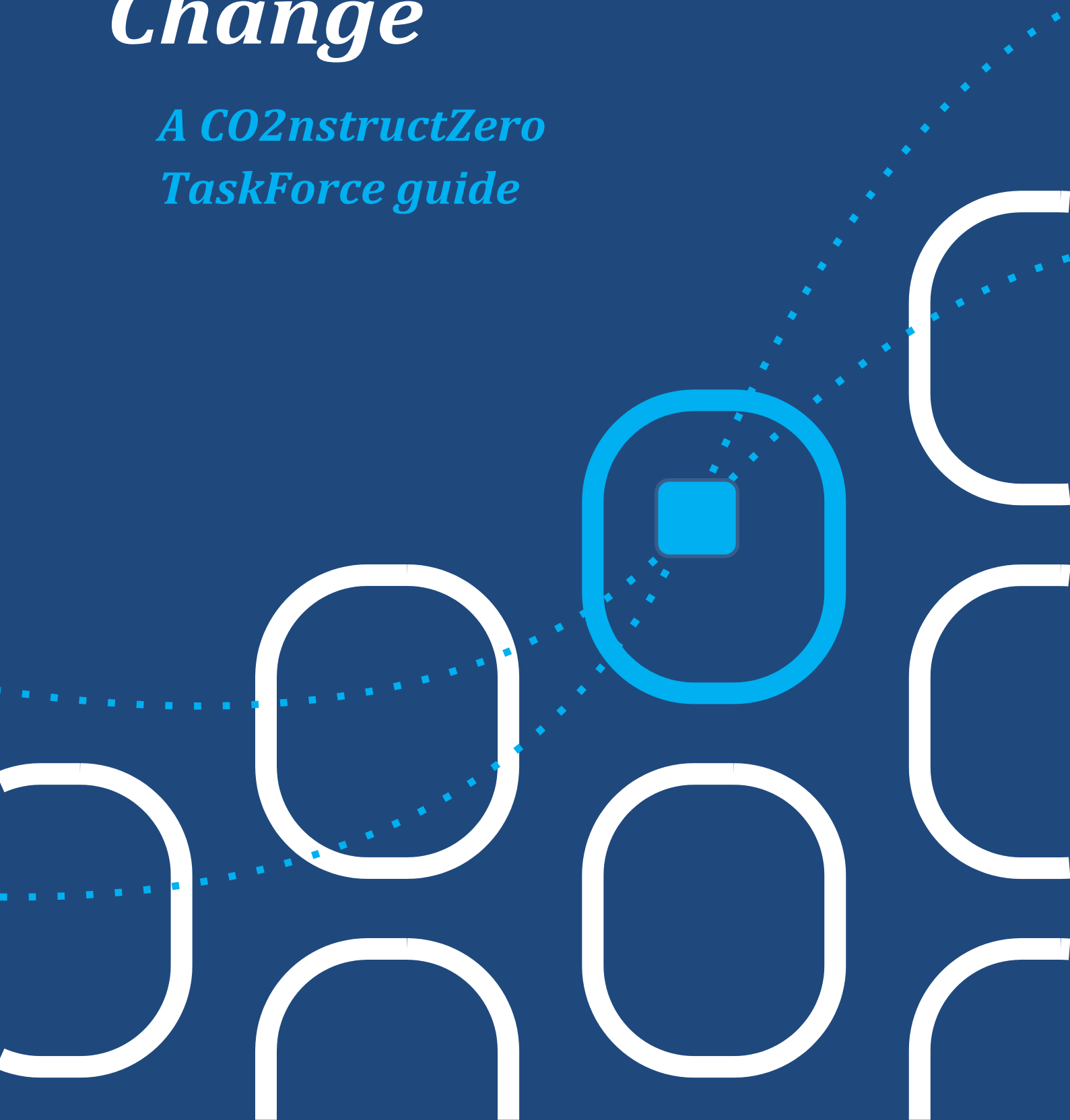
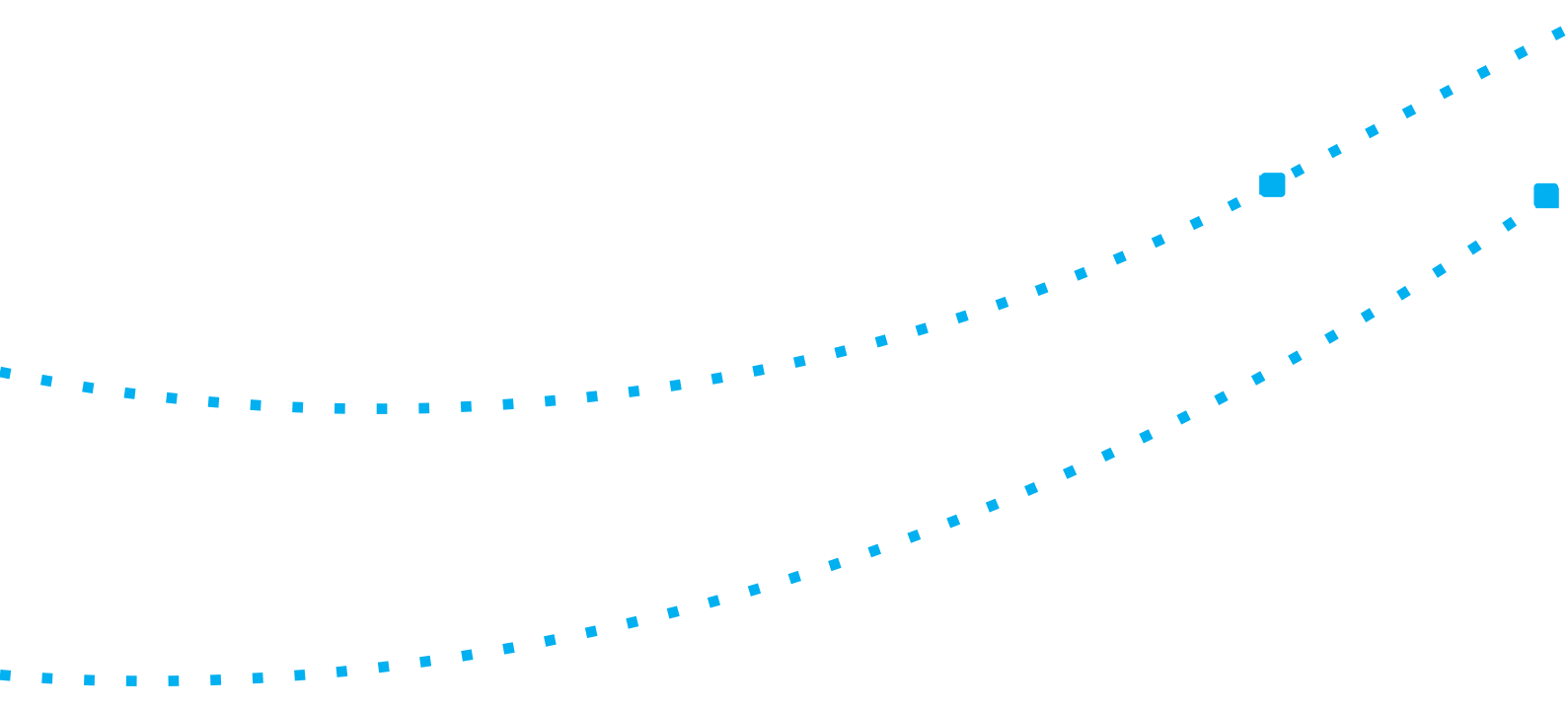


# *Construction & Climate Change*

*A CO2nstructZero  
TaskForce guide*





A guide produced by



with thanks to





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# Executive Summary

*By 2050 all CO2 emissions in the UK will need to be avoided or have their impact offset. With input from CEF's CO2nstructZero Task Force, we have developed this simple yet detailed guide outlining emerging technologies and suggested actions to help industry orientate in this fast-changing space.*

## Regulatory Landscape

There are numerous pieces of legislation that, for the moment, primarily target larger companies.

Key legislation and regulation to be aware of includes:

- **The Climate Change Act (Northern Ireland) 2022** commits the region to net-zero carbon emissions by 2050 and to reduce 48% of baseline emissions of by 2030.
- **Energy Savings and Opportunities Scheme (ESOS)** requires large employers to report on their energy consumption and identify opportunities to make energy savings.
- **Streamlined Energy Carbon Reporting (SECR)** has mandated large companies to report annually on their energy usage as well as emissions.
- **UK Emissions Trading Scheme** is a cap-and-trade system creating a carbon market with a carbon price signal to incentivise decarbonisation.
- **The Climate Change Levy** is an environmental tax charged on the energy that businesses use. It's designed to encourage firms to be more energy efficient.
- **Additional Risk and Risks Disclosures** that challenge businesses to consider the impact of climate change on their operations such as exposure to new risks and opportunities.

## CO2 Emissions Overview: Emission Scopes

Greenhouse gas (GHG) emissions are categorised into three groups or 'scopes':

- **Scope 1** covers direct emissions from owned or controlled sources.
- **Scope 2** covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company.
- **Scope 3** includes all other indirect emissions that occur in a company's supply chain

## Reducing Emissions

Significant emission sources for the construction industry include petrol & diesel, natural gas & heating oil and mains electricity. There are technologies available to reduce emissions including:

- **Renewable Energy Technology-** includes solar photovoltaic (PV) arrays and Air Source Heat Pumps (ASHP) to meet energy and heating requirements.
- **Electric Machinery-** a wider range of heavy machinery used on construction sites will move from diesel engines to fully electric models
- **Hybrid Generators-** an alternative to diesel generators on site, hybrid generators are fitted with a battery bank which can be utilised when energy demand is lower
- **Green Hydrogen -** emitting only water when burned, hydrogen is ideal for reducing the CO2 emissions across a range of appliances.
- **Biofuels-** several biofuel alternatives are current available in the market to fuel vehicles and reduce emissions.

### **Promoting Change Internally**

Encouraging employees to reach sustainability goals is vital if organisations are to reduce emissions. Firms can consider simple steps to begin including nominating energy champions, training employees to save energy and running energy reduction campaigns. Some examples of energy reduction actions an organisation can take to reduce emissions across operations are:

- **Energy**- create an energy reduction plan and carry out energy audits of business premises to identify potential savings and monitor consumption
- **Transport/Plant & Machinery**- start transitioning company fleet vehicles to lower emission alternatives and investigate the viability to switching to alternative fuels such as hydrogenated vegetable oil (HVO)
- **Waste** – reduce waste through careful specification and buying with takeback agreements while identifying opportunities for reuse of waste such as working with local charities.
- **Design & Materials** - prioritise the use of recycled, secondary, and low carbon materials and Incorporate design for disassembly and other circular economy principles into a design

### **Life Cycle Assessment and Embodied Carbon**

Reducing the energy used to make construction products, called embodied carbon or embedded energy, and the need to collect data from industry has prompted the development of methods such as the Life Cycle Assessment (LCA) which evaluates the environmental impact of processes and products during their life cycle.

As companies report their emissions data, they will be required to account for these under scope 3 emissions from supply chains. Ways to reduce embodied carbon include:

- Increasing the recycled and by-product content of the materials used
- Examining environmental information provided by different suppliers such as EPD or carbon footprints to determine which products have lower impact in your building
- Utilising the [Green Guide Online](#) which enables users to compare the overall environmental impact and embodied carbon of similar building elements.

### **Working with Supply Chains**

Procurement Policy Note (PPN) 06/21 requires UK government departments to procure larger contracts only from firms that record and report Scope 3 emissions- those generated by the supply chain. As such supply chains will be of critical importance the construction sector works to reduce emissions.

Early communication with supply chains is recommended. Firms should take action to outline the benefits of beginning a transition to reduce emissions to suppliers. Your expectations should also be conveyed at the earliest opportunity to your supply chain to encourage them to change ahead of further regulation.

## Utilising Data

One of the first steps is to build a GHG emissions inventory. This enables organisations to identify the source of all emissions produced.

Step by Step approach should be taken to:

- Establish baseline measurement of Scope 1, 2 and 3 emissions.
- Analyse impact hotspots and identify the highest potential for reducing emissions.
- Set KPI's & (Science-based) targets
- Execute & monitor your carbon reduction plan
- Analyse & offset your carbon emissions to become carbon neutral

## Understanding your data – key questions to ask:

- What emissions does your business produce?
- Where and when they are produced?
- Where are most emissions produced and what operations do they apply to?
- Are they direct or indirect?
- Who is responsible for them?
- Calculate how many tonnes of CO<sub>2</sub> is produced
- Use this information to build a GHG emissions inventory

Building a carbon inventory will ensure an organisation understands their emissions data. This data is then used to establish baseline, set targets, and track progress overtime including reductions from investment.

## Using your emissions data

- Understand what emissions data is showing:
  - Interrogate the data
  - Identify trends in the data – opportunities for reduction
  - Carbon hot spot - Carbon hotspots represent not only carbon-intense or high volume elements but also quick wins, where measurement data is more easily available and where carbon reductions are possible.
- Establish your baselines
  - Start with Scope 1 and 2
  - Identify low hanging fruit (minimum investment) and what will require more investment to achieve reduction targets – build into Carbon Reduction Plan
  - Opportunities to eliminate / reduce emissions
- Set targets
  - Agree targets and suitable KPIs to and use historical emissions data to forecast
  - Measure, monitor and report impact of investments and progress against targets – use data to track progress



# Introduction

*Estimates on how precisely climate change affects the planet vary, but two things are now certain: it will have a direct impact on business, society and the environment and governments will increasingly seek to mitigate these effects with higher levels of far-reaching regulation. The construction industry like all sectors has, for the most part, freely emitted CO2 until recently but all businesses will increasingly find that emissions have a steep cost, both for their reputation and their bottom line.*

*In 2019, the UK Government reset its 2008 target and became the first developed nation to legislate on a net zero target. This means that, by 2050, emissions from industry, homes, transport, buildings and all other sectors of the economy across the UK need to be avoided or have their impact offset. The built environment contributes approximately 40% of the UK's total carbon footprint, and almost half of this is from the construction process as opposed to their "functional operation".*

*As the largest client and procurer of construction projects the UK Government is moving to provide the regulatory, fiscal and policy framework to accommodate further emission reductions across the public sector. From September 2021, for example, all contractors bidding for UK central government contracts worth more than £5 million a year have been required to provide a Carbon Reduction Plan confirming their commitment to achieving net zero by 2050. It is therefore imperative that our industry continues to prepare. Firms must become familiar with a new nomenclature, develop and devise strategies to upskill and carefully monitor and react as existing and new regulations impact operations.*

*This guide aims to help members and the wider industry understand the direction of travel, where we are and what is on the horizon.*

*Moving forward stakeholders, from employees to shareholders and investors, will demand proactive action to support delivery of the UK's net zero target. A failure to shift working methods and business culture to a more sustainable and low-carbon-based approach could ultimately damage a firm's reputation, ability to win new work and attract the best staff.*

*Refurbishment and retrofitting will be a primary tool of lowering emissions from the built environment and changes to the legislative landscape will continue to funnel the industry toward net zero buildings. The UK government is expected to further incentivise building electrification and adopt stronger requirements for energy efficiency in medium- to large-scale refurbishment projects. In short, the construction sector will need to adapt and change working methods, the products and materials used and equip workforces with new technologies and the skills to achieve this aim.*

*An early commitment to change is therefore advised, firms must not wait for new regulations and policies but consider making commitments to net zero and plan how to adapt at company, project and product level. A transition now, ahead of competitors and in advance of any mandatory measures, could reduce costs and enable the scaling-up of successful net zero measures.*

*With input from our members and with thanks to CEF's CO2nstructZero Task Force, we have developed this simple yet detailed guide outlining emerging technologies and suggested actions to help businesses of all sizes orientate in this fast-changing space with links included to the most relevant information available.*

# Why Act? Regulatory Landscape

*As reporting frameworks around carbon emissions become more standardised, it will become simpler for governments to tax a broader base of carbon emissions generated by businesses and its customers or suppliers.*

## 3.1 Current Regulation Overview

*To date, climate regulations have focussed on large businesses while requirements on smaller companies have remained voluntary. Some examples include:*

- **Energy Savings and Opportunities Scheme [ESOS](#) 2014** – ESOS operates in four year cycles and has required companies (250+ employees or turnover over £44m) to report on their energy consumption and identify opportunities to make energy savings.
- **Streamlined Energy Carbon Reporting [SECR](#) 2019** -the Streamlined Energy Carbon Reporting has mandated large companies to report annually on their energy usage as well as greenhouse gas emissions. This applies to all UK listed companies, large companies (as defined in the Companies Act 2006) and large Limited Liability Partnerships.
- **Adaptation plans** have been requested from [certain individual organisations](#) of national strategic importance, such as infrastructure networks and utility companies.

### **Climate Change Legislation Northern Ireland**

*The headline emissions reduction targets in the UK are to reach net-zero greenhouse gas emissions by 2050. In March 2022 the Northern Ireland Assembly passed climate change legislation also committing the region to net-zero carbon emissions by 2050 with an additional commitment to reduce 48% emissions by 2030. Sectoral ‘carbon budgets’ (the amount each sector of the economy can emit) could be in place by as early as next year.*

### **UK Emissions Trading Scheme**

*Additional ‘carbon taxes’ are being pursued via the climate change levy and the UK Emissions Trading Scheme. The UK Emission Trading Scheme (ETS) is a cap-and-trade system which caps the total level of greenhouse gas emissions, creating a carbon market with a carbon price signal to incentivise decarbonisation. Read [more information and guidance on participating in the UK ETS](#).*

### **The Climate Change Levy**

*The Climate Change Levy is an environmental tax charged on the energy that businesses use. It's designed to encourage businesses to be more energy efficient in how they operate, as well as helping to reduce their overall emissions. Further information can be found [here](#).*



## 3.2 Risk and Risks Disclosures

*Previous UK Government requirements on the private sector have focussed on energy and emissions data, new regulations will go much further and target smaller companies. The aim will be to challenge businesses to not just consider the climate impact **of** a company's emissions, but also the impact of climate change **on** the company – such as exposure to new risks and opportunities. These risks can be divided into two broad categories:*

- **Physical risks:** *such as the impact of extreme weather on business continuity, supply chains and infrastructure.*
- **Transition risks:** *as the market moves toward net-zero, businesses will need to evaluate their model of operation, and how compatible their products and services are with a net-zero future.*

*Currently Regulations and risk disclosures target large employers. A brief summary can be found below:*

### Taskforce on Climate related Financial Disclosures (TCFD)

TCFD are mandatory climate-related financial disclosures by publicly quoted companies, large private companies and LLPs Recommendations have been adopted on both mandatory and voluntary basis around the world. Disclosures across four key themes:

- **Governance:** Disclose the organisation's governance around climate-related risks and opportunities.
- **Strategy:** Disclose the actual and potential impacts of climate-related risks and opportunities on the organisation's businesses, strategy, and financial planning where such information is material.
- **Risk Management:** Disclose how the organisation identifies, assesses, and manages climate-related risks.
- **Metrics and Targets:** Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.
- Further information can be found [here](#)

## Sustainability Disclosure Requirements (SDR)

Announced in 2021 SDR is an integrated framework which focuses on “decision-useful disclosures” – with an aim to better integrate environmental information within capital financial decisions. SDR will apply initially to the following sectors, although its impacts aim to be economy wide.

- **Corporate**, including UK-registered companies, financial services firms (e.g. banks and insurance companies), and UK-listed companies.
- **Asset managers** – such as life insurers and pension schemes.
- **Investment products** – this includes consumer investment portfolios

The rollout of SDR has knock-on implications for Small and Medium Sized Enterprises (SMEs) who will increasingly be required to disclose climate related financial risks to financiers. More information can be read [here](#).

# CO2 Emissions Overview

*Greenhouse gas emissions are categorised into three groups or 'scopes' by the most widely-used international accounting tool, the Greenhouse Gas (GHG) Protocol.*

Direct, indirect and supply chain greenhouse gas emissions are the key metrics for any climate strategy. Every organisation will have to develop an understanding of their emissions which are categorised into three 'scopes':

- **Scope 1** covers direct emissions from owned or controlled sources.
- **Scope 2** covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company.
- **Scope 3** includes all other indirect emissions that occur in a company's supply chain

*Carbon Neutrality has a minimum requirement of covering Scope 1 & 2 emissions and it is encouraged that Scope 3 is measured. To reach 'Net Zero' any organisation must account for Scope 1, 2 & 3 and take action to mitigate these emissions.*

*To achieve 'carbon neutral', an organisation may consider the purchase of carbon offsets that either result in carbon reductions, efficiencies for example. To achieve Net Zero an organisation may have to go further and purchase greenhouse gas removals that result in carbon sequestration from the atmosphere.*

## 4.1 Emission Scopes

### **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*

### **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.*

**Scope 3:**

Emissions from scope 3 include all the other indirect emissions within your value chain. This includes the upstream supply chain (suppliers), as well as downstream GHG emissions e.g. occurring with customers. For example, emissions from business travels, waste disposal transportation, or investments. For many organisations, the scope 3 emissions provide a dominant impact category

As such there are a number of benefits associated with measuring Scope 3 emissions. For many companies, the majority of their greenhouse gas (GHG) emissions and cost reduction opportunities lie outside their own operations. By measuring Scope 3 emissions, organisations can:

- Assess where the emission hotspots are in their supply chain;
- Identify resource and energy risks in their supply chain;
- Identify which suppliers are leaders in terms of their sustainability performance;
- Identify energy efficiency and cost reduction opportunities in their supply chain;
- Engage suppliers and assist them to implement sustainability initiatives
- Improve the energy efficiency of their products
- Positively engage with employees to reduce emissions from business travel and employee commuting

**Three Scopes of Emissions**

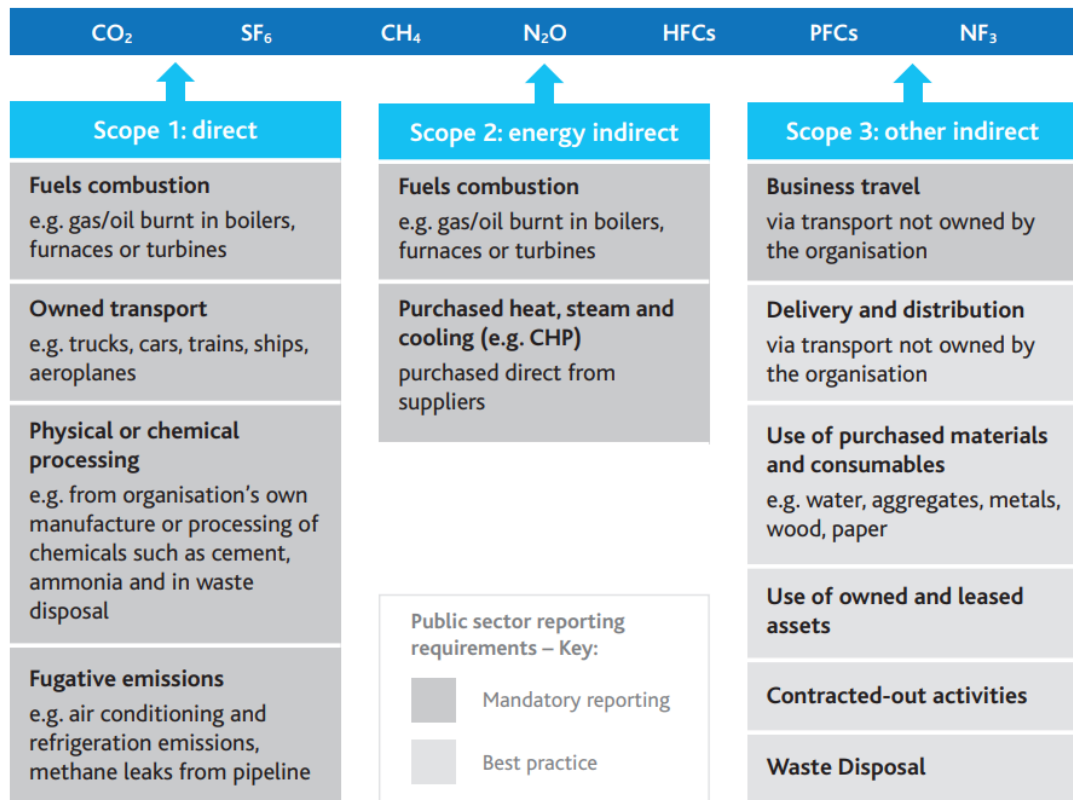
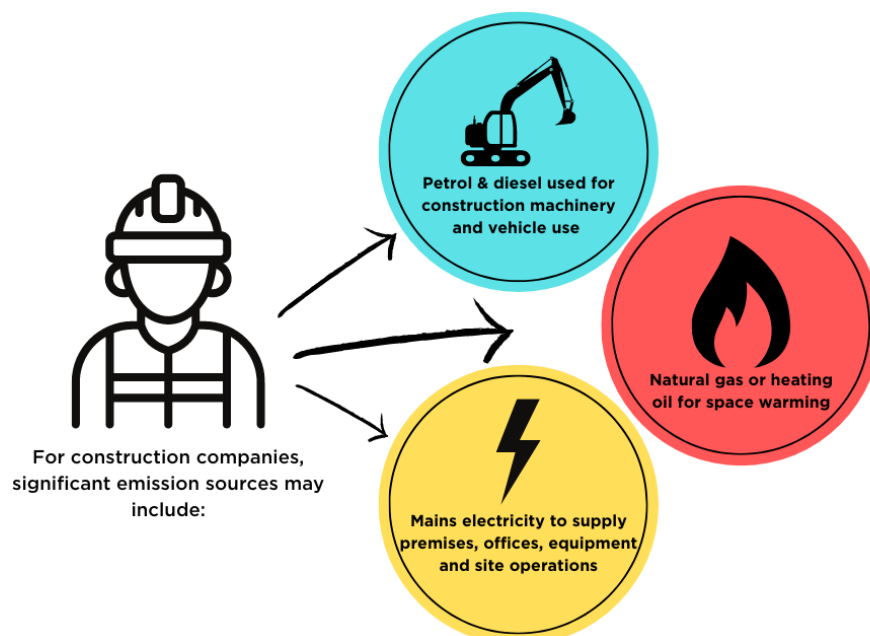


Figure 2: HM Treasury (2019) Sustainability Reporting Guidance 2019-20

# Reducing Emissions

Depending on the scope of direct and indirect emission sources assessed and the significance of the source to an organisation's operational activity, there will be different pathways and technologies to avail of to lower emissions.

## 5.1 On Site - Energy Alternatives Overview



### **REGO Backed Electricity Supply**

The Renewable Energy Guarantees of Origin (REGO) scheme aims to provide transparency about the fuel mix disclosure and the proportion of renewable generation of the supply. The scheme is administered by Ofgem on behalf of the Department for Business, Energy & Industrial Strategy (BEIS) and in Northern Ireland by the Northern Ireland Authority for Utility Regulation (NIAUR). Certificates are issued per megawatt hour and provide evidence that renewable energy sources contributed to the share of supply and evidence of your purchase of renewable power. If electricity usage represents a significant proportion of your organisations carbon emissions, utilising a REGO back supply will demonstrate a commitment to carbon reduction.

### **Renewable Energy Technology**

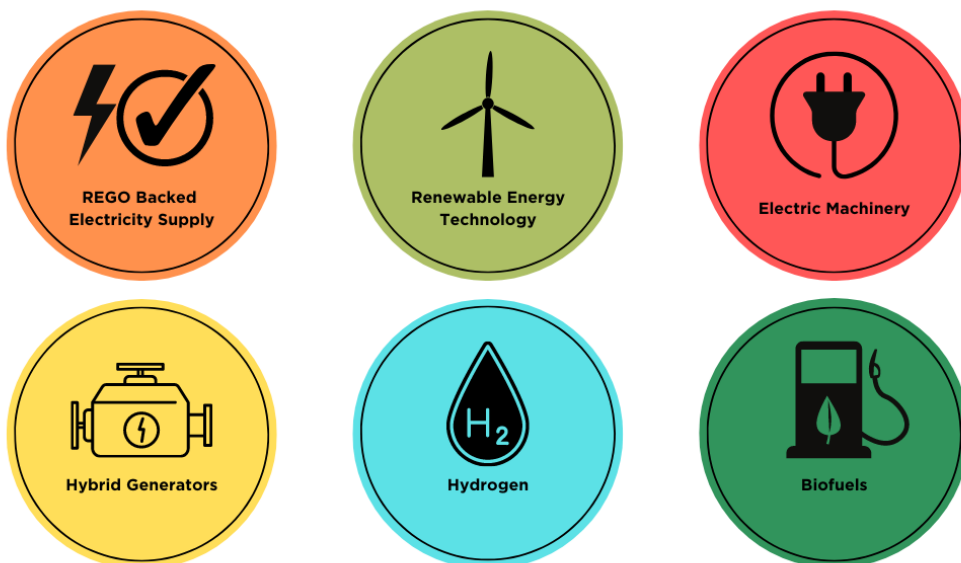
*Decarbonisation of the UK electricity grid will play a pivotal role in reducing carbon emissions associated with the construction industry and presents a win-win scenario. As the phasing out of fossil fuels ramps up and electrification of vehicles and machinery increases, electricity demand on construction sites will rise due to the need to charge vehicle and machinery batteries. It is anticipated there will be a doubling of demand for the UK, from around 300 TWh today to 610 TWh in 2050 (CCC, 2020).*

*To meet increased energy demand there are several renewable energy technologies that offer viable solutions to the construction industry, including solar photovoltaic (PV) arrays and Air Source Heat Pumps (ASHP) to meet energy and heating requirements, respectively. In regard to solar PV arrays, the Energy Saving Trust's Solar Energy Calculator ([Use the solar energy calculator - Energy Saving Trust](#)) offers an insight to the potential cost and energy savings to be made based upon some basic information (e.g., roof slope, shading, roof direction, installation size). By way of example a 10 kWp system, with a 30 degree slope, no shading and facing south could offer potential annual benefits of £533 and carbon savings of 1,950 kgCO<sub>2</sub>e.*

### **Electric Machinery**

*Availability of electric machinery has become more widespread, with a range of heavy machinery, such as excavators marketed by JCB, Volvo and Caterpillar. It is anticipated that a wider range of heavy machinery used on construction sites will move away from diesel engines to fully electric models.*

*Electric machinery will offer significant CO<sub>2</sub>e savings given the absence of fossil fuels, however, the practicalities of running electric machinery can be cause for concern due to the downtime for charging. Furthermore, due to the increased hire costs associated with heavy electric machinery, the works need carefully planned to avoid delays.*



### **Biofuels**

*Several biofuel alternatives are current available in the market, the most notable being Fatty Acid Methyl Ester (FAME) and Hydrogenated Vegetable Oil. although more expensive than traditional diesel, biofuels are significantly better for the environment when compared to diesel derived from fossil fuels. It is estimated that HVO biofuel offers carbon savings in the range of 90%. Given that 1,000 litres of diesel will produce approximately 28 tCO<sub>2</sub>e, by comparison 1,000 litres of HVO will produce in the region of 3 tCO<sub>2</sub>e.*

*Switching to biofuel alternatives also requires no significant alterations to machinery as the chemical structure of HVO biofuel is identical to that of traditional diesel, although the higher lipid fatty acid content of biofuel can result in machine filters clogging, particularly in the colder winter months. Original Equipment Manufacturers (OEMs) including Scania, DAF, Iveco, Renault, Citroen, Peugeot and Volvo all note biofuels are suitable for use in their engines. A note of caution that there have been moves to block HVO more detail on which can be read here: <https://www.theconstructionindex.co.uk/news/view/environment-agency-puts-blocks-on-hvo>*

### **Hybrid Generators**

*Given the works being undertaken on construction sites, temporary power may need provided by means other than a mains electricity connection. Generators offer a reliable solution, however, traditional diesel generators are a significant source of GHG emissions, can exacerbate local air quality issues, and usually create more energy than is used or needed by on site activities. A suitable alternative to diesel generators on site is hybrid generators fitted with a battery bank. Various models are available in the market but the hybrid system works by using the generator during peak periods of consumption, while charging the battery bank, which is then utilised when energy demand on site is lower.*

## **Hydrogen**

### **Low-carbon hydrogen – Green Hydrogen**

According to a [report](#) by Inside Energy and Environment, the EU defines low-carbon hydrogen as: “Hydrogen with an energy content that is derived from non-renewable sources, and that meets a GHG emission reduction threshold of 70% compared to fossil-based hydrogen”.

Hydrogen is fundamental to making net zero possible. Emitting only water when burned, it is ideal for reducing the CO<sub>2</sub> emissions of many vital industries. Clean hydrogen projects are creating innovative ways to reduce the carbon footprint of essential activities. These projects are paving the way to the future of energy.

Green hydrogen production is due to soar, heralding enormous potential for multiple industries on the path to net zero

A recent [report](#) by Hydrogen Europe detailed how more than 30 countries have already begun implementing their own hydrogen strategies, the main goals of which include reducing emissions, especially in “hard to abate sectors” like “the construction industry, mobility, electricity balancing and heating”, diversifying energy supplies, integrating renewables, fostering economic growth, and more.

Despite the hydrogen industry only beginning to develop, some countries have made bold plans to dramatically scale up green hydrogen production to 2040.

### **Hydrogen Fuel Cell Technology**

In the context of hydrogen fuel technology available to the construction industry, in recent years there has been steady development with a myriad of options available in the market, including heavy machinery, generators, and mobile equipment such as lighting towers. While still in its infancy and some practical concerns to address in regard to supply, storage and safe use, it is recognised that hydrogen fuel cell technology will play a pivotal role in net zero ambitions due to zero carbon emissions, practically zero particulate matter (PM) & nitrogen oxide (NO<sub>x</sub>) emissions, and a higher energy density

Hydrogen powered tower lights, such as the Ecolite TH200 hydrogen mobile lighting tower offer a viable alternative to traditional diesel-powered tower lights. Unlike diesel powered units, there is no release of carbon or other harmful GHG emissions. Other added benefits of hydrogen powered tower lights include, silent operation, no harmful outputs, and no ground spill risk during refuelling operations.



## 5.2 Promoting Change Internally

*The actions of individuals are critical to achieving carbon reductions and there is a clear need for employees to understand the climate crisis and the role they play within it.*

*Motivating and encouraging employees to reach sustainability goals should be a priority and a core part of any strategy. The Energy Saving Trust have provided guidance on how to drive behavioural change from within an organisation, which is based around 3 key steps.*

### STEP 1: Nominate energy champions

- Get employees involved directly with energy saving. The energy saving trust have an energy walk around checklist that nominated energy champions can complete [Energy-checklistv3.pdf \(energysavingtrust.org.uk\)](https://www.energysavingtrust.org.uk/energy-checklistv3.pdf)
- Send out information to staff on the benefits of energy reduction
- Set Goals for energy reduction- SMART targets should be set, for example are you targeting a 10% reduction in energy usage per £100k of company turnover by Dec 2023
- Share your success- communicate your achievements and carbon/cost savings through case studies

### STEP 2: Train your employees to save energy

- Consider carrying out training on Climate Emergency with providers such as Business in the Community
- Share learning materials such as toolbox talks, posters. Guidance and posters can be found on the energy saving trust website [Employee engagement resources - Energy Saving Trust](https://www.energysavingtrust.org.uk/employee-engagement-resources-energy-saving-trust)
- Include Energy efficiency measures within your staff inductions
- Reward employees for displaying sustainable behaviours

### STEP 3: Run Energy campaigns and communicate progress

- Measure energy use in the office
- Encourage employees to measure their own carbon footprint
- Communicate information and updates through emails, posters and intranet
- Share interesting and relatable energy facts
- Run seasonal sustainability campaigns
- Share your results

## 5.3 Energy Reduction: Potential Actions to Note

Some examples of energy reduction actions an organisation can take to reduce emissions across operations are:

### Energy

- Create an energy reduction plan which should include estimated potential savings showing how they relate to your most significant carbon emissions. This can include simple reduction measures and behavioural change through awareness raising.
- Carry out energy audits of your business premises to identify potential savings and monitor your consumption
- Establishing an earlier grid connection is a simple and effective measure. Ensuring a mains electricity grid connection is available on site can avoid or reduce the requirement for diesel generators to meet site office and welfare energy demand, in turn saving on hire costs and reducing carbon emissions.

### Transport/Plant & Machinery

- Plan to transition to low emission vehicles within your company fleet
- Consider installing electric charge points at your office
- If you have company vans, consider installing vehicle trackers
- Implement a green travel plan and encourage the use of virtual meetings and public transport
- Plan logistics and select local suppliers to minimise deliveries miles

### Waste

- Reduce waste through careful specification and buying with takeback agreements
- Identify avoidable wastes and investigate methods of reducing their use
- Identify opportunities for reuse of waste. Consider working with international synergies and local charities.

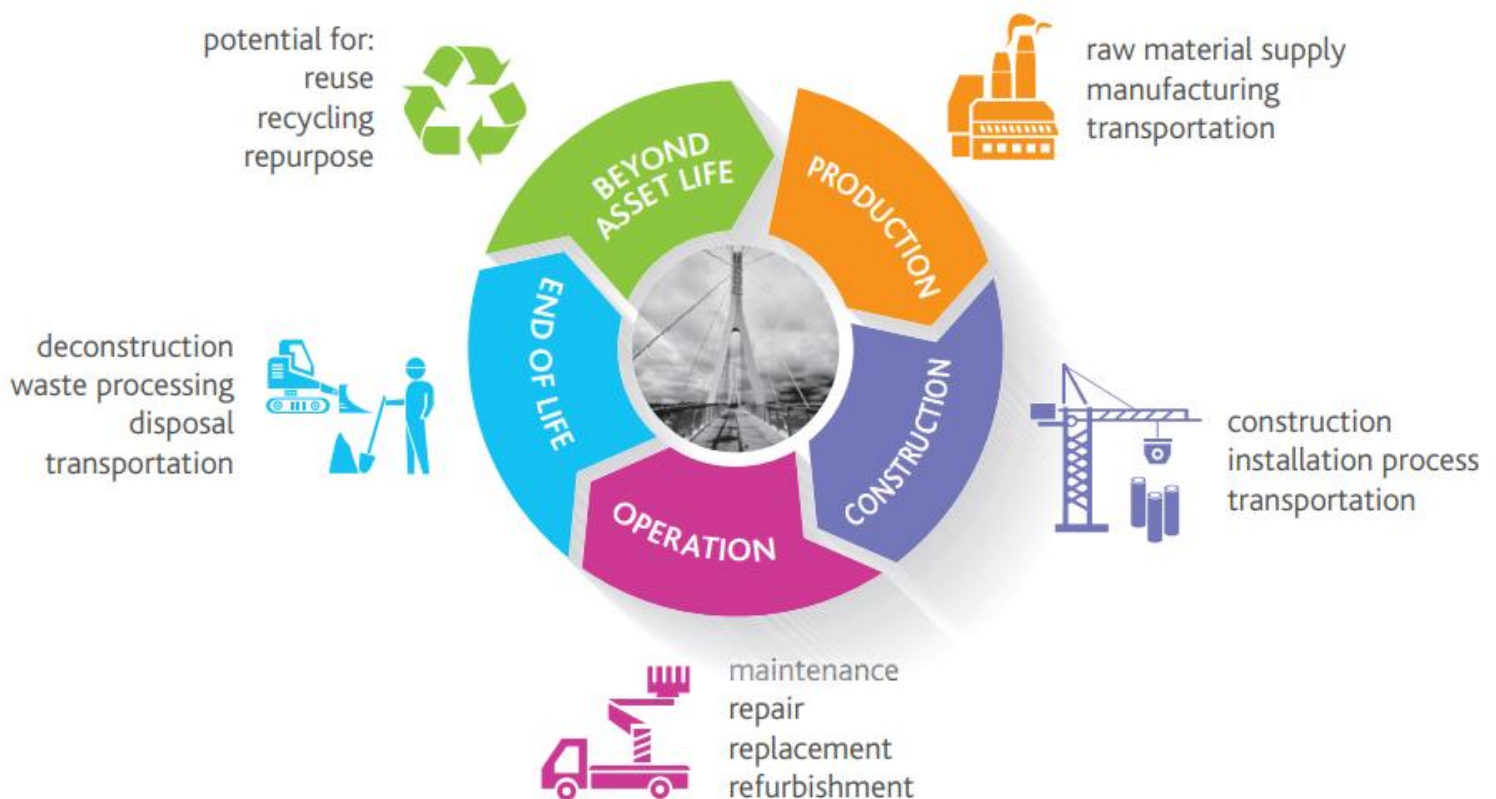
### Design & Materials

- Propose low carbon and innovative solutions to contractors within tenders
- Incorporate design for disassembly and other circular economy principles into your design
- Try to standardise components and designs
- Maximise offsite production and modularisation and measure carbon savings
- Prioritise the use of recycled, secondary, and low carbon materials
- Purchase materials that meet a sustainability standard (e.g. BES6001). [GN18 BREEAM Recognised Responsible Sourcing Certification Schemes and BREEAM Scheme Applicability \(bregroup.com\)](#)
- 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 <https://www.youtube.com/watch?v=PzcmRASfGas->

# Life Cycle Assessment and Embodied Carbon

The UK was one of the first countries to recognise the significance of the energy used to make construction products, called embodied or embedded energy, and to collect data and statistics from industry.

The UK was also a leader in developing Life Cycle Assessment to look not just at the embodied energy, but the resulting environmental impacts and process emissions throughout the supply chain and life cycle. This led to the development of “Environmental Profiles” for construction products, with the reported climate change or global warming impact providing the embodied carbon data.



The BRE Group published a national methodology for assessing the cradle to grave environmental impacts of construction products with the Environmental Profiles Methodology published in 1999.

The Inventory of Carbon and Energy (ICE), a cradle to gate database derived from a literature review of freely available environmental data. The ICE database provides embodied energy and embodied carbon data for over 200 construction materials. More information can be found in Appendix B.

## 6.1 Ways to reduce Embodied Carbon

- Focus on the elements of the building with highest impact.
- Look at the form of the building – can you reduce the amount of key elements by changing the design of the building?
- Investigate ways to increase the resource efficiency of these elements, for example research by Cambridge University suggests buildings commonly use double the steel and concrete that is required by safety codes
- Consider alternative materials that can do the same job – the Green Guide Online lets you compare the overall environmental impact and embodied carbon of similar building elements.
- Look at increasing the recycled and by-product content of the materials you are using – for example increasing the use of alternative cementitious materials like PFA and GGBS in concrete reduces its impact significantly.
- Examine environmental information provided by different suppliers – such as EPD or carbon footprints. Will their products have lower impact in your building?

### **Further Guidance**

*Further information and guidance on embodied carbon and resource efficiency can also be found using the links below.*

- [www.constructionproducts.org.uk/sustainability/products/embodied-impacts/](http://www.constructionproducts.org.uk/sustainability/products/embodied-impacts/)
- [www.wrap.org.uk/sites/files/wrap/Procurement%20Requirements%20for%20carbon%20efficiency%20FINAL.pdf](http://www.wrap.org.uk/sites/files/wrap/Procurement%20Requirements%20for%20carbon%20efficiency%20FINAL.pdf)
- [www.wrap.org.uk/content/business-case-managing-and-reducing-embodied-carbon-building-projects](http://www.wrap.org.uk/content/business-case-managing-and-reducing-embodied-carbon-building-projects)
- [www.wrap.org.uk/content/approach-procurement-resource-efficiency](http://www.wrap.org.uk/content/approach-procurement-resource-efficiency)
- [www.wrap.org.uk/sites/files/wrap/CIBSE-Supplement-2014-03.pdf](http://www.wrap.org.uk/sites/files/wrap/CIBSE-Supplement-2014-03.pdf)
- <http://edition.pagesuite-professional.co.uk/launch.aspx?eid=48622192-3c57-4885-aa81-8002eed5bb8a>

*Examples of embodied carbon can be found in Appendix B. A full detailed survey, complete with original data, methodology and notes, is available from [www.circularecology.com/ice-database.html](http://www.circularecology.com/ice-database.html)*

## 6.2 Working with Supply Chains

### **Procurement Policy Note (PPN) 06/21.**

*From September 2021, contractors bidding for UK central Government contracts worth more than £5 million a year have been required to provide a Carbon Reduction Plan confirming their commitment to achieving net zero by 2050.*

*This public procurement notice requires government departments and their offshoot agencies to procure larger contracts only from firms that record and report so-called Scope 3 emissions. These are the emissions generated by the supply chain – the goods and services brought in from outside.*

*This requirement to report on Scope 3 emissions is more likely to become commonplace as other public-sector bodies – and the private sector – follow Whitehall's lead. It is therefore clear that more regulation and government policies lie ahead – an early change in approach is recommended and supply chains will be of critical importance in this effort. Examples of actions to take include:*

- **Early Communication with Supply Chain.** The benefits of beginning a transition to reduce emissions and your expectations of suppliers should be conveyed at the earliest opportunity to your supply chain to encourage them to change ahead of regulation.
- **Early experimentation and developing relationships throughout current and new supply chains:** Reaching net zero across the UK's built environment will be challenging. Measuring a building's total impact – from construction, through to refurbishment and decommissioning – will require a holistic carbon lifecycle analysis. Construction and refurbishment will need to be weighed against future operational emissions savings. Such analysis and planning will require multiple stakeholders and setting strong and cutting-edge emissions targets will need multiple stakeholder buy-in. Establishing and developing these relationships now could create a competitive advantage in the future.

# Utilising Data

## 7.1 Start Collecting Data and How to use it

If at the start of the journey in calculating your carbon footprint it will be necessary to carry out more upfront work. It is increasingly common for reporting rules that apply to the larger organisations to be pushed down supply chains, either formally or more often informally through a greater focus on scope 2 and scope 3 emissions measurement and reporting.

As you start to build the capability and data systems to collect this information, we would recommend you build in the ability to scenario plan around future carbon taxes. As outlined above businesses should discuss carbon taxes with their suppliers to ensure that they have as full an understanding as possible of potential future cost increases.

### Capturing Data

One of the first steps to take is to build a GHG emissions inventory. This enables the organisation to identify the source of all emissions produced. To help with this exercise, the following questions should be considered:

#### . Understanding your data – key questions to ask:

- What emissions does your business produce?
  - Look at invoices for fuel, electricity, gas etc
- Where and when they are produced?
  - Identify where in the business they are produced (factory, site operations, office)
  - Identify when they are being produced (during manufacturing process, on site operations etc)
- Where are most emissions produced and what operations do they apply to?
  - What operations is the business doing that is generating the emissions
- Are they direct or indirect?
  - Is the business generating the emission directly or are they being produced indirectly off site by someone else
- Who is responsible for them?
  - Who in the business is responsible for producing the emissions
- Calculate how many tonnes of co2e is produced
  - Calculate the total kWh of each emission and then using the UK Carbon Factors, calculate the

*Building a carbon inventory and asking all the questions above throughout the process will ensure the organisation understands their emissions data. Emissions data is then used to establish baseline, set targets and track progress overtime including reductions from investment.*

### **Calculating your emissions**

- The UK and Irish governments have set out some useful information on how to calculate your emissions.
- UK Carbon Factors - <https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting>
- Ireland Carbon Factors - SEAI <https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/>

### **Using your emissions data**

- Understand what your emissions data is telling you about your business
- Interrogate the data
- Identify trends in the data – opportunities for reduction
- Carbon hot spot - Carbon hotspots represent not only carbon-intense or high [volume elements](#) but also quick wins, where [measurement data](#) is more easily available and where [carbon](#) reductions are possible.
- Establish your baselines
- Start with Scope 1 and 2
- Identify low hanging fruit (minimum investment) and what will require more investment to achieve reduction targets – build into Carbon Reduction Plan
- Opportunities to eliminate / reduce emissions
- Set targets
- Agree targets and KPIs suitable to your business – use historical emissions data to forecast
- Measure, monitor and report impact of investments and progress against targets – use data to track progress

### **Measuring, Monitoring & Reporting**

- Agree roles and responsibilities – who is responsible for reporting energy usage, electricity etc
- Agree a frequency for reporting – weekly, monthly etc
- Ensure data is reported consistently and using a standardised process to ensure accuracy
- Centralise the data being reported to facilitate analyse of performance
- Review the data regularly to identify any issues and / or opportunities to reduce emissions
- Always benchmark against baseline year and review progress towards targets to ensure reductions – if not, investigate the data to find out where there is a problem

***Additional Resources:***

- *BITC Climate Action Tool Kit <https://www.bitc.org.uk/toolkit/seven-steps-for-climate-action/>*
- *Use the UKGBC - Net Zero Whole Life Carbon Roadmap - Stakeholder Action Plans to build an action plan - <https://www.ukgbc.org/wp-content/uploads/2021/11/UKGBC-Whole-Life-Carbon-Roadmap-Stakeholder-Action-Plans.pdf>*



## 7.2 Analysing Emissions: Step by Step



### **Step 1: Establish your baseline measurement of Scope 1, 2 and 3 emissions.**

Your direct, indirect and supply chain greenhouse gas (GHG) emissions are the key metrics for a climate strategy. To start off, you first need to understand where your GHG emissions come from.

### **Step 2: Analyse your impact hotspots and identify the highest potential points for reducing your emissions.**

Once you've measured your scope 1, 2, and 3 emissions as outlined above, it's time to analyse them. An LCA measures the environmental impact associated with every step in your product's lifecycle (from production to waste). Meaning; you now have crucial intel on the GHG emissions that are emitted during every step within your supply chain. At what step(s) does the biggest impact take place? Is it the growing of your resources? The production of your products? The packaging?

Instead of trying to do everything at the same time, impact hotspots tell you exactly what to focus your efforts on. This is crucial to the effectiveness of your climate strategy.

Once you have analysed your biggest impact hotspots, use this information to identify and create the most effective reduction measures. Create what if scenarios and compare them. What would happen if I changed a specific business process(es) and replaced it with a more circular process (e.g energy efficiency, alternative materials, recycling)? Would other suppliers for my production process perhaps be able to help me reduce my overall footprint?

### **Step 3. Set KPI's & (Science-based) targets**

Once you've decided on your reduction measures, it's time to make sure you can measure these as well. When it comes to the GHG Protocol, organizations often set science-based targets and KPI's. This helps them to make the claim that they operate 'within the boundaries of the planet'. They link their targets to the Paris Agreement- whether they are 'within the boundaries of 1.5. or 2 degrees scenario'.

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

#### **Step 4. Execute & monitor your carbon reduction plan**

*Now it's time to put all your plans into action. Execute your reduction plan and start monitoring your science based targets. By constantly keeping track of your carbon reduction portfolio you will be able to track your improvements and/or where more efforts are still needed.*

*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.*

*\*\*Start collating data. Use a simple spreadsheet to get started, this can be to record both site and office locations data. Ensure water and electricity metres are installed to take monthly readings and you can use electricity and water bills to verify your data. Uploading of this data will start to create your baseline, where you can set KPI's for carbon and can use this for continual improvement.*

*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<sup>3</sup>), 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 Figure 1 on the following page.*

#### **Step 5. Analyse & offset your carbon emissions to become carbon neutral**

*Never completely rely on carbon offsetting in your climate strategy. Carbon offsetting only works if the company financing it also changes its own operations to become more sustainable. Make sure you first measure and reduce your carbon footprint as much as possible and offset your remaining, most unavoidable emissions.*

*Once you've done so, you can assess the costs and benefits for offsetting your carbon emissions.*

*Figure 1 Scope carbon sources/data*

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 <sup>3</sup> 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 <sup>3</sup>
	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

# *Additional Resources & Glossary*

## *8.1 Additional Training and Resources*

- [Climate Action Pledge - Business In The Community \(bitcni.org.uk\)](https://www.bitcni.org.uk)
- [Addressing emissions in your supply chain - Business in the Community \(bitc.org.uk\)](https://www.bitc.org.uk)
- <https://www.ice.org.uk/engineering-resources/knowledge-programmes/the-carbon-project/>
- [Publications | Climate Northern Ireland](#)
- [Target setting: Getting started on your net-zero journey - Business in the Community \(bitc.org.uk\)](https://www.bitc.org.uk)
- <https://www.supplychainschool.co.uk/>
- <https://www.bitcni.org.uk/programmes/climate-action-pledge/>
- <https://www.ukgbc.org/climate-change-2/>
- <https://www.futurelearn.com/courses/sustainable-construction-development>
- [Task Force on Climate-Related Financial Disclosures \(fsb-tcfd.org\)](https://www.fsb-tcfd.org)
- [NEW: E-learning Course on Science-Based Targets - Science Based Targets](https://www.sciencebasedtargets.org)
- [SBTiProgressReport2020.pdf \(sciencebasedtargets.org\)](https://www.sciencebasedtargets.org/SBTiProgressReport2020.pdf)
- [Toolkit - Chapter Zero](#)
- [BITCI-Report-Progressing-Towards-Science-Based-Targets.pdf](#)
- [WEBINAR SERIES | Ready > Set > Go Beyond! | Quantis \(quantis-intl.com\)](https://www.quantis-intl.com)
- [WWF Footprint Calculator](#)
- [Sixth Carbon Budget - Climate Change Committee \(theccc.org.uk\)](https://www.theccc.org.uk)
- [Completing the picture: How the circular economy tackles climate change \(ellenmacarthurfoundation.org\)](https://www.ellenmacarthurfoundation.org)
- [TESNI-2020.pdf \(soni.ltd.uk\)](https://www.soni.ltd.uk)
- [CCRA3-Briefing-Business.pdf \(ukclimaterisk.org\)](https://www.ukclimaterisk.org)

## 8.2 Glossary

*The Financial Times has put together a useful online resource which is updated- an alphabetical glossary of terms related to climate change which can be found here:*

<https://www.ft.com/content/c617f52a-b46a-4581-8b66-8d92f672f77c>

**Adaptation** *Making changes to deal with the effects of climate change — both now and in the future. This includes building infrastructure such as flood and fire defences, developing crops that can cope with new climatic conditions, and exploring new ways of cooling buildings.*

**Air/Atmosphere** *While oxygen is critical to life on earth, it is not the main component of the atmosphere. It is composed of about 78 per cent nitrogen and 21 per cent oxygen. It also has small amounts of other gases such as carbon dioxide, neon and hydrogen, plus particles such as soot and microbes.*

*The damaging effects of carbon, methane and other greenhouse gases are evident in their description: though small in proportion, they powerfully absorb and trap heat.*

**Air pollution** *Is distinct from carbon and greenhouse-gas emissions, and is not always caused by climate change.*

**AQI** *Air pollution is measured with an Air Quality Index, or AQI, which is calculated as a combination of different types of pollution, such as small particulate matter, nitrogen dioxide and ozone. When the AQI is more than 100, it's about the same as breathing in exhaust from a car all day. However, AQI is not a standardised formula — countries can calculate AQI in different ways.*

**Afolu** *Agriculture, Forestry and Other Land Use is a term that is used in the Intergovernmental Panel on Climate Change (see IPCC) report on climate change.*

**Aosis** *The Alliance of Small Island States, made up of island and coastal states, mostly in the Pacific and Caribbean, that are likely to be the most affected by rising sea levels, extreme weather and other effects of global warming.*

**Biofuel** *A fuel derived from renewable, biological sources, including crops such as maize and sugar cane, and some forms of waste.*

**Biomass** *Renewable organic material that comes from plants and animals.*

**Climate** *is the average of weather, and includes phenomena such as rain, flooding, drought and storms, heat and cold, and other extreme weather events.*

**Climate change** refers to the shifts in climate that result from the warming of the planet. The impact of climate change is not uniform: one place could become wetter because of climate change, and another could become drier. Some places are heating up much more quickly because of climate change (particularly in polar regions) while others have experienced only small temperature shifts.

**Carbon Border Adjustment Mechanism (CBAM)** An EU proposal that will place a carbon price on imports of a targeted selection of products from countries with less ambitious national climate policies. This is designed to avoid what is known as “carbon leakage”, or the transfer of production by businesses to countries with more lax emission constraints.

**Carbon budget** The total amount of carbon that can be released into the atmosphere before breaching a given level that would lead to global warming beyond agreed limits.

**Carbon capture and storage (CCS)** Refers to capturing carbon dioxide — typically when it is close to the source of emissions, such as at the smokestack on a power plant — and then permanently storing (or sequestering) the CO<sub>2</sub>, for example by injecting it underground.

**Carbon capture utilisation and storage (CCUS)** As above, but using the carbon rather than storing it. In other words, capturing and recycling the carbon for further use. For example, by injecting it or binding it to something else, for example to harden “green” cement.

**Carbon dioxide** CO<sub>2</sub> in the air is measured in parts per million — so in 2021 the air contained about 414 parts of carbon dioxide for each 1mn parts of air. This compares with pre-industrial levels of an estimated 280 ppm. Scientific consensus is that the planet remains healthy for humanity at up to 350. Total carbon dioxide emissions in the year of 2021 alone are expected to be 33bn tonnes (source: IEA report).

Total greenhouse gas emissions (see entry) were estimated at 59bn tonnes of carbon dioxide equivalent in 2019, with an error margin of about 10 per cent, according to the scientists behind the latest IPCC report (see IPCC),

**Carbon dioxide equivalent** Greenhouse gases each have a different global warming potential. To be able to compare the amounts of other gases to the equivalent amount of carbon dioxide on the basis of their global-warming potential, the carbon dioxide equivalent is needed.

**Carbon intensity** Measure of carbon dioxide emissions relative to a unit of revenue (for a company, ExxonMobil, for example) or relative to GDP (for a country). For example, if a company is growing its emissions faster than its revenue, then the carbon intensity ratio will decrease over time — even though its absolute emissions will increase.

Some developing countries have adopted carbon intensity targets, rather than absolute emissions targets, to accommodate their fast-growing economies. For example, China’s target is to reduce carbon intensity by more than 65 per cent by 2030, relative to 2005 levels. But that reduction in carbon intensity belies the fact that absolute emissions will rise even while that goal is met.

**Carbon leakage** Refers to the relocation of an industry to countries where emission rules are weaker.

**Carbon neutral** Only refers to the balancing out of carbon emissions with carbon removal. This differs from 'net zero', which typically includes the removal or offsetting of all greenhouse gas emissions, including methane and hydrofluorocarbons.

**Carbon offsetting** Compensating for the release of emissions by making a cut or saving of carbon dioxide from the atmosphere. This could involve the planting of trees or another carbon removal activity.

**Carbon price** A cost applied to carbon dioxide pollution to incentivise businesses and consumers to reduce carbon-intensive activities. It can come in the form of either a tax or a pollution permit that companies trade.

**Carbon sequestration** Storing carbon dioxide, either naturally, through its absorption by trees and plants, or mechanically, through carbon capture and storage (see entry).

**Decarbonisation** Eliminating or reducing carbon dioxide emissions, generally through the replacement of energy sourced from coal, oil and gas.

**Emissions Trading Scheme/System (ETS)** Emissions trading works by setting a cap on the total amount of greenhouse gases that can be emitted by polluters and issuing allowances accordingly. The cap is reduced over time so that total emissions fall. Carbon allowances can be bought at auction and traded, and these markets determine the carbon price. Each unit traded is meant to cover a tonne of carbon emitted.

**EU taxonomy** An EU-wide classification system to provide companies and investors with a common framework for identifying to what degree economic activities can be considered environmentally sustainable. To this end, the EU has set out six environmental goals, with most having a direct or indirect link to climate change. It will require large companies to disclose whether their capital spending is aligned with the EU's environmental objectives.

**Fossil fuels** Formed from the remains of plants and animals over millions of years. The main fossil fuels are coal, petroleum and natural gas. When burnt they release carbon dioxide, methane and other greenhouse gases (see Greenhouse gas).

**Global warming** Refers to the fact that the planet is hotter now, on average, than it has been over the past century. Average air temperatures are estimated to be about 1.1C warmer now than they were in 1900. Oceans have warmed as well.

**Global average temperature** *The mean surface temperature of the Earth measured from three main sources: satellites, monthly readings from a network of land stations and sea surface temperature measurements from a shipping network.*

**Glasgow Finance Alliance for Net Zero (Gfanz)** *Group of financial institutions that has backed the UN Race to Zero campaign that has pledged to decarbonise the world economy and reach net zero emissions by 2050.*

*Under the Gfanz umbrella, the banks are represented by the Net Zero Banking Alliance (see entry) and the fund managers are represented by the Net Zero Asset Managers initiative.*

**Greenhouse gas** *The main gases causing the heating of the atmosphere are carbon dioxide, methane, ozone, nitrous oxide and hydrofluorocarbons (HFCs).*

*Total annual greenhouse gas emissions were estimated at 59bn tonnes of carbon dioxide equivalent in 2019, with an error margin of about 10 per cent, according to scientists that signed off the latest IPCC report (see IPCC). This is mostly made up of carbon dioxide, as well as others such as methane and nitrous oxide.*

**Green bonds** *Green bonds, green loans, nature bonds, social bonds, sustainability bonds — the definition depends on the use of proceeds.*

*Green bonds were created to fund projects that have positive environmental and/or climate benefits. Sustainability-linked bonds and loans involve specific reporting or project selection criteria. Check the requirements as set down by the International Capital Market Association and Loan Market Association.*

**Green hydrogen** *Made by using clean electricity from renewable energy technologies to electrolyse water (H<sub>2</sub>O), separating the hydrogen atom within it from its molecular twin oxygen. Currently expensive.*

**Blue hydrogen** *Produced using natural gas but with carbon emissions being captured and stored, or reused. Negligible amounts in production because of a lack of capture projects.*

**Grey hydrogen** *This is the most common form of hydrogen production. It comes from natural gas via steam methane reformation but without emissions capture.*

**Brown hydrogen** *The cheapest way to make hydrogen but also the most environmentally damaging because of the use of thermal coal in the production process.*

**Pink/purple hydrogen** *Made using nuclear energy to power the electrolysis.*



**Turquoise hydrogen** Uses a process called methane pyrolysis to produce hydrogen and solid carbon. Not proven at scale. Concerns around methane leakage.

**IPCC** The Intergovernmental Panel on Climate Change is a scientific body established by the UN Environment Programme and the World Meteorological Organization in 1988 to provide the world with a clear scientific view on the latest knowledge in climate change and its potential effects. Thousands of scientists contribute to its work on a voluntary basis.

**Levelised cost of energy (LCOE)** is a measure of a power source that allows comparison of different methods of electricity generation on a consistent basis.

The LCOE can also be regarded as the minimum constant price at which electricity must be sold in order to break even over the lifetime of a project.

**Methane Potent** warming gas that comes both from natural and man-made sources, the latter including gas leaks, rice paddies, landfill and coal mining. Natural sources include swamps, cows, wetlands and melting permafrost. Natural gas is made up mainly of methane.

A methane molecule is about 25 times more potent than carbon dioxide on a weight basis. But it also has a much shorter lifespan, lasting about 12 years compared with CO<sub>2</sub>, which stays in the atmosphere for a century or longer.

On a 20-year time horizon, methane has 80 times the warming effect of carbon dioxide.

**Mitigation Ways** to prevent climate change from getting worse, including by reducing greenhouse gas emissions or increasing the absorption of emissions back into nature, by mechanical and chemical processes.

**Net zero** Cutting emissions as close to zero as possible and compensating for any remaining emissions with projects that remove emissions from the atmosphere, such as planting trees or funding offset projects.

**Nationally determined contributions (NDCs)** Each nation's climate plans, including climate-related targets, policies and measures that each government aims to implement in response to climate change and as a contribution to global action. A comprehensive guide to national climate targets is [here](#).

**Net-Zero Banking Alliance Part of the Glasgow Finance Alliance for Net Zero** umbrella group, made up of 98 member banks accounting for more than 40 per cent of global banking assets.

**Nitrous oxide (N<sub>2</sub>O)**, commonly known as laughing gas, is a greenhouse gas with warming potential. It is produced by agriculture and fertilisers.

**Nitrogen dioxide** Pollutant that comes primarily from road transport and diesel vehicles.

**Ocean acidification** The ocean absorbs about a quarter of the carbon dioxide caused by human activity from the atmosphere. When it dissolves in seawater, carbonic acid is formed. Carbon emissions in the industrial era have already lowered the pH of seawater by 0.1. This can affect the survival of marine organisms and kill coral reefs.

**Paris climate agreement** The agreement aims to limit global warming to well below 2C above pre-industrial levels and ideally to 1.5C. It was adopted in 2015 and entered into force in 2016. It has been ratified by 193 countries. Each country sets voluntary targets for their own emissions, and tightens these targets over time (see NDCs).

**PPM** Abbreviation for parts per million. The Intergovernmental Panel on Climate Change (IPCC) has indicated that greenhouse gas levels must remain below 450 ppm CO<sub>2</sub> equivalent in order to avert dangerous climate change. That level peaked at almost 420 ppm in 2021.

**REDD** Reducing Emissions from Deforestation and forest Degradation is a UN-affiliated programme to provide developing countries with a financial incentive to preserve forests.

**Science-based targets** Targets are considered “science-based” if they are in line with what the latest climate science deems necessary to meet the goals of the Paris agreement to limit global warming to well below 2C above pre-industrial levels and pursuing efforts to limit warming to 1.5C.

**Scope 1, 2 and 3 emissions** Greenhouse gas emissions are categorised into three groups or “Scopes” by the most widely used international accounting tool, the Greenhouse Gas Protocol.

**Scope 1** covers direct emissions from owned or controlled sources. **Scope 2** covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company. **Scope 3** includes all other indirect emissions that occur in a company’s value chain. Many companies do not include **Scope 3** emissions in their reporting.

**Sustainable development goals (SDGs)** These are 17 goals under the auspices of the UN agreed in 2015 by world leaders with a 2030 target. They include the goals of ending poverty and other deprivations alongside improvements in health, education, inequality and economic growth, at the same time as tackling climate change and preservation of the natural environment.

**Sustainable finance regulation directive** EU regulation that came into force on March 10 2021. Aims to impose disclosure of sustainability risk on financial institutions, pension funds and insurance companies. Includes all sustainability risk, not only climate but also social and governance.

**Tipping point** Critical climate thresholds that, once passed, can lead to irreversible changes to our planetary systems. Global warming could potentially push several systems past these thresholds.

**TCFD Task Force on Climate-related Financial Disclosures** — launched in 2015 during the Paris climate negotiations as a market-driven initiative, backed by Mark Carney, then Bank of England governor and now UN special envoy for climate action and finance. Former SEC chair Mary Schapiro leads its secretariat.

Their aim is to produce voluntary, consistent, climate-related financial risk disclosures for use by companies in providing information to investors, lenders, insurers and other stakeholders.

**UNFCCC The UN Framework Convention on Climate Change** is one of a series of international agreements on global environmental issues opened for signature at the 1992 Earth Summit in Rio de Janeiro. The UNFCCC aims to prevent “dangerous” human interference with the climate system. It entered into force on March 21 1994 and has been ratified by 192 countries.

**Value chain emissions** Otherwise known as Scope 3 (see Scope 3 above). For many businesses, value chain (scope 3) emissions account for more than 70 per cent of their carbon footprint.

**Watts Kilowatts (1,000), Megawatts (1m), Gigawatts (1bn).** Represents the rate at which energy is used or generated.

The average US home uses just under 11,000 kWh per year, or 1.25kW in an average hour. So we can probably say that 1GW is enough to power about 90,000 US homes per year under average conditions.

**Zero carbon** Means that no carbon emissions are produced at all in. This compares with ‘net zero’, where greenhouse gas emissions are balanced out.

# *Appendices*

# *Appendix A: Carbon Reduction Plan Guidance & Template*



## **CARBON REDUCTION PLAN GUIDANCE**

### **Notes for Completion**

Where an In-Scope Organisation has determined that the measure applies to the procurement, suppliers wishing to bid for that contract are required at the selection stage to submit a Carbon Reduction Plan which details their organisational carbon footprint and confirms their commitment to achieving Net Zero by 2050.

Carbon Reduction Plans are to be completed by the bidding supplier entity and must meet the reporting requirements set out in supporting guidance, and include the supplier's current carbon footprint and its commitment to reducing emissions to achieve Net Zero emissions by 2050.

The Carbon Reduction Plan should be updated regularly (at least annually) and published and clearly signposted on the supplier's UK website. It should be approved by a director (or equivalent senior leadership) within the supplier's organisation to demonstrate a clear commitment to emissions reduction at the highest level. Suppliers may wish to adopt the key objectives of the Carbon Reduction Plan within their strategic plans.

A template for the Carbon Reduction Plan is set out below. Please complete and publish your Carbon Reduction Plan in accordance with the reporting standard published alongside this PPN.

# Carbon Reduction Plan Template

Supplier name:

Publication date:

## Commitment to achieving Net Zero

**Add Company commitment**

## Baseline Emissions Footprint

Baseline emissions are a record of the greenhouse gases that have been produced in the past and were produced prior to the introduction of any strategies to reduce emissions. Baseline emissions are the reference point against which emissions reduction can be measured.

<b>Baseline Year:</b>	
<b>Additional Details relating to the Baseline Emissions calculations.</b>	
<b>Outline Carbon Reduction Plan Scope</b>	
<b>Baseline year emissions:</b>	
<b>EMISSIONS</b>	<b>TOTAL (tCO<sub>2</sub>e)</b>
<b>Scope 1</b>	
<b>Scope 2</b>	
<b>Scope 3</b> <b>(Included Sources)</b>	
<b>Total Emissions</b>	

## Current Emissions Reporting

<b>Reporting Year:</b>	
<b>EMISSIONS</b>	<b>TOTAL (tCO<sub>2</sub>e)</b>

<b>Scope 1</b>	
<b>Scope 2</b>	
<b>Scope 3 (Included Sources)</b>	
<b>Total Emissions</b>	

**Emissions reduction targets**

**[Instructions to Suppliers:**

If existing emissions reduction targets are in place for your organisation, please provide details below. If you have no previous emissions reduction commitment, or if this is your organisation's first carbon footprint, please provide targets for your organisation]

In order to continue our progress to achieving Net Zero, we have adopted the following carbon reduction targets.

**Add Targets:**

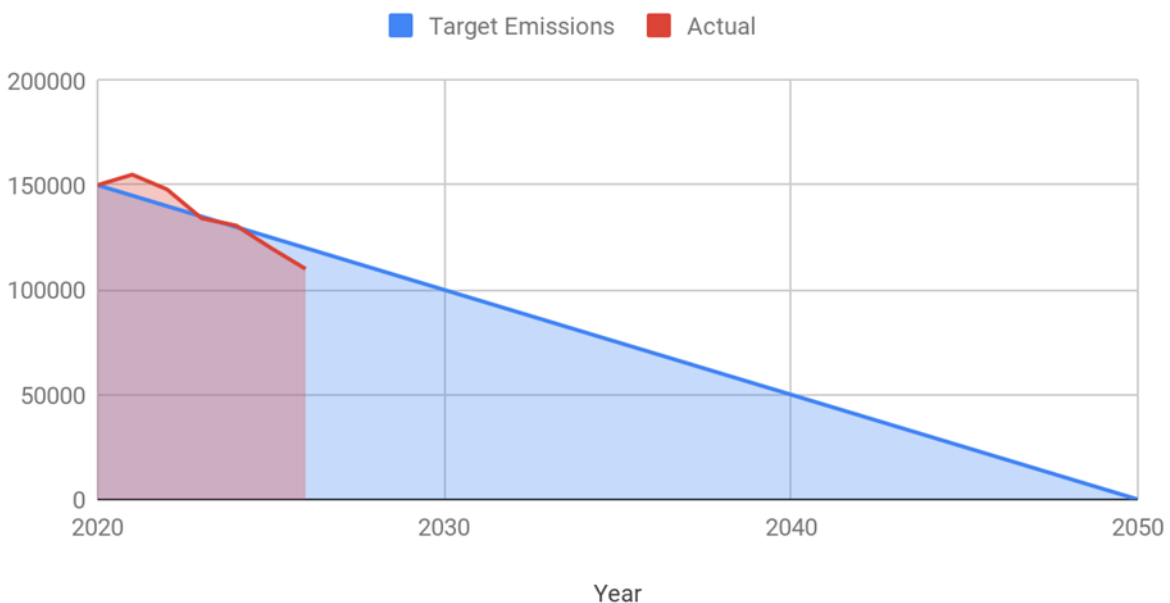
- 

**Summary:**

We project that carbon emissions will decrease by ???? over the next ???? years to ????? tCO2e by Add Year. This is a reduction of ????? %

Progress against these targets can be seen in the graph below:

**Carbon Reduction: Projected vs. Actual**



**Carbon Reduction Projects**

**Completed Carbon Reduction Initiatives**

The following environmental management measures and projects have been completed or implemented since the ?????? (Add baseline year). The carbon emission reduction achieved by

**Construction and Climate Change**

these schemes equate to **XX** tCO<sub>2</sub>e, a **XX**%ge reduction against the **Add baseline year** and the measures will be in effect when performing the contract

**[Instructions to Suppliers:**

**Briefly provide details of some of your completed carbon reduction projects. This is for information only.**

**This may include environmental management measures such as certification schemes like ISO14001 or PAS 2060, signing up to SBTI or specific measures you have taken such as; the adoption of LED/PIR lighting controls, changes to policy resulting in a reduction in company travel and flights or the electrification of the company fleet.]**

## **Declaration and Sign Off**

This Carbon Reduction Plan has been completed in accordance with PPN 06/21 and associated guidance and reporting standard for Carbon Reduction Plans.

Emissions have been reported and recorded in accordance with the published reporting standard for Carbon Reduction Plans and the GHG Reporting Protocol corporate standard<sup>1</sup> and uses the appropriate Government emission conversion factors for greenhouse gas company reporting<sup>2</sup>.

Scope 1 and Scope 2 emissions have been reported in accordance with SECR requirements, and the required subset of Scope 3 emissions have been reported in accordance with the published reporting standard for Carbon Reduction Plans and the Corporate Value Chain (Scope 3) Standard<sup>3</sup>.

This Carbon Reduction Plan has been reviewed and signed off by the board of directors (or equivalent management body).

*Signed on behalf of the Supplier:*

.....

Date: .....

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<sup>1</sup> <https://ghgprotocol.org/corporate-standard>

<sup>2</sup> <https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting>

<sup>3</sup> <https://ghgprotocol.org/standards/scope-3-standard>



## Appendix B: Embodied Carbon Product Breakdown

The figures included in the following table are a much-shortened and abbreviated adaptation of a survey published by the Sustainable Energy Research Team (SERT) of the University of Bath. The survey, 'Inventory of Carbon & Energy (ICE)' V2.0, was compiled and written by Prof. Geoff Hammond & Craig Jones, 2011.

The full detailed survey, complete with original data, methodology and notes, is available from [www.circularecology.com/ice-database.html](http://www.circularecology.com/ice-database.html)

The figures are based on a 'Cradle-to-Gate' analysis of publicly available information.

Material	Energy MJ/kg	Carbon kg CO <sup>2</sup> /kg	Density kg /m <sup>3</sup>
Aggregate	0.083	0.0048	2240
Concrete (1:1.5:3 eg in-situ floor slabs, structure)	1.11	0.159	2400
Concrete (eg in-situ floor slabs) with 25% PFA RC40	0.97	0.132	
Concrete (eg in-situ floor slabs) with 50% GGBS RC40	0.88	0.101	
Bricks (common)	3.0	0.24	1700
Concrete block (Medium density 10 N/mm <sup>2</sup> )	0.67	0.073	1450
Aerated block	3.50	0.30	750
Rammed earth (no cement content)	0.45	0.023	1460
Limestone block	0.85		2180
Marble	2.00	0.116	2500
Cement mortar (1:3)	1.33	0.208	
Steel (general - average recycled content)	20.10	1.37	7800
Steel (section - average recycled content)	21.50	1.42	7800
Steel (pipe - average recycled content)	19.80	1.37	7800
Stainless steel	56.70	6.15	7850
Timber (general - excludes sequestration)	10.00	0.72	480 - 720

Glue laminated timber	12.00	0.87	
Sawn hardwood	10.40	0.86	700 - 800
Cellular glass insulation	27.00		
Cellulose insulation (loose fill)	0.94 – 3.3		43
Cork insulation	26.00*		160
Glass fibre insulation (glass wool)	28.00	1.35	12
Flax insulation	39.50	1.70	30*
Rockwool (slab)	16.80	1.05	24
Expanded Polystyrene insulation	88.60	2.55	15 – 30*
Polyurethane insulation (rigid foam)	101.50	3.48	30
Woodwool board insulation	20.00	0.98	
Wool (recycled) insulation	20.90		25*
Straw bale	0.91		100 – 110*
Mineral fibre roofing tile	37	2.70	1850*
Slate (UK – imported)	0.1 – 1.0	0.006 – 0.058	1600
Clay tile	6.50	0.45	1900
Aluminium (general & incl 33% recycled)	155	8.24	2700
Bitumen (general)	51	0.38 - 0.43	
Hardboard	16.00	1.05	600 - 1000
MDF	11.00	0.72	680 – 760*
OSB	15.00	0.96	640*
Plywood	15.00	1.07	540 - 700
Plasterboard	6.75	0.38	800

Gypsum plaster	1.80	0.12	1120
Glass	15.00	0.85	2500
PVC (general)	77.20	28.1	1380
PVC pipe	67.50	24.40	1400*
Linoleum	25.00	1.21	1200
Vinyl flooring	65.64	2.92	1200
Terrazzo tiles	1.40	0.12	1750*
Ceramic tiles	12.00	0.74	2000
Carpet tiles, nylon (Polyamide), pile weight 770g/m <sup>2</sup>	279 MJ/m <sup>2</sup>	13.7 / m <sup>2</sup>	4.6 kg/m <sup>2</sup>
Wool carpet	106.00	5.53	
Wallpaper	36.40	1.93	
Wood stain / varnish	50.00	5.35	
Vitrified clay pipe (DN 500)	7.90	0.52	
Iron (general )	25	1.91	7870
Copper (average incl. 37% recycled)	42	2.60	8600
Lead (incl 61% recycled)	25.21	1.57	11340
Ceramic sanitary ware	29.00	1.51	

## ***Appendix C: Non-Road Mobile Machinery (NRMM) London***

It is widely acknowledged that construction activity can contribute to poor local air quality due to the reliance upon fossil fueled machinery on site. It is estimated by the London Atmospheric Emissions Inventory (2019) that NRMM exhaust emissions in construction account for approximately 70 tonnes of Particulate Matter (PM) and 1350 tonnes of toxic Oxides of Nitrogen (NOx) emissions in London each year (GLA, 2022)

The objective of the **NRMM Regulations** is to progressively phase out older equipment or the most polluting engines, with new equipment that demonstrates increased energy efficiency and improves air quality. The NRMM Regulations also lay down the procedure engine manufacturers must adhere with to obtain type-approval of their engines, a prerequisite for manufacturers selling in the EU market.

NRMM consists of any machinery fitted with an internal combustion engine that is not solely intended for carrying passengers or goods on the road. On construction sites, examples of NRMM include the likes of excavators, dumpers, piling rigs, generators, mobile cranes, MEWPs, static pumps, compressors, crushers, telehandlers, pavers, bulldozers, etc.

In similar nature to how the Ultra Low Emission Zone (ULEZ) operates, the NRMM Low Emission Zone (LEZ) applies to all plant and machinery with rated power outputs **between 37 kW and 560 kW**.

To combat poor air quality, NRMM on construction sites within Greater London are required to meet **EU Emission Standards** criteria for where the works are being undertaken, also referred to as the Development Zones or NRMM LEZ Zones.

Within Greater London there are several NRMM LEZ Zones:

- **Central Activity Zone (CAZ) & Canary Wharf:** The CAZ and Canary Wharf are defined areas of Central London where stricter NRMM emission standards are in place.
- **Opportunity Areas:** Brownfield areas with significant capacity for development, as such the impacts of redevelopment need to be minimized and therefore, emissions standards in these areas match those in the CAZ and Canary Wharf.

An online map of the development zones is available at <https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/nrmm>.

All NRMM must meet the appropriate emission standards for the project location before being allowed on site. Once the items of NRMM have been identified, they will also need approved through the GLA website by demonstrating compliance with the EU Emission Stages.

### **EU Emission Stages**

The EU Emission Stages are defined in a series of EU Directives and promote the progressive introduction of increasingly stringent standards. These range from **Stage I** which was first introduced into European legislation in 1997, right through to **Stage V** in 2016.

### **Current Requirements**

At present all NRMM within Greater London is required to meet Emission Stage IIIB as a minimum, whereas within the CAZ or Opportunity Areas, NRMM is required to meet Emission Stage IV as a minimum.

### **Future Requirements**

NRMM emission standards will get progressively stricter over time, the following table notes the upcoming changes to NRMM requirements for the Greater London NRMM LEZ zones.

	NRMM LEZ Zone	
	Greater London	CAZ / Canary Wharf / Opportunity Area
Current	Stage IIIB	Stage IV
From 1 <sup>st</sup> January 2025	Stage IV	Stage IV
From 1 <sup>st</sup> January 2030	Stage V	Stage V

Outside of greater London, local authorities across the UK (e.g., Bath, Birmingham, Bristol) are implementing Clean Air Zones (CAZ) to reduce the number of breaches of legal limits for air pollution. In regard to construction transport requirements, cars, vans and HGVs required to move people and resources to a site within a CAZ must meet the specified engine emission stage for the class of vehicle. Daily charges and fines will be set at the discretion of the local authority, however the intention is not to raise additional funds beyond recouping the costs of the CAZ scheme.

**NRMM Compliance – remove reference to PC, focus on subcontractors**

It is the overall responsibility of the Principal Contractor to ensure that all applicable NRMM, including subcontractors’ NRMM, is compliant with the NRMM LEZ for the project location. To this end, it is recommended that the Principal Contractor reminds subcontractors and suppliers of the Emission Stage for project location and submits the **Type Approval Number (TAN)** for in-scope machinery.

The Type Approval Number (TAN) can be found on the engines Type Approval Plate, which is typically fixed to the engine, however, the exact location of the Type Approval Plate may vary from one manufacturer to another. Figure 1. below illustrates the information contained within the Type Approval Plate for the manufacturer Isuzu and notes how to identify key information, including the machines power output and TAN.



Figure 1. Example Type Approval Plates. (NRMM Practical Guide V.5, April 2022).

The TAN follows a specific format that tells us key information about the piece of plant that will in turn help us to identify which Emission Stage the machinery complies with.

The following table provides a breakdown of the TAN displayed in Figure 1.

**e4\*97/68RA\*2012/46\*0354\*01**

<b>e4*</b>	The member state authority where the engine was tested
<b>97/68</b>	The original EC base legislation that the type approval is for
<b>R</b>	the encoding letter of the EU Emission Stage (Emission Code)
<b>A*</b>	Variable speed (A) or constant speed (B)
<b>2012/46*</b>	The latest level of the legislation that the approval relates to
<b>0354*</b>	The identification number of the manufacturer or importer
<b>01</b>	Indicated if the approval has any revisions

Taking the Emission Code (e4\*) and power output of 78.5 kW and comparing it with Figure 2., we can see that the Emission Stage the machinery complies with is Stage IV.

Code	Emission Stage	Power Bands
A	EU Stage I	130 ≤ kW ≤ 560
B		75 ≤ kW < 130
C		37 ≤ kW < 75
D	EU Stage II	18 ≤ kW < 37
E		130 ≤ kW ≤ 560
F		75 ≤ kW < 130
G	37 ≤ kW < 75	
H	EU Stage IIIA	130 ≤ kW ≤ 560
I		75 ≤ kW < 130
J		37 ≤ kW < 75
K	18 ≤ kW < 37	
L	EU Stage IIIB	130 ≤ kW ≤ 560
M		75 ≤ kW < 130
N		56 ≤ kW < 75
P	37 ≤ kW < 56	
Q	EU Stage IV	130 ≤ kW ≤ 560
R		56 ≤ kW < 130
EV6 / EC6	EU Stage V	130 ≤ kW ≤ 560
EV5 / EC5		56 ≤ kW < 130
EV4 / EC4		37 ≤ kW < 56

Figure 2. Emission Stages. (NRMM Practical Guide V.5, April 2022)

In some cases it may be evident that the Type Approval Plate has been removed due to wear and tear rendering it illegible, or it has been removed completely from the engine/machine. In this case, the TAN can be sourced from the Type Approval Certificate issued by the VCA, (the approval authority for the UK) or the manufacturers Declaration of Conformity.

### Retrofit

Retrofitting NRMM involves fitting a new part, not included in the original NRMM when it was manufactured and is designed to make the NRMM meet a higher emission stage. Retrofit technology must be approved by the Energy Saving Trust NRMM certification scheme.

### Exemptions

Exemptions can only be applied for through the GLA website when adding new machinery. There are two types of exemption available.

- **Viability Exemptions:** for specialized machinery that has particular machine specifications, with limited alternatives available. For a viability exemption to be granted the piece of machinery must meet the next possible emission stage.
- **Short Term (Emergency) Exemption:** in an emergency event non-compliant NRMM may be allowed up to 30 days on site if no suitable alternatives are available. Short term exemptions may apply if there is evidence that retrofit equipment has been ordered.

## **Summary**

The current emission standards for Greater London requires NRMM to meet Emission Stage IIIB and in the CAZ and Opportunity Areas, NRMM is required to meet Emission Stage IV, however, target criteria will become more stringent. From the 1<sup>st</sup> January 2025 NRMM throughout all development zones will be required to meet Emission Stage IV, and Stage V from the 1<sup>st</sup> January 2030.

## **Further Information**

Energy Saving Trust (2022) Non-Road Mobile Machinery Certification. [Non-road mobile machinery certification - Energy Saving Trust](#)

Greater London Authority (2022) Non-Road Mobile Machinery (NRMM). [Non-Road Mobile Machinery \(NRMM\) | London City Hall](#)

Non-Road Mobile Machinery (NRMM) Practical Guide V.5 (April 2022). [Non-Road mobile Machinery \(NRMM\) Practical Guide v.5 \(london.gov.uk\)](#)

NRMM Regulations (EU) 2016/1628 [Regulation \(EU\) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations \(EU\) No 1024/2012 and \(EU\) No 167/2013, and amending and repealing Directive 97/68/EC \(Text with EEA relevance\) \(legislation.gov.uk\)](#)