Accelerating the delivery of Net Zero Carbon Buildings through planning

Topic resource part 2: Embodied carbon emissions

Planning for the climate crisis: A guide for local authorities

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Introduction

The built environment accounts for a quarter of all UK greenhouse gas emissions,[1] and a large proportion of these arise from the materials, construction, maintenance and demolition of buildings throughout their lifecycle. These are known as embodied carbon emissions.

As building regulations and energy efficiency improvements reduce the operational emissions arising from buildings, embodied carbon accounts for an increasing proportion of the emissions arising from the built environment. The London Energy Transformation Initiative (LETI) state that embodied carbon can account for between 40-70% of the whole life carbon of buildings.[2]

In 2022, the Environmental Audit Committee reported that limited action was being taken on addressing embodied carbon emissions at a national level.[3] The Climate Change Committee has also repeatedly called for action to address the carbon emissions from buildings, and in the Seventh Carbon Budget identified the need for rules 'to measure and limit the embodied carbon of buildings' as an area of priority action.[4] Despite this, there is currently nothing in national policy that requires the embodied carbon emissions of new buildings to be measured, let alone reduced.

In the absence of clear national direction on this issue, local authorities have an important opportunity to fill the gap by setting their own requirements. Planning authorities have a particularly powerful role because planning policies can influence the design of development at an early design stage, when there is an opportunity to influence decisions on issues such as material use and building form.

This guide outlines how the planning system can be utilised to support this in practice and should be read alongside accompanying topic resources on operational energy and resource efficiency and the circular economy.

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Box 1: Definitions

Operational carbon emissions
Operation carbon emissions are defined by the UK Green Building Council (UKGBC) as the emissions 'emitted through the day-to-day activities of a building – whether that's heating, cooling or ventilation, the running of key infrastructure like lifts or the powering of electronics and appliances.'[5]

Embodied carbon emissions
Embodied carbon emissions are defined by LETI as 'the greenhouse gas emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset.'[6]

There are also further categories of embodied carbon, which are 'upfront', 'in-use' and 'end of life'. The UKGBC provide the following definitions:

- **Upfront embodied carbon: '**the emissions caused in the material production and construction phases of the lifecycle before the building or infrastructure begins to be used.'
- **In-use embodied carbon:** 'emissions associated with materials and processes needed to maintain the building or infrastructure during use such as for refurbishments.'
- **End of-life embodied carbon: '**the carbon emissions associated with deconstruction/demolition, transport from site, waste processing and disposal phases of a building or infrastructure's lifecycle which occur after its use.'[7]

Whole-life carbon
The combined total of embodied and operational emissions over the whole life cycle of a building.[8]

Net Zero Carbon Buildings
The term 'net zero buildings' has been used in recent years to mean different things in different contexts, and often describes a general aspiration to build in a less carbon intensive manner. Definitions vary, as sometimes only operational energy is included in scope, and how carbon offsetting is used varies considerably.

The lack of a single clear definition for a net zero carbon building has caused confusion. To address this, the UK Net Zero Carbon Buildings Standard (UKNZCBS - see Box 5 for more information), has developed a definitive methodology created by UK industry for UK industry on what the characteristics of a built asset should be to be Net Zero Carbon aligned in the UK.

For the purposes of this guide, 'net zero buildings' is viewed as a goal of the planning system. However, it is acknowledged that the universal delivery of buildings to the standard set by the UKNZCBS is currently an aspiration. This guide therefore promotes the role that planning can play in accelerating the delivery of this goal, and pushing for implementation of policy requirements that are consistent with those used in the Standard.

Policy context

Building regulations do not currently include any requirements for the accounting of, or reducing, the embodied carbon emissions arising from new buildings. The National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) do not contain specific content on embodied carbon, although there are important policy levers in the NPPF that justify local policies including:

- Paragraph 161 which states that the planning system should support the transition to net zero by 2050 and contribute to 'radical reduction in greenhouse gas emissions,'[9] and
- Paragraph 8c recognises that the planning system has a role to play in 'using natural resources prudently', and 'minimising waste and pollution.'[10]

The National Model Design Code, which has the same status as the NPPF and PPG, identifies the role of 'minimising embodied energy'[11] to ensure the design of places aims to conserve natural resources and reduce carbon emissions. It promotes the inclusion of guidance on reducing embodied energy in design codes, including through reducing the energy used in construction and using low energy materials.[12]

Figure 1: The embodied carbon cycle

Key principles

Local planning authorities should apply the following key principles when seeking to set policies in development plans or assessing planning applications:

- Engage with developers early on the issue of embodied carbon to identify opportunities to reduce emissions through design and materials.
- Use the development plan to address embodied carbon through setting requirements on assessment, design, targets, and reporting.
- Consider setting a presumption against demolition and using policy to encourage high quality retrofit of existing buildings.

Figure 2: Council housing off Goldsmith Street, Norwich. A highly sustainable development incorporating the use of timber frames. Source: Evelyn Simak

Good practice for plan making

This section addresses key areas where local planning authorities may consider setting policy requirements for embodied carbon in development plans, covering assessment, design, targets and reporting.

Assessment

Understanding of the embodied carbon impacts of new buildings remains, in general, quite low. Therefore, as a first step, it is important to encourage the measurement of embodied carbon emissions, based on a consistent scope and industry recognised datasets, such as the RICS professional standard for whole life carbon assessment.[13] This will help to create

greater visibility of the embodied carbon impacts of development and encourage voluntary reductions in these.

Plan making authorities can consider setting requirements for development proposals above a specified scale to undertake a whole life carbon assessment, which would include operational (regulated and unregulated) and embodied carbon in scope. This could apply to major development, or to a higher threshold that reflects local development typologies.

Box 2: Case study - the London Plan Whole Life Carbon Assessment

The Greater London Authority (GLA) are implementing an approach to whole life carbon through policy in the London Plan. The policy (part F of Policy SI2: Minimising Greenhouse Gas Emissions) requires developers for proposals that are referable to the Mayor (for residential schemes, this is more than 150 units) to undertake 'nationally recognised' Whole Life-Cycle Carbon assessments.

Further guidance for applicants on the production of Whole Life-Cycle Carbon Assessments has also been published by the GLA, giving detailed instruction on the methodology, scope and content of the assessments. The guidance is aligned with existing guidance from the Royal Institute of Chartered Surveyors (RICS), ensuring it follows industry recognised standards and processes.

> F Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Links: The London Plan : Whole Life-Cycle Carbon Assessments Guidance
Authors: Greater London Authority
Date: March 2021

Design

The National Model Design Code points to design strategies that can reduce the upfront embodied carbon emissions of development through efficient building design, for example through reducing the volume of high-carbon materials such as concrete and steel. The design of buildings can also be extremely influential on the in-use embodied carbon emissions of a building, and local planning authorities can set requirements to ensure buildings are designed to be flexible and adaptable for refurbishment or future uses.

Design requirements to reduce embodied carbon from development can be set through local development plans or design codes.

Early consideration of embodied carbon in the design stage ensures all opportunities to reduce emissions are identified and can also result in reducing material use and identifying less energy intensive materials that can reduce costs overall.

Setting targets for embodied carbon emissions

Local authorities can set limits on the amount of upfront embodied carbon emissions that are acceptable for development proposals in their development plans. The targets address upfront emissions which relate to the materials and construction, as those are within the scope of the initial building design, so exclude emissions associated with, for example, maintenance and demolition.

The aim is to secure reductions in the carbon intensity of buildings by setting reasonable carbon limits, expressed as kilograms of CO_2 emissions per metre squared ($kgCO_2e/m^2$) of the building footprint. Different targets can be applied to different scales or different typologies of buildings.

Local targets for embodied carbon emissions must be informed by local evidence that includes development feasibility and viability. This means that targets may vary between authorities. A recent study in Essex has demonstrated that a more ambitious limit on upfront embodied carbon emissions may be feasible for local planning authorities within that county.

Box 3: Case study - Limiting embodied carbon emissions in Bath and North East Somerset

As part of a partial update to the local plan, Bath and North East Somerset Council include a policy (SCR8: Embodied Carbon) requiring all 'large scale' new development (defined as 50 or more dwellings or $5000m^2$ of commercial floor space) to submit an embodied carbon assessment and demonstrating that the development can achieve $900kgCO_2e/m^2$ 'within the development substructure, superstructure and finishes.'

Link: Bath and North East Somerset Local Plan
Authors: Bath and North East Somerset Council
Date: January 2023

Reporting

The carbon emissions of development should be monitored through updated as-designed and as-built embodied carbon assessments. Developments should not only measure performance but also submit whole-lifecycle data to public databases (such as the Built Environment Carbon Database)[14]. Planning authorities may wish to set additional reporting requirements at later stages of the development life cycle, where feasible.

Other considerations

Demolition of existing buildings generally leads to greater embodied carbon emissions, as the carbon embodied within the existing structure is destroyed and replaced with a new building, with its own carbon footprint. Local planning authorities may consider setting a presumption against demolition and promoting a responsible approach to the retrofit of buildings. For more guidance on this see our guide to planning to promote resource efficiency and the circular economy.

Carbon offset can be used in local plan policies as a means for developers to address any shortfall in meeting carbon emission reduction targets. A recent study by a consortium of experts for Essex County Council recommended that offset for embodied carbon should be used cautiously, and instead encouraged policies that 'ensure embodied carbon emissions are reduced as far as possible through the project design and procurement.'[15] Carbon offset should therefore be required as a last resort after other opportunities to reduce carbon emissions have been exhausted.

Figure 3: Traditional building methods are carbon intensive. Source: Duncan Andison / Shutterstock.com

Box 4: Case study - Proposed requirement for limiting upfront embodied carbon in Essex

Recent evidence and modelling to advise local planning authorities in Essex on how to address embodied carbon through local plan policies, set out the following template policy text, applicable to all major development.

New major developments, major renovations and rebuild developments should achieve the following set limits for upfront embodied carbon (A1-A5):

- Low rise residential (up to 11m): ≤500 kgCO2e/m2 (GIA)
- *Mid and high rise residential (over 11m)* -≤500 kgCO2e/m2 (GIA) (LETI band C) or *follow NZCBS limits when available*
- Non-domestic buildings: offices ≤600 kgCO2e/m2 (GIA), education ≤500 kgCO2e/m2 (GIA), and retail ≤550 kgCO2e/m2 (GIA) - (LETI band C) or *follow NZCBS limits when available.*

New major developments should also report on the following:

- List the top five materials (I.e. brick, concrete, tile) by upfront embodied carbon emissions (A1-A5).
- To consider how the highest embodied carbon materials will be treated at the end of life, provide circular economy metrics for the top five highest upfront embodied carbon materials reported (% recycled content/ designed for re-use/ recycling/ disassembly).
- Disclose where products of an unusually low embodied carbon have been intentionally used in the calculation (within the 25th percentile).
- Report the embodied carbon of refrigerants in building services and assess how their associated impacts can be prevented/reduced. *Adopt NZCBS global warming potential (GWP) refrigerant limits when available.*

Link: Essex embodied carbon policy study
Authors: Currie and Brown, Etude, Hawkins Brown, Introba, Levitt Bernstein.
Date: June 2024

Evidence to support policy on net zero carbon buildings

A robust evidence base is essential to support development plan policies that seek to reduce the embodied carbon emissions of new buildings. This should include:

- A carbon literate understanding of how reducing embodied carbon emissions will contribute to the overall strategy for carbon reduction.
- Evidence of the technical feasibility of delivering new buildings to the standards proposed, with consideration of local housing demand and building typologies.
- Understanding of cost implications for developing to the standards proposed, which in turn should feed in to the plan viability assessment.

Figure 4: Recovering steel for reuse at 20 Giltspur Street. Source: Association for Sustainable Building Products

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Box 5: Making use of the UK Net Zero Carbon Buildings Standard in planning

The UK Net Zero Carbon Buildings Standard (the Standard) has been created through widespread collaboration across the UK built environment industry. It is currently in Pilot Version, with Version 1 to be launched in early 2026. It is a voluntary standard which will require third-party verification.

Implementing embodied carbon and operational energy limits in policy

To meet the Standard, buildings must be fossil fuel free, meet upfront embodied carbon and operational energy limits, and meet other requirements. Conformity with the limits must be evidenced based on 12-months of in-use performance data.

The Standard uses metrics that are already familiar to industry, and have been developed through UK-wide industry input, demonstrating national level support and buy-in across industry for using these metrics to define buildings within a single agreed Net Zero Carbon methodology. The Standard can therefore be used by Local Authorities to support implementation of upfront embodied carbon and operational energy reporting requirements or limits. For example, it can be referred in support of the introduction of policies that use these metrics, to show that the Local Authority is being consistent with industry best practice. The Standard also provides a robust definition of how buildings need to perform to be Net Zero Carbon Aligned, this is useful as part of the examination.

For Local Authorities implementing embodied carbon policy that requires measurement and reporting of upfront embodied carbon, the Standard may provide a useful reference point that policy officers can compare against. Hence, the policy could require benchmarking against the Standard.

Using the Standard and its Limits in Policy

It is not yet appropriate for policy to state that buildings need to be verified to meet the Standard, because a) buildings can't be verified to meet the Standard until it is launched in early 2026, and until then the cost of this verification is unknown, and b) the Standard is based on in-use performance, requiring 12 months post-occupancy monitoring which is currently difficult to secure through planning.

There is some scope for Local Authorities to use the Standard's Limits to inform their policy. However, this must be done in a considered way. The Standard's limits have been created to be achievable but ambitious, particularly for new buildings, informed by the required pathway for the UK built environment to stay within its energy and carbon budgets by 2050. This is based on staged uptake, starting with fewer buildings and increasing over time. This means that its suitability for adoption in local plans will vary across Local Authorities, and would need (as for other aspects of policy) to be supported by an assessment of viability specific to that Local Authority.

Once the Standard's Version 1 is launched, the evidence base which supported its development will become publicly available and can then contribute to the evidence base supporting local policies. Furthermore, in 2026, the Standard's team is aiming to make available the model of the UK building stock which informed the Standard's limits. It is also a goal to develop a version of the model which could be adapted to the local level to inform local trajectories and building-level limits.

The UK Net Zero Carbon Buildings Standard's verification process will be launched at the same time as its Version 1. As more buildings use and verify against the Standard, more evidence will be collected on its implementation. In tandem with this, the Standard will explore how it can support RTPI and TCPA to develop resources to help Local Authorities implement net zero polices in future.

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Decision making

In determining planning applications, local planning authorities are advised to expect proposed new development to:

- Be consistent with national targets to reduce greenhouse gas emissions set out in the relevant Climate Change Acts and relevant carbon budgets by ensuring consideration has been paid to reducing carbon through design and materials.

Where local planning policies allow:

- Ensure developers have provided completed required assessments to a suitable standard.
- Can demonstrate compliance with embodied carbon limits set in policy.
- Ensure that development is monitored through an effective approach so that compliance with relevant local policy can be reviewed.

Horizon scanning

It is acknowledged that the **UK Net Zero Carbon Buildings Standard** could be used to support policy development, and there is an intention to support much needed consistency in local net zero policy and/ or resources that can help local authorities implementing net zero polices in future.

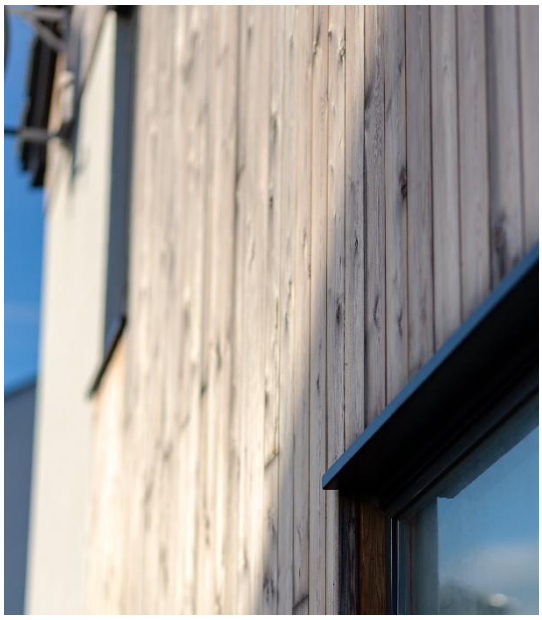

Figure 5: Timber used for cladding at the Halton Mill low carbon development in Lancaster. Source: John Gilbert Architects

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Further Resources

The **Alliance for Sustainable Building Products** provide information and raise awareness of innovations in building materials and showcase exemplar projects to demonstrate the potential of sustainable construction approaches.
https://asbp.org.uk/

Essex County Council have made evidence and resources to support climate policies available on the **Essex Design Guide** website. These include low carbon and net zero buildings evidence, openly available legal advice and model policies. Whilst these are specific to the Essex area, much of the approach and guidance is of relevance to other local authorities. https://www.essexdesignguide.co.uk/climate-change/

The **LETI Climate Emergency Design Guide** sets clear evidence-based requirements for new buildings to meet UK climate change targets and support the transition to net zero carbon. Developed by over 100 built environment professionals, it provides practical guidance across five key areas: operational energy, embodied carbon, future of heat, demand response, and data disclosure.
https://www.leti.uk/cedg

Part Z is a campaign by construction industry leaders to introduce regulation of embodied carbon through building regulations. Although the government have made no commitment to adopting these standards, the website contains resources that reflect industry thinking about how this could be achieved in practice.
https://part-z.uk

The **UK Net Zero Carbon Buildings Standard** Pilot Version provides a science-based, cross-industry framework for a range of building types, new and existing, which can be defined as net zero carbon. Developed collaboratively by leading UK institutions including CIBSE, RIBA, UKGBC, and LETI, the Standard sets clear performance targets for both operational and embodied carbon, aligned with the UK's carbon budgets and a 1.5°C trajectory. https://www.nzcbuildings.co.uk/pilotversion

The **Woodknowledge Wales** Early Stage Embodied Carbon Tool for Low Rise Housing has been designed to inform early design stage decisions to shape developments that use less upfront embodied carbon.
https://esect.co.uk/

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- **Chartered Institute of Building Services Engineers** https://www.cibse.org/
- **UK Green Building Council** https://ukgbc.org/
- **UK Net Zero Carbon Buildings Standard** https://www.nzcbuildings.co.uk/

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[5] *What is Operational Carbon in buildings?* UKGBC. https://ukgbc.org/news/what-is-operational-carbon-in-buildings/

[6] *Embodied Carbon.* LETI, RIBA and WLCN. https://www.leti.uk/publications

[7] Taken from the UKGBC *'Operational & Embodied Carbon explainer guide'* available here: https://ukgbc.org/wp-content/uploads/2023/02/operational-and-embodied-carbon-1.pdf

[8] House of Commons Environmental Audit Committee, 2022.

[9] *National Planning Policy Framework.* MHCLG, December 2024. https://www.gov.uk/government/publications/national-planning-policy-framework--2

[10] Ibid.

[11] Understood to refer to 'embodied carbon'.

[12] *National Model Design Code, Part 2.* MHCLG, 2021. https://www.gov.uk/government/publications/national-model-design-code

[13] Available on the RICS website here: https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/whole-life-carbon-assessment

[14] Available here: https://www.becd.co.uk/

[15] *Essex Embodied Carbon Policy Study.* Currie and Brown, Etude, Hawkins Brown, Introba, Levitt Bernstein. June 2024. https://www.essexdesignguide.co.uk/climate-change/essex-embodied-carbon-policy-study/

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