Carbon Reduction Demystified for SMEs in Civil Engineering

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Front cover image showing WJ Group biogenic road marking system in use.

Contents

Foreword

The UK Government has set out an ambitious target to become Net Zero by 2050 and to play a part in achieving this target, CECA are delighted to be involved in helping those SMEs (small and medium-sized construction enterprises) understand the issues that surround 'carbon'. It is hoped that with this document the task will be made a little easier.

SME organisations are typically those with less than 250 employees although other definitions include those businesses with a turnover of less than c£45m and a balance sheet of less than c£40m. Combined, these make up a significant part of the construction industry.

Many resources have been made available to help organisations with understanding their role around carbon reduction, but we feel that this document, written by a mixture of main and sub-contractor members of the CECA Environment Group, provides specific awareness, advice, and examples of good practice that may be helpful.

This document is a live document, therefore should you have any feedback on it, please don't hesitate to send an email to info@ceca.co.uk with your comments.

Alasdair Reisner
CEO – CECA National

Section 1

Climate Change and Carbon

1.1 Introduction

International action was agreed in December 2015, when 195 countries adopted the first legally binding global climate deal seeking to limit global warming to "well below 2°C above pre-industrial levels" (1850 and 1990) by 2050. Since then, the UK Government have introduced several ambitious targets in line with recommendations from the Intergovernmental Panel on Climate Change (IPCC). In 2019, the Prime Minister announced that the UK would become 'net zero' by 2050, and in 2021 pledged to reduce emissions to 78% of the 1990 level by 2035[1].

More regionally and locally, some client organisations have introduced their own set of metrics. A significant number of county councils, district councils and devolved jurisdictions have declared 'climate emergencies' demonstrating local-level action to tackle emissions. Within the construction industry, commitments include:

- **Environment Agency** target is to reach net zero by 2030.
- **World Green Building Council** Net Zero Carbon Buildings Commitment (pledge to reach net zero operating emissions in their portfolios by 2030 and advocates for all buildings in operation to be net zero in operation by 2050).
- **RIBA** (Royal Institute of British Architects) 2030 climate challenge
- **Contractors Declare** (a consortium of construction businesses acknowledging climate emergency and committing to a reduction in emissions).
- **C0$_2$nstructZero**

The Government are encouraging all small business in the UK to take small, practical steps to cut their emissions as part of the overall aspiration of net zero by 2050 which includes cutting their emissions in half by 2030.

1.2 Impact of Carbon on the Construction Industry

Modern lifestyles depend on physical infrastructure, the construction of which is responsible for half of the global raw resources consumed annually and account for more than one-third of the total global energy use and associated emissions[2]. The construction industry: therefore, faces a challenge to meet the infrastructure needs of a growing population, whilst adhering to the climate change commitments the UK government are legally bound to meet.

In the UK, the construction industry accounts for 47% of total CO_2 emissions[3], showing the contribution and responsibility the sector can make towards meeting climate change commitments.

Construction carbon emissions are typically distinguished between embodied and operational; the former is associated with the initial production of a structure (material acquisition; transport of materials; on-site assembly) and the latter is associated with the operation and maintenance of the structure upon completion (heating, lighting, and air conditioning). Embodied carbon represents a considerable, and growing, proportion of the environment's attributable emissions, as grid electricity continues to decarbonise.

1. UK becomes first major economy to pass net zero emissions law - GOV.UK (www.gov.uk)
2. Science of The Total Environment; Volumes 557–558, 1 July 2016, Pages 791-807
3. Estimating the amount of CO_2 emissions that the construction industry can influence - Supporting material for the Low Carbon Construction IGT Report - Autumn 2010 (publishing.service.gov.uk)

The production of materials is responsible for most embodied emissions from construction. Cement and steel are two of the most carbon intensive materials used in construction, with steel making up around 7%[4] and concrete 7-9%[5] of global carbon emissions.

Concrete is one of the worlds most consumed resources and it has been suggested that using 1m³ of a low-carbon concrete replacement instead of traditional cement-based concrete can save approximately 0.3 tonnes, or the equivalent of driving more than 1,000 miles in a car. It is only through the adoption and use of alternative materials, methods, and technologies that significant reductions in construction emissions can be made[6].

60 year whole life carbon footprint

47,180,000 $kgCO_2e$

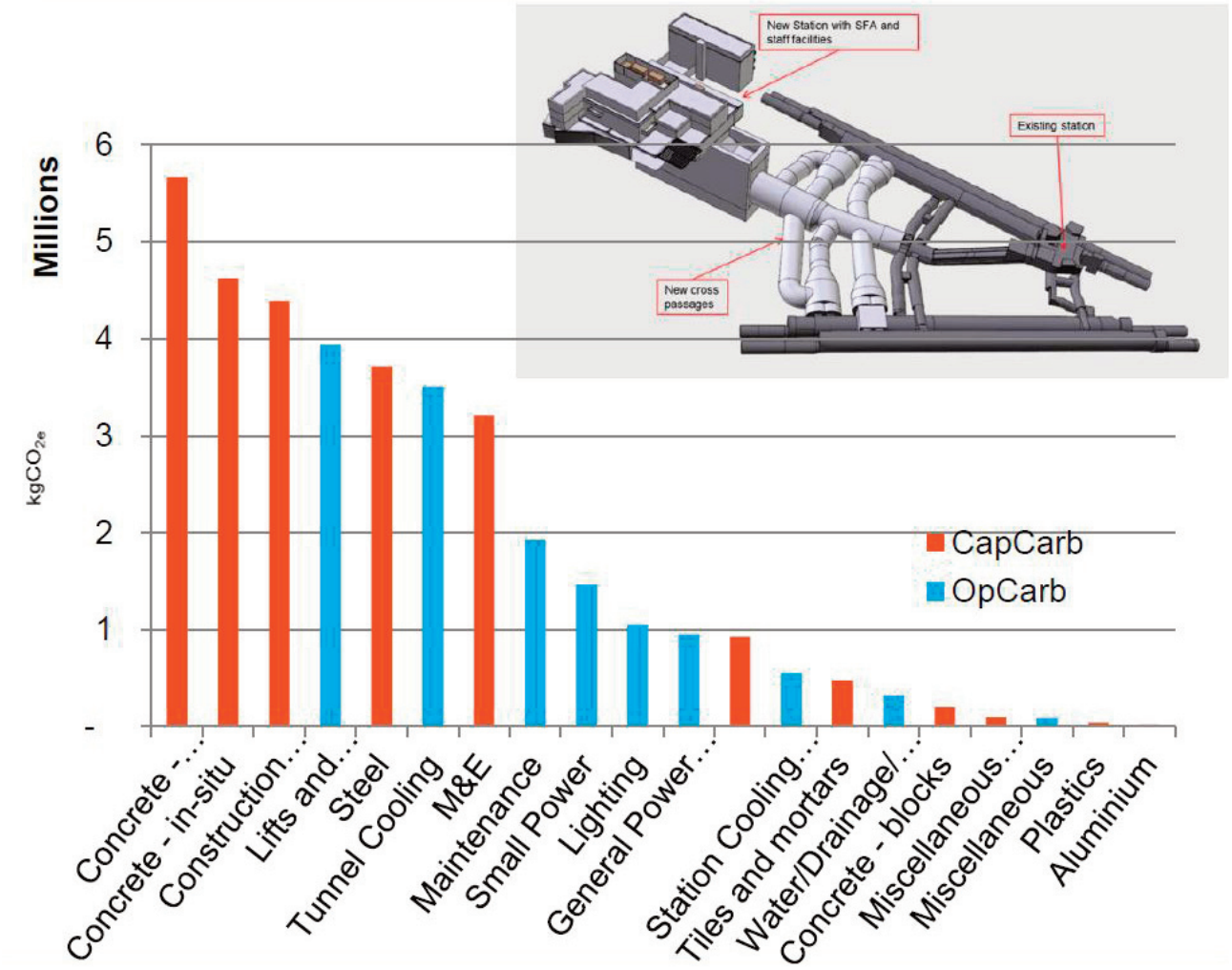

Figure 1: **Example Whole Life Carbon Footprint (Graphic courtesy of Temple Group)**

4. International Energy Agency (2018), Technology Roadmap: Low-Carbon Transition in the Cement Industry: https://www.iea.org/reports/technology-roadmap-low-carbon-transition-in-the-cement-industry
5. Stockholm Environment Institute (2018), Low-emission steel production – decarbonising heavy industry: https://www.sei.org/perspectives/low-emission-steel-production-hybrit/
6. J. Giesekam et al. / Energy and Buildings 78 (2014) 202–21

1.3 Role of the SME

SMEs account for 99.9% of British businesses (one-fifth of which work in construction) employing approximately 25% of the UK population[7]. If the whole UK economy is to shift towards a low-carbon future, the contribution of construction SMEs should not be underestimated.

SMEs are positioned in the middle of the supply chain meaning influence can be exerted by reducing the impact of on-site activities, but also through presenting opportunities to persuade clients to prioritise sustainable methods and materials.

In late 2020, CECA surveyed SME organisations to understand how they were responding to the various carbon challenges and indeed what prevents them from becoming fully engaged in delivering carbon reductions. The responses to the survey were wide-ranging; however, the underlying message was one of lack of support for the SME supply chain.

Several actions were identified because of the survey and the purpose of the following Sections is to provide useful information and guidance for all SMEs.

1.4 Cost and Carbon

There is a strong relationship between carbon and cost.

Carbon is a proxy for energy, the use of natural resources and quantities of materials; therefore, reducing carbon can reduce cost.

CARBON = COST

There may, however, be some options that reduce carbon but increase the cost. These may include novel materials or techniques/technology, but as the market for low carbon materials and construction techniques evolves these costs will reduce until they are the norm.

There may also be higher capital costs and lower operational costs associated with some solutions. It is therefore important that whole life cost is considered both at the company and project level and indeed Government guidance (HM Treasury) states that construction procurement decisions should be based on whole-life cost.

Research & Development (R&D) tax initiatives could also be another avenue worth exploring that could help reduce an SME's carbon footprint and cost!

7. Blog: Small and medium enterprises (SMEs) are vital to UK decarbonisation – how do we meaningfully engage them? | Corporate Leaders Groups

Section 2

Simple Explanations of Key Concepts and Definitions

2.1 Green House Gas (GHG)

A greenhouse gas (GHG) is any gas in the atmosphere that contributes to the greenhouse effect (the process causing climate change). It is both necessary and important to have GHGs within our atmosphere to warm and regulate the surface temperature of the Earth and allow life to exist. However, science is now showing us that increasing the amount of GHGs in the atmosphere increases the temperature of the Earth's surface and can lead to detrimental changes in our climate impacting life on Earth.

Carbon dioxide (CO_2e) equivalent is commonly referenced when discussing GHGs, however, there are many naturally occurring GHGs including methane, ozone, water vapour, and many more manufactured GHGs used for refrigeration and insulation.

2.2 Global Warming Potential (GWP)

Global warming potential (GWP) refers to the ability of a GHG to absorb heat and contribute to global warming. The higher the number, the greater a GHGs impact on increasing the Earth's temperature. GWP is measured against the same mass of CO_2, which has a GWP of 1. For example, methane has a GWP of around 25 so 1 kg of methane is 25 x more harmful than 1kg of CO_2.

2.3 Carbon Dioxide equivalent (CO_2e)

CO_2e is calculated from the GWP. It provides a standard unit for measuring the impact of different gases by describing them in terms of the equivalent amount of CO_2 that would have the same warming impact of that gas. For example, methane has a GWP of 25. A release of 200kg of methane would be equivalent to releasing 5,000kg of carbon dioxide so would be described as 5,000 kg CO_2e.

2.4 Descriptions for Scope 1, 2 & 3 Emissions *(Also see Figure 1)*

2.4.1 Scope 1

Scope 1 carbon emissions are those produced directly from owned or controlled sources by an organisation. Typically, this includes the combustion of petrol, diesel and gas used to power vehicles, plant, and onsite generators as well as any refrigerant and insulation-gas leaks.

2.4.2 Scope 2

Scope 2 carbon emissions are those produced indirectly from the purchase of electricity used by the organisation to power offices, sites, factories and battery-powered tools, plant, and vehicles.

The carbon emissions are related to those produced during the creation of energy such as coal and gas-fired power plants. Procuring electricity from a 'green' energy supplier can significantly reduce or even eliminate Scope 2 emissions.

Renewable (green) energy is that produced by wind, solar, hydroelectric, biomass, etc.

Guaranteeing energy is green or renewable is confirmed when energy is provided with REGO (Renewable Energy Guarantee of Origin) certificates; however, your energy supplier will be able to advise

Non-renewable (brown) energy is that produced by coal, gas, oil and nuclear.

2.4.3 Scope 3

Scope 3 emissions relate to those produced indirectly by an organisation from sources which they do not own or control. These are typically where most of an organisation's emissions sit and can make up to 80% of the carbon footprint. Scope 3 emissions can include those from waste, water, business travel, transport, and distribution, purchased goods and services. Identifying and measuring Scope 3 emissions can be a challenge. Examples of Scope 1, 2 & 3 are given below in Figure 2.

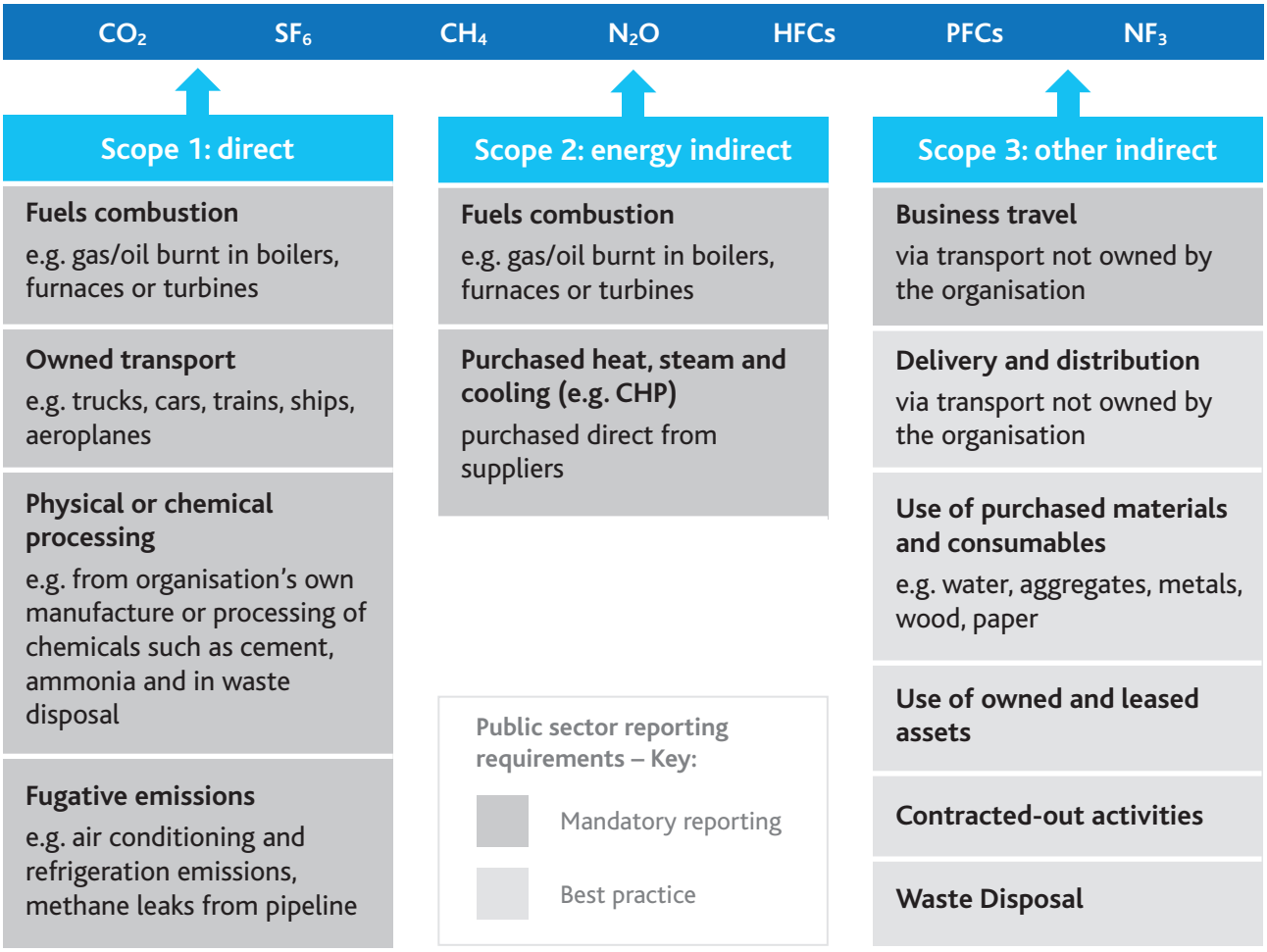

Figure 2: **HM Treasury (2019) Sustainability Reporting Guidance 2019-20**

2.5 Infrastructure Carbon Review

Published in 2013, The Infrastructure Carbon Review sets out a series of actions for government, clients, and suppliers to reduce carbon from the construction and operation of the UK's infrastructure assets, in line with the UK's climate change commitments.

It draws clear links between carbon and cost savings, identifying carbon as a proxy for resources efficiency and using the terms capital and operation carbon to align the language to capital and operational expenditure. PAS 2080 Carbon Management in Infrastructure was developed in response to this review.

The original review was revised in March 2021[8].

8. https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2021/04/Infrastructure-Carbon-Review-seven-years-on_March-2021.pdf

2.6 Capital Carbon

Capital carbon relates to those emissions arising from the creation of an asset including its refurbishment and end-of-life treatment. Capital carbon is being used as a term in the infrastructure sector drawing a comparison to capital cost/ operational carbon.

2.7 Operation Carbon

Operational carbon are those emissions that are related to the operation and maintenance of the asset, and it is typically quantified in terms of tonnes of CO_2e equivalent per year.

2.8 Whole Life Carbon

Whole Life Carbon is the operational carbon and capital carbon emissions over a project's expected life cycle, including construction, use of the asset, demolition, and disposal.

2.9 End-user Carbon

These are emissions from the end-user of the asset. These are not directly controlled by the asset owner; however, they can influence how the asset is used and therefore the associated carbon.

2.10 Embodied Carbon

Embodied carbon is similar to capital carbon; however, in this context, it relates to individual products and not the asset. It takes into account the carbon emissions associated with the extraction and processing of materials and the energy and water consumed during manufacturing to make the product.

2.11 Target setting

A carbon target is the required quantity of carbon emissions that should not be exceeded through the delivery of an asset or programme of works. It can be expressed as either an absolute value or as a reduction relating to a baseline value. A target should be specific, measurable, attainable, relevant and time-bound.

2.12 Baselining

When setting a baseline, it is important to have a clear understanding of what the carbon emissions would have been if planned measures for reducing emissions were not undertaken. It is important to ensure a 'typical' scenario is considered when baselining and not a 'worst case' scenario.

2.13 Offsetting

Carbon offsetting involves reducing or removing carbon to compensate for additional carbon or other GHGs released into the atmosphere because of an activity. Offsetting is normally carried out by paying a third party who will conduct offsetting on behalf of an organisation. One tonne of carbon offset represents the reduction of one tonne of carbon dioxide or its equivalent in other greenhouse gases.

Offsetting should only be considered after all opportunities for eliminating and reducing carbon have been explored and should not be seen as a way of 'paying to pollute.' When selecting an offset, consideration should be made to ensure that any offsetting scheme used is to a recognised standard such as the Verified Carbon Standards or Gold Standard VER (Verified Emission Reduction).

2.14 Insetting

Insetting refers to a company offsetting its emissions through a carbon offset project within its value chain. In contrast to a typical offset project, emissions are avoided, reduced, or sequestered upstream or downstream within the company's value chain.

2.15 Science-Based Targets

Science-based targets show companies how much and how quickly they need to reduce their greenhouse gas (GHG) emissions to prevent the worst effects of climate change. Targets are considered 'science-based' if they are in line with what the latest climate science considers necessary to meet the goals of the Paris Agreement – limiting global warming to well below 2°C above pre-industrial levels and pursuing efforts to limit warming to 1.5°C.

2.16 Carbon Neutral(ity) vs Net Zero?

Boundary – *Carbon Neutrality* has a minimum requirement of covering Scope 1 & 2 emissions with Scope 3 encouraged. *Net Zero* must cover Scope 1, 2 & 3 emissions.

Level of ambition – For *Carbon Neutrality*, there is no requirement for a company to reduce its emissions on a particular trajectory. To be *Net Zero*, an organisation must be reducing its emissions along a 1.5°C trajectory across Scopes 1, 2 & 3.

Approach to residual emissions – To achieve *Carbon Neutrality*, an organisation must purchase carbon offsets that either result in carbon reductions, efficiencies or sinks. For *Net Zero*, an organisation must purchase greenhouse gas removals that result in carbon sequestration from the atmosphere.

Section 3

Carbon Management, PAS 2080:2016 and other carbon standards

3.1 Introduction to PAS 2080:2016

PAS 2080 (PAS stands for Publicly Available Specification) is a carbon management standard for infrastructure although its principles could be applied to any sector. At its core, PAS 2080 sets out how carbon should be managed throughout a whole project life cycle and provides advice, guidance, and requirements for all members of an asset's value chain. It works best when applied by all parties in a project; however, all organisations can also affect change in their direct areas of influence.

PAS 2080 does not set out actual carbon reduction measures, it is not a list of low carbon technologies or solutions which can be applied to an infrastructure project to reduce its carbon impacts. Instead, it is a management standard that defines how a project team should work to identify, assess, and report on low carbon opportunities across the lifecycle of the project.

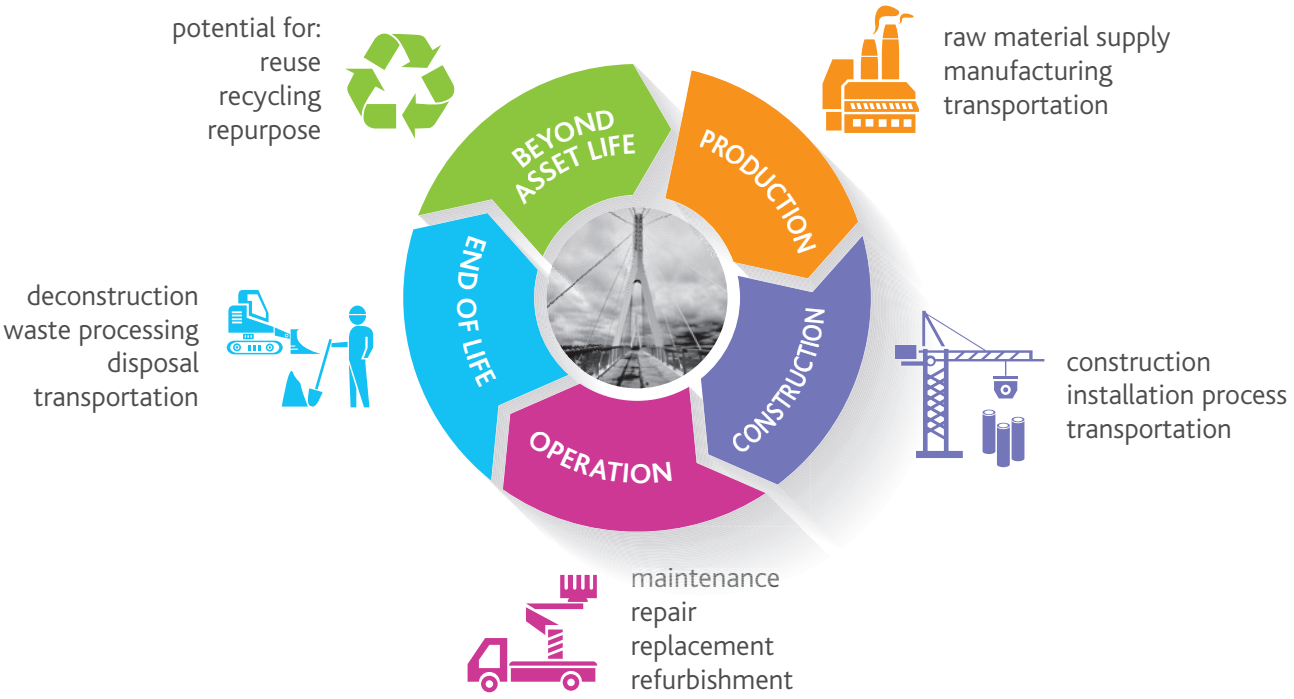

Figure 3: **Project Carbon Lifecycle**

PAS 2080 covers the full project life cycle and defines action under four principal areas: asset owner, designer, consultant, and product/material supplier. It helps to identify how consultation between different value chain members at various stages of the project will support the successful delivery of low carbon solutions. It also requires learning to be captured and applied to the approach for the next project.

3.2 PAS 2080 Requirements

This PAS includes requirements for all value chain members to show leadership and to establish effective governance systems for reducing whole life carbon through the use of a carbon management process. The individual value chain requirements in the carbon management process are structured around the following components:

- setting appropriate carbon reduction targets
- determining baselines against which to assess carbon reduction performance
- establishing metrics (e.g. Key Performance Indicators) for credible carbon emissions quantification and reporting
- selecting carbon emissions quantification methodologies (to include defining boundaries and cut off rules)
- reporting (including regular meetings) at appropriate stages in the infrastructure work stages to enable visibility of performance. This could include carbon reporting during construction on items such as material use, fuel use, vehicle movements, waste, electricity, and
- continual improvement of carbon management and performance.

3.3 What PAS 2080 means for CECA members?

PAS 2080 is an important document that provides an opportunity for CECA members to engage earlier in construction projects. To deliver PAS 2080, asset owners, designers and main contractors need to identify and assess low carbon opportunities for the project which requires the skill set and experience of companies from across the industry.

3.4 What does it mean to work on a PAS 2080 project?

Awareness of what is required

The whole project team must understand what is required of them in terms of achieving carbon targets and goals. To do this you may need to consider:

- Understanding the carbon impacts associated with certain materials and methods of construction. Look at the opportunities for reduction of materials and the use of different materials. Use the principles of Lean Construction. *See link: Lean Construction*
- Providing the correct information to allow carbon emission calculations. Quantities of materials, design mix or specification information that may affect the carbon emissions associated with a material or product.
- Understanding of key carbon impacts with your key supply chain and opportunities for reduction – for example, what low carbon solutions can your supply chain offer, what are the practical considerations (cost (increase/saving), availability, programme (gains or loss) and again, revisit Lean Construction (*see above*).
- Understanding commercial conditions around carbon reduction opportunities and in particular, the effect of carbon on WLC (whole life cost).

Skanska case study

The link to the video provides a useful insight into how a Tier 1 contractor approaches a PAS 2080 project.

View case study

SKANSKA

Carbon Data

You will be asked for data to either allow carbon emissions to be calculated or carbon reduction options to be appraised. Carbon data needs to be consistent, robust, and transparent – remember project teams will be making risk/cost-based decisions so expect data to be scrutinised.

Tendering

When tendering for PAS 2080 projects you will be asked for low carbon solutions or case studies. These do not have to be from PAS 2080 projects so it is worth drawing together a list of information that can be used to support tendering. When preparing examples consider the data used for the example and try to make it robust and transparent to support the project team's evaluation.

Other Carbon Guidance

PAS 2060 – Carbon Neutrality. This is a verification programme that enables participating organisations to prove that their claims to be 'carbon neutral' can be shown to be genuine.

Government Policy Procurement Note 06/21. This government guidance describes how to take account of carbon reduction plans in the procurement of major government contracts. A key part of the contractor's requirements relates to those bidding on government contracts worth more than £5m per year. It will be necessary to provide a Carbon Reduction Plan which confirms commitment to achieving net zero by 2050 and sets out the environmental management measures that need to be in place during the performance of the contract. *See link for further details: PPN 06/21*

Carbon Trust Standards. The Carbon Trust Standard helps organisations develop and communicate their leadership in carbon, water, and waste management. A rigorous third-party assessment means users receive the expertise and knowledge to become climate leaders on their journey to net zero.

The Carbon Reduce Scheme (formally Achilles Cemars). This programme assists organisations to measure, manage, and report their carbon footprint.

ISO 14064-1 Greenhouse Gases – Part 1. This document specifies principles and requirements at the organization level for the quantification and reporting of greenhouse gas (GHG) emissions and removals. It includes requirements for the design, development, management, reporting, and verification of an organization's GHG inventory.

An SME organisation may be able to use the principles as good practice and on a voluntary basis but would most likely not go down the full verification/certification route due to the associated costs.

Supply Chain Sustainability School

The Supply Chain Sustainability School (SCSS) has a vast range of resources that are available, freely to SME organisations. These can be used to help deliver carbon management 'quick wins'. *See Section 7 for the link to the school.*

Section 4

Estimating, Monitoring, and Reporting Emissions (Tools)

4.1 Step #1: Boundary and scope setting

To calculate carbon emissions the first decision is to establish whether this is for an organisation as a whole or a specific element such as work associated with a project.

This is known as setting the 'boundary' constraints.

Organisations also need to determine which elements should be included in the emission calculation. This is typically achieved by considering whether it has financial or operational control of activity.

Where there is such direct control, then it is likely that the emission is your responsibility and is considered in 'scope' and should be included in the calculation.

4.2 Step #2: Time period

The next step is to decide the period across which measurement should be set. This can be the calendar year, the tax year for company reporting, monthly for project reporting or a custom period for the whole project assessment.

A consistent approach should be followed.

4.3 Step #3: Data gathering

You should then gather data on energy consumption.

Energy consumption can be measured as the quantity of fuel (litres), usage (kWh or m^3), or via an indirect measure such as mileage travelled, spend on fuel, the quantity of waste, etc. if an associated emissions factor is available and is used.

Examples of typical data that should be gathered are given in Table 1 on the following page.

Table 1: **Examples of data gathering for carbon reporting**

Scope	Energy consumed / emissions source	Typical units
1	Company vehicle fuels (petrol and diesel use) See link - **Defra Conversion Factors**	Litres Split by fuel type e.g. diesel, petrol, etc.
	Company vehicles (were no fuel data available)	Miles (or kilometres) Odometer readings /mileage travelled Note: take care to split out business and personal travel
	On-site electrical generation (diesel/gas oil use)	Litres Estimation technique: manufactures fuel consumption x hours run (generator)
	Gas (main supply)	m^3 Meter reading or utility bills
	Air conditioning units (for GHG release)	Kgs (of CFC/HCFs) Service records
2	Electricity (main supply)	kWh Meter reading or utility bills
3	Water consumption (potable supply)	m^3
	Waste produced/sent to landfill	Tonnes Waste transfer notes
	Concrete*	Tonnes
	Steel*	Tonnes
	Aggregates*	Tonnes
	Private vehicles (used for company business) (Grey fleet)	Miles (or kilometres) Expenses claims/cost per mile

*Note: Material use can be included as a Scope 3 emission. Carbon factors can be obtained from the Principal Contractor (PC), Supplier of Environmental Product Declarations (EPDs) **

**Environment Product Declarations (EPDs) give bespoke environmental information including carbon impacts for a specific material or product from a particular supplier. They are considered the gold standard in carbon data and offer the most granular information that can be provided for a product or material.

EPDs provide the sort of evidence needed to allow proper comparison between one material or product against another. EPDs are voluntary and do cost suppliers money to develop and publish – they may not be available for the materials or products used in your normal operations. Explore availability of EPDs of the main materials or products. If no EPDs are available, check for more widely published data on the Institution of Civil Engineers (ICE) database or UK Government Green House Gas Conversion factors.

When collecting data, always look to collect the most accurate data possible e.g. litres of fuel used, quantities of electricity (kWh) or gas (m^3) ahead of proxy measures that may introduce small margins of error e.g. miles driven where actual fuel consumption would be influenced by driver behaviour, type of vehicle, engine size, etc.

Also be aware of the potential for double-counting, for instance, if collecting total vehicle fuel consumption in litres of fuel, it is not necessary to get mileage data too, as it would reflect the same energy source.

4.4 Step #4: Emissions factors

The UK Government publish a set of emissions factors for many different fuel types. These are updated annually. Presented in a table format, you first identify the fuel type or emission source type relating to the base unit of measure of your data.

Look up the table for the CO_2e figure for the relevant fuel and unit.
(*See link here https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021 and also at the end of the document*).

4.5 Step #5: Calculation of carbon emissions

The calculation of carbon emissions is based on a simple method:

Carbon emission = energy consumption × relevant emissions factor

For example:

Energy consumption = 143,219 Ltrs diesel

Emissions factor (from Defra tool) *See extract below:*

Fuel	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Diesel (average biofuel blend)	tonnes	3,028.61	2,986.60	0.30	41.71
	litres	2.54603	2.51072	0.00025	0.03506
	kWh (Net CV)	0.25568	0.25214	0.00003	0.00352
	kWh (Gross CV)	0.24057	0.23724	0.00002	0.00331

Emission = 143,219 Ltrs x 2.5460 kgCO_2e/Ltr

= 364,890 kgCO_2e

or 364.9 tonnes CO_2e

Calculate the emissions for each fuel type and/or source to produce a total figure.

4.6 Step #6: Reporting

The sum of all emissions calculated, typically as $kgCO_2e$ or tCO_2e should be reported.

To allow effective comparison of data, it may be appropriate to normalise the output to give a measure of carbon intensity e.g. tCO_2e/£ turnover, tCO_2e/m^2 floor area, tCO_2e/hrs worked, etc.

A brief description of the period selected as well as the scope and boundary should be detailed so that the reader will understand what has been measured and when.

4.7 Estimation techniques

Whilst every effort should be made to gather accurate information i.e. actual quantity of energy consumed, sometimes this is not possible and estimation techniques should be used.

Typical examples include where direct fuel consumption of vehicles or plant is not available. Alternatives could include distance travelled i.e. mileage for which there is a direct emissions factor.

Where this is not possible, an estimation of hours, for example, of operation linked to manufacturers stated typical fuel consumption per hour could be used to estimate consumption.

A further scenario might be where shared office space is used; estimation options could include accounting for the proportion of floor space or proportion based on headcount/occupancy levels of the total energy consumption.

Where such shared facilities are used, it is worth checking the boundary and scope of reporting of any other parties to ensure that double counting and reporting is not occurring.

Whichever estimation approach is used, the objective is to produce a unit of measure of the energy consumed and for which there is a corresponding emissions factor.

4.8 Tools for calculating footprinting

There are several tools freely available that have, in some circumstances, been produced by clients that help the calculation of the carbon footprint. Such tools are typically project specific.

The same basic approach applies in establishing the boundary and scope and gathering base date for a noted period.

The data is then simply entered into the tool (often based on excel worksheets), and it will calculate the carbon footprint in the desired format.

Examples of such tools are presented as an appendix to this document (*see Appendix 1*).

4.9 Target setting

While it is important to measure and report project or company emissions in line with client or legal requirements, the aim should be to reduce absolute emissions as far as possible.

This makes good business sense as any reduction will be reflected in reduced energy costs as well as minimise the operational impact on the environment and contribution to climate change.

Good practice is to set targets and put into place actions that help reduce emissions.

Any such target should be relevant to the business or project. Targets are often based on a reduction in emissions by a pre-determined percentage or reduction in the quantity of a specific fuel. Supporting such targets will be a series of specific time-bound actions that will deliver the reductions.

Factors to consider in setting such targets would be the cost-benefit, resources available, and practicality in the business context.

More widely, the UK Government have agreed to a series of legally binding carbon reduction commitments and is increasingly placing obligations on businesses to deliver against these. These can be found as part of the paper on Nationally Determined Contribution.

See link - UK Government NDC.

A further commitment was provided in the Sixth Carbon Budget to cut emissions by 78% by 2035.

In contributing to this approach, science-based targets of restricting global warming to 1.5°C by 2050 can be set. To help businesses in understanding the targets that they should set, a specific tool can be used (*see Section 7*).

Section 5

Key actions to reduce emissions

5.1 Introduction

After measuring and baselining emissions, you should focus on where you can achieve the greatest CO_2e savings and produce a plan which outlines targets, actions to meet them and clear responsibilities. A good starting point would be to look at IEMA's (Institute of Environmental Management and Assessment) GHG Management Hierarchy, namely:

1) Eliminate

- Influence business decisions/use to prevent GHG emissions across the lifecycle
- Potential exists when organisations change, expand, rationalise, or move a business
- Transition to a new business model, alternative operation, or new product/service

2) Reduce

- Real and relative (per unit) reductions in carbon and energy
- Efficiency in operations, processes, fleet, and energy management
- Optimise approaches e.g. technology and digital as enablers

3) Substitute

- Adopt renewables/low carbon technologies (on-site, transport, etc.)
- Reduce carbon GHG intensity of energy use and energy purchased
- Purchase inputs and services with lower embodied/embedded emissions

4) Compensate

- Compensate 'unavoidable' residual emissions (removals, offsets etc.)
- Investigate land management, value chain, asset sharing, carbon credits
- Support climate action and developing carbon markets (beyond carbon neutral)

You are also likely to need to improve the carbon literacy and understanding of your workforce through comprehensive training and awareness.

5.2 Sector suggestions for reducing carbon emissions

Table 2: **Actions to reduce carbon emissions**

Topic	Area	Actions
Energy	Corporate	• Undertake energy audits of permanent premises and monitor energy consumption. Set targets for reduction • Procure utilities on 100% renewable energy sources, potentially as REGO (Renewable Energy Guarantees of Origin) tariffs • Establish an energy reduction plan, including a behaviour change plan
	Engineering/ construction site	• Prioritise and plan early connections to the grid • Make renewable and low carbon power sources (electric, hydrogen, hybrid, etc.) the accepted standard for all plant and machinery (generators, tower lights, pumps, etc.) • Ensure accommodation incorporates energy-efficient, renewable and low carbon technologies
Transport/ plant & machinery	Corporate	• Cost and plan the transition to ULEV vehicles. Incentivise staff to select a ULEV • Establish a programme to install charging points for electric vehicles • Encourage and incentivise conservative fuel consumption driving behaviours (via vehicle trackers, etc.) • Put in place a Green Travel Plan to encourage the use of virtual meetings and public transport where appropriate
	Engineering/ construction site	• Use energy-efficient plant and machinery (electric, hydrogen, hybrid, HVO fuel, etc.). Consider lifecycle cost, fuel savings and potential for greatest carbon saving • Monitor telematics for plant and machinery and produce idling reduction plan/training • Plan logistics to minimise delivery miles/ consolidate deliveries • Minimise the movement of excavated material off-site and distances moved on site
Waste	Engineering/ construction site	• Ensure management plans for materials and waste are in place and regularly reviewed and updated • Reduce waste through careful specification and buying with takeback agreements • Select your waste contractor based on their waste recovery rate. Find out what happens to your waste! • Identify avoidable wastes and investigate methods of reducing their use • Prioritise waste reuse options e.g. charities, ahead of disposal

Topic	Area	Actions
Materials	Engineering/ construction site	• Prioritise the use of recycled, secondary, and low carbon materials • Purchase materials that meet a sustainability standard (e.g. BES6001). *See link – BES6001* • Buy local materials wherever possible to reduce transport impacts • Consider the longevity of the materials that you use – if it needs to be replaced frequently, its impact will be greater • Ask your suppliers for Environmental Product Declarations (EPDs) and use this data to compare and select products. • Undertake a life cycle assessment on key materials being used and identify alternatives
Design	Engineering/ construction site	• Consider carbon through design and specification decisions • Propose low carbon solutions to clients within tenders/delivery • Challenge clients if you have an innovative low carbon solution to offer • Ensure temporary works are as efficient as possible and explore low carbon options • Incorporate design for disassembly and other circular economy principles into your design • Ensure structural material strengths are not generalized but optimized for different uses • Try to standardise components and designs • Maximise offsite production and modularisation and measure carbon savings
Leadership and awareness	Engineering/ construction site	• Upskill your leaders and ensure staff know this is a business priority • Set targets based on the company's footprint and break down the emissions by target date (some will be much easier than others) • Roll out a carbon literacy programme with training appropriate to the job role. Use existing free resources such as those provided by The Supply Chain Sustainability School • Incentivise staff to address carbon within their remit

Section 6

Case Studies

The following case studies hopefully provide an insight into how an SME can make a difference when it comes to addressing the carbon challenge.

1.0 Bridge Civil Engineering – Net Zero Journey

Bridge Civil Engineering is an SME that delivers projects between £10k and £1m in the SouthWest of England. They were acutely aware that their knowledge around 'carbon' needed to be brought in line with the current government and client aspirations and needed a quick and simple solution to achieve this.

Dave Ellis, their Managing Director, briefly explains their situation before getting help.

"We didn't know where to start and now we know it's directly about our buildings, our offices, our fleet first and then working onto our site emissions, which is a much more complicated process and that involves obviously linking with our suppliers."

"We're homing in first, I think as everybody is, on what we control and attempting to improve there first."

Through a third-party organisation, Bridge Civil Engineering committed to an FNZ (Future Net Zero) initiative including a 'Race to Zero – Pledge & Plan,' and are now delivering against that plan, including:

- Decarbonise fleet via Hydrotreated Vegatable Oil (HVO), electrification
- Ensuring their energy supply is via a 100% renewable or low carbon source
- Assessing investment in onsite generation (Solar PV)
- Installing a renewable heating system to replace oil-fired heating at site including combustion of fuels onsite within the reporting period April 2021 – March 2022
- Explorong Scope 3 value chain emissions and reporting emissions from the most appropriate activity and looking at material use (bricks, concrete, aggregates, metals etc.)
- Planning, developing and executing a carbon neutral project

There is a cost to providing this service; however, the graphical representation via a Dashboard provides simple, easy to understand information that can be acted upon if necessary.

The resulting Action Plan concluded that Bridge Civil Engineering had set out a future roadmap that will be embedded into the company's culture. Actions included buying from renewable sources, using less energy and waste. They now have a good understanding of the operational Scope 1 & 2 carbon footprint and in going forward in the reporting period of 2021-2022 they will start to include fuel combusted on work sites and look to include Scope 3 material use into their reporting. They will be looking to report Scope 3 activities in the footprint report going forward and should explore planning a carbon neutral project by 2025.

2.0 Colas – Immingham Link Road – use of CCS & CEEQUAL

The use of CCS (Considerate Constructors Scheme) and CEEQUAL (Civil Engineering Environmental Quality Assessment Scheme) are often undervalued by clients in helping to drive the low carbon agenda. In particular, Colas has taken it upon themselves to commit to the use of CEEQUAL on all UK projects because it provides a hugely valuable framework for identifying, minimising, and monitoring environmental impacts.

The project included the construction of a 2.5km link road with a footway/cycleway connecting the towns of Immingham and Grimsby.

Key outcomes included:

Waste	• Processed and re-used 13,176t of hardcore waste and 581t of soil • Recycle/re-use rate of ≥95% • Use of sustainable timber • Carbon steel re-bar produced from scrap metal • 1A General Fill 100% recycled • 6F5 Course Capping 67% recycled • Type 1 Sub-base 100% recycled
Innovation	• Deep-soil mixing technique reduced onsite activity and material consumption • Use of hydrogen-powered site cabins
Social Value	• Recruited local personnel • Local supply chain used for £2.7m of spend • Green buffers and wildflower meadows provided

3.0 FM Conway – Westminster City Council King Street Low Carbon Trial

The King Street low-carbon roadworks scheme covered 270m² of the street and involved replacing existing paving which had reached the end of its lifespan. The trial was used to compare low carbon working against more traditional methods and a comparison was made with a similar-sized site also located at Malborough Hill.

The table below shows the difference between the two schemes.

	Marlborough Hill	King Street
Estimated Value	£35,500	£41,000
Paving (m²)	306m²	268m²
Kerb (m)	108m	124m
Kerb line Asphalt (m²)	32m²	37m²
Excavation (m³)	61m³	29m³
Excavator Model	KUBOTA KX015-4	JCB 19C-1 Etec Excavator
EV Charging Points	N/A	2 x 22kv CityEV Chargers & FP
Cycle Stands	N/A	Relocate 8no & reused 8 from other scheme
Wacker Model	Belle PCLX320	WackerNeuson AP1850WE
Saw Model	STIHL TS410	Hasqvarna K535i
Welfare Unit Type	Eco – With Diesel Generator	Eco – With Electric Connection
Grab Lorry Fuel Type	Diesel	HVO
Delivery Vehicle Fuel Type	Diesel	HVO
No of Operatives on Site	3	3
Operative Travel Type	Diesel Van, Public Transport	Electric Van, Public Transport
Supervisor Travel Type	Diesel Van	Electric Van

CO_2 savings were made by:

- Reducing paving thickness, which allowed for more efficient vehicle deliveries – saving 291kgCO_2e. Those reductions also meant a saving in embodied carbon, reduction in waste removal and reduction of packaging giving a further carbon saving of 110kgCO_2e
- The site welfare facilities were being powered by electricity from renewable sources and on-site renewable energy – seeing a 2750kgCO_2e saving on conventional diesel welfare cabins
- The electric-powered plant and small vehicles making savings in red diesel consumption and petrol equating to 1300kgCO_2e
- Using HVO (Hydrotreated vegetable oil) in diesel HGVs where the technology was not available to change to an electric or zero-carbon alternative. HVO can save up to 90% of carbon emission but for the purposes of the trial, the evaluation has assumed 50% savings equalling 550kgCO_2e

4.0 Jackson Civil Engineering – Woodbridge Floodwall

One of the more obvious areas to focus on is the replacement of carbon-intensive materials such as concrete.

Jackson Civil Engineering identified concrete as the single largest contributor to its carbon footprint. Carbon embodied in concrete is four times greater than the organisation's scope one and two emissions combined annually.

They have been trialling low carbon concretes for some time but were keen to trial and use a new cement-free concrete on this project to ascertain its performance and promote its wider use.

Because the product is innovative, there was resistance to its use from designers, but the team worked closely with the client and the Environment Agency to get its use agreed, jointly taking all risks for its use. A zero-cement, sustainable alternative to concrete had been used to form the concrete core of the new floodwall.

This was the first application of this concrete in permanent works anywhere in the country. The team worked together with the manufacturer and trialled the material in a test slab in the site compound to gather data on workability, strength gain, and durability of surface finishes, as these were all concerns raised by the supplier.

However, after a successful trial, the material was passed for use in the wall core and gives a carbon saving against the equivalent low carbon concrete mix of around 67%, which equates to a saving of around 7.842 tonnes of CO_2e for the site. Against a traditional mix, this is a saving of up to 90%.

5.0 WJ Group Ltd - Hydrocarbon vs Biogenic systems for road lining

WJ's drive towards net zero and having a sustainable legacy came about following a review of their operations. The process was highly informative and led them to significant carbon savings by swapping traditional hydrocarbon equivalents to using biogenic binder systems in their road marking activities.

Although conducted at quite a small scale, WJ has proved that innovative thinking can be applied in any situation, namely on a small project in Dorset. See below.

Activity	C5 Resin tCO_2e/t	Bio-resin tCO_2e/t
Product	0.36	0.07
Delivery	0.06	0.06
Boilers & Lances	0.17	0.17
Travel to site	0.06	0.06
Total	0.65	0.36

There was a carbon saving of 44% and WJ have calculated that with an economy of scale, on a larger project the carbon saving is more likely to yield a 67% saving.

Further, WJ Group Ltd is leading on a project called the Product Carbon Footprint Model which is a quick, efficient, and reliable means of assessing and reducing carbon on its products.

For further information see link - WJ Carbon Footprint Model

Section 7

Training and Useful Links

The following section provides links to further reading and useful links to organisations and bodies that provide more detailed information around Carbon and more often than not associated training on the topic.

Table 3: **Useful information links**

Organisation / Topic	Known As	Link
BRE Range of technical papers	BRE	GO
British Standards Institute PAS 2080	BSI	GO
Building Services Research and Innovation Association Whole Life Cost Analysis	BSRIA	GO
Construction Leadership Council & the Green Construction Board Zero Avoidable Waste in Construction	CLC & GCB	GO
Chartered Institution of Water & Environmental Management Range of environmental topics	CIWEM	GO
Ellen Macarthur Foundation Looks at Circular Economy		GO
Green Book Live Search for approved environmental products and services		GO
Institution of Civil Engineers The Carbon Project: the critical role of the engineer in reaching net zero	ICE	GO
Institute of Environmental Management and Assessment Carbon footprint	IEMA	GO
One Click LCA Ten design commandments for cutting your buildings embodied carbon	LCA	GO
Science-Based Targets Provides all necessary links to set up SBTs and become verified		GO
Supply Chain Sustainability School Most topics	SCSS	GO
UK Green Building Council Delivering Low Carbon Infrastructure	UKGBC	GO
UK Business Climate Hub (for SMEs)		GO

APPENDICES

Appendix 1: Carbon Calculators

Organisation / Tool	Comments	Link
Project-wide Tools		
National Highways	Latest version v 2.3 published 2019	GO
Transport Scotland Project Carbon Tool	Last updated 2016. (Needs checking). No direct link available – must contact TS for access (free)	GO
Environment Agency Carbon Tool	Please contact the Environment Agency for further advice. Updated in 2021	GO
Certification Tools		
Achilles Carbon Reduce	Certification to ISO 14064 or PAS 2050. Offers calculation methodology. Fees apply	GO
Carbon Trust	Carbon Trust Third Party verification of carbon emissions. Fees apply	GO
PAS 2080		
See section 3 of this guide	Note: several consultancies offer paid-for calculation tools and services	GO
Conversion Factors		
UK Government Annual published conversion factors	Annually updated comprehensive suite of carbon emissions factors to enable a DIY approach to carbon calculation	GO
University of Bath: ICE calculator	ICE Version 3.0	GO
UK Government Pathway Calculator		
The Mackay Carbon Calculator	This provides a model of the UK energy system that allows you to explore pathways to decarbonisation, including net zero by 2050	GO

Organisation / Tool	Comments	Link
Specific Carbon Calculators		
Build Carbon Neutral (USA)	Online estimation tool enabling approximate embodied carbon calculations. (Note: US tool)	GO
Asphalt Pavement Embodied Carbon Tool (ASPECT)	**ASPECT provides a methodology** to calculate the life cycle greenhouse gas emissions or 'carbon footprint' of asphalt used in highways	GO
BRE Green Book	Required to register (free with BRE). Greenbook provides information on the carbon footprint of products.	GO
EPD Eco-Platform		GO
EPD Registry		GO
Briefing Paper		GO
Target Setting		
Science Based Targets	Process and declaration tool for setting science-based targets for 2050 (when emissions already known)	GO

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Please send any comments to **info@ceca.co.uk** in the first instance