduction from domestic organisations, combined with increases in emissions in other jurisdictions where carbon policy is either less ambitious or does not exist. This can lead to a net increase in global emissions. Standardised accounting processes, in concert with the appropriate carbon policy, across international borders can go some way to mitigate this.

International competition is complex due the multitude of factors that affect investment decisions (e.g. exchange rates, labour, and capital costs, as well as carbon policies). As jurisdictions transition to low carbon economies, organisations will increasingly need to compete on carbon intensity. This will be indirectly represented as a cost through mechanisms (e.g. the EU's CBAM).

Carbon Border Adjustment Mechanism (CBAM)

A CBAM can be used by a country (or trading bloc) to address asymmetric carbon polices between jurisdictions. A domestic carbon price is applied on producers (e.g. via a carbon tax or resulting from an emissions trading scheme), which is also levied on products imported from countries that do not adopt equivalently stringent carbon policies. In addition, exports may be eligible for rebates. In its most basic form, a CBAM can be a tariff or other fiscal measure applied to imported goods. A CBAM can also be implemented by extending other regulatory obligations to imports, such as the requirement to purchase emission allowances or meet purchasing standards. Or CBAMs can be applied to exports; for example, through tax or regulatory relief.

Many stakeholders highlighted a role for a CBAM to help mitigate competitiveness concerns arising from imported goods. A significant proportion of existing industry exports goes to EU customers, and there are concerns for the viability of this existing market if the UK does not align with the EU's forthcoming CBAM.

5.2 Encouraging Innovation Through Collaboration

While levelling the playing field for competition is necessary, intensive competition also encourages high levels of commercial sensitivity and protectionism over intellectual property. There is a balance between encouraging competition and encouraging collaboration, which itself can be a source of innovation. A well-designed carbon accounting framework should promote both where appropriate.

Decarbonising Industrial Processes

For some sectors, carbon dioxide is so integral to their industrial process that the only option is to find ways to prevent its release into the atmosphere. There may be opportunities to develop sustainable ways to exploit these "waste" emissions further, which requires cross-sector or supply chain collaboration.

Stakeholders expressed concerns that the way in which carbon is accounted for could limit their opportunities to develop innovative solutions and work with partners. We have previously highlighted some of the limitations of bounded inventory reporting, as well as opportunities for consequential accounting practices to ensure decarbonisation beyond a fixed boundary[36].

[36] Energy Systems Catapult (2022). Carbon Accounting in Industry: Learning from the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework. https://es.catapult.org.uk/report/carbon-accounting-in-industry/

Carbon policies attributing emissions within defined boundaries may need to accommodate collaborations with cross sector partners and supply chains beyond these boundaries (see Figure 4).

Additionally, stakeholders suggested there may be opportunities for industry and their partners to export R&D knowledge and best practices into developing low carbon products, thus supporting carbonisation efforts globally.

Promoting Circular Economy Principles

Stakeholders highlighted the need to incorporate circular economy principles, such as recyclability, into carbon accounting standards to support the co-design of low carbon products with supply chain partners.

Determining at what stage within a product's life cycle to account for emissions should be considered with care. To promote a whole systems approach to decarbonisation, carbon accounting standards need to be adaptable to enable industry to work with new partners to co-design innovative solutions that reduce emissions over the complete life cycle of a product.

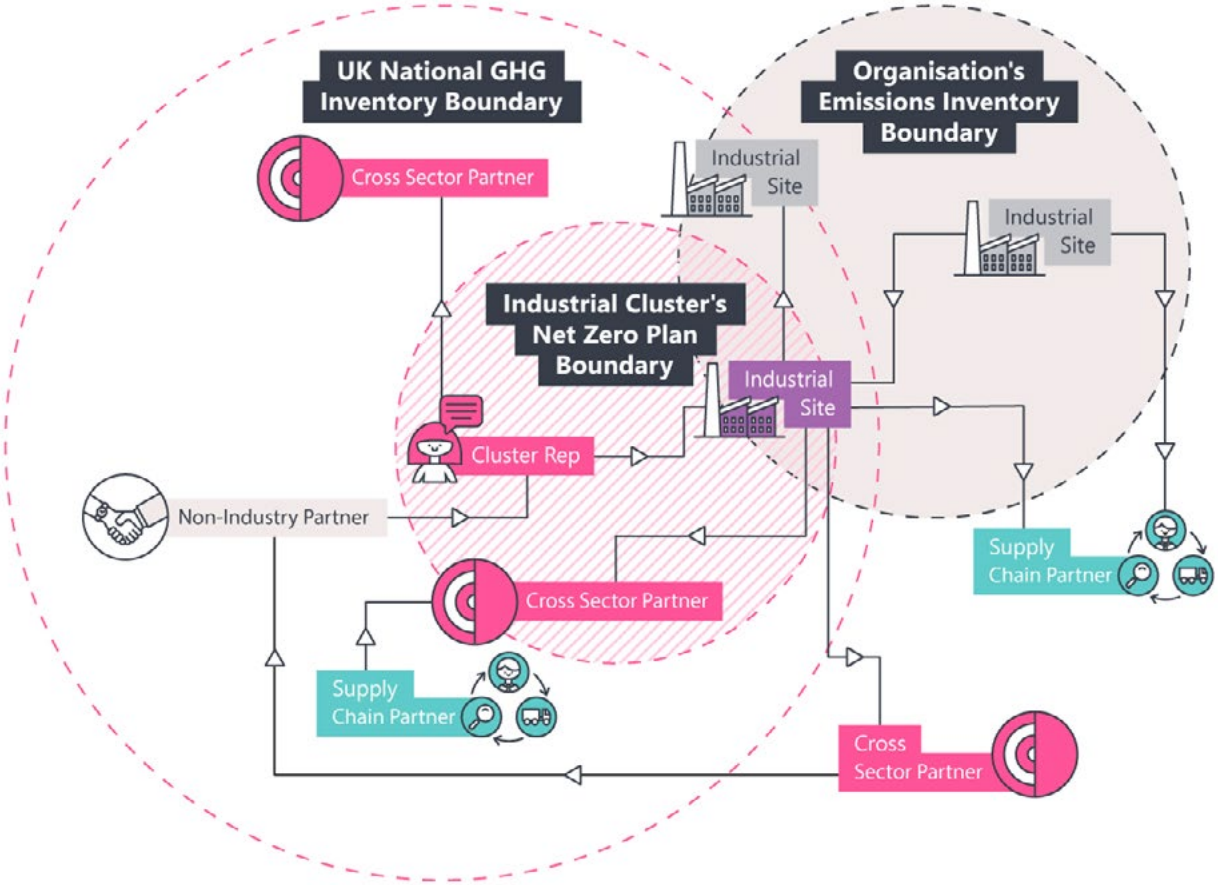


Figure 4. Demonstration of cross sector collaboration activities to support innovation.

5.3 Section Summary

Standards and standardisation have a role to play in enabling fair competition – by levelling the playing field, both domestically and internationally. The success of this will depend on the enduring nature of the carbon policies that use standards, the consistency in the carbon accounting principles applied, and the extent to which standards are designed to adapt to new opportunities for collaboration.

Industry is largely wary of any additional reporting requirements, including increased transparency of emissions data, citing competitiveness concerns. Standardising practices of emissions data sharing and facilitating comparability could further quantify these concerns and help design targeted support for specific sectors, as well as the communities dependent on industry.

The ability for industry to decarbonise, while remaining competitive, currently depends on several factors outside of its control (e.g. energy prices, technology readiness levels). For Government to maintain industry as viable sectors of the UK economy, there is a need to understand the source and scale of these barriers. A carbon accounting framework can go some way to creating the enabling conditions to drive long-term demand for low carbon industry in the UK.

Effective standards can also protect SMEs from being disproportionately penalised by additional reporting requirements. Clear standards and data exchange formats enable software service providers to build more generalised products that can be marketed to a wider audience. This enables SMEs to use off-the-shelf products or services to meet their carbon accounting obligations, reducing the need for more complex and expensive, bespoke processes.

6. Towards a Streamlined and Standardised Approach

A carbon accounting framework needs to be designed in recognition of the following high-level aims explored in previous sections:

- To use emissions data to build a more complete picture of UK emissions and track progress towards Carbon Budgets and Net Zero targets.
- To use emissions data to establish the conditions for both competition and collaboration to transition towards a low carbon economy.

Clearer recognition of these high-level aims could have a significant impact on both the design and implementation of carbon policies and the development of the carbon accounting landscape needed to support them. These considerations must be economy-wide, recognising the opportunities for cross-sector partnerships, while also being sensitive to the specific needs and challenges of different sectors.

In this section, we set out a framework for carbon accounting that can meet the above requirements. This framework consists of:

- Distributed digital systems to facilitate comparability (or interoperability) of emissions data.
- A coordinating body, with regulatory oversight to encourage adoption.

To achieve global decarbonisation, international considerations are also necessary to trace emissions through complex supply chains and ensure any carbon accounting framework developed for the UK can adapt to emerging international frameworks and schemes. We set out these considerations in Section 6.3.

Net Zero is a long-term goal requiring an economy-wide carbon accounting framework that is accurate enough to give confidence to investors and consumers, but also adaptable enough to respond to future developments and opportunities for collaboration. While our focus in this section is industry, our work and the high-level principles of the carbon accounting framework laid out are applicable economy-wide.

6.1 Enabling Conditions for a Low Carbon Economy

Through our interviews and workshops with industry stakeholders, we have identified the following characteristics of a prosperous, low carbon economy where UK industry can thrive:

- **Industry** – confidence in the long-term feasibility of domestic low carbon production to prevent offshoring of industry.
- **Industry sectors** – ability to compete on a level playing field when producing materials and products that serve the same function so that sectors can target R&D efforts effectively.

- **Investors** – confidence in the credibility and long-term value of low carbon investments.
- **Industry customers** - clear guidance and policy enablers to help improve demand for domestic production of low carbon products.
- **Government** - accessible emissions data to support policy design and ensure activities have a material effect on emission reduction economy-wide.

The carbon accounting framework we set out would facilitate this type of ecosystem by:

- **Ensuring comparability** of data by establishing standards for the formatting of emissions disclosures and for the interoperability of data between reporting systems.
- **Improve accessibility and transparency** of data to enable collaborative partnerships, such as between academia and industry, and help industry customers make informed purchasing decisions.
- **Improve credibility and completeness** of emissions data to give investors and industry customers confidence.
- **Improve carbon traceability**, building on and maturing the existing carbon accounting ecosystem to make it easier for industry customers, and further down the supply chain, to quantify the carbon intensity of their products.

6.2 A Carbon Accounting Framework for a Low Carbon Economy

In this section, we highlight the key components required to develop a carbon accounting framework that enables the conditions required for industry to thrive in a low carbon economy. We focus on two areas that are essential to the effective delivery of a standardised carbon accounting framework:

- **Distributed digital systems** – supporting the comparability of emissions data and reducing the administrative burden on industry through the improved coordination of the distributed digital systems used to report emissions.
- **Governance and regulation** – ensuring adoption of standardised MRV practices through the introduction of a Carbon Regulator, and oversight of the different policy requirements to account for emissions to ensure they can be supported through a standardised approach.

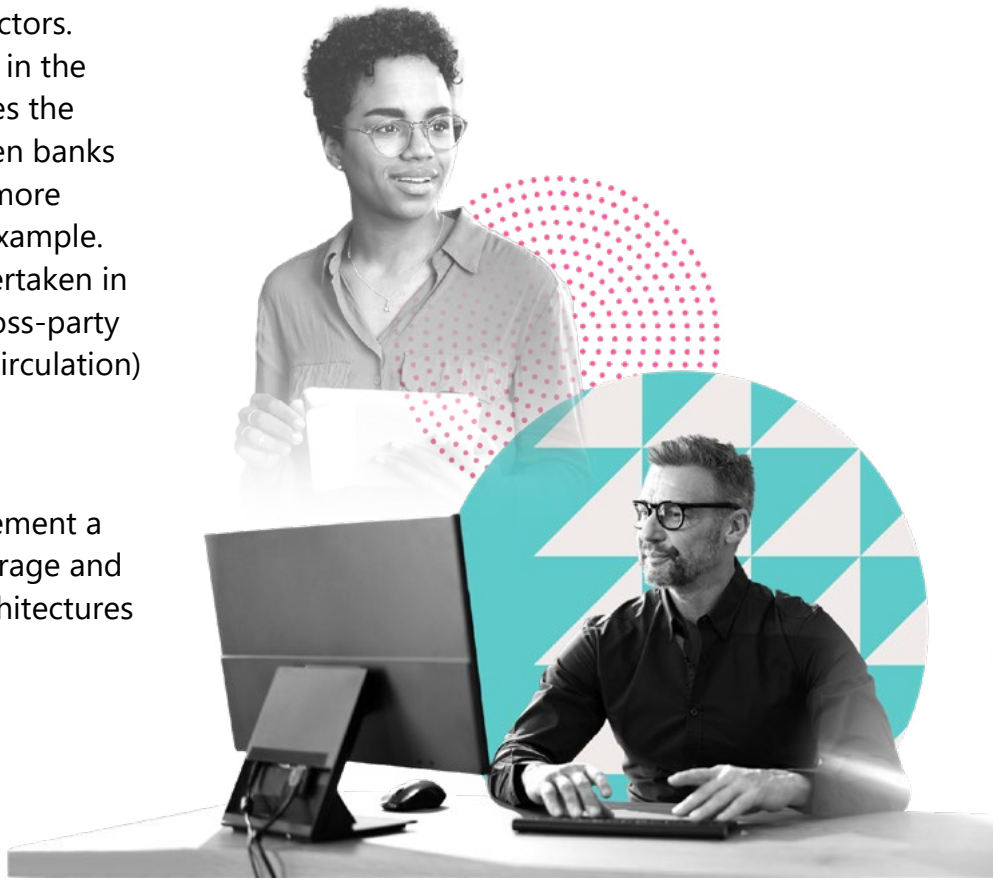
6.2.1 Distributed Digital Systems

The requirements on industry to report emissions will evolve over time with emerging stakeholder needs and new Government policies. It is unlikely that a single platform can be designed and managed in such a way that future use cases can continually be accounted for. To enable the exchange of higher resolution and more timely emissions data across industry, it is necessary to pursue an approach that is both more scalable and flexible in the long-term.

A carbon accounting framework can build on the lessons of initiatives to share data between organisations across sectors. The Open Banking[37] programme in the finance sector, which standardises the sharing of customer data between banks to enable account visibility and more efficient switching, is one such example. A similar approach is being undertaken in the energy sector to facilitate cross-party sharing of both shared (limited circulation) and open data.

These projects, and many others tackling similar challenges, implement a distributed approach to data storage and transfer, using more modern architectures and data sharing technologies.

This is done by decoupling the "generation" and "consumption" elements of the data pipeline into distinct data domains, so a more flexible and scalable system can be developed. Each domain is required to maintain the minimum amount data related to its core activities that enable onward uses. Ofgem's Data Best Practice Guidance[38] sets out a framework for good data management practices that are required to facilitate distributed data sharing, stipulating that data should be discoverable, addressable (a unique ID to enable repeated programmatic access), self-describing (well documented) and trustworthy (with published expectations and known issues).



[37] Open Banking. https://www.openbanking.org.uk/

[38] Ofgem (2021). Best Practice Guidance. https://www.ofgem.gov.uk/sites/default/files/2021-11/Data_Best_Practice_Guidance_v1.pdf

We propose that the following high-level principles are adhered to when scoping and designing the digital infrastructure that facilitates wider emissions data sharing:

- **Distributed data hosting** – emissions data that relates to the fundamental activities of an organisation should be maintained by the organisation and made available for onward consumption by any authorised parties. This ensures that a single source of truth is maintained and propagated.
- **'Pull' not 'push'** – data consumers (e.g. Government and industry customers) should pull data from all relevant sources at the point of need rather than prescribing routine submissions of bespoke data. This ensures that data consumers are able to implement their own processing techniques and enables a 'one-to-many' relationship between data generators and data consumers.
- **Coordinated governance** – acoherent approach to standards must be applied not only to the carbon accounting processes, but also the data requirements that facilitate them. Data requirements need to be streamlined and broken down to the 'lowest common denominators' to minimise the burden on data generators.

The UK Government launched a feasibility study[39] into the creation of a 'digital spine' to facilitate such a flexible and extensible data infrastructure. While still in early stages, this feasibility study is looking into the key technological and architectural choices, as well as the governance approach. The project is initially targeting energy sector specific use cases. The approach and implementation will address the same cross-sector data sharing challenges that underpin the carbon accounting data requirements.

[39] DESNZ (2022). Energy System 'Digital Spine' Feasibility Study. https://www.gov.uk/government/publications/energy-system-digital-spine-feasibility-study

Similarly, The Virtual Energy System (Alpha) project is an Ofgem funded technology project that is implementing a distributed, 'digital spine' based infrastructure as part of a cross-electricity network sharing programme. Given the overlap in these projects and relevance of the energy data to feed carbon accounting methodologies, a similar and cooperative approach should be adopted. Inspired by the Virtual Energy System work, we have set out an example of a distributed digital system's architecture that could help account for emissions across the life cycle of a product, while also supporting the MRV requirements of specific policy mechanisms (see Figure 5).

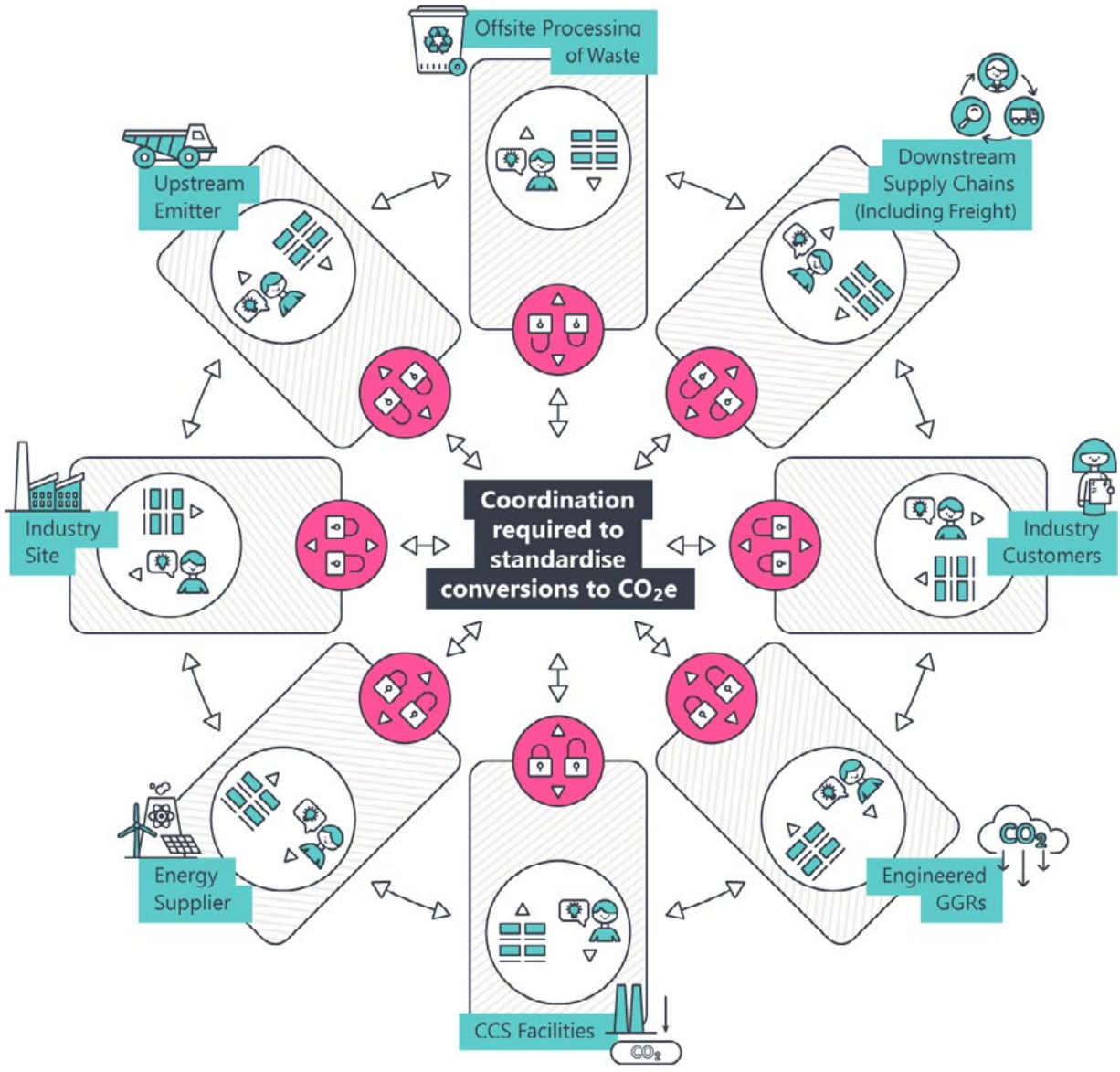


Figure 5. Example of how a distributed approach to data management could enable a more scalable, multi-directional transfer of information between key parties to support different carbon accounting requirements. Similar approaches are being pursued in the energy and finance sectors.

6.2.2 Governance and Regulation

Distributed and interoperable data systems will ensure a "single source of truth" and reduce the administrative burden. Coordination is required to mature the carbon accounting ecosystem and reduce the administrative burden on industry. Without effective coordination and extensive adoption, the development of any carbon accounting framework risks adding further complexity to already confusing space and undermining the objective of creating a more complete picture of emissions.

In our previous report[40], we recommended the decoupling of emissions MRV and carbon accounting practices in policy design. We demonstrated that existing MRV requirements have been driven by the needs of a particular policy mechanisms to account for emissions within different boundaries and over different timescales, which created an additional administrative burden on industry. Decoupling MRV from policy requirements enables a more consistent, accessible, and transparent picture of emissions at the national level, which is essential for quantifying the impact of carbon policies on decarbonisation in line with the Climate Change Act's legally binding Net Zero target[41].

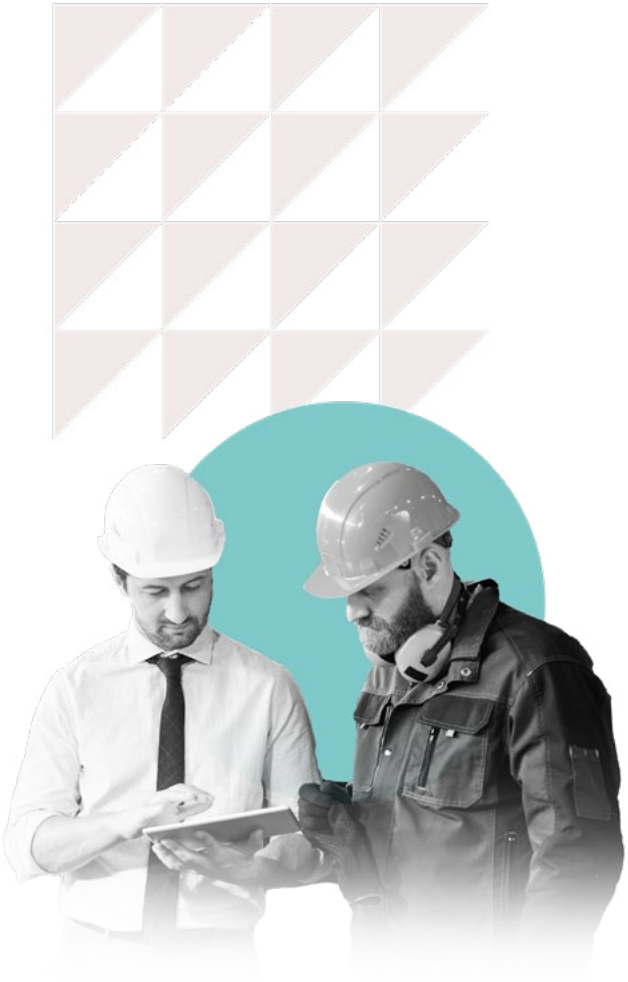
In this section, we set out the regulation required to standardise emissions MRV practices and the wider governance considerations required to enable policymakers to effectively support a carbon accounting framework that reduces the administrative burden on industry.

[40] Energy Systems Catapult (2022). Carbon Accounting in Industry: Learning from the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework. https://es.catapult.org.uk/report/carbon-accounting-in-industry/

[41] UK Legislation (2019). Climate Change Act. https://www.legislation.gov.uk/ukpga/2008/27/section/1

Standardisation of Emissions MRV

The standardisation of MRV must be mandatory or it will not be adopted at the scale required to mature the carbon accounting ecosystem. Government is best placed to coordinate the standardisation of emissions reporting and encourage widescale adoption; this would be best facilitated through the establishment of an independent body to provide regulatory oversight.



We have previously proposed the introduction of a Carbon Regulator to have economy-wide oversight over emissions MRV, and to ensure that carbon accounting approaches are coherent and consistent across the economy[42]. Regulation will provide a stable and credible carbon accounting framework that boosts investor confidence and clearly signals to industry and innovators that Government is committed to laying the groundwork necessary for a sustainable, low carbon economy.

The Carbon Regulator would be a public body with the authority to mandate emission MRV practices and coordinate the use of carbon standards economy-wide. Crucially, a Carbon Regulator would need to be independent of industry, and potentially Government, to ensure the needs and concerns of different stakeholders and industry sectors are equitably considered in the development of standardising practices. Industry stakeholders we interviewed were receptive to the idea of a Carbon Regulator, providing its independence could be assured.

[42] Energy Systems Catapult (2021). The Case for an Economy-Wide Carbon Regulator. https://es.catapult.org.uk/report/the-case-for-an-economy-wide-carbon-regulator/

We propose the following responsibilities for a Carbon Regulator to promote the standardisation of MRV practices:

- Coordinating reporting requirements for emissions disclosures required to deliver and support carbon policies, which are currently disparate.
- Introducing mandatory emissions disclosures, using the UK ETS as an anchoring policy for the standardisation of emissions disclosures (we set out this recommendation in more detail in our previous report[43]).
- Oversight of the digital architecture required to ensure the interoperability of emissions data from distributed reporting systems. This will likely involve setting standards and principles for the development of distributed digital systems used to support MRV and carbon accounting to meet different stakeholder needs.
- Certification of third-party verifiers required to ensure compliance with MRV standards and use of distributed digital systems.

Carbon Accounting to Support Policy Design

The standardisation of emissions MRV will enable Government to have a more complete picture of emissions at the national level to track progress towards Net Zero. Emissions data is also required to hold emitters accountable for the emissions within their control at different boundaries and over different timescales. In Section 5, we highlighted this accountability needs to be done in a way that both incentivises decarbonising activities and avoids constraining opportunities for innovation (e.g. new cross-sector partnerships to promote circular economy principles).

Some industry stakeholders told us they are concerned that further standardisation of carbon accounting practices could limit opportunities for cross-inventory boundary collaborations and encourage a one-sided "picture of emissions" that misses opportunities for innovation. Government will need to be sensitive to boundary constraints when using emissions data to support the design of policy incentives.

[43] Energy Systems Catapult (2022). Carbon Accounting in Industry: Learning from the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework. https://es.catapult.org.uk/report/carbon-accounting-in-industry/

There is no "one size fits all" approach that will meet all the requirements to account for emissions within different boundaries and levels. Some flexibility will be required to meet different objectives. The flexibility within current carbon accounting methodologies has not been well coordinated - leading to a complex and disjointed landscape with multiple points of emissions disclosures, ways of processing emissions data (and proxy measurements), and ways of accounting for this data.

A well-coordinated carbon accounting framework can promote standardising where it makes sense (e.g. at the point of emission disclosure), to enable flexibility to account for emissions without creating additional administrative burden. Improving the completeness and consistency of emissions reporting through standardisation provides the necessary foundations for a well-coordinated carbon accounting framework.

Effective coordination will be required to facilitate the standardisation of MRV can support different accounting requirements of policymakers and other stakeholders. This may require feasibility studies for individual sectors, building on existing best practice and promote international alignment where feasible.

Early engagement from across Government and industry will be essential to review existing carbon accounting standards and requirements, but there will also need to be long-term coordination to support new requirements as they arise. A Carbon Regulator would be best placed to provide this coordinating role in the long-term, for example, to support the inclusion of international dimensions for potential future policies such as a CBAM.

6.3 International Considerations

UK consumption-based emissions (including embodied emissions from imported goods) have not declined at the same pace as territorial emissions[44] and global GHG emissions have increased by 12% in the past decade[45]. For carbon policies to have a material effect on global emissions reduction, they should consider imported emissions.

A low carbon economy requires a fundamental decoupling of economic growth and GHG emissions on a global scale. This will only be possible with a concerted international effort to ensure emissions are fully traceable throughout global supply chains.

[44] WWF (2020). Carbon Footprint: Exploring the UK's Contribution to Climate Change. https://www.wwf.org.uk/sites/default/files/2020-04/FINAL-WWF-UK_Carbon_Footprint_Analysis_Report_March_2020%20%28003%29.pdf

[45] IPCC (2022). Climate Change 2022: Mitigation of Climate Change. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SummaryForPolicymakers.pdf

The existing carbon accounting landscape has not supported a transparent picture of global emissions or the traceability of emissions moving between international boundaries. The UK could play a leading role in improving the global transparency of emissions, demonstrating best practice through the adoption of a streamlined and standardised carbon accounting framework.

The international dimension of emissions reporting needs to be built into the framework from the outset. Considerations include:

- **Carbon accounting requirements can level the playing field for international competition.** Low carbon production could reveal new export markets, but for UK industry to compete on carbon intensity, similar international requirements are required to ensure fair competition.
- **Requirements on MRV must support comparability of emissions data** used and set by other countries and regions (e.g. EU's CBAM) to avoid additional administrative burden on industry engaging with these schemes.
- **Emissions are rarely confined to their attributed inventory boundaries.** Carbon accounting boundaries (i.e. an international cluster or state territory) are largely artificial, created to establish accountability for emitters. What emissions (i.e. Scope 1, 2, & 3 categories) are included within bounded carbon accounts should be transparent to avoid double counting or misinterpretation.
- **International standards require consensus from a wide range of stakeholders.** Some countries may be disadvantaged if they cannot access the same levels of investment or infrastructure, requiring concessions in how their emissions are reported. Greater flexibility may be necessary to ensure adoption of carbon accounting standards at the global scale, but this could limit the comparability and accuracy of accounts.

A carbon accounting framework designed to support the UK's transition to a low carbon economy should be adaptable to international carbon accounting developments. Decoupling emissions MRV from accounting practices can enable carbon accounting frameworks to adapt and align to global standards and practices with international partners as they mature.

The distributed data source and consumption architecture set out in Section 6.2.1 yields further benefits when considering how international emissions can be factored into reporting imported emissions and comparing the carbon intensity of international competitors. As data transfer interfaces and standards align, expanding to include international organisations is no more complex than adding a local supplier – this demonstrates the scalability advantage of a distributed data architecture.

6.4 Section Summary

Without enduring policy frameworks that support both the supply of, and demand for, low, zero, and negative carbon technologies and behaviour changes, the UK's decarbonisation targets will not be achieved. Stable and enduring policies that cover all key emitting economic sectors and reward investment and innovation in reducing emissions will be necessary[46].

A well-regulated, streamlined, and standardised carbon accounting framework that sustains the low carbon economy of the future must ensure GHG emissions are fully traceable and accountable economy wide. This transparency of emissions could play an important role in transforming our economy. In the short- to medium-term, industry, investors, and consumers will need additional tools and support to transition to Net Zero. Improving the completeness and consistency of emissions reporting through standardisation provides the necessary foundations for a well-coordinated carbon accounting framework.

We have highlighted the opportunity for a distributed digital system of carbon accounting, with a Carbon Regulator to ensure emissions data is comparable and accessible, to meet the needs of both Government and industry stakeholders.

Through the development of a carbon accounting framework, the UK could play a leading role in international efforts to ensure the traceability of emissions through global supply chains. Decoupling MRV requirements from policy mechanisms and other accounting requirements will ensure the carbon accounting framework is adaptable to future needs and scalable to support international coordination.

[46] For more details, see our back catalogue of Net Zero Carbon Policy work: https://es.catapult.org.uk/project/net-zero-carbon-policy/

7. Summary of Policy Recommendations

Carbon accounting, the standards and digitalisation that drive it, is fundamental to achieving industrial decarbonisation in line with Net Zero, as well as supporting economy-wide decarbonisation.

Now is the right time to establish a carbon accounting framework that supports the high level aims recognised in this report, and that works for both industry stakeholders and Government. We recommend that policymakers take the following actions to make such a framework a reality:

1. **Introduce a Carbon Regulator to provide effective coordination and adoption of a carbon accounting framework.** Its independence is crucial to ensure the long-term credibility and cross-sector consistency necessary for industrial decarbonisation and Net Zero. In addition, ensure that data governance is factored into carbon regulation and reporting requirements (e.g. utilise Ofgem's Data Best Practice Guidance to ensure that data is able to be shared cross-sector).
2. **Adopt a "disclose once" principle across a standardised carbon accounting framework.** A single point of disclosure reduces the administrative burden placed on industry and establishes a single source of truth. To allow for flexibility across different reporting requirements, improvements in the comparability of data, and cohesion of carbon policies, this approach needs to be supported by a distributed data system.
3. **Engage with the digital spine programme[47] and embark on the development of a distributed, scalable digital infrastructure to underpin emissions data exchange.**
4. **Fund feasibility studies to better understand how a standardised carbon accounting framework and distributed data system can be implemented across different industrial sectors,** followed by trials in key industrial sectors and their associated supply chains. This should eventually be extended to include other emitting sectors to establish an economy-wide framework.
5. **Work closely with international partners to maintain standardisation of accounting across international boundaries,** including in any future development of policies applied at the border used to mitigate carbon leakage.

[47] DESNZ (2022). Energy System 'Digital Spine' Feasibility Study. https://www.gov.uk/government/publications/energy-system-digital-spine-feasibility-study

8. Appendix

8.1 Glossary of Terms

Carbon Accounting	Carbon accounting refers to the processes used to measure and allocate greenhouse gases (GHG) emitted within a boundary – spatial (e.g. site-specific installation) and temporal (e.g. over a period of a year) – for the purposes of maintaining GHG inventories, producing corporate environmental reports, or calculating the carbon footprint of a product or service.
Carbon Leakage	Carbon leakage can occur if the competitiveness impacts that arise from carbon policies leads to emissions reduction from domestic firms combined with increases in emissions in other jurisdictions where carbon policy is either less ambitious or does not exist. This can lead to a net increase in global emissions.
Carbon Policy	Carbon policy is a shorthand term for all policies that require or incentivise action to reduce or remove greenhouse gas emissions, including pricing, regulation, subsidies, and standards. These can be combined with complementary policies, such as innovation support and access to finance, to form policy packages.
Carbon Standard	The term 'carbon standard' is used to encompass any regulation, standard, or policy mandate on an economic actor (e.g. a business or a household) to meet a decarbonisation requirement or metric. Examples include product or performance standards, regulatory targets, regulated obligations, or market rules.
Circular Economy	An economic system based on the reuse and regeneration of materials or products, especially as a means of continuing production in a more sustainable way.
Cost-Benefit Analysis (CBA)	A systematic process that businesses use to analyse which decisions to make and which to forgo.
Digital Spine	UK Government funded feasibility study in the development of a common data sharing architecture based on distributed data storage and access.

Digitalisation	Is the integration of digital technologies into a process, organisation, or system. For example, improved digitalisation can simplify emissions reporting and verification processes and increase transparency of emissions data.
Dispersed Sites	Industrial sites located outside of industrial clusters.
Economy-Wide Carbon Policy Framework	A framework that delivers incentives for emissions reduction across all major emitting sectors that are consistent with carbon targets, while achieving beneficial social and economic outcomes for all of society. Crucially, an economy-wide carbon policy framework can be created by combining sectoral policy packages and does not necessarily depend on implementing a single economy-wide carbon pricing or policy instrument, such as a carbon tax or an emissions trading system.
Foundation Industry	Industrial sectors producing metals, ceramics, glass, chemicals, paper, and cement.
Industrial Clusters	Places where geographically related industries have co-located.
Installation Level	An installation is a stationary technical unit where one or more activities under the scope of the European Union Emissions Trading Scheme (EU ETS) and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution.
Offshoring Industries	Relocation of business activities to a different country. Organisations may choose to do this in order to access lower labour costs or additional skills.
Onshoring Industries	Also known as reshoring, involves returning business activities to the organisations country of origin. Reasons for onshoring include developing a more resilient supply chain or reducing transport costs.
Scope 1 Emissions	Direct emissions from operations owned or controlled by the reporting company.

Scope 2 Emissions

Emissions from the generation of purchased electricity, steam, heating, or cooling for use in direct operations.

Scope 3 Emissions

All indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company and where companies might consider themselves to have influential control over.

Standards

A proposed way of doing things, with guidelines, criteria, and assumptions that aim to achieve the greatest degree of order to a given context. The use of standards is widespread in industry, ranging from process requirements to financial record keeping, with all organisations having followed some form of standard. Different types of standards:

- Voluntary, opted in, to give organisations credibility. Standards might also start out voluntary with compliance phased in over time.
- Outcome-based, to specify an objective.
- Prescriptive, to specify a process.
- Mandatory, with regulatory oversight
- Minimum requirement or baseline.
- Flexible, with advice and guidance.
- Aspirational, aiming towards a higher standard.

Whole Energy Systems Approach

A whole energy systems approach considers:

- How the entire system is controlled and shaped by policy, markets, and digital arrangements.
- All end users (e.g. households and businesses) of energy.
- All parts of the physical system that transforms primary energy (e.g. wind, solar, fuels) into usable energy or services.

A whole energy system approach also recognises specific sectoral challenges and seeks to address them.

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