By Alistair Stewart, Energy and Carbon Advisor, Heidelberg Materials UK

Understanding the Scope 3 Landscape

Scope 3 carbon emissions are among the most challenging aspects of carbon management. Encompassing indirect emissions across an organisation's value chain, Scope 3 emissions require a holistic approach to identify, quantify and reduce. This article provides a practical framework for energy managers to tackle Scope 3 emissions effectively, highlighting strategies to avoid common pitfalls and maximise reduction opportunities.

When discussing Scope 3 emissions, it is critical to avoid a one-size-fits-all approach. Each organisation's profile is unique, requiring a tailored strategy. Prioritising efforts starts with quantifying emissions by category, as not all activities have the same level of impact. For example, reducing emissions from business travel may be less relevant for organisations where remote work is prevalent. This underscores the importance of starting with a clear understanding of where your emissions lie.

Start with the "Why"

The first step in Scope 3 management is understanding why emissions are being reported. Your goals will dictate which categories to prioritise, the required level of detail, and the resources allocated. For instance, Procurement Policy Note (PPN) 06/21[1] is a UK government requirement for carbon reduction plans from companies bidding for public contracts. It mandates reporting on five of the 15 Scope 3 categories (4, 5, 6, 7 and 9) but includes minimum boundaries and optional inclusions. As a result, this reporting framework is neither complete nor consistent. For example, if one organisation had added the optional inclusions, it may look like they are more carbon intensive than one that didn't.

Category 1: Purchased goods and services
Category 2: Capital goods
Category 3: Fuel- and energy-related activities
Category 4: Upstream transportation and distribution
Category 5: Waste generated in operations
Category 6: Business travel
Category 7: Employee commuting
Category 8: Upstream leased assets
Category 9: Downstream transportation and distribution
Category 10: Processing of sold products
Category 11: Use of sold products
Category 12: End-of-life treatment of sold products
Category 13: Downstream leased assets
Category 14: Franchises
Category 15: Investments

This is especially important when discussing emissions' reductions. If you exclude something that you have a large degree of control over, then you miss the opportunity to make a reduction and have a positive impact.

Leverage Available Information

Scope 3 reporting doesn't need to start from scratch. Many organisations already collect data for other reporting obligations that can serve as a foundation.

Some categories, such as transportation-related activities (categories 4, 6, 7 and 9), can often be calculated using readily available tools. For example, the UK government's greenhouse gas conversion factor data tables provide emission factors for freight haulage or business[2]. Provided you know the distance travelled and load of your transport, you may make quick estimates.

By mapping current data availability, you can identify categories you can immediately address and where the gaps lie.

Identify Data Gaps

Once you've used existing data to calculate initial estimates, the next step is identifying the missing pieces. This often includes less accessible categories, such as:

- Purchased goods and services (category 1)
- Capital goods (category 2)
- Waste and processing (categories 5 and 8)
- Other downstream emissions (categories 10–15)

These categories often require more specific methods to estimate Scope 3, but by systematically addressing these gaps, you can improve the

[1]Gov.UK 2023 (PPN06/21 guidance), pg 3/4 | [2]Gov.UK 2023 (greenhouse gas conversion factors)

completeness and reliability of your Scope 3 reporting.

An important note on Scope 3 reporting is to avoid double counting across categories. For example, if transportation is included in a spend based calculation for category 1 reporting. If we double count this, when we reduce, we would be overstating our improvement.

Embrace Iteration

Scope 3 reporting is a process of continuous improvement. Initial estimates will almost always be incomplete, and as you refine your data collection and methodologies, your reported emissions may increase. This is not a failure but a positive step towards greater accuracy.

Each iteration helps identify which categories have the largest impact, enabling organisations to focus on high-priority areas. By moving from estimates or industry averages to actual data / Environmental Product Declarations (EPDs), businesses can take meaningful action to reduce emissions and improve the reliability of their reporting.

STRATEGIES FOR EMISSION REDUCTION

Once a robust reporting framework is established, the focus shifts to reduction. Strategies vary by category and depend on the level of control an organisation can exert over them.

Working with Suppliers

Suppliers often represent a significant portion of an organisation's Scope 3 footprint. Reducing emissions in these areas requires a structured approach with close collaboration.

Step 1: Identifying High-Impact Goods and Suppliers

The first step is understanding which goods and suppliers contribute the most to your Scope 3 emissions. A spend-based calculation can provide valuable insights into these impacts. This is a method of estimating Scope 3 carbon for all the purchased goods and services used with the organisation by firstly classifying all purchases by their type using standardised data tables such as NAICS (North American Industry Classification System) or CEDA (Comprehensive Environmental Data Archive). These systems assign codes to different product types. Then, after assigning a country of origin to each item, as carbon factors vary significantly between regions, we multiply the cost of each purchase by the carbon factor associated with its code and country of origin. This finally gives us a cost of carbon for each purchase that we may group by type of goods or supplier.

This analysis highlights the "hotspots" in your supply chain - specific suppliers or product types responsible for a disproportionate share of emissions, and is key for the next step of reduction.

Step 2: Engaging High-Impact Suppliers

With key contributors to your Scope 3 emissions identified, the next step is engaging with these suppliers to

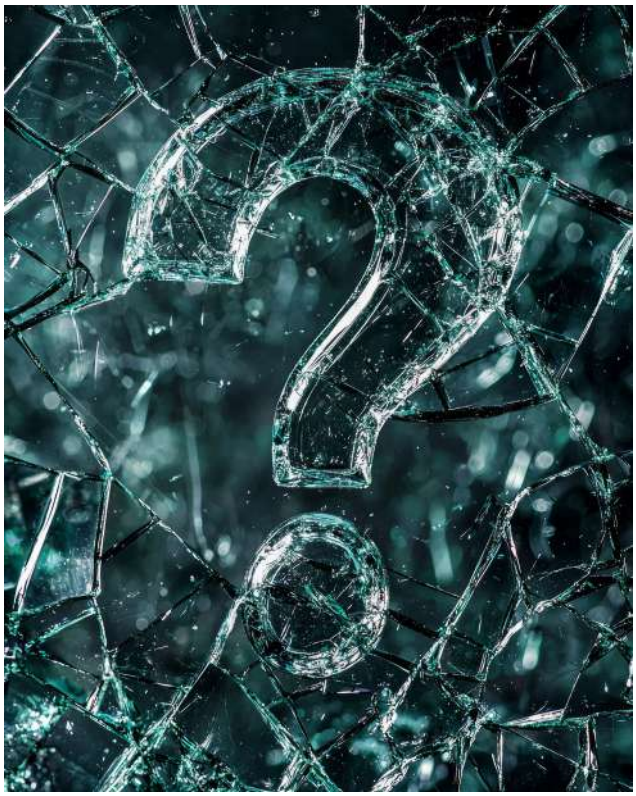
explore reduction opportunities. These are the suppliers that have a largest impact on emissions so this is where most efforts or resources should be spent. This can be approached in several different ways.

Request Carbon Data: Ask suppliers to provide detailed carbon data for their products or processes. This could include lifecycle assessments or information on their own Scope 1 and 2 emissions. By asking for the information, this creates an awareness within the supplier that this information is important and worth properly recording – this starts the process.

Explore Low-Carbon Alternatives: Work with suppliers to identify low-carbon product alternatives within their process, perhaps they already have a good alternative to the product that is lower carbon, or a different manufacturing process that could reduce emissions but was not considered. If an alternative supplier already has a low carbon alternative it may be possible to switch to them, or at least tell your supplier you will if they do not supply the same product. Also, "if you build it, they will come", if there is demand for a low carbon product then that may be perceived as a business opportunity by the supplier who may start investigating solutions.

Collaborate on Solutions: Finally, as the last step, if the need to reduce a specific goods carbon impact is great and the alternatives are sparce, it may be possible to partner with suppliers to optimise operations, such as improving energy efficiency at their facilities, streamlining transport logistics or funding an entirely new product line. This is obviously an expensive option and involves additional business risk to some degree.

It's important to approach these discussions collaboratively. Many suppliers may already be facing similar requests from other customers, but not all will have the resources or expertise to make immediate changes. Providing support, such as sharing best practices or co-investing in efficiency improvements, can help build stronger partnerships and drive mutual success.



AVOIDING BACK STEPS - UNEXPECTED CHALLENGES

To those outside sustainability roles, Scope 3 carbon emissions are often overlooked. Without proper understanding, it's easy to take well-meaning actions that inadvertently increase overall emissions.

Hidden Pitfalls: Hidden Costs of HVO (Hydrotreated Vegetable Oil)

With the majority of focus on Scope 1 emissions, many organisations in industry are switching to HVO as a low-carbon alternative to diesel due to its biomass content. However, its production carries significant Scope 3 implications, including well-to-tank emissions (category 3.3), land-use changes and resource transportation. Increased demand for HVO can strain sustainable sources, leading to unintended environmental impacts and reduce the carbon saved.

So, we could spend our time looking for the perfect fuel, however if instead we look at the root cause we can make potentially larger impacts. If we look to reduce the amount of fuel we consume in our processes, we can reduce both Scope 1 emissions, Scope 3.3 emissions and reduce our operating costs.

Whatever process you may be involved with, there will likely be situations such as these that may be identified and investigated.

Hidden Pitfalls: From Company Drivers to Franchisees - a Shift from Scope 1 to Scope 3

For a heavy industry organisation, transportation can form a large part of the emissions as it involves the transportation of large amounts of raw and processed materials. This can be done with either company owned or contractor vehicles. The type of transport used determines which Scope it is placed into, Scope 1 or Scopes 3.4 and 3.9. Ultimately, the total emissions are the same, but as a business decision, if a company

were to shift from company owned vehicles to contractor owned vehicles, their Scope 3 emissions may dramatically increase. Depending on what data you were focused on, it may appear as a step forward or back. Instead, we should focus on how the situation has changed and how to reduce the total emissions, which as a result would have the largest positive impact.

If vehicles were company owned, we could dictate which routes our transportation fleet use to minimise travel time or maximise fuel efficiency. We could choose to maintain a fleet of efficient diesel or electric trucks. Or try to maximise our fleet utilisation by making sure a truck is always transporting goods rather than travelling empty. All this makes best use of the fuel we consume to operate the business.

If the vehicles are contractor owned, we may have less managerial control and more financial control. In this circumstance, there are several levers we may use to encourage our contractor to reduce their fuel consumption:

- We may dictate a contract clause that says the contractor must purchase their own fuel.
- We may offer financial incentives for fuel efficiency targets.
- Or in niche circumstances, we may even allow them to deliver concurrently with a different client to maximise fleet utilisation in exchange for shared benefits.

Regardless of your challenges, the key point is not to become too fixated on one metric, take the time to assess and shift focus if necessary.

CONCLUSION: BUILDING A PATHWAY TO MEANINGFUL EMISSIONS REDUCTION

Scope 3 emissions represent a significant challenge in that they force organisations to interact with each other in ways that extend beyond finance. Avoiding back steps, such as shifting emissions from one category to another, highlights the importance of holistic carbon accounting and the importance of educating key stakeholders.

Ultimately, reducing Scope 3 emissions comes down to two core strategies: minimising consumption and optimising processes. Whether through reducing fuel usage, streamlining logistics or adopting low-carbon alternatives, these approaches tackle emissions at source rather than shifting responsibility, and require us to look beyond organisational boundaries.

"Ultimately, reducing Scope 3 emissions comes down to two core strategies: minimising consumption and optimising processes."

By adopting a practical, iterative approach, organisations can navigate the complexities of Scope 3 emissions and make meaningful contributions to sustainability goals. Hopefully, you may learn some interesting lessons from the above topics and pass the learnings on.

Author's profile:

Alistair has worked with Heidelberg Materials for four years, serving as Energy and Carbon Advisor for the past two. He specialises in managing Scope 3 carbon emissions, energy data, and compliance reporting for UK ETS, SECR and ESOS, with a keen focus on leading reporting trends in the construction sector.

By Richard Hildersley, Director, Ethos Industrial Ltd

Scope 3: Tackling Category 1 Emissions from Purchased Goods and Services

Preparing a complete corporate carbon footprint (CCF) inventory and setting targets aligned with science and organisational sustainability goals presents companies with significant data management and reporting challenges. Whilst a complete CCF requires integrated reporting across scopes 1,2 and 3, this article focuses on one of the most challenging and complex classes of 'value chain' category 1 emissions – purchased goods & services.

Understanding Category 1 Emissions

The Greenhouse Gas (GHG) Protocol provides the following definition of scope 3 category 1 emissions: *"All upstream (i.e. cradle-to-gate) emissions from the production of products purchased or acquired by the reporting company in the reporting year. Products include both goods (tangible products) and services (intangible products)".*

Several methods can be used to calculate category 1 emissions based on the guidance presented in the GHG Protocol. The selection is initially and largely dependent on the data maturity and management system quality prevalent in an organisation, and critically, those of its material supply chain partners.

Typically, at the outset of scope 3 reporting, companies will start with 'secondary data' sources such as spend-based reports for the range of goods and services procured, and apply generic emission factors (EFs) for each good or service type. As data quality improves over time companies then develop hybrid approaches using 'average data' measures such as product weight or volume data allowing more tailored emissions factors, e.g. for a specific material type to be applied. Making incremental progress is a requirement of the GHG Protocol.

"Companies should reduce uncertainties in the quantification process as far as practicable and ensure the data are sufficiently accurate to serve decision-making needs. Reporting on measures taken to ensure accuracy and improve accuracy over time can help promote credibility and enhance transparency".

Ultimately, making the transition to using supplier-specific product-level data (based on cradle-to-gate emissions inventory) is considered the highest point of attainment in the emissions accounting journey, it can also improve the choices made in emission reduction plans.

This article considers the improvement process in a FTSE 100 manufacturing company with a complex supply chain, a large range of products and global supply operations. The journey to improve the data is shared in distinct phases demonstrating the internal evolution - activity by activity. We explore some of the key learnings and practices adopted, and future good practices required for reporting enhanced category 1 emissions.

Data Management Evolution (2022-2024)

PHASE 1 – As part of the manufacturing company's sustainability strategy development, the central sustainability team took on a project to define the full CCF and, following the appointment of third-party consultants to validate the review, a cross business internal team was assembled to process the data for all categories and formulate the CCF inventory. The initial CCF data gathering and inventory assessment process is outlined in Table 1 on the next page.

Activities	Outputs	Challenges
Initial process of gathering physical and spend-based data from internal colleagues, 3-months	The initial data set presented a base of over 5,000 suppliers with product spend lines requiring significant consolidation into 'major' categories of goods and services Both the scale and complexity of the challenge are realised	Limited availability of physical data relating to purchased goods, e.g. weight Differing accountancy systems & classification coding variances Not all spend data is clearly defined - notably for procured 'services', and all spend values require conversion to a standardised single currency First attempt very time consuming for procurement teams – delivery of the CCF project timeline is extended
Classification of major spend categories, 1-2 months	Key goods began to emerge from divisional business, including plastics & rubber, multiple metal fractions, electronic equipment & controls, liquid & powder chemicals, lubricants, packaging	Goods do not easily match simple itemisations, such as motors which contain more/less electronics Metal and plastic types, e.g. polyurethane/stainless steel not broken down or clearly defined
Exploration of sources of key emissions, 1 month	Utilising and testing emission factors (EFs) against the categories of key goods shows where to focus effort on a 'Pareto' basis and further understand the critical supply chain partners	Difficulty in applying specific EFs without deeper supplier engagement & product analysis
Consolidation of CCF inventory using further supplier knowledge, 1 month	Categories given greater detail for specific larger spend lines, e.g. steel types and emission values for key categories are established Data set meets initial test quality for CCF using GHG Protocol	A variety of 'known unknowns' are still apparent relating to materials and physical data requiring an improvement plan for phase 2
Testing and review, 2-3 weeks	Final CCF for presentation to senior leadership Initial draft of emission reduction activities emerge Data improvement plan	Communication of the CCF and associated strengths and weaknesses of the assessment Resource challenge to sustaining the next phase of assessment

Table 1 Initial CCF Data Gathering & Inventory Assessment

Lessons learned from phase 1 for the assessment team and internal business partners:

- Engage divisional procurement specialists and attend supplier meetings
- Build relationships with key suppliers to inform and educate them in the overall methodology
- Increase the conversion of spend-based data to physical data, such as weight
- Support procurement specialists to define commercial benefits using improved contract data
- Communicate emissions reduction benefits and commercial opportunities to senior leadership and relevant divisional colleagues
- Improve the efficiency of the overall data gathering process and tools used

PHASE 2 - The original CCF inventory required an extension to cover a new business acquisition using the original cross business internal assessment team. Third party consultants were reappointed to help improve and validate the revised CCF. The undertaken process is outlined in Table 2 below.

Lessons Learned from phase 2 for the assessment team and internal business partners:

- Define which suppliers to engage first and where to direct more effort
- Sort suppliers by relevance according to:
  - the most strategic products within each product category
  - the most emission-intensive product/product category as per the CCF baseline
- Identify suppliers with long lasting relationships and/or higher leverage (e.g. in terms of spend)
- Engage current and future suppliers to collect necessary information for the maintenance of the CCF – reduce impact on internal teams
- Complete the conversion of spend-based data to physical data, such as weight
- Automate the overall data gathering process and tools

Activities	Outputs	Challenges
6–8-week process of gathering physical and spend-based data from internal colleagues	Period for gathering data reduced with process enhancements and improved staff engagement Increased reporting breadth of both purchased good types and business services	Some push back from management as activities encroach on procurement teams' resource and core function Emission results impacted by remaining spend-based data due to currency conversions & inflation, as well as the nature of spend based emission factors
Enhancement of major spend categories and relationship building with partners	Physical weight data increased for key categories reducing the reliance in inaccurate spend-based data Enhanced commercial data, i.e. spend to weight ratio between different suppliers Suppliers engaged with company decarbonisation strategy and quality/ nature of industrial processes start to emerge	Communication of benefits to senior leadership Awareness of the need for data and improved industrial practice in terms of sustainability identified as key risk with certain SME level suppliers
Consolidation of CCF inventory using further supplier knowledge	Emissions from key categories reduced as spend-based EFs change to physical data accounting	Further pressure to increase physical reporting data and supplier inputs to the process
Testing and review	Costs of assessment reduced by third party consultants	N/A

Table 2: Re-baseline Exercise Following Acquisition & Expansion of Emissions Baseline

using internal and external software specialists, and AI solutions

Lessons learned in the procurement process to reduce scope 3 emissions and enhance supply chain performance relating to key emission sources and reductions:

• Define contract terms and conditions which favour suppliers with low emission products and services:

- for example, metal-based products contracts will specify

i) low emission smelting processes such as the use of electric arc furnaces

ii) electricity generated or procured from renewable sources

iii) the maximisation of recycled metal content

- for example, in IT and data management services contracts will specify

i) low energy hardware, data storage and server technologies

ii) sustainable refrigerant use or natural cooling technology

iii) electricity generated or procured from renewable sources

• Define methods for applying supplier sustainability targets and emissions reduction activity reviews into the contract management process

• Integrate the emissions target reduction plan with any internal product life cycle assessment (LCA) programme - working together to prioritise product assessments and the resulting commercial opportunities

Summary Points

• Evolving the data management process for category 1 between phases 1 & 2 enabled a 30% emission reduction in procured metals' products using better data and more applicable EFs – this will be replicated across other goods and services.

• Improved data engagement with key suppliers goes hand in hand with improved commercial capability as product pricing is aligned with physical attribute data and cost reductions can be negotiated.

• Contract terms and conditions can be enhanced to support suppliers investing in sustainable technologies with reduced emissions compared to rivals with poor product performance and potential reputational risks.

• Data digitalisation will further extend the automation of the data gathering process, reducing team resource demands and allowing specialists to focus upon analysis, commercial support and emissions reduction activities.

• The CCF reduction plans and externally reportable roadmaps become more robust, and the near-term and long-term target commitments become more achievable to realise.

Author's profile:
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By Charles Sainsbury, Energy and Sustainability Manager, Eden Project

Scope 3: Tackling Category 2 Emissions from Capital Goods

With increasing regulatory requirements around the measurement and disclosure of carbon emissions, as well as a drive to contribute to the UK government's 2050 net zero target, scope 3 emissions categories now demand focused attention from organisations in meeting their environmental obligations. By having a robust strategy in place to measure and tackle relevant scope 3 emissions categories, organisations are likely to also benefit from improved supply chain resilience, as well as increased commercial value in retaining and winning business. This article focuses on emissions from category 2 of the 15 scope 3 categories - capital goods.

The capital goods category includes all upstream emissions (i.e., cradle-to-gate) from the production of products purchased or acquired by an organisation. Capital goods are final products that are used by the organisation to manufacture a product or provide a service. In financial accounting these are treated as assets or as plant, property and equipment[1]. Examples of capital goods include:

- Equipment
- Machinery
- Buildings
- Facilities
- Vehicles

This category can be highly variable from year to year depending on an organisation's level of business activity, e.g. through construction projects or expansion activities. Similar to purchased goods and services, an element of uncertainty in the measurement of emissions from capital goods can occur due to an over reliance on spend-based emissions factors. Emissions from the use of capital goods are accounted for under either scope 1 (e.g., fuel usage) or scope 2 (e.g., electricity usage).

MEASURING EMISSIONS FROM CAPITAL GOODS

Before being able to tackle and influence the impact of emissions from upstream capital goods, it is essential to gather a complete picture of data based on appropriate measurement techniques. Completing this overview of emission hotspots will identify areas for improvement, potential gaps in data as well as valuable context into supplier activity. Based on the GHG protocol[2], there are four primary calculation methods for scope 3 emissions from capital goods:

1. **Supplier based data** – will provide the most accurate calculation of emissions based on supplier specific data. Typically, this will come in the form of a Life Cycle Assessment (LCA) or Environmental Product Declaration (EPD) that specifies product level cradle-to-gate GHG data.
2. **Hybrid approach** – focusses on prioritising supplier specific based data and using secondary data beyond the organisation's value chain to fill any gaps where this is not available. Secondary data sources should typically be sourced from peer reviewed databases, e.g. Defra conversion factors in the UK.
3. **Activity based data** – involves estimating emissions by collecting data on the mass or number of units purchases (e.g. kg, hours spent), multiplied by the cradle-to-gate emissions factor per unit of mass or unit of a product (e.g. kg CO2e/kg or kg CO2e/hour spent).
4. **Spend based data** – if no other method is feasible (e.g. due to data limitations) then the spend based method should be used by analysing the economic value of purchases, multiplied by a relevant secondary emissions factor, such as industry averages, to estimate emissions.

It should be generally recognised that the data quality of emissions from capital goods will improve over time as data collection and supplier engagement processes become more comprehensive. The intention being to eventually work to a point where the majority of calculations are focussed at the top of the above hierarchy, i.e. from primary supplier based data.

[1&2] *Greenhouse Gas Protocol (2013),* Technical Guidance for Calculating Scope 3 Emissions

Introduction to Whole Life Carbon Analysis (WLCA)
Whilst cradle-to-gate (or upstream emission factors) should generally be used in calculating emissions from capital goods, life cycle emissions factors consider the emissions that occur at every stage of a material or product's life, from acquisition, generation and through to end of life.

Life cycle stages for completing Whole Life Carbon Analysis (as defined by EN 15978:2011) are summarised in Figure 1[3] below.

Stages A1-A3 – Product stage (Cradle to gate) – includes raw materials production, transport and manufacturing.

Stages A4-A5 – Construction stage – includes transport to site and construction process. When combined with stages A1-A3 forms Cradle to practical completion also referred to as upfront carbon.

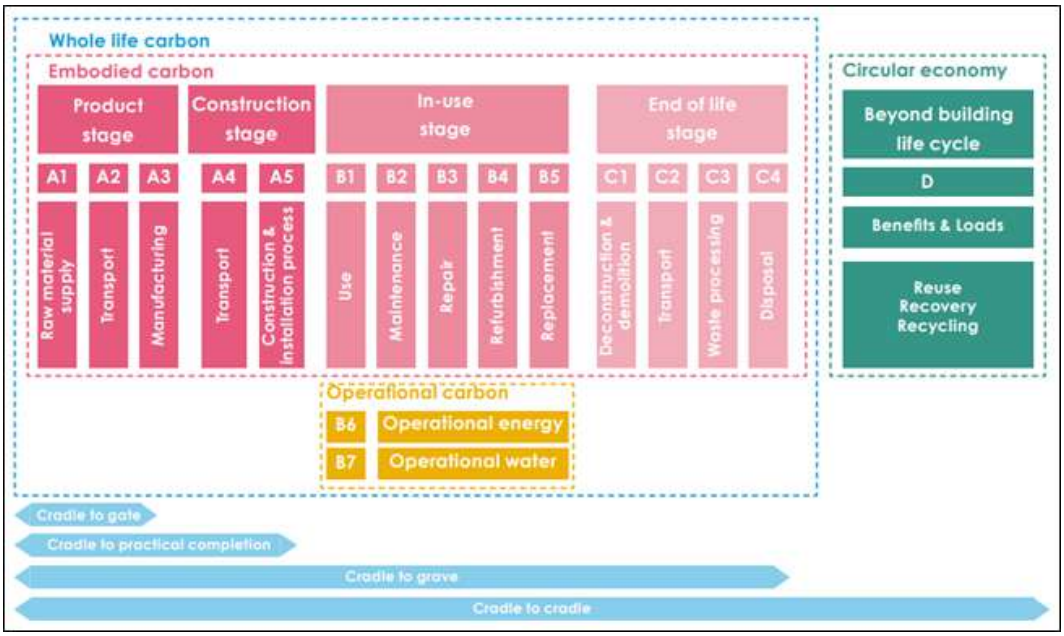

Figure 1[3]- System Boundary: EN 15978:2011 Display of modular information for the different stages of the building assessment

Stages B1-B7 – In use stage – includes use, maintenance and repair of equipment as well as operational energy and water use.

Stages C1-C4 – End of life stage – includes demolition, disposal and waste processing. When combined with stages A1-A5 and B1-B7 forms Cradle to grave.

Stage D – benefits and loads beyond the project life cycle – includes environmental benefits from reuse, recovery and recycling.

Only by looking at the whole life cycle carbon of products, materials and projects can the true impact of design choices and opportunities for reduction be understood. Adopting the whole life cycle analysis at an early stage of the decision-making process gives the greatest chance of embedding circular economy principles. Adopting these principles to integrate re-use, recycled materials and innovative design standards is fundamental in tackling emissions from capital goods.

Introduction to Environmental Product Declarations (EPDs)
EPDs are based on internationally accepted methods for LCA and are critically reviewed by an independent verifier. Specific benefits from generating or obtaining EPDs include:

- **Certification** – in order to achieve credits with environmental assessment schemes, such as BREEAM and LEED.
- **Compliance and procurement requirements** – EPDs are increasingly specified as essential requirements in organisations' tender specifications.
- **Building LCAs** – EPDs enable building life cycle assessment.
- **Product comparison** – enabling different product specifications to be benchmarked against each other.

The scope of an EPD must cover the following life cycle stages:

- **Cradle to gate:** this is the minimum scope for an EPD.
- **Crate to gate with options:** for EN 15804+A2, this is the mandatory scope.
- **Cradle to grave:** this covers the whole life cycle.

Any EPDs for products or materials used for construction projects must cover life cycle stages A1-A3, C1-C4 and stage D.

A BUILT ENVIRONMENT PERSPECTIVE - considering embodied carbon and whole life cycle carbon across construction projects.

According to the World Green Building Council

[3]*London Energy Transformation Initiative (2020),* LETI Embodied Carbon Primer, *Supplementary guidance to the Climate Emergency Design Guide*

(WorldGBC), the built environment is responsible for 39% of global carbon emissions[4], with 28% arising from operational emissions and 11% from materials and construction. In the UK, the construction industry is responsible for 49% of carbon emissions[5] and therefore represents a crucial area in the efforts to limit climate change, and achieve net zero carbon emissions. Whilst representing an opportunity for the construction industry to lead the way in decarbonising buildings, the regulatory landscape to tackle whole life carbon emissions is evolving, with current proposals under Part Z of the building regulations likely to make the completion of whole life carbon assessments mandatory for all major projects.

Embodied carbon - the level of carbon dioxide and other greenhouse gas emissions from the product, construction, use and end of life stages.

+

Operational carbon - carbon dioxide and other greenhouse gas emissions from the operation of a building from heating, hot water, cooling, ventilation, lighting, cooking and equipment.

=

Whole life carbon[6]

As the decarbonisation journey for buildings evolves, the importance of embodied carbon is growing quickly as it makes up a higher proportion of whole life carbon. As buildings source more energy from renewables and operate more efficiently, the embodied carbon from materials becomes the dominant source of carbon emissions.

Finally, a key fundamental objective in designing for optimal whole carbon, net zero carbon outcomes is the concept of circular economy. London Energy Transformation Initiative (LETI) defines[7] a circular economy as one that replaces the linear economy 'end of life' concept with restoration and regeneration, and a shift towards renewable energy and the elimination of waste through the use of materials that can be re-used, repaired and recycled.

Approaching design in this way maximises the potential for carbon recovery reported at stage D, particularly for example, when considering the end of life re-use process that can be applied to materials such as timber, steel and aluminium.

Further carbon reductions can also be achieved by selecting materials with a high carbon sequestration potential, such as sustainably sourced timber, given its ability to remove and store CO_2 from the atmosphere. This is termed biogenic carbon[8], which is carbon derived from or contained in biomass. These benefits must be reported in stage D and not stages A-C, because the carbon storage from timber used may continue after the building's life cycle is complete. For example, if it was to be disassembled and re-used on a new project elsewhere. This approach is often preferable over the use of carbon offsets to achieve net zero embodied carbon, given the potential risks around transparency and effectiveness that can come with offset schemes.

Key Design Considerations

It is crucial that whole life carbon ambitions are considered as soon as possible from the outset and concept design of any project in order to drive significant reductions in embodied carbon. A net zero operational carbon building is supplied by 100% renewable energy and meets energy performance in-use targets in line with national climate change targets. Reducing embodied carbon requires a far more in depth and considered approach across the journey of each project stage.

[4] *World GBC (2019)*
[5,6 & 7] *London Energy Transformation Initiative (2020), LETI Embodied Carbon Primer, Supplementary guidance to the Climate Emergency Design Guide*
[8] *London Energy Transformation Initiative (2020), LETI Embodied Carbon Primer, Supplementary guidance to the Climate Emergency Design Guide, page 43, appendix 3*

Table 1[9] below summarises key practical steps that can be taken by project stakeholders to drive embodied carbon reductions, summarised from the LETI (2020) Embodied Carbon Primer, Supplementary guidance to Climate Emergency Design Guide.

SUMMARY

The insights from designing and constructing new developments for the built environment highlight the importance of all stakeholders working in collaboration to achieve net zero ambitions on major projects, through embodied carbon reduction strategies.

This article has introduced the key concepts and approaches associated with tackling scope 3 emissions from capital goods, emphasising the importance of a holistic approach to whole life carbon based on circular economy principles that can also be applied more widely to the purchase of goods and services. Particular insight has been drawn from the built environment recognising both the significant challenge and opportunity the construction industry is presented with in decarbonising buildings to reach net zero through a shift to a regenerative, circular design philosophy focussed on the re-use and recycling of natural materials.

Author's profile:

Charles has over 10 years' experience spanning across a number of sectors including healthcare, property management and hospitality. Charles' expertise lies in building services, energy performance contracting, on-site generation and low carbon building design. In his current role, Charles is responsible for delivering the organisation's approach to regenerative sustainability and for all aspects of energy and water provision, including utilities procurement.

Who	Role	Actions
Client / developer	Decision making	- Define objectives for achieving net zero carbon and circular economy advancements - Identify employees in the organisation who will be given responsibility - Create a project brief which will specify low embodied carbon aspirations and adopt principles of reuse - Create a carbon reduction strategy which will specify how embodied carbon targets will be met - Appoint an experienced design team - Specify in the contract the duties of the principal contractor, such as monitoring, reporting and compliance with performance targets
Policymaker	Strategy	- Adopt a policy that prioritises circular economy principles and reuse/ refurbishment over demolition and new construction - Adopt a policy that mandates embodied carbon reduction strategies - Adopt clear embodied carbon targets - Adopt a consistent methodology for monitoring data and whole life carbon analysis - Implement a mandatory requirement for EPDs for essential building components, such as substructure, frame and upper floors
Designer	Implementation	- Adopt circular economy principle of reuse/refurbishment over new build - Train the design team to improve in-house capabilities and understanding in the areas of embodied and whole life carbon reduction - Include embodied carbon as a sustainable design metric and calculate embodied carbon of all projects - Request EPDs from all suppliers

Table 1[9] – Key actions to tackle embodied carbon to support net zero carbon developments

[9]London Energy Transformation Initiative (2020), LETI Embodied Carbon Primer, *Supplementary guidance to the Climate Emergency Design Guide*