



Version 'A' - May 2021

Improving Consistency in Whole Life Carbon Assessment and Reporting

May 2021

Scope:

Carbon Definitions for the Built Environment, Buildings and Infrastructure

Carbon Definitions for the Built Environment, Buildings and Infrastructure

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1. Introduction

The UK is required to achieve Net Zero by 2050 and 78% reductions by 2035 in line with the Climate Change Act of 2008 and subsequent revisions in 2019 and 2021. The built environment is therefore making efforts to decarbonize the delivery of buildings and infrastructure across all professions and disciplines.

However there remains significant inconsistency with respect to the basic definitions in use with reference to carbon and net zero carbon terminologies over the life cycle of buildings and infrastructure.

This document provides a common set of definitions. It has been put together initially by a working group within the Whole Life Carbon Network (WLCN, a group of some 90 built environment professionals) and including detailed discussions with LETI. (This document is Stage 1 of the WLCN 'Consistency Project')

The Definitions are based on BS EN 15978: 2011 and use the life cycle modular structure. This has been adapted for National Infrastructure definitions as per PAS 2080: 2016.

The **WLCN/LETI** Working Group for this project is as follows:

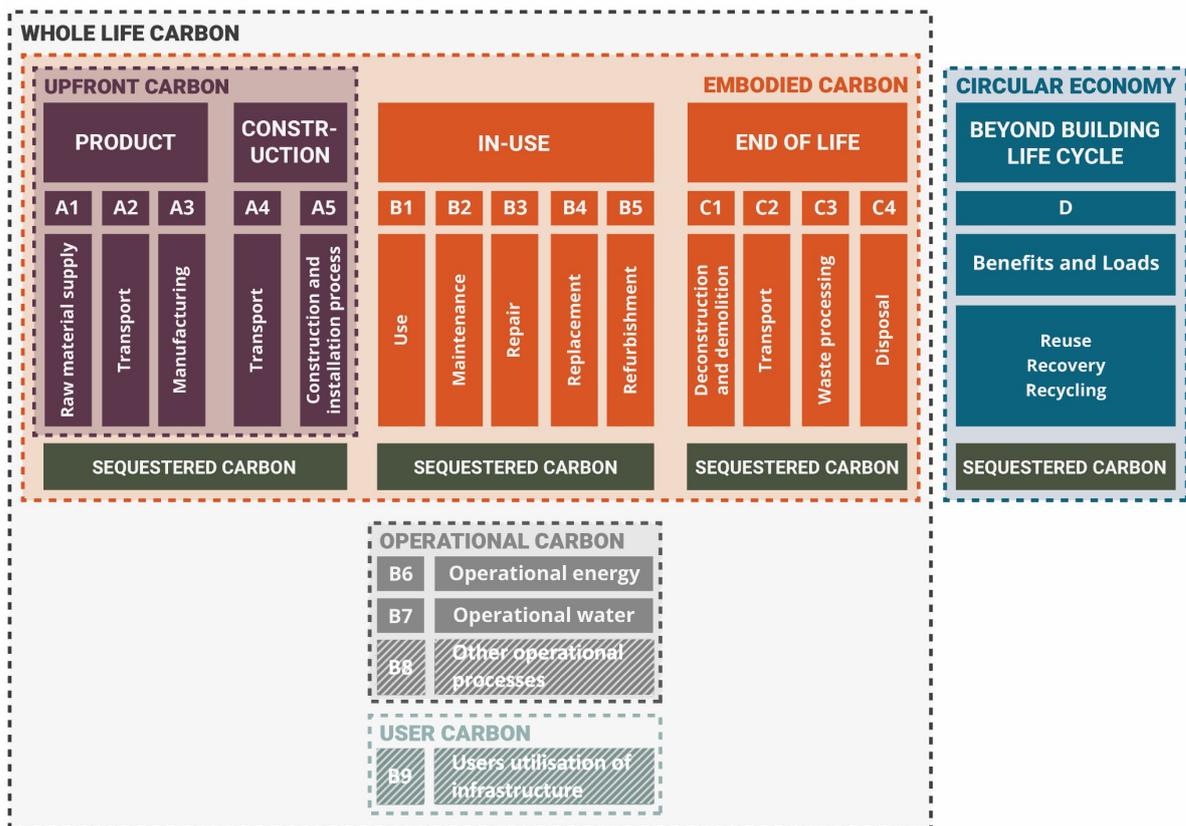
- | | |
|----------------------------------|---------------------------|
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| - Maria Smith | Buro Happold |
| - Simon Sturgis (<i>chair</i>) | Targeting Zero |
| - Simon Wyatt | Cundall |

2. Definitions for Buildings and Infrastructure

Currently there are many variations in the terminology used to define carbon emissions (operational, embodied, whole life etc.) which leads to confusion amongst stakeholders. The definitions in this document build on the work of others (see Appendix 1) but have been altered and developed as a 'family' of definitions that work together, with the intention of achieving greater consistency across the built environment industry.

The 'net zero carbon' definitions set out below are based on the 'Paris Proof' approach which dictates that the Built Environment Industry should only use the limited amount of carbon – including energy and material resources – apportioned to it, in order for the UK economy as a whole to reach net zero emissions by 2050 and ensure best efforts to limit global warming to 1.5 degrees Celsius. This requires reducing built environment emissions in line with a science-based trajectory (i.e. 50% reductions by 2030) as a priority measure, and a decreasing reliance on offsets over time to achieve a net zero carbon balance.

These Definitions apply to new build, retrofit and infrastructure.



NB: Hatched modules are for infrastructure only.

Reference Diagram showing the Life Cycle Modules adapted from BS EN 15978 and PAS2080 (for Infrastructure). It shows the modules used in assessing all carbon emissions over an asset's entire lifecycle and the various terms that are used.

Carbon Definitions

Greenhouse Gases (GHG)
(Often referred to as 'carbon emissions' in general usage):

'Greenhouse Gases' are constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. For these 'Carbon Definitions', we are only addressing the GHGs with Global Warming Potentials assigned by the IPCC, e.g. carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's), and sulphur hexafluoride (SF₆).

Whole Life Carbon

'Whole Life Carbon' emissions are the sum total of all asset related GHG emissions and removals, both operational and embodied over the life cycle of an asset including its disposal (Modules: A1-A5; B1-B7 (plus B8 and B9 for Infrastructure only); C1-C4). Overall Whole Life Carbon asset performance includes separately reporting the potential benefit from future energy recovery, reuse, and recycling (Module D).

Embodied Carbon

The 'Embodied Carbon' emissions of an asset are the total GHG emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset (Modules A1-A5, B1-B5, C1-C4).

Upfront Carbon

'Upfront Carbon' emissions are the GHG emissions associated with materials and construction processes up to practical completion (Modules A1-A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion.

Operational Carbon - Energy

'Operational Carbon – Energy' (Module B6) are the GHG emissions arising from all energy consumed by an asset in-use, over its life cycle.

Operational Carbon - Water

'Operational Carbon – Water' (Module B7) are those GHG emissions arising from water supply and wastewater treatment for an asset in-use, over its life cycle.

Carbon Sequestration

'Carbon Sequestration' is the process by which carbon dioxide is removed from the atmosphere and incorporated as 'Biogenic Carbon' in 'Biomass', through photosynthesis and other processes associated with the carbon cycle.

Biogenic Carbon

'Biogenic Carbon' refers to the carbon removals associated with carbon sequestration into biomass as well as any emissions associated with this sequestered carbon.

Biomass

'Biomass' is material of biological origin excluding material embedded in geological and/or fossilized formations.

Specific to Infrastructure**Other Operational Processes¹**

'Other Operational Processes' are those GHG emissions associated with the operation of infrastructure (B8) required to enable it to operate and deliver its service. These exclude all other 'B' Modules in the In-Use stage.

User Carbon²

'User Carbon' are those GHG emissions relating to users' utilisation of infrastructure and the service it provides during operation (B9).

¹ PAS 2080: 2016 Module B-8

² PAS 2080: 2016 module B-9

Net Zero Definitions

Net Zero (Whole Life) Carbon

A 'Net Zero (Whole Life) Carbon' Asset is one where the sum total of all asset related GHG emissions, both operational and embodied, over an asset's life cycle (Modules A1-A5, B1-B7 (plus B8 and B9 for Infrastructure only), C1-C4) are minimized, meet local carbon, energy and water targets, and with residual 'offsets', equals zero.

Net Zero Embodied Carbon

A 'Net Zero Embodied Carbon' asset is one where the sum total of GHG emissions and removals over an asset's life cycle (Modules A1-A5, B1-B5 and C1-C4) are minimized, meets local carbon targets (e.g. kgCO₂e/m²), and with additional 'offsets', equals zero.

Net Zero Upfront Carbon

A 'Net Zero Upfront Carbon' asset is one where the sum total of GHG emissions, excluding 'carbon sequestration', from Modules A1-A5 is minimized, meets local carbon targets (e.g. kgCO₂e/m²), and with additional 'offsets', equals zero.

Net Zero Carbon - Operational Energy

A 'Net Zero Carbon – Operational Energy' asset is one where no fossil fuels are used, all energy use (Module B6) has been minimized, meets the local energy use target (e.g. kWh/m²/a) and all energy use is generated on- or off- site using renewables that demonstrate additionality. Any residual direct³ or indirect emissions from energy generation and distribution are 'offset'.

Net Zero Carbon - Operational Water

A 'Net Zero Carbon - Operational Water' asset is one where water use (Module B7) is minimized, meets local water targets (e.g. litres/person/year) and where those GHG emissions arising from water supply and wastewater treatment are 'offset'.

Net Zero In-Use Asset

A 'Net Zero In-Use Carbon Asset' is one where on an annual basis the sum total of all asset related GHG emissions, both operational and embodied, (Modules B1-B7 (plus B8 and B9 for Infrastructure only)) are minimized, meets local carbon, energy and water targets, and with residual 'offsets', equals zero.

³ e.g. Biomass

Additionality⁴

Procurement of renewable energy for the asset's use which results in new installed renewable energy capacity that otherwise would not have occurred had the intervention not taken place.

Definitions Relating to Offsets**Carbon Offset⁴**

'Carbon offset' means emission reductions or removals achieved by one entity can be used to compensate (offset) emissions from another entity.

Offsetting Methodology

Modules A1-A5 should be offset post completion based on a verified post practical completion carbon assessment of A1-A5.

Modules B1-B7 (plus B8 and B9 for Infrastructure) should be offset annually, based on verified calculations based on actual activities rather than those predicted at design stage.

Modules C1-C4 are offset post deconstruction and disposal.

Net Zero Carbon

All carbon emissions are reduced in line with the Paris Agreement 1.5°C trajectory, with residual emissions offset through carbon removals or avoided emissions.

Carbon Neutral

All carbon emissions are balanced with offsets based on carbon removals or avoided emissions.

Absolute Zero Carbon

Eliminating all carbon emissions without the use of offsets.

⁴ See UKGBC ['Renewable Energy Procurement & Carbon Offsetting Guidance for Net Zero carbon Buildings 2021'](#)

3. Achieving Net Zero Carbon

Whole Life Carbon - Achieving 'Net Zero Carbon'					WLCN/LETI
	Whole Life Carbon				Assess Separately
Project Stage	Upfront Carbon (A1-A5)	In-Use Embodied Carbon (B1-B5)	In-Use Operational Carbon - Energy and Water. (B6-B7)	End of Life (C1-C4)	Module D
Concept Design	Prediction based on generic values	Prediction based on generic values	Prediction based on generic values	Prediction based on generic values	Prediction based on generic values
Detailed Design	Prediction based on specific values	Prediction based on specific values	Prediction based on specific values	Prediction based on specific values	Prediction based on specific values
Practical Completion	Calculated on actual values	Prediction updated using as built values	Prediction updated using as built values	Prediction updated using as built values	Prediction updated using as built values
Use Stage		Calculated on actual usage	Based on actual metered consumption	Prediction updated using as built values from B3-B5	Prediction updated using as built values from B3-B5
End of life				Calculated on actual values	Prediction updated using as deconstructed values
Future Projects (A1-A3)					Calculated on actual values
Residual Offsets to achieve 'Net Zero'	At Practical Completion based on third party verified assessment	Annually in use based on third party verified assessment	Renewable energy with annual offsets for residual indirect emissions from energy and water	End of Life based on third party verified assessment	N/A
KEY:					
Net Zero Carbon in design	Designed to be 'Net Zero Carbon', but which does not have actual embodied or operational performance data to allow verification of 'Net Zero Carbon' status				
Net Zero Carbon enabled	Designed to be 'Net Zero Carbon' 'In-Use', but which does not have actual 'In-Use' or 'End of Life' performance data to allow verification of 'Net Zero Carbon' status				
Net Zero Carbon	Verified as 'Net Zero Carbon', using actual measured data and a third party verified assessment. Net Zero 'Upfront Carbon' can be claimed at Practical Completion, and 'Net Zero' 'In-Use' can be claimed annually.				

This table sets out how to achieve net zero carbon at each project stage. It also illustrates the requirements across project life cycle modules through to Module D and the relationship to achieving net zero through residual carbon offsets.

- **'Generic values'** would be industry average EPD or ICE Database data or defaults for scenarios and could be typical assumed quantities/m2
- **'Specific values'** would be specific EPD data from the products specified, measured quantities, assumed wastage and transport assumptions from EPD etc
- **'Actual values'** or 'actual usage' would be EPD data for the actual products used (if available), with the actual quantities used (eg including waste quantities, fates and transport data etc

For example;

- At the design stage the asset can be predicted to be net zero, based on generic values.
- At Practical Completion an asset can be net zero upfront carbon based on actual values, subject to verification and residual offsets.
- At Practical Completion, an asset is also potentially net zero carbon enabled to allow the occupier to have a net zero occupation subject to actual usage data, and actual metered consumption plus residual associated offsets.

4. Appendix 1:

Documents examined in the preparation of these definitions.

DGNB: German Sustainable Building Council<https://www.dgnb-system.de/en/index.php>**UKGBC: Zero Carbon Buildings**
[UKGBC Zero Carbon Buildings: A Framework Definition: https://www.ukgbc.org/wp-content/uploads/2019/04/Net-Zero-Carbon-Buildings-A-framework-definition.pdf](https://www.ukgbc.org/wp-content/uploads/2019/04/Net-Zero-Carbon-Buildings-A-framework-definition.pdf)
LETI: Climate Emergency Design Guide<https://www.leti.london/cedg>**LETI: Embodied Carbon primer**<https://www.leti.london/ecp>**WGBC: Bringing Embodied Carbon Upfront**
[WorldGBC Net Zero: https://www.worldgbc.org/advancing-net-zero/what-net-zero](https://www.worldgbc.org/advancing-net-zero/what-net-zero)
CCC - Net Zero- The UK's contribution to stopping Global Warming<https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>**Office for National Statistics (ONS): Net zero and the different official measures of the UK's greenhouse gas emissions**<https://www.ons.gov.uk/economy/environmentalaccounts/articles/netzeroandthedifferentofficialmeasuresoftheksgreenhousegasemissions/2019-07-24>**RIBA 2030 Challenge**<https://www.architecture.com/about/policy/climate-action/2030-climate-challenge>**IPCC: The Carbon Cycle and Atmospheric carbon Dioxide**<https://www.ipcc.ch/site/assets/uploads/2018/02/TAR-03.pdf>**RICS Professional Statement: Whole life carbon assessment for the built environment**
<https://www.rics.org/globalassets/rics-website/media/upholding-professional-standards/sector-standards/building-surveying/whole-life-carbon-assessment-for-the-built-environment-1st-edition-rics.pdf>
Greater London Authority- Policy SI2 Whole Life Carbon Draft Detailed Guidance
<https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/planning-guidance/whole-life-cycle-carbon-assessments-guidance-pre-consultation-draft>

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BS EN 15978: 2011

<https://shop.bsigroup.com/ProductDetail/?pid=000000000030256638>

PAS 2080: 2016

<https://www.standardscentre.co.uk/bs/PAS-2080-2016/?kw=PAS%202080&ad=>

**Climate Change Act
Amendment 2019**

<https://www.legislation.gov.uk/ukdsi/2019/9780111187654>

CIBSE TM65

<https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q3Y00000IPZOhQAP>

**IStructE Calculating
Embodied Carbon**

<https://www.istructe.org/resources/guidance/how-to-calculate-embodied-carbon/>

**UKGBC Renewable Energy
Procurement and Carbon
Offsetting**

<https://www.ukgbc.org/wp-content/uploads/2021/03/Renewable-Energy-Procurement-Carbon-Offsetting-Guidance-for-Net-Zero-Carbon-Buildings.pdf>

UN Race to Zero Lexicon

<https://unfccc.int/climate-action/race-to-zero-campaign>

5. Appendix 2:

Background to GHG emissions and Net Zero

- Legislation:** The overarching context for UK emissions reduction is the Climate Change Act 2008, and more recently the amendment of June 2019 which introduced a target for at least a 100% reduction of greenhouse gas emissions (compared to 1990 levels) in the UK by 2050 and the 2021 target of 78% reductions by 2035.
- The Office for National Statistics (ONS) defines Net Zero:** “Net zero means that the UK’s total greenhouse gas (GHG) emissions would be equal to or less than the emissions the UK removed from the environment”. This is on a territorial basis as covered by the UK’s current reporting obligations under the United Nations Framework Convention on Climate Change and the Kyoto Protocol
- GHG emissions attributable to built environment activities arise in different locations and can be represented through different accounting systems:

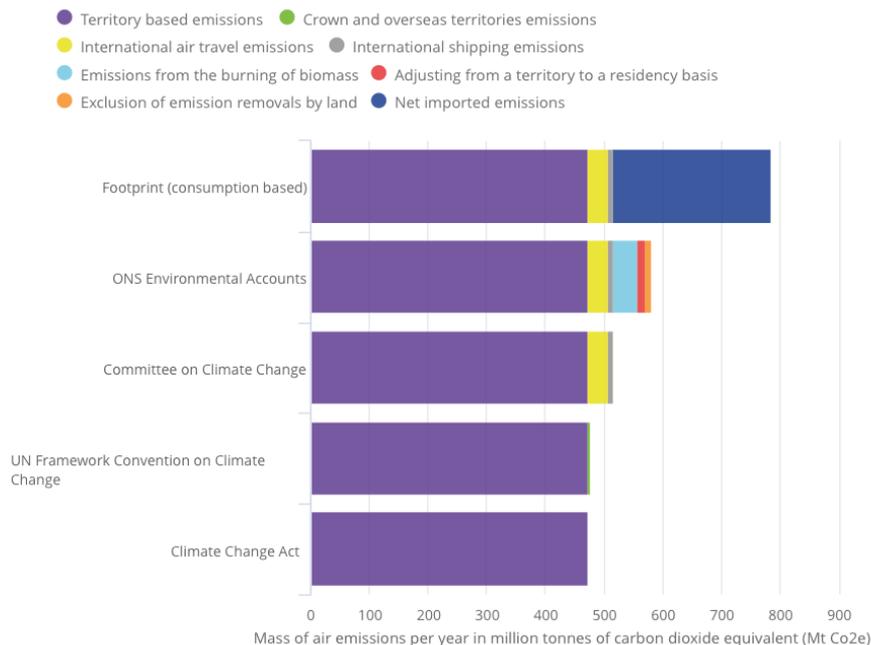


Diagram showing difference between Climate Change Act calculation of UK emissions (bottom bar) with Consumption based approach including imported goods (top bar). Source: ONS.

- Consumption-based emissions:** The built environment is essentially a consumption-based sector. Emissions attributable to built environment supply chains are not limited to the UK, therefore built environment carbon assessments are ‘footprint estimates’ adopting a consumption-based boundary. Note the following from the ONS, which can also relate to UK based project assessments: “Footprint estimates are calculated on a consumption basis and provide estimates of emissions associated with the consumption of goods and services by households within the UK. They include estimates of emissions associated with each stage of the supply chain for those goods and services, irrelevant of whether or not their production process occurs within the UK.”

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- **Territory-based emissions:** Further, assessments of Territory-based emissions only *'include emissions released in the UK by tourists and foreign transport operations and exclude the emissions of UK residents abroad. Similarly, emissions from businesses based in the UK but registered abroad are included, those from businesses registered in the UK but based abroad are excluded'*. Climate Change Act estimates are compiled on this basis.