



European Network of Construction Companies for Research and Development

Construction CO₂ Measurement Protocol

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1 The ENCORDER Construction CO₂ Measurement Protocol

1.1 Introduction

The following measurement protocol has been developed by the members of ENCORDER (European Network of Construction Companies for Research and Development), along with partners from other like minded worldwide construction organisations, to detail the method to be used when measuring the greenhouse gas (GHG) emissions of an organisation within the construction sector.

This document identifies the intended users of the protocol, the main sources of emissions over which a construction company may have some influence, and the method of measuring these emissions. Guidance is also provided on reporting methods at a company and project level, with a view that companies will report their emissions publicly. This is also intended to assist current and future work undertaken to reduce emissions from specific construction related activities and operations.

The protocol follows the methodology of the Greenhouse Gas Protocol (GHG Protocol) March 2004 revision, which was originally developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The GHG protocol is used as the basis of measurement by organisations such as the Carbon Disclosure Project (CDP) who invite organisations around the world to supply information on their performance for disclosure to investors.

This protocol will be updated from time to time to take account of any new standards or changes to current methodologies.

1.2 Background

Global warming and climate change are now key sustainable development issues. Companies must be able to understand and manage their GHG risks if they are to ensure long-term success in a competitive business environment. A well-designed and maintained corporate GHG inventory, which aligns with business specific issues is an essential business tool and is increasingly seen as a marker for good management practice. Those that perform well are demonstrating their ability to manage risk, drive efficiencies, and offer the best value to clients. Globally, buildings account for a significant proportion of our Carbon Dioxide (CO₂) emissions and increasing attention is being paid to the part that the construction industry can play in helping to reduce these. There are now a range of drivers impacting on the construction industry:

- Construction companies must seek to offer the best value to clients. Construction is an industry with a high turnover, but with relatively low margins. Energy costs, which make up a significant proportion of construction costs, have increased over the years. By measuring and managing CO₂ emissions, organisations can reduce energy consumption and therefore reduce costs, directly benefiting the bottom line.
- Many governments are taking steps to reduce GHG emissions through national policies that include the introduction of emissions trading programs, carbon or energy taxes, and regulations and standards on energy efficiency and emissions.
- For large listed companies, CO₂ reporting and management is becoming part of their investors' decision making process. The Carbon Disclosure Project (CDP) collects carbon reporting data from large companies on behalf of investors who have already started to target the construction and property sector.
- Voluntary sustainability standards, such as the Global Reporting Initiative (GRI), are now becoming part of contractor selection processes. CO₂ emissions are a major part of such standards and as such, business could be lost in cases where a company is seen to be ignoring its climate change

impacts. The GRI are currently developing a sector supplement for construction and property, which means they intend the sector to follow specific guidelines.

The construction industry is complex, with different types of company operating at different points in the value chain, spanning across finance, design, materials manufacture, construction and life cycle maintenance. It is important that companies are reporting against the same guidelines so that a clear picture is presented to the outside world. Given the diverse range of businesses within the construction sector it is also important that the methodology employed is able to draw distinct lines of responsibility for CO₂ emissions within the construction / building value chain. There is a danger that standards developed outside of the construction sector will miss these key issues and therefore have an adverse impact.

Rather than wait for regulations that dictate how we should approach measuring and reducing carbon emissions, it is important for construction companies to take the initiative and ensure that any regulations reflect the needs of our industry.

1.3 Using the Protocol

The protocol is designed to be used by construction companies to measure GHG emissions, expressed as a CO₂ equivalent (CO₂e), that result from their operations and those of the supply chain.

While the principals of GHG measurement can be applied to any size of company involved in construction, this protocol is aimed at large companies which either act as a main contractor, or that are a large subcontractor for major building and infrastructure projects. It can also be used by materials manufacturers who are not already covered by a sector specific protocol.

The protocol sets out the approach for company reporting emissions for construction activities and provides examples of how information/data can be brought together from a company's different activities.

Section 2 outlines the areas of operation within the construction sector to which this protocol applies.

Section 3 provides guidance on setting organisational boundaries.

Section 4 introduces the concept of scope and significance in measuring emissions.

Sections 5 and 6 outline the key sources of emissions ('emission blocks') for a construction company, the minimum requirements for reporting against this protocol and provide guidance on how these should be measured.

The outputs (i.e. reported emissions data) are intended for use by regulatory bodies and governments, clients, standards bodies and any other organisation/individual that has an interest in the key sources of emissions from the construction processes. It is intended that, by adopting a standardised approach to measurement and reporting, the industry will have the greatest opportunity to work with stakeholders to reduce emissions. In addition, robust measurement of emissions will allow companies to identify inefficiencies in their operations and develop solutions which will lead to reduced costs and emissions.

1.4 Principles of GHG accounting

As outlined within the GHG Protocol, companies wishing to report against this protocol shall ensure that GHG accounting is based on the following principles:

Relevance

Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.

Completeness

Account for and report on all GHG emission sources and activities within the chosen boundaries. Disclose and justify any key exclusions.

Consistency

Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.

Transparency

Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.

Accuracy

Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

2 Construction Sector Areas of Operation

2.1 Areas of Operation

The protocol applies to organisations involved in the construction sector and is intended to identify the emissions from key construction processes over which a company has control or influence (see section 3 for guidance on setting organisational boundaries). The construction sector is split between three broad areas of operation:

- Off-site production and transport of materials used for construction
- Project design and construction (civil engineering or building, including demolition and refurbishment, and on-site materials manufacture)
- Project operation (the management and/or use of the final product)

Each area of operation has the potential to be a significant source of green house gas emissions but each will have a different level of impact and therefore they cannot be compared like for like. The 'Construction Company' reporting under this protocol may be involved in just one, or all three of these areas of operation.

An example of the supply chain for a construction project is detailed below in figure 1.

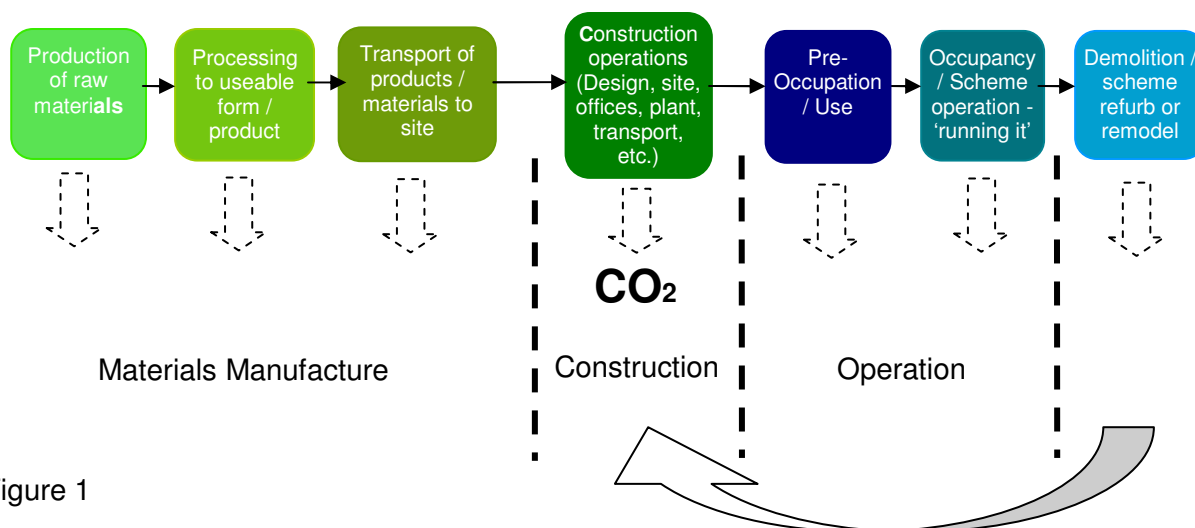


Figure 1

Companies shall identify which parts of their organisation fit into the above areas (according to the chosen organisational boundary as outlined in section 3), and measure the emissions for each area separately under the following headings.

- Materials manufacture
- Construction
- Operation

Example 1: Organisation A is involved in the design and construction of buildings and roads (Construction). They also manufacture Asphalt for use in the construction of roads (Materials Manufacture), and manage buildings which are let to residents and occupiers (Operation). The emissions associated with each of these areas of operation will vary significantly in size and should therefore be reported separately.

2.2 Support Services and Activities

Emissions from supporting services and activities of the company, such as the running of offices for staff, business travel and the operation of premises which support the company’s activities (e.g. plant depots, warehouses), shall also be included.

Where possible these should be included under the applicable area of operation, however where this is not possible the emissions should be included under the main area of operation.

Example 2: Organisation A has an asphalt plant with associated offices on the same site; however its management of buildings, which accounts for only a small amount of turnover, operates out of the same offices as the construction business. Therefore, for organisation A, the support services for asphalt production would be reported within the materials manufacture emissions area. However the support services emissions from the management of buildings which cannot be separated out would be reported under the construction emissions area, which is the main area of operation.

2.3 Sector and Project Type

Where an organisation wishes to differentiate and compare between the various areas of operation within their organisation, the following sectors and project types should be used.

It is recommended that only emissions relating specifically to projects (e.g. construction sites) make use of the following sector and project split.

Tier 1 differentiates between the sector and Tier 2 differentiates between project types.

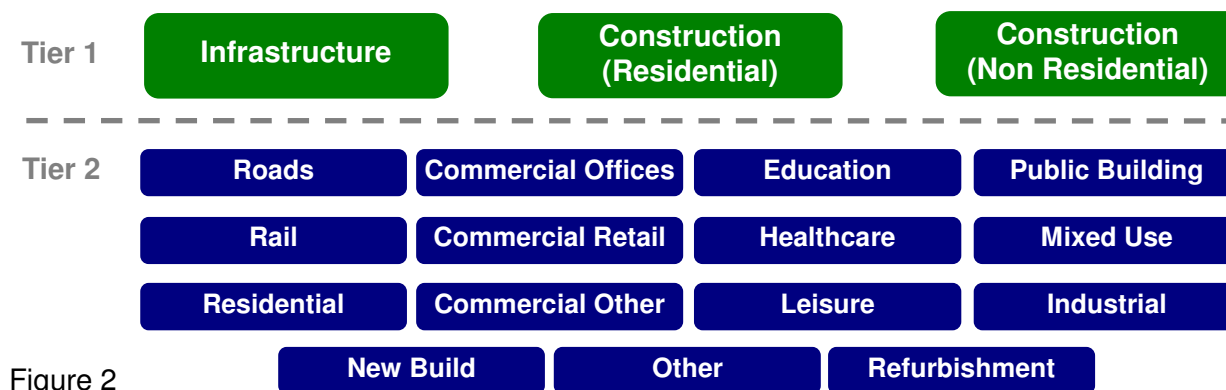


Figure 2

Organisations should report each sector separately where possible (Tier 1). For best practice, projects should also be identified by their project type where these are being compared (Tier 2), and whether this is new build or refurbishment project.

This type of breakdown will allow companies to produce benchmarks and will also highlight any major differences between the operations of different companies e.g. a company mostly involved in refurbishment is likely to have lower emissions than one mostly involved in new build.

3 Organisational Boundaries

In order to define which operations emissions should be measured from, companies must first establish their organisational boundary. As described in section 2, companies operating within the construction sector may have varied business operations and they may differ in their legal and organisational structures. These may include wholly owned operations, joint ventures (especially in the case of PFI schemes) and wholly or partly owned subsidiaries.

The GHG protocol defines two distinct approaches which can be used to define organisational boundaries, the equity share and the control approaches. The control approach is split into financial and operational control.

A brief description of each approach is provided below. For further guidance, companies should consult the GHG protocol 2004 revised addition.

Equity share approach - Under this approach, a company would record its emissions according to (pro rata) the equity share it holds in each operation, i.e. according to ownership. This is based on the assumption that the economic risks and rewards for a company are comparable to its ownership share. There may be cases where equity share differs from ownership, in which case the economic share a company has in an operation would override its share of ownership, to better reflect the risks and rewards at stake.

Financial control approach - Under this approach a company would record emissions from facilities, sites or operations over which it has financial control i.e. it has the ability to direct the financial and operating policies with a view to gaining economic benefits from its activities. A company accounts for 100% of the emissions of those operations over which they have financial control.

Operational control approach - Under this approach, a company would record emissions from facilities, sites or operations over which it or one of its subsidiaries, has operational control i.e. the authority to introduce and implement its operating policies at the operation. A company accounts for 100% of emissions from operations over which it or one of its subsidiaries has operational control.

Companies can choose which approach they use based on which best suits their particular business. However, given the nature of the construction sector and the operations most companies are involved with, it is recommended that companies should use the operational control approach and in cases where operational control is not clearly assigned the equity share approach should be used e.g. in the case of PFI schemes. Taking this approach is likely to identify those emissions over which the company has most influence in reducing and which stakeholders are currently concerned with.

4 Scope of Measurement

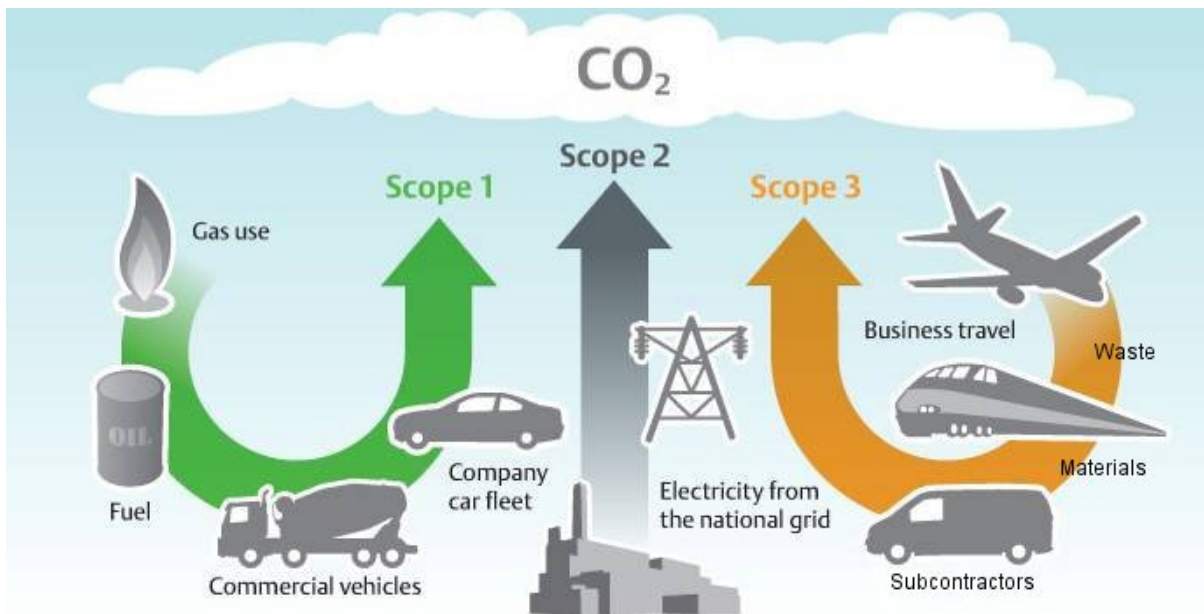


Figure 3

The GHG Protocol breaks emissions down into three distinct areas known as ‘scopes’:

- Scope 1 – Direct Emissions (from the burning of fuel)
- Scope 2 – Indirect Emissions (from the use of Electricity & Steam)
- Scope 3 – Other Indirect Emissions

Although Scope 3 emissions are optional within the GHG Protocol, they make up a significant percentage of the CO₂ emissions of the construction sector. Within each Scope a number of emission sources are quoted. ENCORD are proposing to group these sources into ‘*Emission Blocks*’ (see section 4) which can then be associated with the GHG Protocol scopes. Details of the emission sources included within each block, and how the quantity of each emission is obtained, are detailed in section 5.

4.1 Significance

When assessing each emission block, organisations should consider the ‘significance’ of the emissions from that source. Significance can be determined by considering the following criteria:

- **Scale:** How large is an emissions source in comparison to your company’s total emissions? For indirect (Scope 3) emissions, which are the largest sources connected to your companies operations?
- **Relevance to your business:** Which sources of emissions are most important to your business and your stakeholders (e.g. which will your clients expect you to measure and report and which are linked to significant direct or indirect costs)
- **Potential for reductions:** Is there potential for your company to influence or reduce emissions from a particular source

Organisations shall aim to report at least 90% of their emissions, therefore where a source is found to be insignificant this source could be discounted. When a construction company reports it’s emissions it should state clearly and with full transparency which sources it has included, and which are excluded and the reasoning behind these decisions.

5 Key Sources of Emissions

As described in section 2 companies shall separate emissions between materials manufacture, construction, and operation. This section outlines the key sources of emissions from these operations.

Construction Company ‘Emission Blocks’

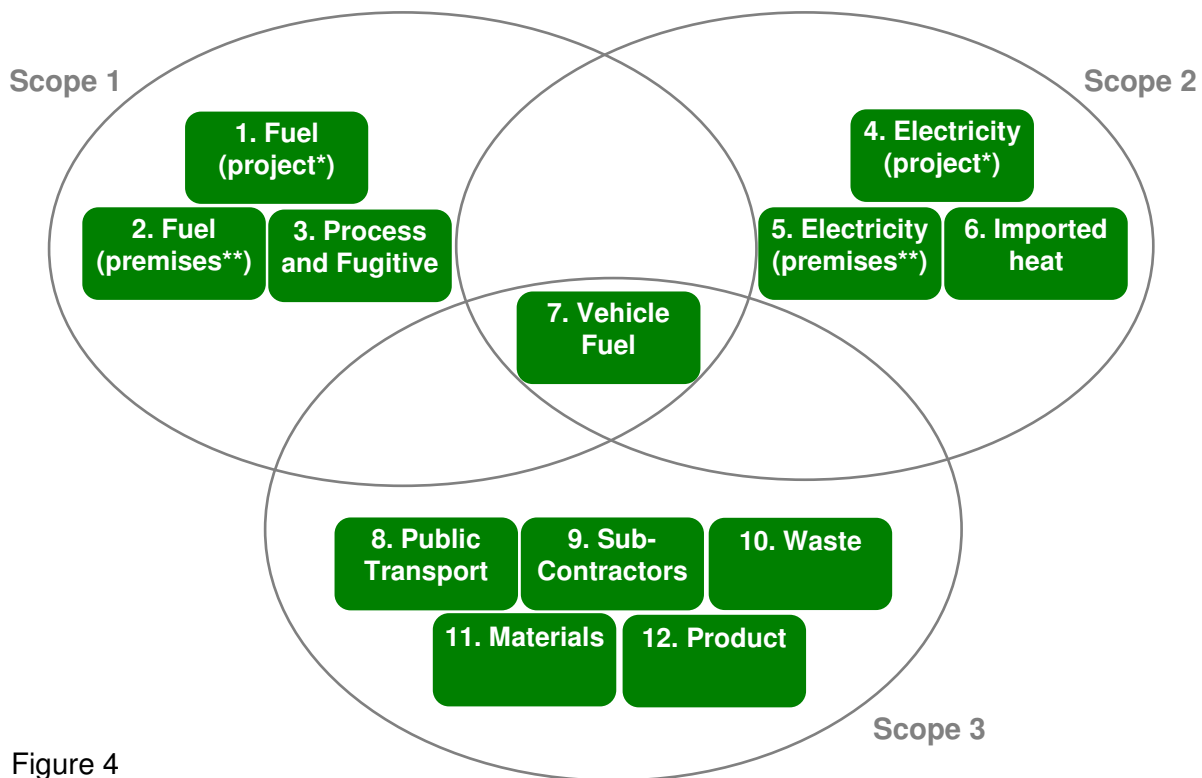


Figure 4

* Projects include construction sites and managed assets

** Premises include offices, warehouses, plant depots, etc occupied by the company

The ‘*Emission Blocks*’ have been identified by ENCORD as distinct sources of Green House Gas emissions for which the ‘Construction Company’ may have some responsibility, and over which it could have some influence in reducing. When grouped together these blocks represent the most significant emissions of the construction process.

Each ‘*Emission Block*’ has been numbered for reference. Section 5 details the make up of each emission block and outlines how they should be measured. The order and numbering of blocks is not intended to indicate their relative significance. However, companies reporting against this protocol shall measure emission blocks 1 to 7 as a minimum. This is consistent with the requirement, under the GHG Protocol, to measure and report scopes 1 and 2 as a minimum. For best practice companies should aim to measure emission blocks 8 and 9 also. There are currently no standard methods of measurement for emissions within blocks 10 and 11, therefore further research is required before companies can begin reporting these in a standardised way; however companies should aim to start measuring the quantities involved in these blocks. Emissions for block 12 are not specifically measured, however companies are asked here to consider the performance of the product in use.

A reporting tool will be developed that includes all *Emission Blocks* in the sector, along with the associated emission sources and agreed conversion factors. These conversion factors will be based on the following:

- WRI / International Energy Agency (IEA) figures (Default Conversion Factor)
- Country standard conversion factors where these have been subject to third party verification (e.g. DEFRA in the UK). These are to follow national reporting guidelines.

The information/data required to measure emissions may be collected in a number of different ways, and shall then be brought together at company level and split between areas of operation (as outlined in section 2.1). Figures 5 and 6 below detail the possible flow of information from a typical construction project, an organisations premises (such as an office, depot or plant yard) and supporting activities (such as transport) into the company emissions for construction and materials manufacture areas of operation.

Example Construction Emissions

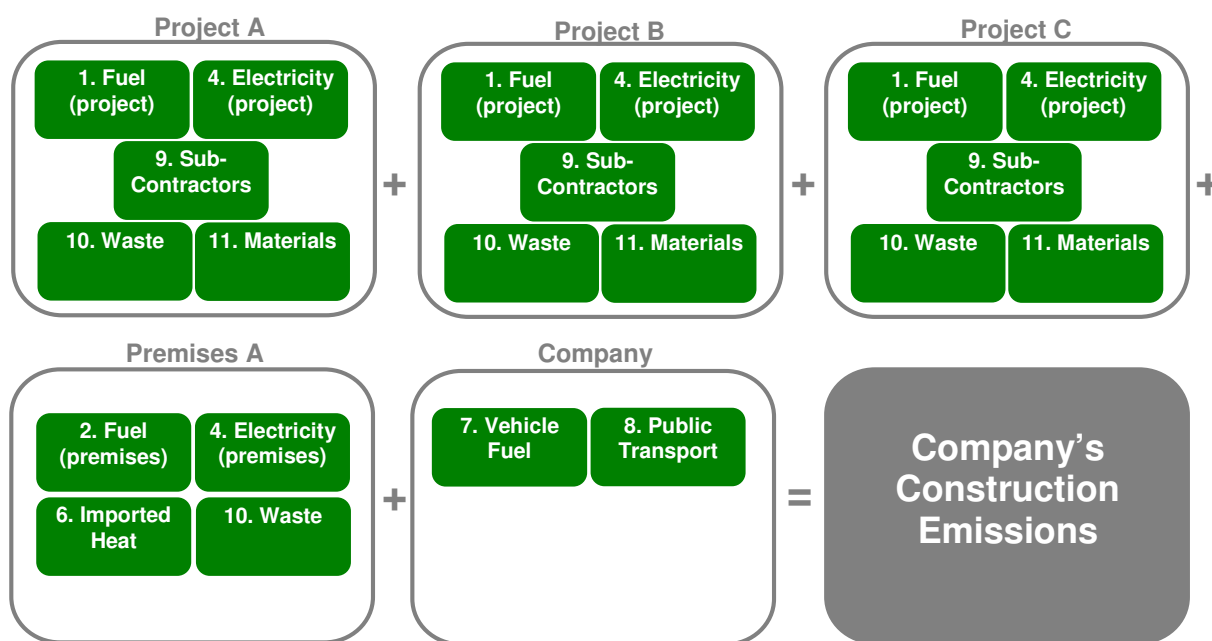


Figure 5

Example Material Manufacture Emissions

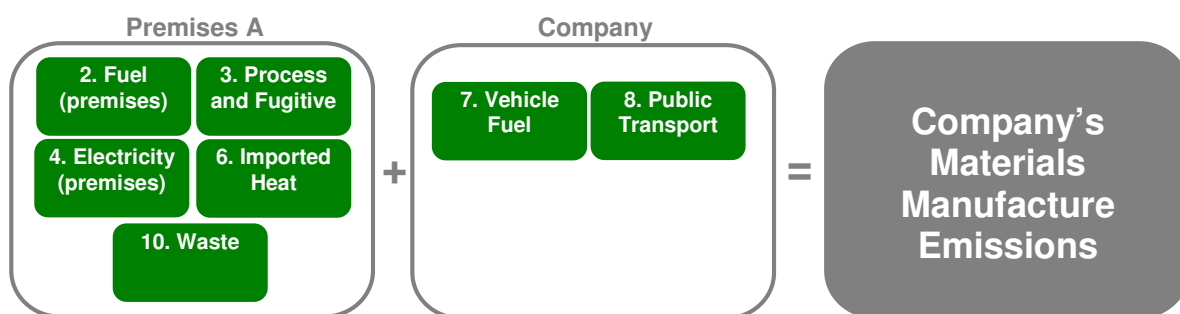


Figure 6

6 Measuring Emissions

As outlined in section 4, companies wishing to report against this protocol shall measure and report their emissions from blocks 1-7 as a minimum.

Block 1: Fuel (project)

Includes all fuel purchased by the organisation for use in plant and machinery in use on, or at, a project (including construction sites and managed assets such as buildings and roads). Where materials are manufactured on a construction site (e.g. concrete), then the fuel used in this process should be included within this block also. It should not include any fuel used in vehicles travelling on the public highway as this is measured under block 7. The fuel used can be measured using a number of different units of measurement (e.g. kWh, litres, kg, m³, etc.) and may include the following:

- Gas Oil
- Diesel
- Petrol (Gasoline)
- Fuel Oil
- Heating Oil
- Natural Gas
- Liquefied Petroleum Gas (LPG)
- Compressed Natural Gas (CNG)
- Coal

Emissions should be calculated using actual data wherever possible, such as purchased fuel and a relevant conversion factor. Where not all of this information is available, or it is impractical to collect data of this type, emissions may be calculated using a robust estimate of fuel consumed. This should be based on robust metrics such as the energy requirements of machinery/plant (e.g. horse power), working hours (e.g. typical period machinery is in use), and the efficiency of machinery (e.g. to determine how much fuel it will use to produce the required energy for the required amount of time). When reporting emissions calculated in this way, the company should clearly state the method used and assumptions made.

Block 2: Fuel (premises)

Includes all fuel purchased by the organisation for use at premises which support the company's activities. This will include offices, production facilities, warehouses, plant storage/maintenance facilities, and/or sites used for assembly of construction materials. The fuels included in this block are the same as those listed for block 1 above.

Block 3: Process and Fugitive Emissions

Process - Includes green house gas emissions from physical or chemical processing involved in the production of mineral products (such as cement and lime) and metal products (such as steel and aluminium) within facilities owned or controlled by the company. This is only likely to apply to companies which have large manufacturing facilities within their business. These should be measured and reported separately as part of the company's material manufacturing emissions.

Fugitive - Includes green house gas emissions from air-conditioning and refrigerant leaks from equipment either owned or controlled by the company. Unless you operate large refrigeration or cooling plant it is unlikely that these emissions will be significant. Where they are, emissions should be reported in CO₂e and converted using an appropriate global warming potential (GWP) conversion factor.

Block 4: Electricity (project)

Includes all electricity purchased by the organisation for use at a project (including construction sites and managed assets such as buildings and roads). Where materials are manufactured on site, then the electricity used in this process should be included here also.

The conversion factors will include any 'green' electricity in the mix; therefore all electricity will be measured on a gross basis. Where an organisation has signed up to green energy tariffs, and/or green energy certificates have been issued, then a net figure can also be quoted in addition to the gross figure, i.e. the total energy consumed and net CO₂ taking into account the amount of green energy purchased.

Block 5: Electricity (premises)

Includes all electricity purchased by the organisation for use at premises which support the company's activities. This will include offices, production facilities, warehouses, plant storage/maintenance facilities, and/ or sites used for assembly of construction materials. As indicated for block 4, emissions from electricity should be calculated on a 'gross' basis.

Block 6: Imported Heat

Includes all heat (e.g. steam from combined heat and power) purchased by the organisation for use at the company's projects or premises. Conversion factors from the supplier should be used where available or relevant generic factors used e.g. Defra in the UK.

Block 7: Vehicle Fuel

Includes all fuel paid for by the organisation (either directly, or indirectly through mileage allowances or expenses) for use in vehicles travelling on the public highway. Under best practice measurement and reporting, organisations should differentiate between fuel used for business journeys and fuel used in commuting to and from work. The following types of vehicles should be included:

- Company owned vehicles (Cars, Vans, HGVs, etc.)
- Leased vehicles (Cars, Vans, HGVs, etc.)
- Privately owned vehicles (Cars, Vans, HGVs, etc.)

The fuel used will generally be measured in litres and may include the following:

- Diesel
- Petrol (Gasoline)
- Liquefied Petroleum Gas (LPG)
- Compressed Natural Gas (CNG)
- Electricity (measured in kWh)

Emissions can be calculated using actual purchased fuel conversion factors, or where not all of this information is available, mileage or km conversion factors can be used. Where mileage/km conversion factors are used, these are to be broken down into the following three categories as a minimum (e.g. based on DEFRA conversion factors):

- Average car (unknown fuel) including MPVs (kg CO₂/km)
- Average vans up to 3.5 tonnes (kg CO₂/km)
- Average HGV over 3.5 tonnes (kg CO₂/km)

Where more accurate vehicle data is available for transport emissions (e.g. average government CO₂ emissions for cars in the fleet) then this should be used.

Block 8: Public Transport

Includes all public transport (Air, Train, Bus, Coach, Taxi, etc.) used by employees, and paid for by the organisation (either directly, or indirectly through allowances or expenses).

Information may be obtained from travel surveys of at least 10% of the organisations staff, covering all areas of operation, with the resulting data being aggregated up to establish the total distances travelled. Emission are to be calculated based on approved standard conversion factors for miles/km travelled on each form of transport (e.g. DEFRA).

Block 9: Subcontractor

This should include all emissions associated with a sub-contractor at project level. These emissions should be measured in line with the guidelines above for fuel (project), electricity (project), vehicle fuel, and public transport (i.e. blocks 1, 4, 7 & 8). Each emissions source should be measured and identified separately wherever possible.

Block 10: Waste

Includes CO₂ and CO₂ equivalent (CO_{2e}) produced as a result of the disposal of waste, including transport off site

Measurement of the waste quantities is to be carried out in accordance with agreed guidelines (e.g. WRAP Measuring and Reporting Construction Waste Guidelines in the UK). These must, as a minimum, differentiate between the different sources of waste (Construction, Demolition and Excavation), and the destination (e.g. Landfill, Incineration, Recycling, Reuse)

Emissions will be calculated on agreed standard conversion factors (e.g. Environment Agency / WRAP data in the UK). This is to include the CO₂ equivalent emissions for the various greenhouse gases produced as part of the disposal process (e.g. Methane produced as a result of landfill), as well as any associated transport CO₂ emissions.

(Note: There are currently no standard methods of measurement for emissions from waste; therefore further research is required to establish appropriate conversion factors for the waste sources and disposal processes before companies can begin reporting in a standardised way.)

Block 11: Materials

This is to include the embodied CO₂ in materials, plus an allowance for transport to site, for the following key construction materials:

- Structural steel frame components
- Concrete and concrete products
- Steel reinforcement
- Cladding materials, including insulation
- Aggregates
- Bituminous products

Embodied CO₂ in materials is to be measured in accordance with approved national/international standards once they have been fully developed and tested (e.g. PAS 2050 / ISO14067), and is to include all emissions up to the factory gate.

An allowance for transport CO₂ emissions to the production site will then need to be added to the material production figure based on distance travelled between the production and use sites. (Note: The transport emissions associated with materials delivery require further investigation to establish agreed metrics and conversion factors).

Block 12: Product

The emissions from the product during its use (e.g. a building or length of road) are not specifically measured within this block; however we must not forget that this is the area where there is most potential to reduce the CO₂ emissions from the 'Operation' phase. Therefore, where the company has influence over the specification, every effort should be made to reduce the impact of the product over its lifetime (within technological and financial constraints).

In addition to the above, where performance measures exist, companies should record the performance of the product. Currently this would include the 'Energy Performance in Buildings Directive' label / certificate rating per m² of the completed buildings (e.g. Energy Performance Certificate (EPC) in the UK).

The 'Common Carbon Metric' will be the preferred method of measuring carbon emissions resulting from buildings and should be used once it has achieved widespread adoption. ENCORDER will update the protocol to reflect agreements reached through the UNEP sustainable buildings and construction initiative.

Other emissions

Where other significant emissions are reported, the method of measurement, source of data, and assumptions made, should be explained.

Reporting of emissions from sources of energy not included in global or country specific reporting guidance should be considered individually. Where new technologies are being used which seek to avoid or reduce direct CO₂ emission sufficient evidence should be provided and third party verification should be sought. This is an area for further investigation to ensure a fair and transparent approach is applied.

7 Industry KPI

When reporting construction company CO₂ emissions, the following normalising Key Performance Indicators should be used. The primary indicator should always be used and where possible it is best practice to use the secondary indicator.

Materials Manufacture – Tonnes CO₂ / unit of product

Construction – Tonnes CO₂ / (€ / £ / \$) 1 million turnover (primary indicator)
– Tonnes CO₂ / m² gross internal floor area (secondary indicator)
– Tonnes CO₂ / km of road/rail (secondary indicator)

Operation – Kilograms (kg) of CO₂ / m² gross internal floor area or km of road/rail

8 Acknowledgements

This Protocol has been developed by experts in the field of environment and sustainability within the construction sector from the member companies of ENCORD and its partners in this project.

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