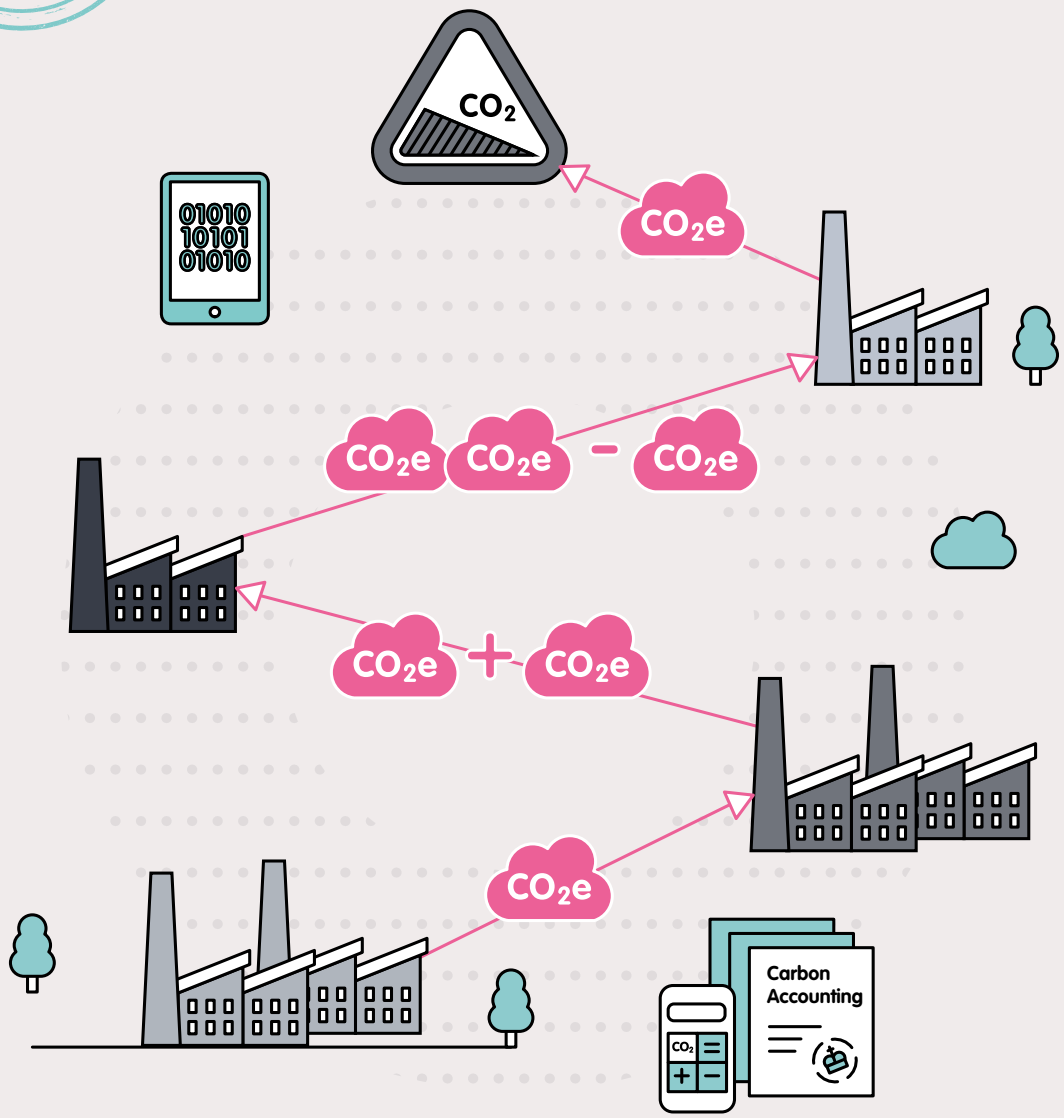
Net Zero Carbon Policy

CATAPULT Energy Systems



Carbon Accounting in Industry:

Learning From the South Wales Industrial Cluster to Develop a Consistent and Coherent National Framework

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.

Authors

Elle Butterworth, Energy Policy Advisor

Dr. Danial Sturge, Carbon Policy Practice Manager

Research Support

Dinesh Mattu, Energy Policy Advisor

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SOUTH WALES INDUSTRIAL CLUSTER PLAN

A PLAN FOR CLEAN GROWTH

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Providing feedback does not imply endorsement and the content of the report remains solely that of Energy Systems Catapult.

Executive Summary

In this report, we review options for policymakers to support a more consistent and coherent approach to the monitoring, reporting and verification (MRV) and accounting of greenhouse gas (GHG) emissions in industry.

As of 2021, industry made up 16% (72 Mt CO_2e) of total UK emissions. Tackling industrial emissions is integral to achieving the UK's Net Zero by 2050 target. To achieve the deep decarbonisation of industry and help industry support the decarbonisation of the whole energy system, it is important to develop a complete and quantifiable picture of industrial GHG emissions to support decision makers and track progress towards the UK's Net Zero target. And to do so in way that helps identify feedbacks and unintended consequences at different levels of the system.

We review a range of contexts (or 'decarbonisation mechanisms') where carbon accounting is (or should be) integral. These include carbon markets such as the UK Emissions Trading Scheme (ETS), carbon disclosures such as the UK Government's Streamlined Energy and Carbon Reporting (SECR), and the potential role for carbon standards such as a low carbon emissions standard for steel.

We highlight several inconsistencies in MRV methodologies used to support industrial decarbonisation. Such inconsistencies make it difficult to derive meaningful comparisons of emissions across industry sub-sectors, clusters, and regions. The inconsistencies also increase the administrative burden of reporting on industry and exposes mechanisms to unintended consequences, for example, the double counting of emissions.

We also highlight the lack of coherence and transparency in the way emissions data is reported. Often, only aggregated emissions data is available, for example, at the corporate level. This protects industry from exposing sensitive operational data, but means it is not always clear how emissions have been aggregated, the boundaries, and scopes of emissions covered, and at what stage offsets have been accounted for.

But blanket imposition of a single set of carbon accounting standards and definitions would not be feasible due to legitimate variations in the objectives and operation of different decarbonisation mechanisms.

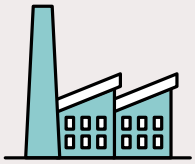
We propose **consistency in MRV** and a **carbon accounting framework for industry**. These would **simplify and strengthen the methodologies** used by industry in measuring and reporting emissions. The MRV and carbon accounting framework should be supported by a **digital exchange platform** to report and verify emissions, along with **regulatory oversight.**

A consistent and coherent carbon accounting framework for industry should be developed in a way that:

- **Encourages innovation** with policies that enable open and competitive markets that reveal the value of clean energy resources and technologies.
- **Understands business needs** with an emphasis on reducing the administrative burden of carbon policies where possible to ensure industry, particularly SMEs, can thrive in a low carbon economy.

- **Adopts a whole systems approach** using industry expertise to support economy-wide decarbonisation, facilitate regional partnerships, promote international best practice, and encourage reshoring of industry (whilst preventing further offshoring).

To achieve these outcomes, we propose developing a carbon accounting framework for industry that reduces the complexity and administrative burden of MRV and accounting to improve the coordination of mechanisms:



Installation Level MRV

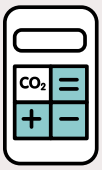
MRV at the installation level across industry.

Supported by expansion of the UK Emissions Trading Scheme and carbon standards.

Digitalisation

Simplify reporting and verification processes.

Increase transparency of emissions data.



Regulatory Oversight

Promote accounting principles.

Certify third party verifiers.

Keep across scientific evidence.

Industry Relevant Mechanisms

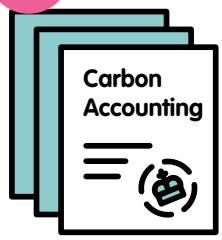
UK Emissions Trading Scheme as anchor for development of complementary mechanisms.

Enable collaboration and investment.

Recommendations for Policymakers

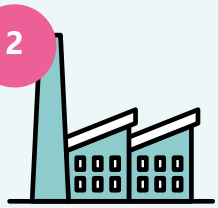
The following recommendations are intended to provide the overarching enablers for Government in developing a more consistent and coherent national carbon accounting framework for industry:

1



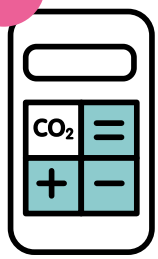
Commit to establishing a national carbon accounting framework for industry with Government providing steer to simplify and strengthen carbon accounting practices across industry. The UK Emissions Trading Scheme could act a starting point for this framework, targeting the MRV of emissions at the installation level with complementary mechanisms developed to consider supply chain emissions and opportunities for innovation as part of a whole systems approach to decarbonising industry and the wider economy.

2



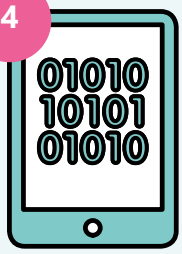
Fund industrial pathfinders that aim to develop an integrated carbon accounting framework for a chosen subset of industry sub-sectors and industrial clusters. This would act an important intermediate step towards developing an industry-wide framework, including understand the digitalisation tools required to support the transition.

3



To support carbon accounting in industry, explore establishing a Carbon MRV and Accounting Regulator. Such a body would be responsible for ensuring MRV is consistent and comparable across mechanisms, including mitigating double counting. Ensuring quantifiable emissions reduction occurs in line with Carbon Budgets and the Paris Agreement through supporting policymakers. This should build on (and extend) Government's commitment in the Net Zero Strategy to explore options for regulatory oversight to provide consistent MRV of greenhouse gas removals.

4



Improve digitalisation to simplify reporting and verification processes and increase transparency of emissions data for external decision makers. An open-source digital carbon accounting platform could facilitate data aggregation for regional and sub-sector emissions to help with tracking and decision making, while protecting sensitive company data. Such a platform could use emissions data already reported at the installation level via the UK ETS's reporting platform.

1. Introduction

The South Wales Industrial Cluster (SWIC) is a partnership between a diverse set of:

- Industry (including oil refining, paper, nickel, insulation, chemicals, LNG import, coin production, general manufacturing, steel, and cement),
- Energy generation and distribution,
- Infrastructure providers,
- Academia,
- Legal sector,
- Service providers, and
- Public sector organisations.

The 'South Wales Industrial Cluster – A Plan for a Clean Growth' project aims to develop a phased approach to decarbonisation for the region, in order to achieve Net Zero by 2040.[1]

Energy Systems Catapult (ESC) is leading on the national carbon accounting for industry deliverable, which builds on our Net Zero Carbon Policy thought leadership project[2], focusing on how the UK can develop an innovation-friendly, economy-wide policy framework for Net Zero.

This report builds on work delivered by ERM on carbon accounting in SWIC.[3] ERM collated information on a range of carbon accounting mechanisms used by industry stakeholders in South Wales. ESC built on this work and its engagement with Expert Advisors, to provide proposals for a national carbon accounting framework for industry.

Understanding how individual organisations within clusters currently account for carbon provides a useful starting point for working with Government to develop a more consistent and coherent framework, that better captures and considers the entire industrial supply chain.

There is also an opportunity for a carbon accounting framework to link with broader themes such as the role and remit of our previously proposed Carbon Regulator[4], which Government have committed to exploring in their Net Zero Strategy[5] for the purposes of providing oversight for greenhouse gas removals (GGRs).

With our whole systems approach, and through a combination of policy and engineering expertise, we intend to add to the state of the art in this space.

[1] South Wales Industrial Cluster. https://www.swic.cymru/

[2] ESC. Net Zero Carbon Policy. https://es.catapult.org.uk/project/net-zero-carbon-policy/

[3] ERM (2022). SWIC Carbon Accounting Summary Report.

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

[5] HM Government (2021). Net Zero Strategy: Build Back Greener. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf

In this report, we focus on the various approaches to monitoring, reporting, and verification (MRV) of emissions and carbon accounting mechanisms relevant to industry in the UK:

- Section 1 introduces the concept of emissions MRV and carbon accounting, and its importance in industrial decarbonisation.
- Section 2 describes the variations in carbon accounting methodologies.
- Section 3 describes the range of decarbonisation mechanisms used by UK industry where carbon accounting is integral to their function.
- Section 4 introduces carbon accounting principles and highlights the barriers and requirements to carbon accounting in industry.
- Section 5 lays out proposals to improve the consistency, accuracy, and transparency of carbon accounting in industry.
- Section 6 makes specific recommendations for policymakers that could enable the development of a more consistent and coherent carbon accounting framework.

1.1 What is Carbon Accounting?

Carbon accounting refers to the processes used to measure and allocate greenhouse gases (GHGs) 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. It is also crucial for the operation of policy mechanisms to incentivise decarbonisation, including market-based mechanisms such as the UK Emissions Trading Scheme (UK ETS).

To date, the application of carbon accounting across these uses has not led to the development of consistent definitions, protocols and/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.

Accounting for Greenhouse Gases

Throughout this report, we use the terms carbon accounting and decarbonisation mechanisms such as carbon markets, 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. Hence, whilst 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.

As scientific understanding of global warming impact increases, it may also be necessary to account for some GHGs separately (e.g. CH_4). Consistent and coherent MRV, supported by regulatory oversight, would still be needed in this instance.

1.2 What is MRV (Monitoring, Reporting, and Verification)?

We define decarbonisation mechanisms as falling under the umbrella term of 'carbon policy' (see Box below). For the purposes of this report, we refer to decarbonisation mechanisms in which emissions require quantification in order to operate. Carbon accounting involves allocating amounts of emissions within defined boundaries and scopes to achieve different objectives of decarbonisation mechanisms, for example, attributing emissions resulting from a site-specific installation to comply with GHG operator permits under the UK ETS. There also exists a feedback loop, whereby a wide range of existing mechanisms have steered current MRV guidance, which has resulted in an inconsistent approach across the sector. We review these in Section 2.

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.

At the heart of carbon accounting is the requirement for consistent and coherent MRV to ensure emissions are accurately accounted for and that methodologies support the aims of the specified decarbonisation mechanism.

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.

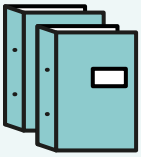
Reporting involves presenting data for the requirements of a decarbonisation mechanism. Reporting requirements may influence the emissions data monitored by industry and in some cases, there may be emissions that are monitored, but not transparently reported.

Verification involves validating the carbon accounts provided, ensuring they are accurate and robust, adhering to a set of predetermined accounting principles.

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

Monitoring

Monitoring emissions with variations in frequency and approaches used, for example, measured directly from a stack or proxied through energy use or by other metrics.



Reporting

Reporting of polluting activities with variations in accounting principles, reporting levels, accounting methodologies, scope of emissions covered and conversion calculations.

Verification

Verification of monitored and reported data with variations in compliance requirements, self-verification methods, and certification by accredited third-party verifiers.

Strengthening guidelines on MRV will be integral to ensuring a consistent and coherent carbon accounting framework for industry, which we discuss further in Section 5. Guidelines also need to ensure reporting accurate emissions data is balanced with the administrative burdens it could place on an organisation, in particular SMEs.

1.3 Why is Carbon Accounting Important for Industry?

For industrial decarbonisation, consistent and coherent MRV in decarbonisation mechanisms will be particularly important for:

- Accurately **reporting the reduction, atmospheric avoidance, and removal of carbon emissions** through energy efficiency and fuel switching, using carbon capture and storage (CCS) to abate industrial processes, or by using GGR approaches, such as bioenergy with carbon capture and storage (BECCS) or direct air carbon capture and storage (DACCS).
- Revealing credible **opportunities for low carbon investment,** inspiring investor confidence and helping industry remain internationally competitive in low carbon economies.
- Recognising **low carbon manufacturing** processes and products. For example, promoting a more circular economy, opportunities for low carbon exports and to support regional decarbonisation through the integration of waste products and energy.
- **Fuel switching, including biomass, hydrogen, and direct electrification,** which does not currently see carbon tracked across markets and supply chains at a granular level.

- Industry seeking to influence the decarbonisation of their supply chains, including opportunities to promote an agreed **global standard for carbon accounting in industry sub-sectors.**
- **Industrial clusters seeking a coordinated approach to tracking emissions** and progress towards placed-based emission targets.
- Ensuring **UK Government is able to track industrial emissions** to support policy design and implementation as part of its wider efforts for achieving Net Zero

As a result, there may also be opportunities to streamline existing reporting processes (e.g. Climate Change Agreements, Energy Savings Opportunity Scheme, and Emissions Trading Schemes) to reduce the associated administrative burden. We discuss this further in Section 5.

For trade exposed sectors, there is an additional incentive that carbon accounting is accurate (as far as possible) and globally consistent so that domestic industry is not placed at a competitive disadvantage with international competitors. The UK Government recently announced that it will consult later in the year on a range of carbon leakage mitigation options, including whether measures such as product standards and a carbon border adjustment mechanism (CBAM) could be appropriate tools in the UK's policy mix.[6] The EU recently adopted a carbon legislation package, which includes first steps to implementing a CBAM that will work in tandem with the EU ETS. The transitional phase is set to start in 2023, initially applying to imports of cement, iron and steel, aluminium, fertilisers, and electricity.[7]

[6] UK Parliament. Update on Carbon Leakage Mitigations. https://questions-statements.parliament.uk/written-statements/detail/2022-05-16/hcws26

[7] European Commission. Carbon Border Adjustment Mechanism: Questions and Answers. https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3661

2. Variations in Carbon Accounting

Carbon accounting supports the quantification of GHG emissions across a range of mechanisms used to support decarbonisation objectives. Practices differ in scope and approach owing to variations in business models, access to data, feasibility of monitoring, and the objectives of decarbonisation mechanisms requiring MRV.

In this section we highlight inconsistencies in carbon accounting methodologies that exacerbate the administrative burden for businesses and make decarbonisation mechanisms vulnerable to 'greenwashing'[8]. The complexity and flexibility of accounting methodologies has led to inconsistent MRV approaches required from compliance and voluntary decarbonisation mechanisms (covered in Section 3). We identify that some flexibility in accounting approaches will be essential to support innovative decarbonisation and encourage partnerships across sectors and regions. However, a delicate balance will need to be struck between consistency and flexibility that will require clear, industry-wide guidance.

Variations in MRV and carbon accounting approaches include:

- **Overarching methodologies** can be consequential or attributional (ex-ante or ex-post).
- **Operational levels** can be discretely reported or aggregated (e.g. project level, corporate level, national level).
- **Areas of responsibility** could be determined by equity share, operational or financial control.
- **Emissions coverage** ranges from direct emissions (Scope 1) to emissions from energy use (Scope 2) and throughout the supply chain (Scope 3).
- **Direct and proxy monitoring** with some direct monitoring more feasible for industry than other sectors (monitoring stack emissions is already required by the Environment Agency for some operators under the UK ETS).
- **Conversion calculations,** including use of emission factors for proxy monitoring and converting GHG emissions into CO_2e.
- **Reductions, removals, atmospheric avoidance, and offsets** and the stage at which they are accounted for.
- **Temporal and spatial boundaries,** especially for offsets, which do not always match attributed emission timescales.
- **Verification requirements** from self-verification to certified third party verification.

[8] 'Greenwashing' is where an organisation uses misleading tactics to appear 'greener' than they are. Scrutiny of greenwashing has intensified in the financial sector and Government has committed to imposing a Green Taxonomy on businesses to protect investors and insurers from greenwashing. However, there is no such blanket protection for decarbonisation mechanisms and industry participating in these schemes.

Accusations of greenwashing can harm the credibility of decarbonisation mechanisms and the reputation of businesses. If found to be true it could also reduce the accuracy of GHG inventories in tracking progress towards Net Zero.

2.1 Attributional and Consequential Carbon Accounting

At a high level, there are two main approaches to carbon accounting: consequential and attributional accounting. Their application depends on the intended objective of the MRV process.

Consequential accounting is a decision-making approach used when seeking to predict the impact of an intervention on GHG emissions to a counterfactual baseline, whereas attributional accounting relies on the measurement of actual emissions caused by polluting activities within a defined boundary.

In simple terms, consequential accounting is used to determine if the activity should take place (ex-ante) and attributional accounting is used when the emissions have already been emitted (ex-post).

The table below describes how different actors may use the two approaches:

Actor	Consequential	Attributional
Government	To assess the potential impact of policies, for example, the distributional impacts that could arise from a carbon price on imported goods and services.	To collate a national inventory of GHG emissions for previous years.
Industry & Sub-Sectors	To review the potential impact of industrial processes on emissions reduction investment choices.	To allocate emissions to a specific installation, for example, for reporting purposes under the UK ETS.
Businesses	To understand the emissions of business outputs, for example, the potential emissions resulting from a future product.	To allocate emissions to a specific corporate entity, for example, producing annual director reports.
Industrial Clusters & Regional Authorities	To support investment decisions for reducing emissions across organisational and regional boundaries.	To assess prior emissions reduction in previous year.

Both approaches have a place in promoting and incentivising decarbonisation, but they are often conflated when attempts are made to widen the coverage and functions of carbon accounting. For example, consequential methods may be incorporated into a bounded corporate level carbon disclosure to estimate downstream emissions that have been avoided by a process change.[9]

[9] Matthew Brander (2021). The Most Important GHG Accounting Concept You May Not Have Heard Of: The Attributional-Consequential Distinction. https://ghginstitute.org/2021/04/21/the-most-important-ghg-accounting-concept-you-may-not-have-heard-of-the-attributional-consequential-distinction/

The attributional approach is most appropriate for validating carbon accounts in market mechanisms such as the UK ETS, because reductions can be more accurately monitored when fixed within a boundary such as a site-specific installation. However, attributional methods are vulnerable to subjective decision making in allocating emissions where a system has more than a single output, for example, where waste or a by-product has potential for emissions reduction elsewhere (e.g. waste heat used in district heating).

For the purposes of this report and carbon accounting in industry, our focus is on attributional accounting.

2.2 Reporting Parameters

In quantifying GHG emissions, several parameters are set to determine which emitting activities should be included. These parameters can be set by guidance in decarbonisation mechanisms, but it is often up to businesses to determine parameters relevant to their business model. These include:

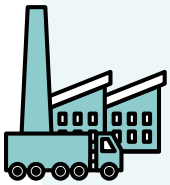
- Operational levels.
- Equity and share control.
- Emissions coverage.
- Spatial and temporal boundaries.

2.2.1 Operational Levels

There are various operation levels where GHG emissions can be accounted for:

- National level, such as the UK GHG inventory.
- Corporate level for reporting companywide emissions to investors and shareholders.
- Project level to report emissions avoided or reduced by a particular project.
- Product level where the embodied emissions (see box below10) of a product might be accounted for.
- Site-specific installations where direct emissions might be monitored for compliance purposes.

[10] UCL. Embodied Carbon: Fact Sheet. https://www.ucl.ac.uk/engineering-exchange/sites/engineering-exchange/files/fact-sheet-embodied-carbon-social-housing.pdf



Embodied Emissions

Embodied carbon includes all emissions associated with the production of goods. It is estimated from the energy used to extract and transport raw materials and emissions from manufacturing processes. Whereas "Consumption Emissions" usually include disposal and usage emissions of products. The measurement and reporting of embodied emissions will be important for future policies implemented at the border on imported goods (steel, cement, cars), for example, product standards or a carbon border adjustment mechanism (CBAM).

Installation Level Reporting

For industry, mandatory Government reporting requirements typically focus on direct emissions from controlled operations in specific geographical jurisdictions. For example, facilities covered by the Integrated Pollution and Prevention Control (IPPC) Directive in Europe must report emissions exceeding a specified threshold for GHGs covered under the Kyoto Protocol, these reports are then published in the publicly accessible European Pollutant Emissions Register (EPER).

The primary driver for reporting in UK industry comes from requirements under the UK ETS, which targets site-specific installations. Site-specific installations in industry are more physically bounded and, therefore, support the use accounting methods to monitor stack emissions and metered polluting activities.

In Section 4 and 5 we make the case for simplifying MRV requirements for industry down to the installation level and using site-based emissions data to improve the transparency of emissions across different levels of the energy system, such as at the regional level and for national policymakers to develop targeted carbon policies.

We define the installation level in accordance with Article 3(e) of the EU ETS Directive: "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."

Cluster and Regional Level Reporting

Currently, there is limited transparency of regional economy-wide and industrial cluster-wide emissions. The variation in carbon accounting methodologies, including where offsets (see Section 2.3) are accounted make regional and industrial cluster comparisons difficult.

Improved transparency of GHG emissions at the regional level could help Local and Regional Authorities consider opportunities for local industry to support low carbon economic growth. This could also extend to better integrate industry into Local Area Energy Planning, as suggested in our recent report on the Strategic Role for Industrial Clusters[11].

[11] 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/

2.2.2 Equity Share and Control

Companies may choose to account for emissions they are responsible for in terms of 'equity share' or in the areas that they have 'operational' or 'financial control'.

An equity share approach would allocate a share of emissions from an installation depending on the percentage of ownership, whereas control methodologies may be applied where a company is deemed to have full control either operationally or financially[12].

The relevance of each of these methodologies varies by sector. Industry is more likely to have direct operational control over their installations (within the confines of legislation and competitiveness considerations). The majority of industry in SWIC consulted by ERM use an operational control methodology.

Larger multi-national corporations or companies with several subsidiaries and subsidiary partners may decide to adopt a financial control or equity share methodology if they do not necessarily have direct operational control, but do exercise high levels of influence through shared ownership or investments.

The challenge with such variation is that published corporate level reports cannot be used to make comparisons of emissions reductions by a sector or region, because more than one company could be accounting for the same asset (one with operational control and one with financial control). Mechanisms lacking robust verification processes may also be open to abuse from these subjective reporting boundaries.

2.2.3 Emissions Coverage

A wide range of direct and indirect emissions can be included in carbon accounts. A typology of emissions coverage that has gained international popularity among institutions producing carbon accounting standards, such as the GHG Protocol, is to talk in terms of Scope 1, 2 and 3 emissions (see Table 1).

The inconsistencies in reporting scopes largely exist at the corporate reporting level and under voluntary mechanisms with limited guidance and verification. Compliance-based mechanisms targeting industry, such as the UK ETS, target emissions that can be attributed to a site-specific installation.

[12] World Resources Institute and World Business Council for Sustainable Development (2004). The Greenhouse Gas Protocol. http://pdf.wri.org/ghg_protocol_2004.pdf

Table 1 Summary of the classifications, coverage, and definitions of the GHG Protocol's three scopes.

Scope	Emission Type	Definition	Example
Scope 1	Direct	Direct emissions from operations owned or controlled by the reporting company.	Industrial process emissions from cement production. Where direct measurement is not practical, Scope 1 emissions can be 'estimated' based on an accessible metric of activity (such as tonnes of coal used, or km travelled).
Scope 2	Indirect	Emissions from the generation of purchased electricity, steam, heating, or cooling for use in direct operations.	A steel manufacturer buys 50 MW of electricity and converts said energy consumption into units of CO2 or CO2e based on GHG inventory conversion factors.
Scope 3	Indirect	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.	'Upstream' such as supply chain emissions from products purchased for use by the company. 'Downstream' emissions resulting from operational decisions such as the recyclability of materials or provisions made for employee's commuting to work.

Most global standards on corporate carbon reporting now include guidance for the incorporation of Scope 3 categories, but it is up to the company to determine which categories it includes. This may be influenced by the availability of data or the relevance of the categories to the company's business model. Categories such as business travel are easier to track compared with predicting what might happen to a product at the end of its life.

The inclusion of indirect emissions risks the double counting of carbon, which can be a particular problem for the credibility of market-based mechanisms.

In theory, if all sectors of the UK economy were required to report their Scope 1 emissions for participation in compliance-based market mechanisms, such as the UK ETS, territorial Scope 2 and 3 emissions would be covered as a result. Additional carbon policies, such as border standards, would still be needed to influence global decarbonation and consider Scope 3 emissions from outside the measurement boundary, such as imported goods and services.

2.2.4 Spatial and Temporal Boundaries

The variation in reporting approaches means carbon is currently allocated over several different timescales and geographical boundaries, elevating the risk of accounting overlaps (double counting) if such reports are used as the basis for offsetting polluting activities and allocating carbon credits.

Spatial considerations can include the geographies or elements of the supply chain in which carbon is attributed to for accounting purposes. Spatial boundaries that extend between jurisdictions will also become increasingly important as industry seeks to tackle Scope 3 emissions resulting from imported goods and services.

The time over which carbon is attributed for accounting purposes varies from monthly allocation to 5-yearly allocation. Biological carbon cycles, such as in afforestation schemes, may function over longer timeframes than can be attributed to annual carbon accounts.

Much of the spatial and temporal complexity and inconsistency in carbon accounting is caused by an existing reliance on difficult to verify offsets in aggregated carbon reporting. For example, decisions around where and when to account for an afforestation scheme that may not reach maturity for several years.

2.3 Accounting for Carbon Avoidance, Reductions, Removals, and Offsets

The area of carbon accounting covering carbon avoidance, reductions, removals, and offsets is the least well established and open to the most potential for controversary. It will, however, be of critical importance for enabling achievement of emissions reduction goals for industrial sectors and processes where abatement is particularly difficult or costly.

The table below defines three main decarbonisation approaches that may be accounted for within carbon accounting:

Approach	Definition	Examples
GHG Reduction	Activities that improve the efficiency of an emitting process and, therefore, reduce emissions. Most relevant for consequential accounting and strategic decision making.	Energy efficiencies, use of combined heat and power, or reduction of materials used. Electrification or fuel switching to low carbon vectors.
Atmospheric Avoidance	Activities that prevent carbon from being emitted into the atmosphere that would have otherwise occurred in a business-as-usual scenario.	Carbon capture and storage (CCS), where the emitted carbon is captured and stored e.g. underground, preventing the carbon from entering the atmosphere.
GHG Removal (GGR)	Activities that remove carbon out of the atmosphere and store them either temporally or permanently.	Direct air capture and storage (DACCS) or the use of Bioenergy with CCS (BECCS), where biomass absorbs carbon from the atmosphere before being used as fuel and the carbon recaptured and stored.

The options to reduce, avoid, or remove GHG emissions vary by sector. Some of these approaches depend on emerging technologies (e.g. CCUS, DACC) that are yet to reach a market readiness level to make them accessible to most sectors. However, industry is uniquely positioned to take early advantage of some of these technologies.

GHG Offsets

Businesses may choose to directly decarbonise, for example through fuel switching, CCUS or improvements in energy efficiency. Alternatively, businesses may choose to 'offset' their emissions by purchasing the right to emit an amount of GHG matched by an offset credit. Offset credits are provided by other organisations who have completed projects that avoid or remove GHGs. Like carbon credits, offset credits can be traded in market-based mechanisms.

In industry, offsetting is generally approached within individual project activities, offsets are then aggregated in corporate level reports, though associated timescales can vary. Alternatively, companies may choose to offset a portion of their total corporate emissions at the end of a reporting timeframe – such as an annual report.

Offsets raise challenges for carbon accounting, particularly at aggregated reporting levels, including:

- Ensuring accurate verification (e.g. additionality) with transparent reporting of net and gross emissions.
- Attributing credits to the appropriate entity to prevent double counting.
- Ensuring incentives that encourage offsetting are driving genuine overall emissions reduction.

The Clean Development Mechanism (CDM) (see Section 3.2) developed under the Kyoto Protocol first introduced the use of offsets globally.

2.4 Emissions Factors

The process of measuring direct stack emissions and other point source emissions may be well established in some industry sub-sectors, but it is not always practical for all GHG emissions to be measured directly.

Companies may instead monitor activity-specific data, such as the amount of coke used in steelmaking and apply a conversion calculation to monitor associated emissions. The conversion of monitored activity data into emissions data is standard practice across carbon accounting mechanisms and reporting guidelines. But there is some variation in the activities monitored and the emissions factors used.

For the UK ETS, a simplified monitoring process has been adopted for certain polluting activities using emission conversion factors based on the UK's GHG inventory. This means companies might monitor their emissions through a combination of direct analysis of site-specific emission activities and estimated emissions determined by the national GHG inventory for other fuel uses and industrial processes.

Most published emissions inventories for conversions, such as the UK GHG Inventory, are location-specific and should not be used to calculate conversions beyond their defined geographical coverage. A 2017 review of the UK GHG inventory found it to have a high level of accuracy in most areas (except land use where there are known issues).[13] However, ensuring the accuracy and credibility of conversion calculations internationally will be important for the monitoring of international supply chains and to support international carbon markets.

Reporting in Carbon Equivalent (CO_2e)

For accounting purposes, GHG emissions can be converted into terms of carbon dioxide equivalent (CO_2e) using Global Warming Potential.

Conversions are based off complex calculations that determine the Global Warming Potential (GWP) of each GHG over a specified timeframe, most commonly 100 years. GWP-100 is by no means perfect, for example, it can deflate the effects of CH_4 which has a higher, short-term GWP.

Organisations may exclude certain GHGs from disclosed CO_2e calculations, though these decisions are not always transparent. Some mechanisms require the discrete reporting of CO_2 (e.g. the UK ETS).

As the scientific community improves its understanding of GWPs, it may be necessary to facilitate the separate accounting and trading of CH_4, for example.

2.5 Verification

While the responsibility of verification sits with the emitters, it is set by the regulators of the respective decarbonisation mechanisms and delivered by accredited third-party verifiers.

The role of a third-party verifier is to independently check the contents of emissions reports to ensure accounts are credible. However, there are variations to the ways in which companies validate and verify their reporting. Some decarbonisation mechanisms support self-verification and others have stringent accreditation processes that verifiers must go through.

The inclusion of Scope 3 emissions in several voluntary mechanisms makes it much more challenging to verify emissions accurately, particularly where data exists, but is unreliable or based on average industry data.

Having verifiable empirical data can help manage reputational risk and enable investor confidence. However, organisations often indicate that engaging with verification processes, bodies, and standards is costly, administratively challenging, and time consuming.[14] Verification processes are not well aligned and streamlined across the various mechanisms industry are required to report to.

[13] CCC (2017). Quantifying Greenhouse Gas Emissions. https://www.theccc.org.uk/publication/quantifying-greenhouse-gas-emissions/

Verification Example: Energy Savings Opportunity Scheme (ESOS)

ESOS is a mandatory energy assessment scheme for organisations in the UK, which aims to support energy efficiency, by raising awareness of energy management and proposing opportunities for energy saving measures.

The ESOS scheme is verified through mandatory energy audits every 4 years by an ESOS auditor, who surveys an organisation's data then provides relevant recommendations on energy saving options. Like the Climate Change Agreement (CCA) mechanism and the UK ETS, the monitoring and reporting for the scheme is overseen and enforced by the Environment Agency, but the mechanisms have different verification processes.

The 4-yearly verification cycle of the ESOS does not lend itself well to continual monitoring and reporting or align to other mechanisms. In a recent consultation, BEIS sought views on Phase 3 of the mechanism, drawing up proposals on how to improve the scheme including align it with the Streamlined Energy and Carbon Reporting (SECR) mechanism.

[14] ERM (2022). SWIC Carbon Accounting Summary Report.

3. Carbon Accounting in Decarbonisation Mechanisms

Decarbonisation mechanisms are designed to incentivise industry and consumers to reduce emissions by quantifying their emissions and emphasising accountability. Carbon accounting is, therefore, integral to the function of decarbonisation mechanisms.

Decarbonisation mechanisms can also improve the transparency of polluting activities and can be used to increase the cost of emitting GHGs to drive investment in cleaner alternatives. However, the wide range of voluntary and compliance-based mechanisms available has led to inconsistencies in carbon accounting methodologies used, limiting the overall transparency of GHG emissions.

In this section, we consider three main types of decarbonisation mechanisms relevant to industry where carbon accounting is either already an integral component, or could be strengthened to improve the measurability of a mechanism's outcome:

Carbon Disclosures

- Requires companies to disclose emissions from polluting activities to a regulatory body or relevant stakeholders (e.g. Director's Reports).
- Includes reporting of emissions to meet contractual obligations and demonstrate commitment (e.g. SECR).
- May be used to develop aggregated emissions inventories (e.g. GHG inventory) or to verify financial investments (e.g. CDP).

Carbon Markets

- Option to buy carbon credits to offset polluting activities.
- Mix of voluntary and compliance-based markets.
- Price of carbon can be regulated by capping the number of emissions available to trade (e.g. UK ETS).

Carbon Standards

- Product and material standards that might set requirements on embodied carbon.
- Operational standards to guide industrial processes (e.g. for CCUS).
- Border standards to account for imported carbon in international supply chains.

Decarbonisation mechanisms aim to influence behaviour in industry and other sectors through financial considerations. Drivers include financial considerations (investment opportunities and financial risk), company reputation, and meeting regulatory compliance requirements.

As an energy and carbon intensive sector, Government have implemented a range of decarbonisation mechanisms and other financial incentives targeting the sector.

Industry has also been required to adopt more stringent compliance-based mechanisms such as operator permits required for the UK ETS. This compliance focus has already encouraged some MRV alignment and puts industry in a good position to adopt a more consistent sector-wide carbon accounting framework.

3.1 Disclosure-Based Mechanisms

Disclosure-based mechanisms encourage decarbonisation by increasing the visibility of polluting activities (see Table 2 for a summary of examples).

Compliance driven disclosure mechanisms include the UK Government's requirement for companies to report under the Streamlined Energy and Carbon Reporting (SECR) mechanism. In addition, the Companies Act 2006 was updated in 2013 to require companies to disclose their GHG emissions in the Director's report for the financial year. Most companies use internationally recognised carbon accounting standards such as the GHG Protocol to produce annual reports, selecting elements of guidelines deemed most relevant to their business model.

There are also voluntary schemes either supported by or independent from Government, including international schemes such as the Carbon Disclosures Project (CDP), which helps inform financial investment decisions. For industry, there may also be sub-sector-specific mechanisms such as voluntary disclosures to the World Steel Association.

Disclosure mechanisms can also require the reporting of emissions in support of contractual obligations to reduce emissions, which may be encouraged through financial incentives such as Climate Change Agreements (CCAs) where operators receive a discount on the Climate Change Levy, a tax added to electricity and fuel bills, in return for agreements to reduce energy use and CO_2 emissions.

Companies may also choose to demonstrate their climate ambitions and progress through disclosure-based mechanisms. Reputation may be more of a driver for some companies than others, so engagement in these voluntary mechanisms vary. There have also been accusations of 'greenwashing' suggesting voluntary scoring mechanisms could benefit from a more robust MRV process.

Some mechanisms provide scores that can be published by companies, promoting competition across industry sectors, such as through CDP (see Box below). Scores may be required by potential investors so there may be an additional financial incentive to participating in some of these schemes.

CDP (formally known as Carbon Disclosure Project)

CDP is a global disclosure mechanism. Companies are usually asked to disclose to CDP by customers and investors, suggesting it has a credible reputation in the global marketplace. The CDP database can be searched for companies that are scored on areas such as water security and climate change. Companies report to the CDP through an online response system. Third party verification must be completed in accordance with recognised standards such as ISO 14064-3. Given the international scope and varying geographic and sectoral boundaries of CDP, there are several verification standards that are acceptable within the framework including sector-specific guidelines for industry.

The current disclosure-based mechanisms provide some flexibility for industry in their emissions reporting, but there is variation in reporting requirements. Because most of these mechanisms are voluntary (or compliance-based with MRV flexibility), industry may be selective in which mechanisms it adopts to reduce the administrative burden of carbon disclosures. The administrative burden of making multiple disclosures may also prevent smaller companies from being able to access the financial incentives and investment available to them.

Table 2 Summary of disclosure-based mechanisms examples relevant to industry.

Disclosure-Based Mechanism	Objective	Disclosure Requirements	MRV Guidance
UK Government SECR	Aims to encourage energy efficiency and GHG reduction. Economy-wide with targeted requirements for quoted (publicly listed) and large companies. The same companies are already required to monitor GHG emissions as part of Mandatory GHG Reporting since 2013. Smaller companies encouraged to report voluntarily.	Varies for quoted and large companies. More robust disclosure requirements for quoted companies, including global energy use and derived emissions. Quoted and large companies required to disclose energy efficiency steps taken and the methodology used in calculations.	Varies with some sector-specific guidance documentation and some flexibility to suit different business models. Parent-level reporting required, though some exempt subsidiaries can be excluded. Methodology must be disclosed, but does not need to be independently verified.

Science Based Targets initiative (SBTi)	Aims to provide businesses with defined pathways to reduce their GHG emissions by setting 'science based' targets – in line with the latest climate science.	Companies that partake 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-term and long-term targets.	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 and agriculture, and steel.
CCA	Aims to encourage uptake of energy efficiency measures for companies to reduce the amount of CCL they pay.	Companies are required to report energy use and carbon emissions from eligible processes, such as energy intensive processes in manufacturing.	Annual reporting required that must meet an energy saving target measured at every two-year target period. Audits are carried out each year on selected operators to verify eligibility and performance.
ESOS	Aims to ensure that large UK companies are energy efficient, by raising awareness of energy management and proposing opportunities for energy saving measures.	Focused on large private companies with more than 250 employees, or a turnover greater than €50 m and balance sheet greater than €43 m who are required to show the energy supplied and consumed by their organisations through mandatory energy audits.	Total energy consumption monitored in energy use (kWh) or spend (£). Reported annually using 12 consecutive month's data. Verified through mandatory energy audits every four years by an ESOS assessor.
CDP	Aims to help companies, cities, regions, and states with disclosing their environmental impact and measuring and managing risks and opportunities on climate change, water security, and deforestation.	Companies are required to collect data on environmental impact and report emissions in CO_2e or by other metrics (e.g. revenue) via an online system.	CDP requires verification to be completed in accordance with recognised verification standards through an accredited third-party external organisation.

3.2 Market-Based Mechanisms

The importance of consistent, accurate, and transparent carbon accounting has become increasingly apparent in recent decades as more countries and organisations participate in market-based incentives to reduce their GHG emissions.

State sponsored market-based mechanisms for decarbonisation were promoted by the Kyoto protocol, which came into force in 2005. The protocol committed signatories to reduce greenhouse gas emissions and included three market-based mechanisms to support this aim:

- Clean Development Mechanisms (CDMs) – where countries with targets might 'offset' emissions by investing in carbon reduction projects in developing countries.
- Joint Implementation (JI) Mechanisms – like CDMs, but both countries must have carbon reduction targets.
- Emissions Trading (or 'Cap-and-Trade') – whereby an upper limit of emissions – the 'cap' – is set for all participating installations and reduced over time so that total emissions fall, thereby providing a long-term market signal for participants to trade in the scheme.

For carbon intensive industry, the most relevant of these market mechanisms are emissions trading schemes. Globally, there are currently forty-eight emission trading schemes that are either in force, under development, or under consideration.[15]

GHG considerations for market-based mechanisms

Unlike many disclosure-based mechanisms which report in CO_2e, GHG emissions data included in market-based mechanisms vary. For example, the UK ETS covers CO_2, N_2O and PFCs. While CH_4 is not currently incorporated into the UK ETS – but it is under consideration by Government – recent scientific reports paint a concerning picture for methane (CH_4) contribution to global warming feedbacks.

The UK Emissions Trading Scheme (UK ETS)

The UK ETS is a key policy for achieving the UK's target of reaching Net Zero emissions by 2050. It entered into operation on 1 January 2021, following the UK's departure from the European Union's Emissions Trading Scheme (EU ETS).

The UK ETS, a cap-and-trade scheme, is a market- rather than taxation-based pricing mechanism, to incentivise and control the reduction of emissions in a cost-effective way. The UK ETS currently covers electricity generation, heavy industry, and domestic aviation – approximately a third of UK territorial emissions. Under the 'cap and trade' principle, an upper limit of emissions – the cap – is set for all participating installations, which is reduced over time so that total emissions fall, thereby providing a long-term market signal.

Allowances are created for each tonne of CO_2 permitted to be emitted within the system. The total number of allowances released corresponds to the emissions cap and each installation

[15] ICAP. ETS Map. https://icapcarbonaction.com/en/ets

covered by the system must acquire allowances equal to what it emits. Allowances within the system are either auctioned off or allocated for free (provided to trade exposed industry and airline operators[16]). Trading of allowances between parties can occur on the secondary market (once allowances have been released through auction and free allocation), for example, if an installation exceeds or outperforms its limit or via third parties that own allowances, revealing a market price for carbon across traded sectors. If the demand for allowances rises, then so does their price, such that all abatement cheaper than the allowance price is incentivised, which in theory should be sufficient to ensure that the allowance cap is met with the cheapest abatement within the system.

MRV requirements and process currently match those of the EU ETS, with the obligation remaining at the point of emission. Emissions are self-reported by operators on an annual basis, supported by independent third-party verification processes (see Figure 1), with the Environment Agency as Registry Administrator of the UK ETS.

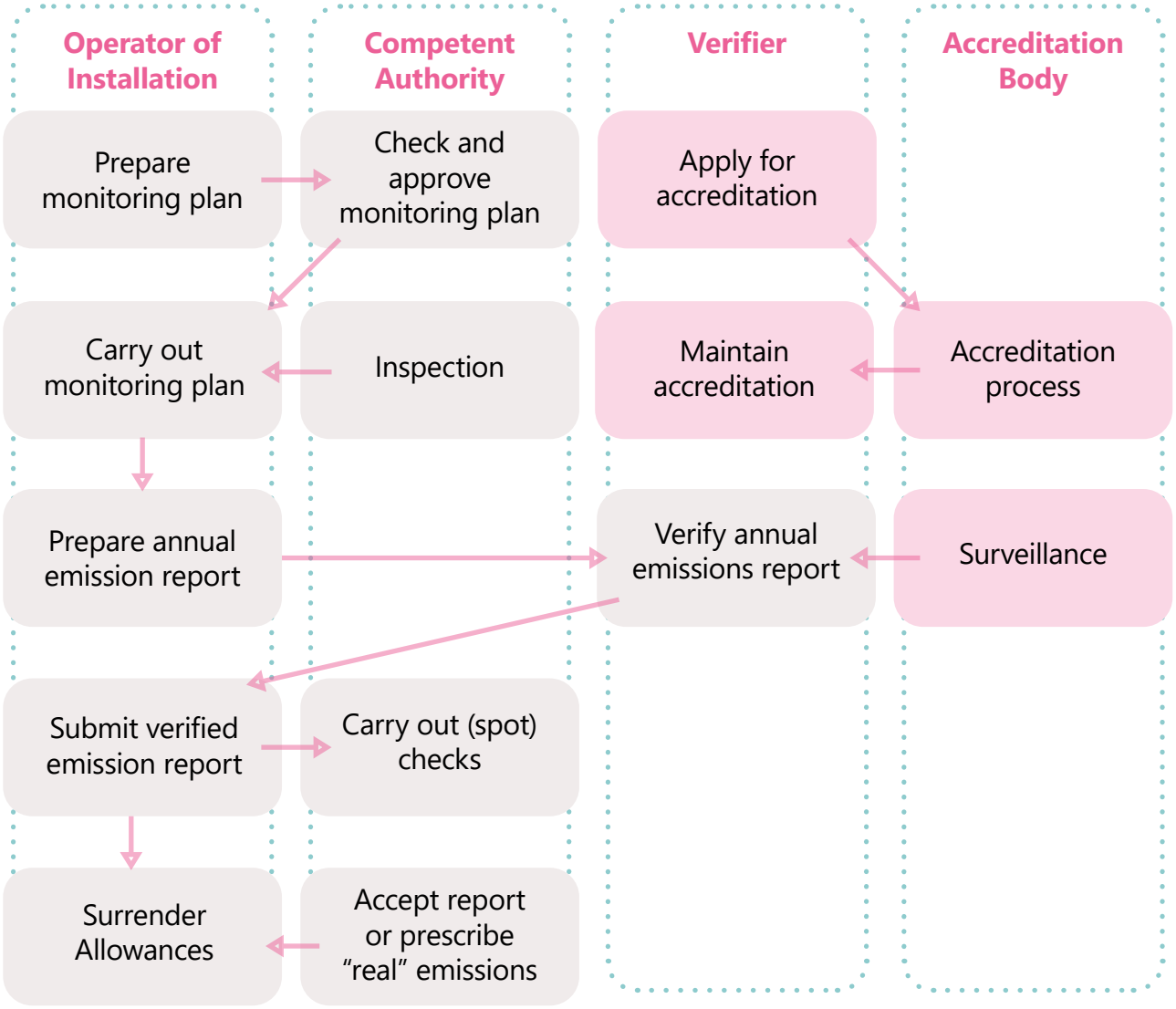


Figure 1 An overview of the roles and responsibilities of the main actors in the EU ETS.[17]

[16] BEIS (2022). UK ETS Allocation Table for the 2021 to 2025 Allocation Period. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1076560/uk-ets-allocation-table-may-2022.csv/preview

[17] European Commission (2012). Guidance Document: The Monitoring and Report Regulation – General Guidance for Installations.

Coherent MRV and consistent accounting approaches will be essential for credible carbon trading between sectors and internationally. Ambitious jurisdictions, such as New Zealand, have attempted to include all major emitting sectors including agriculture into their ETS, but administrative complexity has resulted in a mix of obligated and voluntary participants, with different levels of emissions reporting required.[18]

Accurate MRV has important implications for mitigating carbon leakage and competitiveness impacts. We have previously recommended the free allowance allocation methodology is improved and free allowances are phased down over time, as other policies are introduced to mitigate investment and carbon leakage. [19]

Options include introducing a Carbon Border Adjustment Mechanism (CBAM), which places an equivalent carbon price on imported goods. However, CBAMs are largely untested so there is uncertainty around their effectiveness. Another option is to introduce border carbon standards, which are likely to have a better chance of success in the near-term. Both options will require coherent MRV and regulatory oversight to ensure policies are linked effectively.

3.3 Voluntary Market-Based Mechanisms

In addition to compliance-based market mechanisms such as the UK ETS, there are a range of voluntary-based mechanisms in use by industry and other sectors. Many businesses have their own internal ambitious targets to reach Net Zero, and in some cases net negative, on timelines that outpace their abatement ability. It is often the case that such businesses do not trade in compliance carbon markets, such as the UK ETS. Therefore, voluntary carbon markets provide the flexibility in meeting these targets that would otherwise be out of reach.

Voluntary market mechanisms are driven by states, companies, or individuals that take responsibility for their own emissions or planning for future unavoidable emissions. Examples of these markets are listed in Table 3.

Table 3 Summary of voluntary mechanisms examples relevant to industry.

Voluntary Market Mechanism	Overview	Requirements
Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)	A global marked-based mechanism that aims to stabilise international civil aviation net CO_2 emissions at 2019 levels by using offsets. Participation is voluntary for the first two phases (2021-2023 and 2024-2027). Offsetting is not intended as an alternative to new technology, but as part of a suite of measures to stabilise and reduce emissions.	To quantify the GHG reduction benefits from an offsetting project, a baseline must be determined to represent what would have happened if the project had not been implemented. Emissions reductions will need to be quantified using accurate measurements, valid protocols, and be independently audited.

[18] ESC (2021). Developing Carbon Credits Markets. https://es.catapult.org.uk/report/developing-carbon-credit-markets/

[19] ESC (2020). Industrial Decarbonisation: Net Zero Carbon Policies to Mitigate Carbon Leakage and Competitiveness Impacts. https://es.catapult.org.uk/report/industrial-decarbonisation-and-carbon-leakage/

Japan – Advanced Technologies Promotion Subsidy Scheme with Emission Reduction Targets (ASSET)	A subsidy based voluntary cap-and-trade system that aims to promote carbon reduction technologies. Firms set their own emissions reduction targets, which are then evidenced to the Japanese Government in order to qualify for subsidy funding for their proposed technologies.	Companies set baselines based on the prior year's emissions, establish an emissions reduction target, and propose implementation of new technologies to achieve that target. These technologies can include heat pumps, LED lighting, transformers, and co-generation systems.
Thailand Voluntary Emissions Trading Scheme (Thailand V-ETS)	A voluntary pilot program that aims to develop and test MRV systems for twelve GHG-intensive sectors, including those within industry such as petrochemicals, cement, and iron and steel. Split over two phases, Phase 1 (2015-2017) aimed to develop guidelines and design elements of the scheme, while Phase 2 (2018-2020) aimed to familiarise participants with permit trading through a trading platform.	Based on an emissions intensity cap (except for the cement sector, which took part in the scheme with an absolute emissions cap), participants are required to submit an annual emissions report based on previous year's emissions, which are verified by third party auditors as accredited by the National Standards Committee.
Indonesia Power Sector ETS – Pilot	A pilot stage ETS with a focus on the Indonesian power sector targeting coal-fired power plants. An initial phase of the ETS was implemented between April and August 2021 and will continue updating with new phases before becoming a mandatory ETS in 2024. It aims to familiarise stakeholders with the mechanism and help inform the development of a national compliance based ETS in future.	Focused on eighty coal-fired power plants that make up over 75% of CO_2 emissions from the power sector in the country. Different intensity-based benchmarks are set across three different subgroups depending on the size of generator capacity.
AirCarbon Exchange (ACX)	Launched in 2019 with a vision of bringing transparency, efficiency and liquidity to carbon markets, ACX is a voluntary digital exchange platform that applies traditional commodity trading techniques to carbon offsets.	The exchange is open to entities, financial traders, carbon project developers, and other industry stakeholders to trade nature-based carbon credits including tokenised assets such as AirCarbon CORSIA Eligible Tokens (CET). The token and carbon credit verification process are overseen by the British Standards Institution (BSI).

3.4 Standards

Standards is an all-encompassing term for various approaches to decarbonisation that have been determined and defined by a regulatory body or a membership organisation, for example, the BSI.

Standards can promote a well-coordinated approach to industrial decarbonisation, which looks beyond site level reporting boundaries adopted by market-based mechanisms. Options for industry might include:

- **Product and material standards**, which set requirements on embodied carbon to encourage the consideration of supply chain emissions.
- **Operational standards** to guide the MRV of emissions in industrial decarbonisation processes (e.g. for CCS and hydrogen), including standards for reporting and accounting for leakage.
- **Border standards** to account for imported (or embodied) carbon resulting from an international supply chain. Border standards could also be used to create a market for low carbon exports from UK industry.
- **Overarching taxonomies** that promote sustainable practices, but do not specifically quantify emissions.

In the existing standards landscape, there is a disconnect between carbon accounting standards and the need to account for emissions in specific product and operational standards.

Globally recognised carbon accounting guidelines and standards are available, such as the GHG Protocol[20] and ISO 14064[21], but most guidelines offer enough flexibility to be utilised by a wide range of businesses. It is not always clear what methods and elements of these standards (e.g. operational control or categories of Scope 3 emissions) have been used to report carbon emissions as most mechanisms do not require full reporting transparency to protect sensitive company data.

As the carbon policy landscape is strengthened to meet the UK's Carbon Budgets and consider global emissions, a package of carbon standards will be needed where carbon accounting will be integral to their function. Industry is already calling for low carbon emissions standards to be introduced, such as to improve the market proposition for low carbon steel (see box below).

[20] Greenhouse Gas Protocol. https://ghgprotocol.org/

[21] International Organisation for Standardisation. ISO 14064 Part 1. https://www.iso.org/standard/66453.html

Standards for low, or zero, carbon emission steel

There is currently no globally adopted product or material standard for low, or zero, carbon emission steel, which limits the consistency and transparency of product life cycle assessments (LCAs).

ArcelorMittal, a steel and mining company, suggest there is growing customer interest in low carbon emission steel and have published a concept for a global standard. In addition to facilitating LCAs, such a standard could provide a market differential for low carbon emission steelmakers. ArcelorMittal's proposal includes a dual score system with LCA values for finished products and a producer rating system to encourage producers to further decarbonise.

Accounting for the different ways in which steel is manufactured and used by sectors with existing standards (such as the automotive industry), and considering options for carbon abatement (e.g. by utilising CCS) within an emissions standard will be challenging. Consistent and coherent MRV guidelines and regulatory oversight will be required. It may be that more specific standards are required to account for different product uses and to distinguish Net Zero steel from low carbon emissions steel.

There is potential for UK steel manufacturers and users to differentiate themselves from international competitors by taking a leading role in the development of emission standards, creating a low carbon, and eventually Net Zero steel sector in the UK[22].

[22] UK Steel (2022). Net Zero Steel: A Vision for the Future of UK Steel Production. https://www.makeuk.org/about/uk-steel/net-zero-steel---a-vision-for-the-future-of-uk-steel-production

4. Carbon Accounting in Industry: Principles and Requirements

In this section, we describe the principles for carbon accounting and main requirements for industry in tracking progress towards Net Zero in a consistent and coherent way.

As of 2021, industry makes up 16% (72 Mt CO_2e) of total UK emissions.[23] Tackling industrial emissions is, therefore, integral to achieving the UK's Net Zero by 2050 target.

The Prime Minister's 10 Point Plan for a Green Industrial Revolution[24] makes it clear that industry needs to be part of the green transition, emphasising the UK's strengths in R&D to support innovation in low carbon technologies for energy intensive industry. For example, with physical site-based assets, industry is well placed to support the development and installation of CCS.

In recognition of industry's important role in achieving the UK's Net Zero targets, a carbon accounting framework for industry should be developed in a way that supports the following:

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

In addition to supporting the needs of a sector, a prerequisite for any carbon accounting framework at the regional and national level is to effectively quantify and track progress towards the UK's Carbon Budgets. Progress towards decarbonisation should, therefore, be quantifiable and transparent across sectors, sub-sectors, regions, and international supply chains.

4.1 Principles of Carbon Accounting

The development of a carbon accounting framework should be guided by an overarching set of principles that seek to limit variation in reporting while ensuring administrative burden on businesses is kept to a minimum and enabling stakeholders to make informed decisions.

The below five principles are widely accepted as the key principles for carbon accounting in guidelines provided in the GHG Protocol and by the International Standards Organisation. We have expanded on these principles to support the considerations listed above:

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

[24] BEIS (2020). The Ten Point Plan for a Green Industrial Revolution. https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution/title

- **Relevant – Carbon accounting approaches should serve the decision-making needs of stakeholders (e.g. policymakers, investors, industry),** with the emissions covered and boundaries selected relevant and representative of normal operation.
- **Consistent – Calculations and methodologies used should allow for meaningful comparison over time and geographies to identify trends and to assess performance against targets.** Consistent reporting parameters should include spatial and temporal considerations. Consistency between mechanisms is crucial to facilitate comparisons and prevent double counting of emissions, but consistency across is also important to alleviate the administrative burden of carbon accounting, especially for smaller companies. Variations in accounting approaches should be kept to a minimum. Where required for mechanism relevance, variations should be supported with tools to alleviate administrative burden, such as through the use of proxy measurements.
- **Complete – Includes all relevant GHG emission sources within the defined boundary.** Both voluntary and compliance-based mechanisms should contain clear guidance on emissions covered and organisations must justify any specific exclusions.
- **Transparent – Based on a clear audit trail and include the disclosure of assumptions or proxies, potential inaccuracies, and data flows.** Emissions should be reported as gross (before avoidance, removals, and offsetting) unless specified by the mechanism guidelines.
- **Empirical Accuracy – Data should be sufficiently precise 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, including the use of agreed proxies where necessary, and verified by a third party where appropriate. Techniques for measuring emissions or developing agreed proxies may continually improve over time to account for the latest scientific empirical evidence and understanding.

4.2 Barriers to Adoption

Adopting these principles in the development of a more consistent and coherent carbon accounting framework can support the deep decarbonisation of industry. There remains, however, barriers that must be addressed to ensure adoption is feasible in the near-term. Examples of these include are described below.

4.2.1 Barriers for Innovation

The main barrier for innovation is the availability of data for decision makers, which is cited as a significant barrier for both innovation and investment. Stakeholders report the need for more forward-looking (tied to national emissions pathways) and granular data (geographic, entity or asset-level) in order to make assured investment decisions[25]. Currently, reported data is not transparent enough to highlight new opportunities for innovation or whole systems integration (see later section).

[25] NGFS (2021). Progress Report on Bridging Data Gaps. https://www.ngfs.net/sites/default/files/medias/documents/progress_report_on_bridging_data_gaps.pdf

In addition, the incentive to innovate is largely limited to technology or vector-specific support mechanisms. While a critical initial step, there is an important opportunity to ensure that carbon accounting is fit for purpose in supporting industrial decarbonisation in the long-term. More consistent data provides more opportunities to inform policy design, which in itself can enable innovation.

ESC's report for the Energy Digitalisation Taskforce outlines that improving the granularity of carbon emissions data is central to driving innovation and recommends that carbon emissions need to be measured at source with data reported and shared in a standard format[26].

4.2.2 Barriers for Business

The administrative burden that carbon accounting currently places on businesses remains the most significant barrier. In their current application, the methods by which organisations report emissions can vary significantly between mechanisms. In addition, SWIC partners have reported using a myriad of systems to compile and track emissions data – including bespoke software, supplier data, central databases, and manual spreadsheets. This view has been further supported by industry responses to Government's recent call for evidence a market for low emissions industrial products.[27]

Managing the different monitoring, reporting, and where applicable, verification requirements between mechanisms is also becoming an increasingly complex task. For Net Zero, emissions will need to be accounted for across all sizes of business, but it is often prohibitively resource intensive for SMEs. As a result, to date SMEs in many cases are exempt from compliance-based mechanisms such as the UK ETS.

4.2.3 Barriers for a Whole Systems Approach

Industrial decarbonisation will require decisions around the placement of infrastructure to support the use of low carbon vectors and the capture and storage of emissions. Currently, the disparate approach to carbon accounting, often taken at the site level, with limited transparency reduces the ability for effective decision making to take place at the regional and national level.

4.3 Requirements for Carbon Accounting in Industry

Considering the overarching principles of carbon accounting for industry and barriers listed above, the table below identifies key requirements for industry that could be supported by an industry-wide carbon accounting framework:

[26] ESC (2022). Delivering a Digitalised Energy System. https://esc-production-2021.s3.eu-west-2.amazonaws.com/2022/01/ESC-Energy-Digitalisation-Taskforce-Report-2021-web.pdf

[27] BEIS (2022). Towards a Market for Low Emissions Industrial Products: Call for Evidence Summary of Responses. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1092716/market-low-emissions-industrial-products-cfe-summary-responses.pdf

	Principle Aim	Current Status	Barriers	Requirement
Relevance of Reported Emissions	Should serve decision making needs of internal and external stakeholders and track progress towards Net Zero.	Complex reporting landscape with overlapping boundaries and emissions scopes across multiple mechanisms.	Decision makers cannot always access the information they need at the relevant boundaries, such as industrial clusters or sub-sectors (e.g. steel manufacturers).	Simplify reporting boundaries to those most relevant to industry (e.g. site/ installation level) and support decision makers through aggregation tools.
Consistency of Approach	Methodologies should be consistent to allow for meaningful comparisons to be made.	Subjective MRV guidance has led to inconsistent methodologies that prevent comparisons.	Prevents comparisons required across industry sectors, sub-sectors, and locations, which are essential for tracking decarbonisation.	Clear MRV methodology guidelines required for each mechanism adopted by industry, aligned to a central compliance-based mechanism (e.g. UK ETS). Variations should be justified.
Completeness of Inventories	Comprehensive and meaningful inclusion of emissions sources.	Completeness of reported emissions data determined by mechanism guidelines which varies, but often excludes CH4 and land use due to uncertainties in scientific evidence base.	Mechanism guidance is not always clear on what to include and it is often left to business interpretation and subjective verification methods.	Government support is required to ensure reporting covers all GHGs, adapts to the latest scientific evidence, and verifiers all work to a consistent standard. This should include incremental reviews of reporting methodologies and improvement over time where applicable.

Transparency of Calculations	Factual and based on a clear audit trail.	Emissions often reported at an aggregate level, not always clear how and at what stage offsets have been incorporated into calculations or what emissions factors have been used.	The conflation of net and gross emissions, where the extent of carbon abatement is unclear, does not support the tracking of progress towards Net Zero.	Information on processes, procedures, assumptions, and limitations of inventory should be disclosed in a factual, neutral, and understandable manner, verified by a certified third party.
Accuracy of Data	Data should be sufficiently precise to enable users to make decisions with reasonable assurance that the reported information is credible.	Businesses rely on the accuracy of conversion calculations and estimation tools. Scientific accuracy is improving but has led to inconsistency in calculations adopted (e.g. AR4, 5 or 6).	The GHG inventory is relatively accurate, but should not be used for international conversions. The process is inefficient with users having to download complex Excel tables.	Limit industry relevant mechanisms to direct emissions and energy consumption at site/installation level where accuracy is better established. Improve digitalisation of MRV to streamline process. Establish clear guidelines for audits to be conducted by certified third parties.

The accuracy of carbon accounting should improve over time to account for the latest scientific empirical evidence and understanding. There are still areas with gaps in the evidence base (e.g. land use), but revisions need to be adopted in a way that does not increase the variation and complexity MRV.

Carbon accounts should serve the decision-making needs of both internal and external users and allow for meaningful comparisons to be made over time. The wide range of voluntary and compliance-based decarbonisation mechanisms available has led to a complex and varied landscape of MRV methodologies and parameters incompatible with the needs of the sector in tracking progress towards Net Zero and supporting innovation.

To remove the administrative burden of emissions reporting MRV should be further simplified to parameters and approaches most relevant industry. For example:

- Installation level reporting of direct Scope 1 emissions and energy consumption (Scope 2) using attributional accounting methods ensure the completeness of inventories. Most of industry already monitor emissions at this level in accordance with GHG operator permits and participation in the UK ETS. Industry is also well positioned to account for atmospheric carbon avoidance (e.g. CCUS) captured at the installation level.
- Consequential reporting of estimated project and product level emissions to help industry make strategic decarbonisation decisions, including opportunities to utilise low carbon technologies; this may require sub-sector-specific guidance.

To support a whole systems approach, carbon accounting frameworks should facilitate the tracking of decarbonisation progress for specific industry sub-sectors (e.g. cement manufacturers) and specific regional activity and partnerships, such as industrial clusters and support for local areas, to better inform decision making across geographics, vectors, and other sectors.

For industry, reporting direct emissions at the installation level could facilitate the development of a wide range of cross cutting inventories for decision makers. Data aggregation would need to be supported by digitalised data platforms as currently the majority of industry is using Microsoft Excel to monitor and report missions, including to obtain proxy emissions calculations from the GHG inventory.

5. Developing a Carbon Accounting Framework for Industry

In this section we review the steps Government and industry could take to align the sector towards a more consistent and coherent carbon accounting framework, by simplifying and streamlining practices.

We propose four components required for a consistent and coherent approach to carbon accounting in industry (see Figure 2):

1. Installation level MRV,
2. Improved digitalisation of data,
3. Regulatory oversight, and
4. Complementary package of compliance-based mechanisms.

To achieve the deep decarbonisation of industry and support its role in the decarbonisation of the wider economy, it is important to develop a complete and quantifiable picture of industrial GHG emissions to support decision makers and track progress towards the UK's Net Zero target.

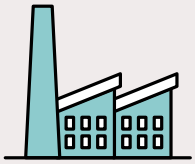
ESC acknowledges the importance of developing a carbon accounting framework for industry that is sympathetic to business operations, supportive of low carbon technologies, and facilitates a whole systems approach. Currently, the wide range of mechanisms and variations in MRV are disjointed and limit the overall transparency of emissions activity, while increasing the administrative burden of carbon accounting.

A blanket carbon accounting standard is not feasible due to variations in mechanism objectives and business models. Internationally recognised standards already exist and accommodate flexibility to support different business models. Instead, a carbon accounting framework could promote a much more consistent and industry-relevant approach to MRV, supported by regulatory oversight and simplified through the digitalisation of data.

ESC proposes a standardised approach to MRV that is not dependent on the specifics of individual mechanisms, which we describe as a "decoupled" approach (see Section 5.1). A stronger steer from Government could be valuable and even more pertinent given the recent High Court ruling where there was a significant emphasis on providing published quantifiable analysis on how Carbon Budget 6 will be met[28].

To ensure consistency, such a framework should be compliance driven, using mechanisms already adopted by industry, such as the UK ETS, and simplified MRV requirements relevant to industry, such as installation level MRV required for the UK ETS.

[28] High Court of Justice (2022). Friends of the Earth vs BEIS Approved Judgement. https://www.judiciary.uk/wp-content/uploads/2022/07/FoE-v-BEIS-judgment-180722.pdf



Installation Level MRV

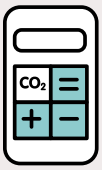
MRV at the installation level across industry.

Supported by expansion of the UK Emissions Trading Scheme and carbon standards.

Digitalisation

Simplify reporting and verification processes.

Increase transparency of emissions data.



Regulatory Oversight

Promote accounting principles.

Certify third party verifiers.

Keep across scientific evidence.

Industry Relevant Mechanisms

UK Emissions Trading Scheme as anchor for development of complementary mechanisms.

Enable collaboration and investment.

Figure 2 Summary of the four key components we propose are required in a carbon accounting framework for industry.

[28] High Court of Justice (2022). Friends of the Earth vs BEIS Approved Judgement. https://www.judiciary.uk/wp-content/uploads/2022/07/FoE-v-BEIS-judgment-180722.pdf

5.1 Installation Level MRV

In Section 4 we highlighted a need to match the reporting boundaries of emissions to those most relevant to industry and to ensure emissions inventories within determined boundaries are as complete as possible. Physical infrastructure and site boundaries suggest industry is well placed to account for its direct GHG emissions and energy consumption at the site/installation level.

Focusing on installation level MRV would also reduce the administrative burden of carbon accounting for industry. For example, industry has a long history monitoring direct stack emissions for air quality legislation, and in recent decades, this has been expanded to incorporate GHG emissions. In the UK, most of industry already monitor emissions at the installation level in accordance with GHG operator permits and participation in the UK ETS.

Proxy reporting at the installation level can also be done with reasonable efficiency for standardised manufacturing processes where the quantification of materials used is already required for general operations and financial accounting purposes (e.g. tonnes of coal used). Assuming the process can be standardised, proxy monitoring can also provide a good level of accuracy.

Industry is also well positioned to account for decarbonisation activities at the installation level, such as site-specific emissions reductions from improvements to a manufacturing process, atmospheric carbon avoidance from captured emissions, and fuel switching (e.g. direct electrification or hydrogen).

Decoupled Approach to MRV and Decarbonisation Mechanisms

In the current carbon accounting landscape, variations in MRV approaches have been driven by diverging requirements from decarbonisation mechanisms. ESC proposes a decoupled approach to MRV guidance and decarbonisation mechanisms, supported by digitalisation and complementary policies (Figure 3). In a decoupled approach, industry could focus emissions MRV where most relevant and efficient, the site/installation level, with clear MRV guidelines provided by a Carbon Regulator. An installation level focus for MRV will need to be complemented by digitalisation and carbon policies that support a whole systems approach to decarbonisation.

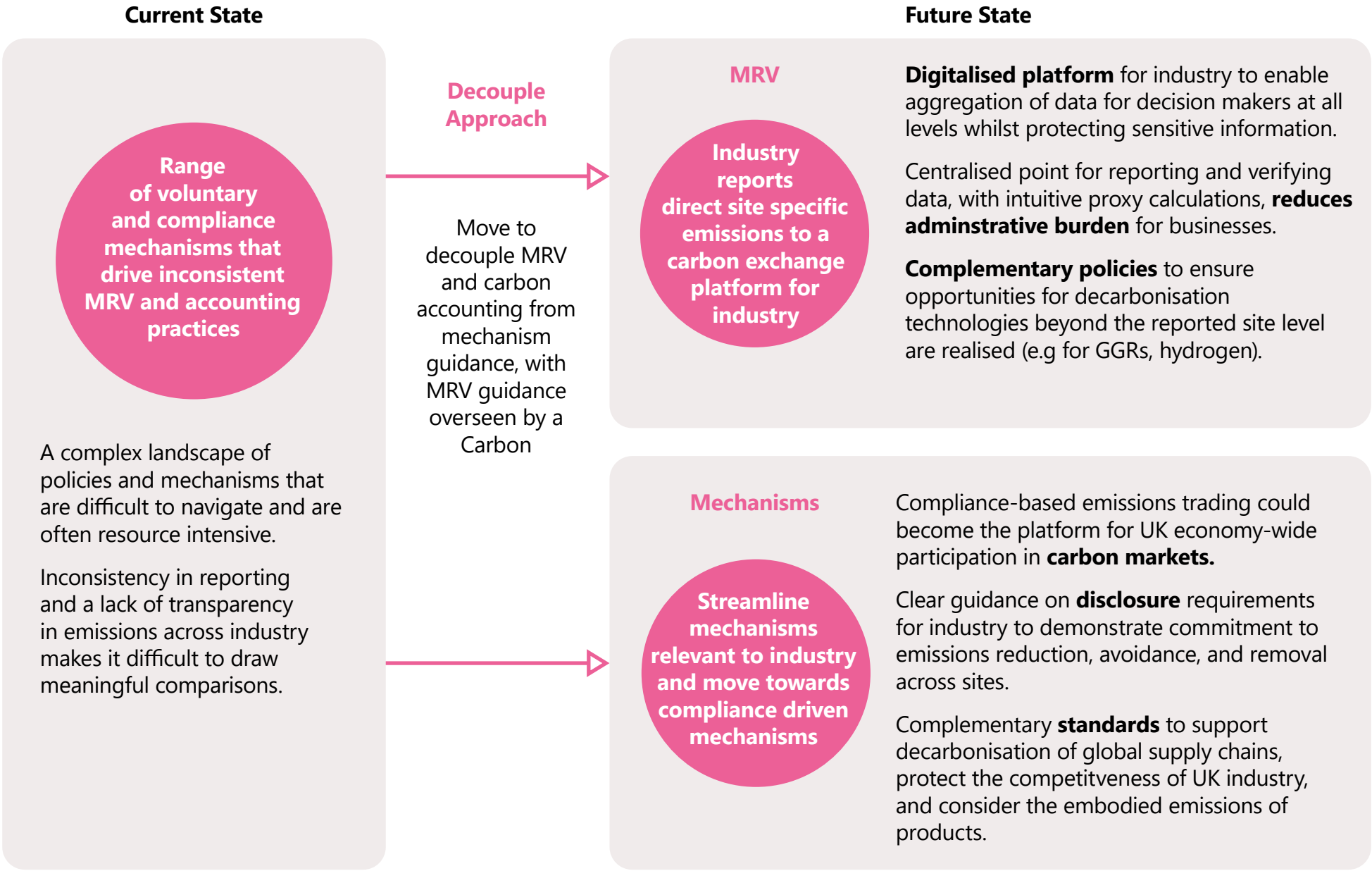


Figure 3 Proposed decoupling of MRV guidance and decarbonisation mechanisms for industry.

5.2 Digitalisation

A decoupled approach to MRV and decarbonisation mechanisms, where the monitoring and reporting of emissions data is targeted at the installation level, requires digitalisation to support the tracking of progress across the different mechanisms and carbon accounting levels.

Digitalisation should also simplify verification processes and increase transparency of emissions data, whilst protecting sensitive company information. In the current carbon accounting landscape, aggregated emissions data is published where it is not always clear how emissions have been grouped, the boundaries, and scopes of emissions covered, and at what stage offsets have been accounted for.

Protecting sensitive company data is important, but existing approaches limit the availability of publicly visible data. Such data can support strategic decision making for infrastructure development, integrating innovative technologies and vectors, and provide Government with clarity on targeted incentives. The lack of public data can be particularly problematic for SMEs who might lack the resources needed to investigate strategic opportunities in detail. Data sharing is a recognised challenge for innovation across industry. ESC is working on projects to improve insights and data exchange across the energy system, including for industry through the Smart Manufacturing Digital Hub (see Box below).

Smart Manufacturing Digital Hub

SMEs in the manufacturing industry are missing out on key energy and carbon saving opportunities. Data sharing is one of the key challenges – there is a lack of incentive for companies to share their energy usage data, and a lack of consistency in the data across organisations. The Smart Manufacturing Digital Hub (SMDH) aims to tackle this. SMDH will deliver a Manufacturing Data Exchange Platform that allows companies to choose to share their data for certain purposes, add to it over time, and receive useful insight in return. For example, several manufacturing SMEs sharing energy data could allow for performance benchmarking of energy usage across a particular manufacturing sector. Results from analysis of the shared data may also present insights into where key energy saving opportunities lie and allow for achievable goals to be set for individual companies regarding their energy usage and carbon footprints. ESC is working with a consortium led by Ulster University to deliver The Smart Manufacturing Digital Hub.

Industry currently uses the Emissions Trading Scheme Workflow Automation Project (ETSWAP), for permits and reporting required by the UK ETS. The UK ETS authority is developing a new digital permitting and MRV (PMRV) system to replace ETSWAP with a phased launch commencing in the Autumn of 2022.[29] The development of the PMRV seems to be in recognition of the need for a simpler and more intuitive user experience for industry, something we also recognise in this report.

[29] BEIS (2022). Guidance of Participating in the UK ETS. https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets#new-permitting-monitoring-reporting-and-verification-system-from-autumn-2022

To further support industry needs, emissions data obtained by the PMRV system could feed into other digital platforms to facilitate the aggregation of emissions data at different reporting levels, for required company disclosures and to support regional and sub-sector emissions tracking while protecting sensitive company data. For example, there may be an opportunity to modernise the UK's GHG inventory to enable transparent and consistent accounting of GHG emissions at regional, cluster, and industry sub-sector levels, facilitated by the digital integration of installation level data obtained by the PMRV system. This will become increasingly valuable as the ETS is expanded to other sectors, providing a more complete picture of the UK's territorial emissions.

To support this, we propose funding industrial pathfinders that aim to develop an integrated carbon accounting framework for a chosen subset of industry sub-sectors and industrial clusters. This would act an important intermediate step towards developing an industry-wide framework, including understand the digitalisation tools required to support the transition (see Figure 4).

5.3 Regulatory Oversight

ESC has previously proposed a Carbon MRV and Accounting Regulator[30] that would provide economy-wide regulatory oversight to ensure that carbon accounting approaches are coherent and consistent across the economy. A Carbon Regulator could also support coordination between sector-specific and economy-wide carbon accounting principles and decarbonisation mechanisms.

A Carbon Regulator could play a pivotal role in supporting:

- Verifiable empirical and scientific methods for measuring or accurately estimating emissions.
- Reported emissions reduction actually occurs in line with Carbon Budgets and the Paris Agreement.
- Reductions in, and removals of, emissions are accounted for and rewarded appropriately through Government implemented policy.

In its Net Zero Strategy, Government committed to exploring regulatory oversight to provide robust MRV of GGRs. This report has further demonstrated that MRV and carbon accounting would benefit from coordinated regulatory oversight to improve consistency and coherence economy-wide.

Many of these challenges are not limited to industry. A Carbon Regulator could ensure MRV guidance is made consistent economy-wide, making sector-specific recommendations where relevant and ensuring MRV practices are compatible with any future expansion of the UK ETS and the adoption of other cross-sector mechanisms, such as carbon border standards, where relevant.

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

California Air Resources Board

The California Air Resources Board (CARB) provides an example of how an economy-wide carbon regulator could apply in the UK. Reporting of GHG emissions by major sources is required by the California Global Warming Solutions Act of 2006 (AB 32). The Regulation for Mandatory Reporting of GHG Emissions is applicable to electricity generators, industrial facilities, fuel suppliers, and electricity importers. It also requires the independent verification of GHG emissions data reports. Crucially, CARB has oversight across all carbon policies within California, providing economy-wide supervision.

Regulatory oversight could be applied by providing additional powers to existing regulators, such as the UK ETS regulator (e.g. Environment Agency), or by setting up a new regulator. We propose the responsibilities of an economy-wide Carbon Regulator should include:

- **MRV Guidance:** Establishing MRV guidance that complements the objectives of decarbonisation mechanisms, facilitating a decoupled approach.
- **Scientific Coordination:** Tracking the latest science in MRV of emissions and making recommendations to update MRV practices when necessary. Drawing on the increased digitalisation of MRV could mitigate the administrative burden for businesses and ensure changes are adopted consistently.
- **Certifying Verifiers and Conducting Audits:** Ensuring the monitoring and reporting of emissions is transparent and accurate as far as possible, with credible verification processes defined across all major emitting sectors. A Carbon Regulator could also support the investigation of 'greenwashing' complaints and misleading decarbonisation claims (much like the Advertising Standards Agency does for marketing).
- **Setting Standards for Proxy Emissions Monitoring:** Where the direct monitoring of emissions is not possible, a Carbon Regulator could oversee objectively independently verified proxies for use instead. Proxy use should be consistent, taking risks such as leakage (fugitive emissions) into consideration. This could be facilitated by digital platforms such as the upcoming PMRV.

Given the cross-cutting nature of decarbonisation a Carbon Regulator will also need to work with a variety of partners, including partners that set standards (e.g. British Standards Institute), partners who maintain emissions inventories (e.g. UK's GHG Inventory), and partners who collate the latest international scientific evidence (e.g. IPCC).

5.4 Industry Relevant Mechanisms

ESC supports the use of compliance-based carbon policies, including carbon markets, to incentivise decarbonisation. Some of the inconsistency in carbon accounting is driven by the variation of MRV requirements in voluntary mechanisms. A shift compliance-based mechanisms could offer a more coherent and consistent approach to carbon accounting for industry, supported by a Carbon Regulator to provide MRV guidelines and support the verification of emissions.

For industry, this means enhancing and expanding coverage of the existing UK ETS as the market mechanism of choice, supported by carbon disclosures and carbon standards that complement. It is our view that the UK ETS should eventually be extended to include all material sources of emissions across the economy. The strategy for extending the scope of emissions trading will need to be adapted to reflect the unique challenges and opportunities of individual sectors.

As the UK ETS is strengthened and extended to incorporate more sectors, industry will be able to move away from voluntary mechanisms to demonstrate their commitment to reducing Scope 3 emissions and reduce the administrative burden of mixed-method reporting. This will need to be facilitated by carbon policies to drive deep industrial decarbonisation and promote investment in new technologies, including carbon disclosures and carbon standards where carbon accounting will be integral.

Carbon Disclosures

Carbon disclosures are most effective when they promote accountability by tracking progress towards a quantified commitment, such as targets for improved energy efficiency. There may be a role for multiple disclosure-based mechanisms to encourage industry participation in decarbonisation schemes and incentives.

In our review of carbon disclosures relevant to industry (Section 3.1), we identified overlapping disclosures, such as ESOS and CCAs. To reduce the administrative burden on industry, disclosure-based mechanisms may need to be simplified to those that complement the UK ETS, drive innovation, and promote a whole systems approach to decarbonisation. This should be done in consultation with industry to avoid unintended consequences, such as increased administrative burdens.

ESC advocates for moving towards a compliance-based carbon accounting framework, but variations in business models and innovation opportunities means the adoption of some disclosure mechanisms will need to be voluntary in the near-term and possibly sub-sector-specific. To ensure disclosures complement the wider package of carbon policies aimed at industry, we suggest opt-in voluntary mechanisms should be developed with the support of Government and once adopted, should eventually require the same level of commitment and regulatory oversight as compliance-based mechanisms.

Carbon Standards

ESC has previously advocated for exploring the use of carbon standards on both producers and purchasers as part of the long-term policy framework to enable industrial decarbonisation.[31] In Section 3 we highlighted an opportunity to strengthen the role of standards to support a whole systems approach to decarbonisation, which looks beyond site level reporting boundaries adopted by market-based mechanisms with standards for embodied and imported emissions.

[31] ESC (2021). Rethinking Decarbonisation Incentives – Future Carbon Policy for Clean Growth. https://esc-production-2021.s3.eu-west-2.amazonaws.com/2021/08/Rethinking-Decarbonisation-Incentives-Future-Carbon-Policy-for-Clean-Growth.pdf

Standards should be supported by industry bodies with good levels of engagement and understanding of industry sub-sectors, with coordination from Government to ensure that they complement the aims and objectives of other mechanisms such as the UK ETS. It is also important that standards should be designed to avoid unintended consequences, such as stifling innovation.

5.5 Proposed Timeline of Carbon Accounting Framework

Below we propose a timeline (Figure 4) for achieving a carbon accounting framework for industry that is aligned to the indicative policy timeline from the Industrial Decarbonisation Strategy[32].

In Section 5, we set out four key components required for a consistent and coherent approach to carbon accounting in industry:

- Simplified MRV with an installation level focus to reduce the administrative burden.
- Improved digitalisation to facilitate the exchange of MRV data.
- The role of a Carbon Regulator to develop consistent MRV guidelines and support the accreditation of verifiers.
- A complementary package of compliance-based mechanisms, anchored around the UK ETS.

We suggest these elements are integral to the development of a carbon accounting framework for industry that promotes the carbon accounting principles and requirements covered in Section 4, ensuring carbon accounting supports innovation and promotes a whole systems approach whilst remaining sensitive to business needs.

Given our recommendation to use the UK ETS as the market-based mechanism of choice, the first step to developing a carbon accounting framework for industry is to agree a small number of complementary mechanisms to support industrial decarbonisation and a timeline for the phasing out of existing mechanisms that are not supported in the framework.

In Section 5.4 we suggest it is likely that carbon disclosures will need to be simplified, as existing disclosure mechanisms overlap and increase the administrative burden on industry, and carbon standards will need to be introduced.

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

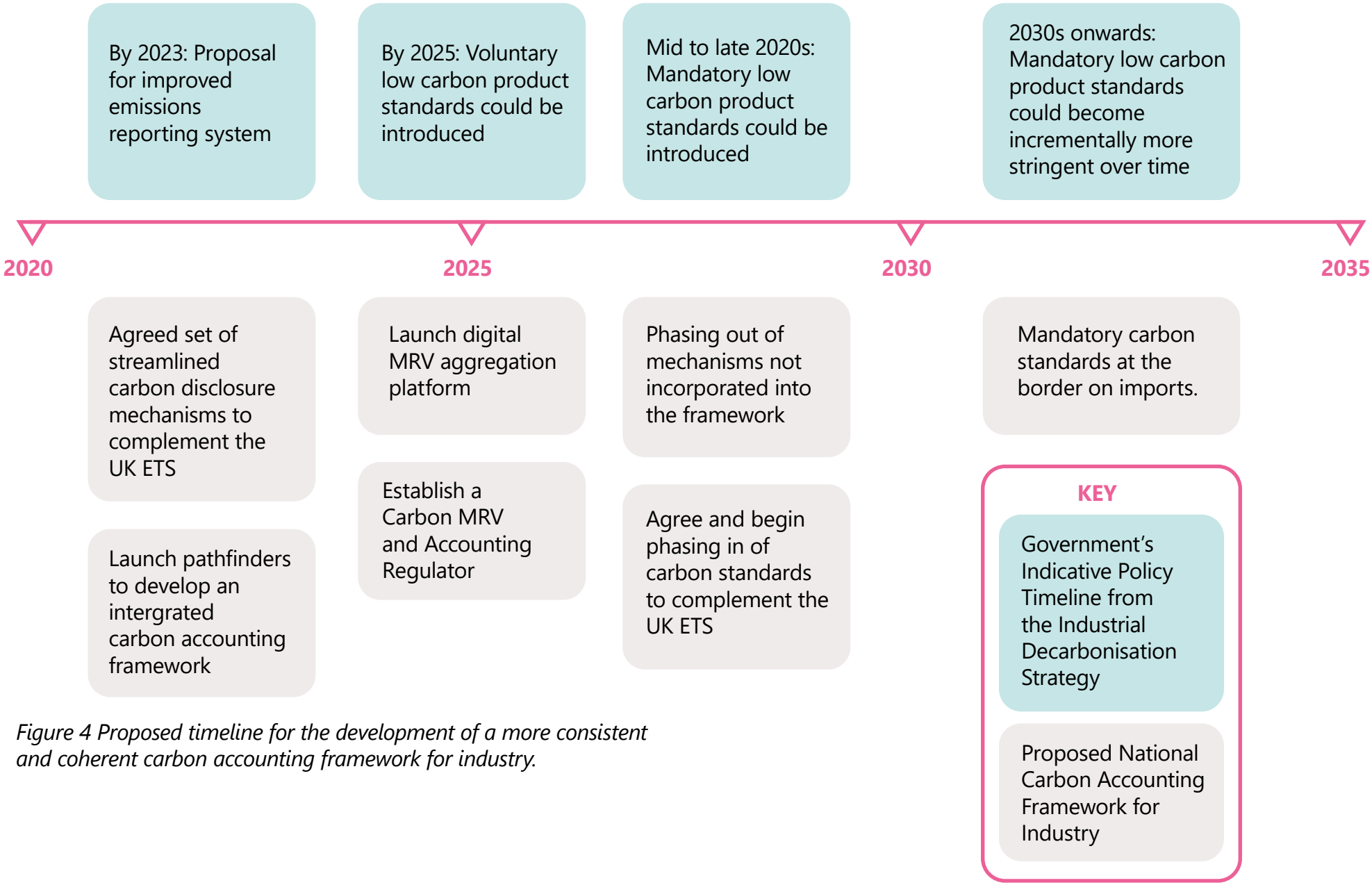
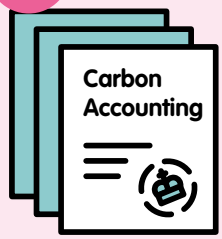


Figure 4 Proposed timeline for the development of a more consistent and coherent carbon accounting framework for industry.

6. Recommendations for Policymakers

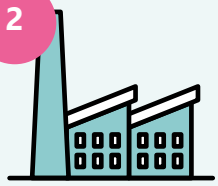
We recognise that further work will be required to ensure that changes in carbon accounting requirements align with Government's wider decarbonisation commitments and targets and, importantly, supports industry through the transition. The following recommendations are intended to provide the overarching enablers for Government in developing a more consistent and coherent national carbon accounting framework for industry:

1



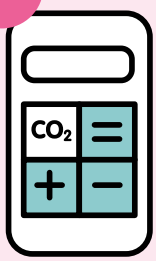
Commit to establishing a national carbon accounting framework for industry, with Government providing steer to simplify and strengthen carbon accounting practices across industry. The UK Emissions Trading Scheme could act a starting point for this framework, targeting the MRV of emissions at the installation level, with complementary mechanisms developed to consider supply chain emissions and opportunities for innovation as part of a whole systems approach to decarbonising industry and the wider economy.

2



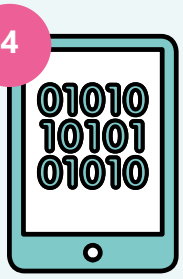
Fund industrial pathfinders that aim to develop an integrated carbon accounting framework for a chosen subset of industry sub-sectors and industrial clusters. This would act an important intermediate step towards developing an industry-wide framework, including understand the digitalisation tools required to support the transition.

3



To support carbon accounting in industry, explore establishing a Carbon MRV and Accounting Regulator. Such a body would be responsible for ensuring MRV is consistent and comparable across mechanisms, including mitigating double counting. Ensuring quantifiable emissions reduction occurs in line with Carbon Budgets and the Paris Agreement through supporting policymakers. This should build on (and extend) Government's commitment in the Net Zero Strategy to explore options for regulatory oversight to provide consistent MRV of greenhouse gas removals.

4



Improve digitalisation to simplify reporting and verification processes and increase transparency of emissions data for external decision makers. An open-source digital carbon accounting platform could facilitate data aggregation for regional and sub-sector emissions to help with tracking and decision making, while protecting sensitive company data. Such a platform could use emissions data already reported at the installation level via the UK ETS's reporting platform.

The above builds on the Climate Change Committee's recent recommendation from their 2022 Progress Update Report to Parliament[33]:

"Review, invest in, and initiate reform of industrial decarbonisation data collection and annual reporting to enable effective monitoring and evaluation, and policy implementation. This will require additional data collection and reporting to allow for effective tracking of energy efficiency, material efficiency, fuel switching, CCS, including progress developing these measures, and more holistic measurement on a product or whole life cycle carbon basis. This reform should also be used as an opportunity to remove overlaps in reporting between existing schemes, which place an unnecessary burden on industry."

[33] CCC (2022). 2022 Progress Report to Parliament. https://www.theccc.org.uk/publication/2022-progress-report-to-parliament/

Glossary Of Terms

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.

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.

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.

Just Transition
Ensuring that costs and benefits of the transition to Net Zero are fairly shared between income groups, industries, and regions – as well as between current and future generations.

Sector Led Approach
A sector led approach can enable the stepwise creation of a coherent economy-wide carbon policy framework by:

- Progressively introducing or strengthening tailored sectoral carbon policies, such as incentives or standards, to drive required emissions reductions in major emitting sectors.
- Enabling sectoral price or regulatory policies to be supported by packages of complementary policies (e.g. innovation support or access to finance) specifically designed to address key sectoral challenges and barriers (e.g. transitional or distributional impacts).
- Linking sectoral carbon policies by introducing trading and validated carbon credit market mechanisms to enable the emergence of a balanced economy-wide framework of decarbonisation incentives.

A sector led approach can pragmatically and progressively improve the low and imbalanced current pattern of effective carbon prices across major emitting sectors. It also recognises that increasing effective carbon prices will not be sufficient to drive innovation and private investment on its own. A range of complementary policies will also be required to address the variety of sector-specific barriers, characteristics, and transition challenges.

Whole Energy Systems Approach
A whole energy systems approach considers:

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

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

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For further information please contact:
Dr. Danial Sturge, Practice Manager - Carbon Policy
danial.sturge@es.catapult.org.uk

7th Floor, Cannon House,
The Priory Queensway,
Birmingham, B4 6BS

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