CARBON ACCOUNTING: A REVIEW OF THE CURRENT DATA MANAGEMENT LANDSCAPE IN UK MANUFACTURING

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Document User Guide

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INTRODUCTION AND BACKGROUND

As the importance of environmental awareness and regulatory scrutiny increases, organisations are expected to reduce their carbon footprint and demonstrate their commitment to sustainability.

The UK has aligned with international climate agreements, and domestic climate targets greatly emphasise reducing carbon emissions. This makes carbon accounting a critical discipline for the manufacturing industry and its supply chains.

A robust carbon data management system is essential for all organisations to effectively manage carbon emissions within their supply chains to mitigate environmental impact. Accurately collecting carbon data and managing its quality and integrity is fundamental to achieving the objectives set by the UK Government.

This report relates to Work Package 3 of the Cross-Catapult Carbon Accounting (CCCA) programme and is based on the research undertaken by Digital Catapult. It explores the complex data management landscape in the UK and the challenges the manufacturing industry faces in obtaining and reporting carbon accounting data, which include regulatory compliance, stakeholder engagement, data collection and quality assurance.

From the insights derived from our research, we provide best practice guidance and make recommendations for a carbon accounting data management system, regarding data strategy, governance, data trust, interoperability and transparency. These recommendations will streamline and enhance carbon accounting in manufacturing and the supply chain.

Organisations that measure and report their carbon emissions can then do more to reduce them while demonstrating their commitment to sustainability and supporting a more sustainable and resilient supply chain.

PROJECT CONTEXT

The Cross-Catapult Carbon Accounting Programme (CCCA) began in 2022, and is funded by Innovate UK. It is led by High-Value Manufacturing Catapult, collaborating with Connected Places Catapult, Digital Catapult, Energy Catapult and Satellite Applications Catapult.

The programme focuses on the need for a carbon accounting data management system for manufacturing and supply chains that will:

- Accurately calculate the scope 1, 2 and 3 upstream emissions that comprise most of the carbon footprints of manufacturing and supplier businesses.

- Support the creation of a comprehensive UK framework for carbon emissions, with agreed standards and tools that can be used for accounting, tracking and reporting carbon emissions throughout entire supply chains. This will inform decision-making, enabling businesses to take timely and appropriate actions to accelerate their decarbonisation.

- Unlock investment, creating an environment where manufacturers can excel on the global stage, making the UK stand out as a destination for low-carbon manufacturing.

As part of the CCCA, Digital Catapult provides recommendations for carbon data management based on the various aspects of the data landscape, including data collection, quality, privacy, interoperability, transparency and sharing.

This work supports the outputs from other Catapults in terms of the need for the UK to have a carbon regulator, including:

CATAPULT Energy Systems

Promoting the consistent use of emissions data.

CATAPULT Connected Places

Managing the data through the user journey.

CATAPULT High Value Manufacturing

Steps and tools required for the carbon accounting process.

CATAPULT Satellite Applications

Verifying data to ensure accuracy and consistency.

Digital Catapult research and insights

Our work in the 3-year CCCA programme is on understanding the current challenges and gaps in terms of carbon data, and providing recommendations to support implementation of an ideal data management system. These are based on insights from interviews with industry stakeholders and literature research.

- **Year one** work focused on a feasibility study using the ecometer, a tool we created to systematically capture, monitor and analyse carbon emissions.

- **Year two** explored the challenges associated with managing carbon accounting data across a supply chain and best practices for achieving data consistency. This has involved interviews with stakeholders from multiple sectors, including finance, construction, and the manufacturing supply chain. This report details our insights from these interviews and our literature research findings. By identifying the data challenges faced by the industry, it establishes a clear context for why a carbon accounting management data framework is needed. Our research findings and recommendations for what should be included in the data management framework are collated in the summary table, Figure 1.

- **Year three** will focus on providing recommendations for a data framework that helps organisations to manage their carbon data effectively and efficiently, enabling them to make informed decisions to accelerate decarbonisation. The outcome will be to present solutions for the gaps and challenges identified in this report.

Digital Catapult CCCA data framework recommendations		
Data challenges	**Recommendations through the data management framework**	**Actions to be taken through process framework and regulations**
No standardised data format for sharing carbon accounting information	Insufficient transparency, consistency and data sharing	Use standard data formats that enable easy and consistent sharing of carbon accounting data across the supply chain
No third-party data verification requirements	Limited data transparency and trust	See Satellite Applications Catapult report and data framework
No trusted data-sharing system	Lack of data transparency, affecting interoperability	Implement data privacy and security solutions to enable confident sharing of sensitive data between parties
No standardised emissions factor datasets, and significant gaps in scope 3 emissions factor availability	Limited accuracy and consistency of data being shared, affecting data trust	See Energy Catapult work on carbon regulators
Insufficient data integration within an organisation, due to data scattered across disparate systems	Inaccurate calculation of scope 1, 2 and 3 emissions	Include data governance guidance
No standardised tools	Inconsistencies in reporting formats and outputs, affecting the sharing of carbon calculations in the supply chain	See High Value Manufacturing Catapult work on tools horizon scan (Work Pack 4 and Work Pack 2b)
Lack of clarity on data to be collected and reported for scope 3 upstream	Omission of scope 3 calculations, which may account for up to 80% of an organisation's carbon footprint	Provide clarity through the data model that will be designed for the framework
Insufficient availability of primary data, forcing users to use the spend-based method	Inaccurate and inconsistent data leading to inaccurate carbon calculations	Provide data collection and quality guidance

Figure 1: Research findings

CURRENT CHALLENGES IN CARBON ACCOUNTING DATA MANAGEMENT SYSTEMS

In interviews with stakeholders from the Finance, Construction and Supply Chain industries, we discussed the challenges in carbon accounting for their industries and captured recommendations for solutions.

Our interim report considered the recommendations, gaps and challenges identified in detail. These are summarised over the following pages.

Data challenges

Accurate and timely emissions data is the foundation of effective carbon accounting, enabling organisations to measure, manage and mitigate their carbon footprint in alignment with their environmental goals and stakeholder expectations.

Data management systems encompass the tools, processes and technologies used to collect, store, analyse and report carbon emissions data. Storing and managing carbon inventory data to **account for carbon emissions** can help an organisation understand its carbon footprint and take corrective action as needed.

However, there are challenges in managing, storing, processing and exchanging this data, as evidenced in the World Bank's 2016 publication, Greenhouse Gas Data Management.

Data collection and quality

The manufacturing industry is diverse and complex. Any organisation will have its own data management issues, in addition to any from its various supply chains.

Collecting data internally and from external sources can be difficult. A lack of primary or activity data means that organisations mostly use secondary or proxy data to calculate their carbon emissions. This involves making assumptions or generalisations that lower the data quality and lead to incorrect or inaccurate estimates, undermining carbon reduction efforts.

For accurate carbon calculations, the collected data must itself be accurate, complete, and consistent, and it must correctly represent the carbon footprint of the organisation.

Multiple reasons for gaps in data collection and quality are identified in RMI's report: Toward a Technology Ecosystem for Carbon Accounting:

- The organisation may rely on collecting more-readily-available secondary data or spend-based data in preference to primary data. They may not have the required data to begin carbon accounting.

- Receiving data from multiple external sources can lead to inconsistencies. It may vary in quality and levels of granularity, with different calculation methods used in the various organisations within the supply chain. This impacts data quality, leading to inaccuracies in carbon calculation and reporting.

- Errors in data collected can arise from incorrect or incomplete data collection methods. For example, manual calculations or entries can include human error, and inaccuracies may only be visible when the data is analysed. Checking for and resolving such errors can make the data collection process time-consuming and difficult.

- Inconsistencies in carbon calculations and measurement techniques across various tiers in the supply chain and internally in the organisation can lead to inaccurate estimations of the organisation's carbon footprint. An error in one tier can propagate to the entire supply chain, resulting in inaccurate reporting.

- Data availability is an issue. Organisations often do not receive activity or primary data from their supply chain and resort to using secondary or proxy data to calculate their emissions.

- The company or organisation in the supply chain may not share their data due to privacy or security reasons. They may not have collected the right information or have access issues themselves.

- Due to the lack of standardisation when sharing, data received may lack required quality, or may require time-consuming modifications or pre-processing before it can be used. Such processes can themselves impact data quality.

- The reporting organisation may not have operational influence on other organisations in the supply chain. Manufacturers may lack the influence of their partners or suppliers to reduce their carbon footprint and provide the required data.

- [Data is often not available readily or in real time](), so most organisations rely on historical data. This creates a lag in operations, adding delays and difficulty to decision-making processes. If data is collected in real-time, it should be integrated seamlessly into day-to-day operations, so that immediate action can be taken.

Data consolidation

Whether generated internally or externally, an organisation's data may not be immediately ready for analysis and use. There may be a requirement to pre-process the data or transfer it into a different format.

For example, companies seeking data from their supply chain may receive it in different formats, such as Excel files, PDFs, or simply pasted into an email. This would make collation difficult and time-consuming, and potentially less useful in making strategic business decisions if there is a delay in finally receiving it in a usable correct format.

Data validation and verification

Unlike [greenhouse gas reporting in the finance sector](#), which is regulated heavily by national and international standards, carbon accounting in manufacturing does not currently follow a single standard.

The multiple standards and protocols in existence are open to interpretation, resulting in organisations reporting their carbon emissions differently rather than following a single reporting practice.

This makes verifying data challenging and brings in issues with data traceability and trust. Companies may not be able to verify or validate third-party data themselves or areas where estimates or secondary data has been used, as they have no control or ownership over it, although there may be instances where they can use consultancies to do this for them.

Data lineage

One of the challenges that poses a risk to verifying and validating data is data lineage. When either receiving data from an external source or when dealing with internal data, organisations do not know the lineage of the data. That is, they do not know what transformation and change the data has undergone over time to reach its current state. While [verification and validation of data is important](#), it becomes difficult when there is little evidence of its accuracy, consistency and quality.

Data interoperability and comparison

Data interoperability is one of the major issues in carbon accounting, which arises due to the challenges present in data sharing between the various organisations in a supply chain.

- Organisations may not have the data readily available, or may not want to share it.
- As there is no easy way of sharing data, it is likely to be a tedious process.

- There is no standard format through which data can be shared and compared effectively

- Data is shared in different formats by different sources and can require possibly time-consuming and tedious preprocessing.

A typical process followed today when sharing product emissions data between a vendor and reporting organisation is as follows:

- The reporting organisation's procurement or sustainability team identifies the need to collect data from a supplier and emails the supply chain partner to request the information needed.

- The supplier may have the data readily available, may not have it at all, may not be willing to share it due to privacy and security concerns, or may not know how the data was collected and whether it is accurate or consistent.

- Even if the supplier vendor does agree to share the data, there may be confusion over what data to include and what to leave out.
  - Do they need to include data for all scopes or just scope 3?
  - Have the correct boundaries been used and the appropriate data collected?
  - Do the emission factors used need to be shared or does an estimation need to be provided?

- Supplier data will vary in granularity and quality, making it harder for the reporting organisation to manage it and make comparisons between supply chain partners.

- The reporting organisation will receive the data in various formats and require restructuring to meet their needs. They might enter it into their own spreadsheet or system manually, which may lead to errors, which could be compounded over years.

Data sharing and trust

The most significant challenges organisations face when sharing data are data privacy, security, and transparency.

Data privacy and security
Product-level or company-level emissions data can offer insights into production processes, product consumption and supplier networks, making it commercially sensitive. In their 2023 report on supply chain data-sharing for scope 3 emissions, [Stenzel and Waichman](#) found that 42% of production firms fear losing their innovative edge or their competitiveness in the market if data is shared or locked into a central data platform. The anxiety surrounding sharing core data and the perceived risk of exposing business secrets is one of the major barriers to data sharing. Businesses fear not knowing who will have access to their data and are unsure of how secure it will be once shared. These data security and privacy concerns contribute to the lack of data sharing, creating obstacles to accurately calculating carbon emissions.

Data transparency
The complexity of supply chains and lack of transparency across them make it difficult to collect data relating to scope 3 emissions. Data privacy and security concerns also make data transparency challenging.

Other challenges

Digitalisation

Some companies have digitised their data yet, or their digital transformation journey hasn't yet reached a stage where they can manage data, or become data-ready to collect carbon emissions data.

Regulations and policies

There are no mandatory regulations and policies for standardising data collection, emission calculation and reporting. This has been identified in stakeholder interviews, and is supported by Energy Catapult's report on operationalising a carbon regulator. As a result, different sectors have different coefficients, and therefore different calculations. There is also a risk that the spend-based method can lead to double counting.

Lack of incentive

There is no incentive for carbon accounting and reporting, and no fear of penalty either. Organisations do not see any value-add or commercial benefit for themselves or their shareholders when trying to account for carbon emissions, so it is seen as an added overhead. As there are no regulations to transgress, and therefore no accountability or penalisation, businesses do not make it a priority.

Determining boundaries and scope

While it is relatively easy to identify which carbon emissions fall into scope 1 and 2, the same cannot be said for scope 3 emissions, which are divided into upstream and downstream. There are some standards, such as the GHG protocol, which define the activities that can fall into scope 3, but there is still work to be done. Updates are currently still ongoing.

The main challenge when determining scope or setting an organisational boundary, is which carbon emissions should be included into which scope, the underlying calculations, and in which stages of the supply chain the emissions occur.

Different protocols or standards set different boundaries, and if different organisations are not using a standard protocol differences in calculation and reporting will occur.

Double counting

When reporting carbon emissions, there must be no double counting. This gives rise to a challenge with a company's scope 3 emissions, which are controlled or owned by others in the value chain (such as third-party retailers, suppliers, and transporters). Looked at another way, they can be thought of as the direct emissions of the supplier organisation.

If two or more companies account for the same emissions in their scope 3 emissions, this is known as double counting. The diagram in Figure 2 shows how two entities in the same supply chain (a manufacturer and a retailer) could report transportation-related emissions as scope 3.
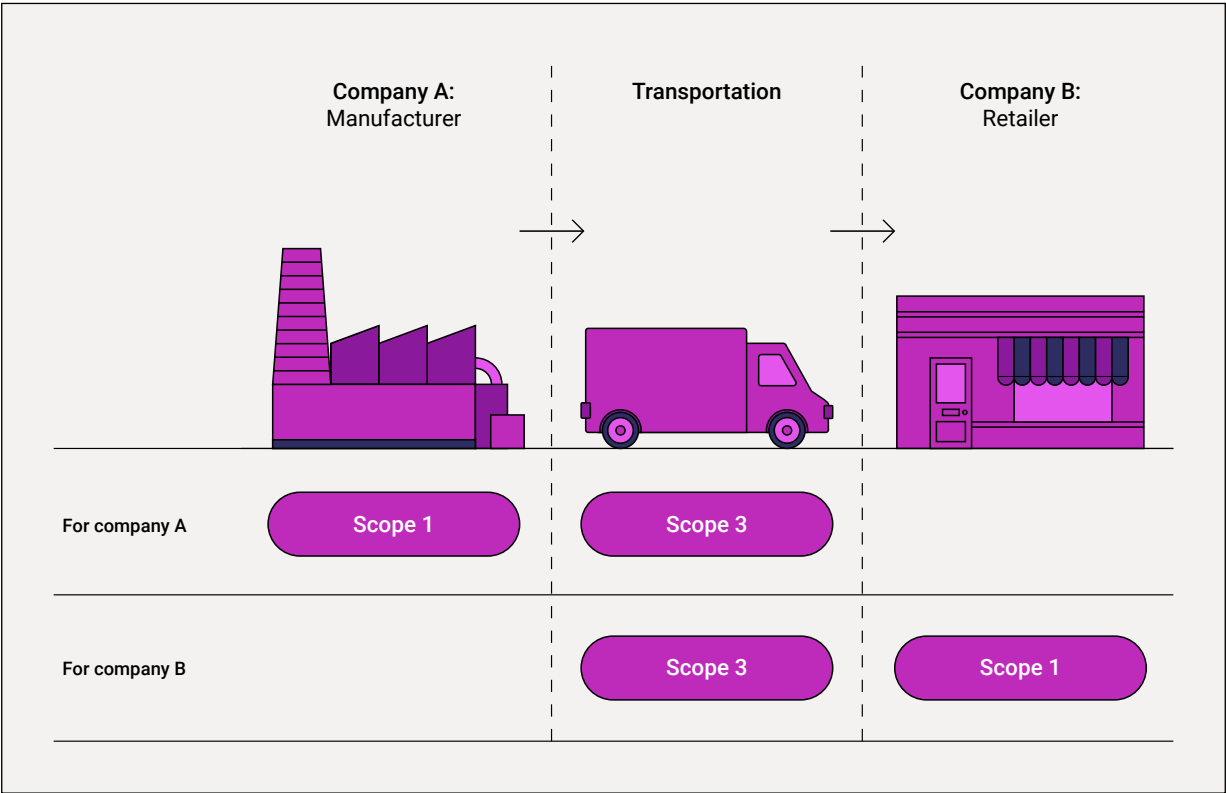

Figure 2: An example of double counting

As part of a [recent survey conducted by GHG Protocol](#) one company gave an example of double counting which was not covered by current protocol guidance. The example showed that the current guidance for scope 3 emissions in the GHG protocol does not take into account double counting of scope 3 emissions for intentional activities between entities in the same segment of the value chain, such as multiple retailers.

This has discouraged suppliers from engaging in reporting emissions. The challenge is amplified in sectors such as construction, agriculture, food and healthcare, which are dominated by small and medium-sized enterprises that are not mandated to report their scope 1 and 2 emissions, and face limited pressure to do so. This results in larger organisations elsewhere in the supply chain bearing the burden of scope 3 emissions reporting. This burden, combined with the lack of guidance on double counting, has contributed to the lack of meaningful progress towards reaching scope 3 goals.

BEST PRACTICES AND LEARNINGS FROM THE FINANCE AND ENERGY SECTORS

This section highlights best practices in non-manufacturing industries that could be applied to carbon accounting data.

Financial sector

Eventually, reporting carbon emissions will require alignment with financial reporting, as the sustainability efforts of an organisation will have financial implications, and vice versa.

The underlying principles of financial practice ensure consistency checks and direct comparability for any two sets of accounts since both have been created using the same standard principles and methodology.

Some of the underlying principles that govern the financial domain are as follows:

- Financial reporting is essential for every organisation and is embedded into the sector through mandates and regulations. Adherence to standards and regulations is required of every entity.

- Income and expenses are measured consistently in all organisations, irrespective of when and how they occur. This also usually involves the use of standard tools.

- Data can be transferred or shared from one entity to another using recognised and available standard formats.

- Reporting mechanisms are all standardised, and all audits follow standard rules.

- Skilled resources are widely available, with a single governing body — the Financial Reporting Council (FRC) — overseeing recognised accounting qualifications. This means that everyone works the same way: the skills used are the same in all organisations and are aligned to the requirements of the sector's reporting systems.

Energy sector

The energy sector is one of the significant creators of carbon emissions, and their proposed technology developments include many improvements that should be considered as recommendations for the carbon accounting data framework.

Energy Systems Catapult has recently outlined the concept for a [digital spine for the energy industry](). This supports interoperability and standardised data sharing in three key ways, which are subject to technical and governance considerations:

- Data preparation involving a containerised solution that formats data to a given standard, creating an interoperable data-sharing infrastructure

- Ecosystem trust, created by a governance or trust framework for data sharing, with defined roles, responsibilities and security controls

- Data sharing between two entities, standardised according to technical capabilities and associated governance.

MOVING TOWARDS AN IDEAL DATA MANAGEMENT FRAMEWORK

The regulatory landscape is constantly evolving, and keeping pace with environmental and sustainability legislation and targets is a significant challenge for manufacturers.

Organisations need to stay up-to-date with local, national and global requirements, adapting quickly and making the changes required to ensure compliance.

From our research and the stakeholder interviews, it was evident that accurate and consistent data is imperative for carbon accounting. Organisations need a data framework to be able to manage carbon accounting in their organisation as well as across the supply chain.

- Without a standard data framework to report carbon accounting at a company level, different functions within organisations may use different methods to account for carbon, leading to inconsistency in the reporting of emissions.
- Organisations that already have a data framework may not want to make changes that could affect integration with their other systems.
- Data collection and quality are causes for concern in many organisations with limited resources for effective data collection and management.

- Organisations have very little say or control over indirect emissions data, which is managed and collected by other organisations in the supply chain. These third-party suppliers are not necessarily collecting data accurately, if at all — if reliable primary data is not available, reporting companies have to resort to using secondary sources or industry averages instead.

- Because of a need for commercial confidentiality and data privacy, there is a reluctance to share data or information, making it difficult for organisations to work together.

For manufacturers to achieve their carbon reduction goals, these challenges need to be overcome, so that their decision-making can be informed by accurate and timely carbon accounting data. This can only be enabled through the effective use of technology, the support of a carbon regulator (recommended by Energy Catapult) and the right tools and process framework (recommended by High-Value Manufacturing Catapult) .

Drawing from the insights gained from our research, Digital Catapult recommendation is the introduction of a carbon accounting data management framework that solves the challenges identified in this report and can help organisations easily navigate the complexities of collecting and reporting on their carbon emissions.