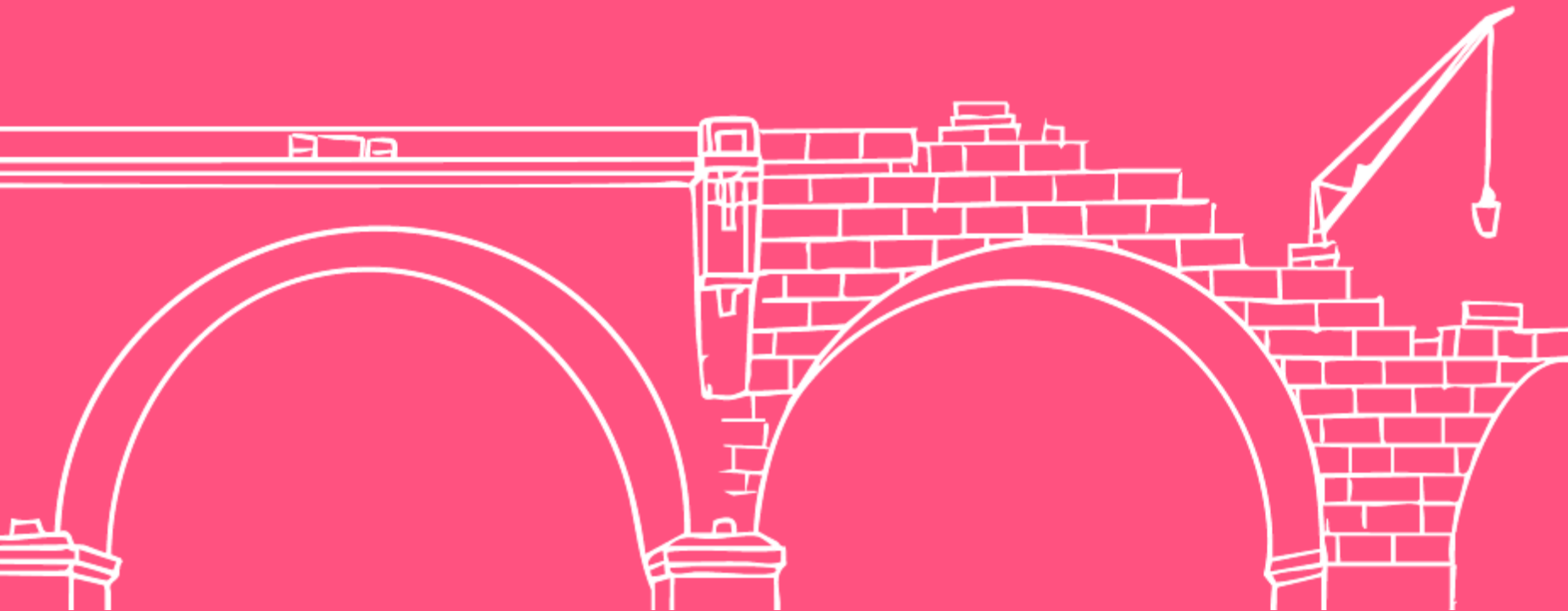




Stockport Embodied Carbon Policy Study

A technical evidence base for planning policy

June 2026

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Technical summary – About this evidence base

The purpose of this study

The purpose of this Embodied Carbon Policy Study is to provide the technical and cost evidence to support the development of planning policy to reduce embodied carbon emissions in new developments in Stockport.

Addressing embodied carbon emissions through planning policy is important to meet local and national climate targets, especially where regulation is lacking. Stockport Council has simultaneously commissioned an operational energy evidence base, to compliment this embodied carbon study.

What is embodied carbon?

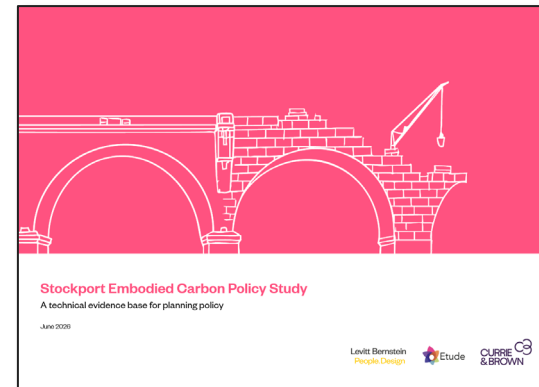
The embodied carbon emissions of a building are the total green house gas emissions associated with materials, construction processes, maintenance and demolition. This study focuses on upfront carbon, the emissions associated with manufacture, transport, and use of materials in buildings, as these are most effectively dealt with during early stages of design. A full glossary of terms can be found in the Appendix [Section 6.1](#).

The evidence-base provides wider context for the recommended policy requirements. It also provides a technical evidence base for the introduction of upfront carbon targets (specifically for residential and commercial use Class E developments). Lastly, it provides information on the opportunities to streamline planning submission requirements while maintaining consistency, accuracy and quality across all planning submissions for new developments in Stockport.

Who the study is aimed at

This study was prepared primarily for Stockport Council to inform the development of their planning policy. It builds on an existing body of evidence and was also prepared for members of the public, the Planning Inspectorate, planning officers, the development industry and others interested in how to reduce embodied carbon emissions in new development.

Two interconnected technical and cost evidence bases used to develop planning policy in Stockport:



This study – A technical and cost evidence base for embodied carbon planning policy. The embodied carbon policy study looks at how to reduce the emissions generated by the manufacture, transport, and use of materials in the construction of buildings.

Embodied carbon is the carbon associated with the manufacture, transport, and use of materials in buildings.

Aim of the embodied carbon policies:

To reduce the carbon intensity linked to buildings during their construction through design, and to support the development of lower carbon buildings through sustainable materials and construction techniques.



Complimentary study – A technical and cost evidence base for operational energy planning policy. The operational energy policy study looks at how to reduce new buildings' energy use and increase on-site renewable energy.

Operational energy is the energy used by the building during its operation and that can be measured by the building's energy meters.

Aim of the operational energy policies:

To go above and beyond the legal minimum set out in building regulations to make homes and buildings lower carbon on a day-to-day basis, and more affordable to run.

Technical summary – Embodied carbon explained

The making of materials, their transport, repair and deconstruction lead to carbon emissions. In order to account for and reduce these emissions, embodied carbon is assessed across different boundaries, as shown opposite and explained below. Carbon emissions are measured in tonnes (tCO₂e) and normalised to kgCO₂e/m²GIA to provide a comparable area based metric.

Whole life carbon (WLC)

For buildings, whole life carbon is the sum of **life cycle embodied carbon** and **operational carbon**. The focus of this evidence base is on embodied carbon, but Stockport policy covers both operational and embodied carbon.

Life cycle embodied carbon

Life cycle embodied carbon includes both upfront carbon and the embodied carbon associated with using the building and its end of life (demolition or reuse).

The primary focus of this evidence base is on **upfront carbon**, as it represents the parts of embodied carbon where planning policy has the greatest influence.

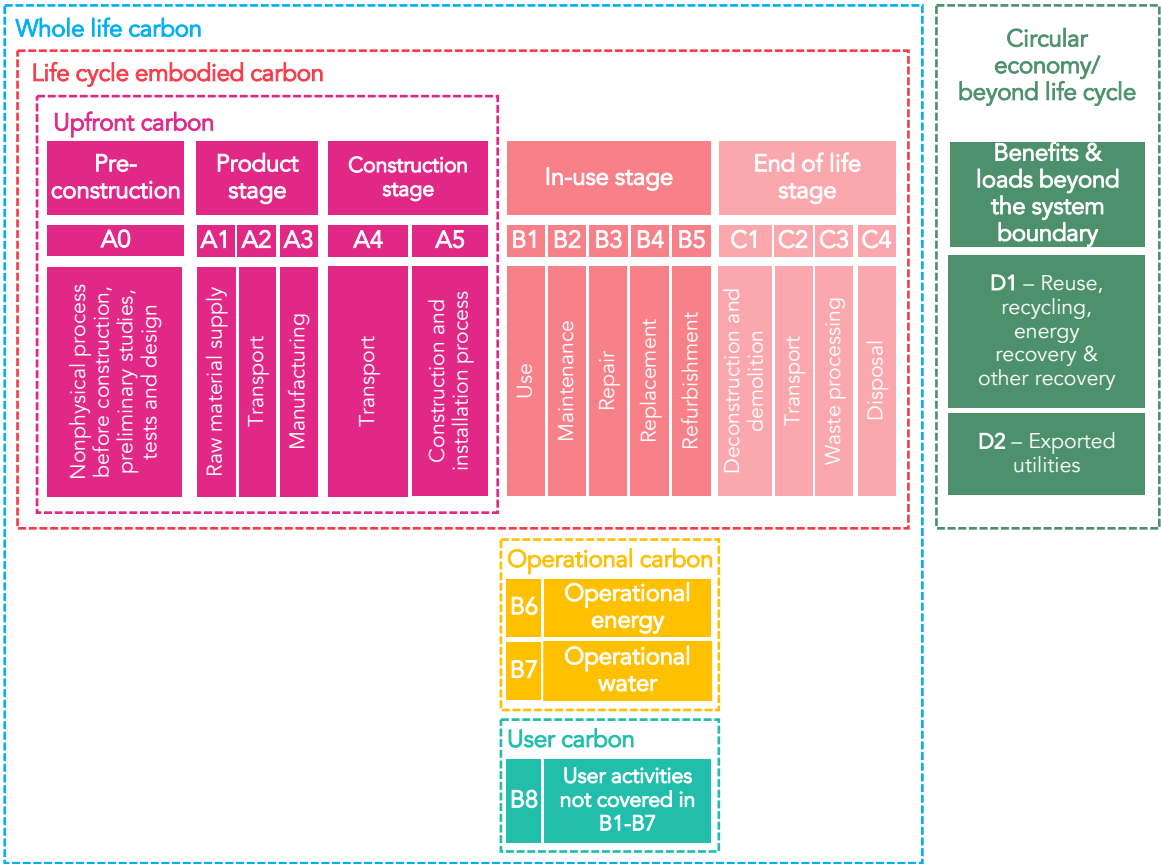
Upfront carbon

Upfront carbon is part of life-cycle embodied carbon and refers to the greenhouse gas (GHG) emissions associated with design, material use and construction stages, this includes the carbon locked in a building up to its practical completion (i.e. preliminary studies, raw material supply, manufacture, transport and construction of all building elements).

Designers have the greatest ability to reduce upfront carbon pre-planning by considering how a new building can be optimally designed and through the materials specified. This lends itself to benchmarking or target setting through planning policy, as it is the area most easily influenced by policy and addressed by client and design teams during the planning process.

To have the greatest immediate influence on the design and construction of buildings in Stockport, the primary focus for this evidence base is upfront carbon.

"Upfront carbon emissions are GHG emissions associated with materials and construction processes up to practical completion (modules A0-A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion. RICS 2023 definition of upfront carbon"



Modular information for the different boundaries of the building assessment. This version of the diagram is adapted from a combination of the diagram from the BS EN 15978, RICS 2023 and LETI.

Biogenic carbon

Biogenic carbon is the sequestered carbon stored within specific natural materials that could be incorporated into the building, such as timber. RICS methodology excludes biogenic carbon from upfront carbon calculations and requires it to be reported separately; however, the use of natural materials can provide long-term carbon storage benefits that are not fully reflected in the upfront carbon number alone. Recognising biogenic carbon as a positive contribution could help highlight the value of natural materials and support increased demand. This, in turn, may contribute to improved availability and reduced costs over time. Find more about the importance of natural materials [here](#).

Technical summary – The need for an embodied carbon policy for new buildings in Stockport

There is a climate emergency

There is overwhelming scientific consensus that climate change is happening. The latest Intergovernmental Panel on Climate Change (IPCC) report highlights the urgency for action and has generated a high level of interest in society.

The Climate Change Committee's (CCC) key actions for the Seventh Carbon Budget suggests that minimum standards should be set for the whole-life carbon impact of products that are at risk of increasing the UK's imported emissions. This could include new rules to measure and limit the embodied carbon of buildings. Embodied carbon of buildings is linked to three of the six highest-emitting sectors and therefore has significant scope to be reduced.

There is no minimum requirement in Building Regulations

Unlike operational energy which has building regulations Part L to reduce emissions from building in-use, there are no regulations on the reduction of carbon emissions associated with embodied carbon. Therefore planning policy is required to fill this gap.

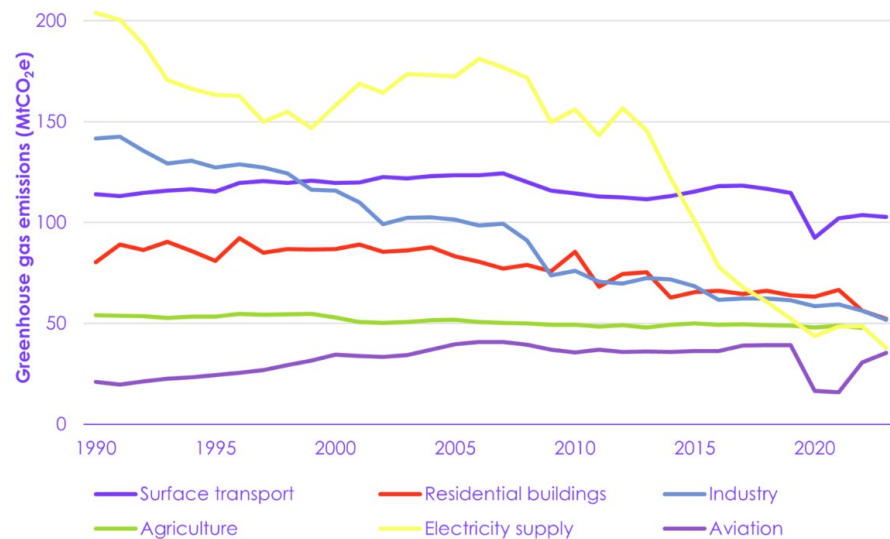
Stockport Council climate change commitments

Stockport Council formally declared a climate emergency in March 2019 and since then it has set two main targets: to be operationally net zero by 2030 and carbon neutral by 2038. The Climate and Nature (CAN) Strategy sets out key objectives on which planning policies should be based on – including reducing carbon emissions of buildings and creating healthier environment for residents.

Stockport Council has duties and powers to mitigate climate change

The National Planning Policy Framework 2023 recognises that the Climate Change Act 2008 duties are relevant to planning for climate change. Paragraph 158 requires that local plans should “take a proactive approach to mitigating and adapting to climate change”. Section 19 of the Planning and Compulsory Purchase Act 2004 requires that development plan documents must include policies designed to secure that development and use of land “contribute to mitigation of, and adaptation to, climate change”.

(a) Today's six highest-emitting sectors



Climate Change Committee – Seventh Carbon Budget – The residential building sector has been the second highest emitter of greenhouse gas emissions by sector since 2017. The emissions from these buildings are closely linked to their operational energy use, which relies on the building fabric to be effective. Embodied carbon is inherently locked up in the building fabric and therefore affects the ability to bring building emissions down. Embodied carbon also features in the first and third highest emitters – surface transport and industry, from which materials are moved and processed.



[Stockport Council's - Climate and Nature \(CAN\) Strategy 2025-2030](#)

Technical summary – The need to reduce upfront carbon emissions

Stockport Embodied Carbon Policy Study provides an evidence base for the setting of embodied carbon planning policy, to contribute to the delivery of net zero carbon buildings.

The importance of reducing embodied carbon emissions

Addressing the national carbon emission targets for the building sector has traditionally focused on reducing operational carbon emissions (associated with energy consumed in a building) through regulation and planning policy. However, as buildings become more energy efficient, the operational carbon emissions over the building's lifetime are reduced. Therefore, embodied carbon emissions associated with the materials are a greater portion of the total carbon emissions of a building.

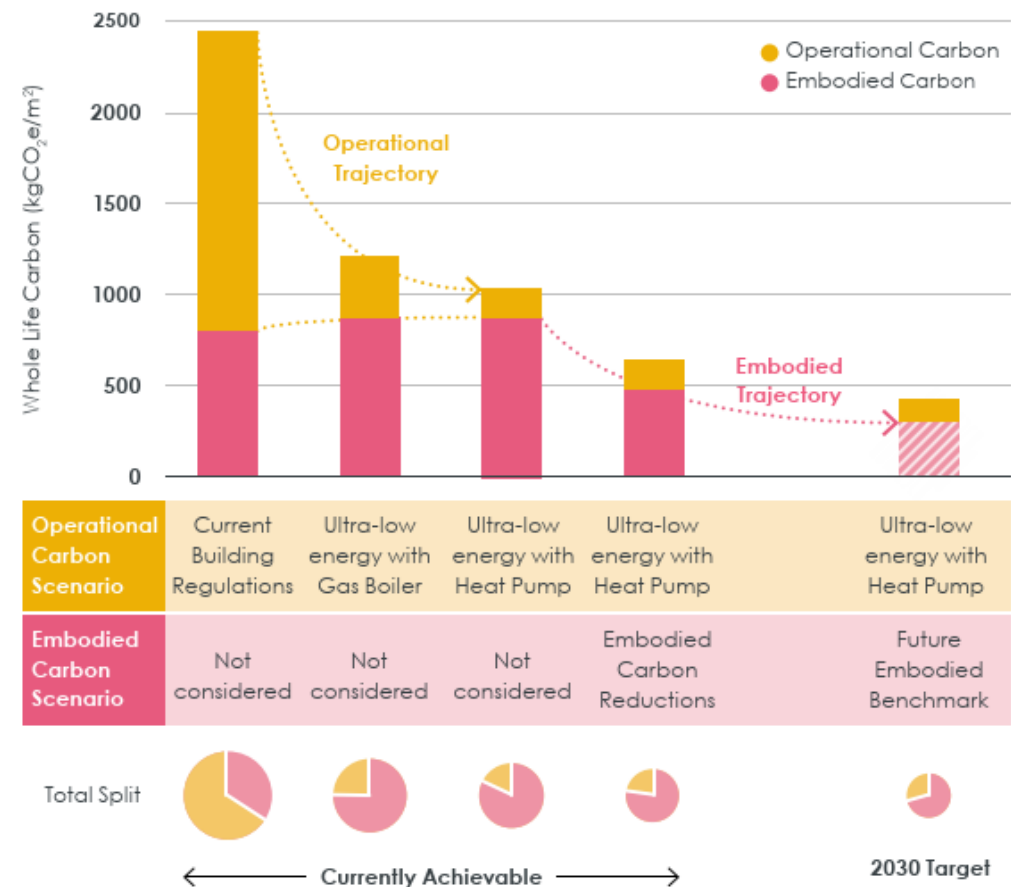
Addressing embodied carbon and the circular economy through planning policy is therefore crucial to meet local and national climate targets.

Bringing embodied carbon into policy

Despite the absence of building regulation in England to reduce embodied carbon, local authorities have a duty to mitigate climate change through planning policy. An increasing number of local authorities (Greater London Authority, Westminster City Council, City of London, Bath and North East Somerset, Bristol City Council and some others emerging now) are therefore incorporating embodied carbon and/or whole life carbon considerations into planning policy.

To have the greatest immediate influence on the design and construction of buildings in Stockport, the primary focus for this evidence base is on upfront carbon. This includes the carbon locked in a building up to its practical completion (material manufacturing, transport, use on-site and waste), and it represents the parts of embodied carbon where planning policy has the greatest influence.

To this end, comprehensive upfront carbon and capital cost modelling has been carried out on two house types and one commercial use class to assist in setting policy targets. Policy requirements have been recommended across domestic and non-domestic building types.



General operational and embodied carbon trajectories for buildings in the UK, typically over an assumed 60-year lifespan. As operational emissions are reduced in new buildings, the proportion of embodied carbon emissions becomes higher. (Source: [LETI](#))

Technical summary – Wider considerations for embodied carbon in planning policy

The recommended policy requirements for embodied carbon sit within a wider context with the following considerations:

Links between operational and embodied carbon policies

The focus should be on reducing embodied carbon alongside supporting ultra-low energy buildings, as opposed to trading one off another.

Solar PV offers one of the lowest carbon forms of electricity generation available, and it is getting better all the time. For this reason, it is one of the central technologies for decarbonising our energy supply.

To prevent an unwanted trade-off of carbon between the operational energy and embodied carbon policies, PV panels generating energy and solar shading to minimising overheating have been calculated separately from calculations.

Net Zero Carbon Building Standard – well evidenced targets

The Net Zero Carbon Building Standard (NZCBS) represents the biggest cross industry working group that has looked at a net zero carbon standard. The research is a comprehensive review of previous guidance and targets and pulls information from a variety of data sources (including planning submissions and databases) to arrive at proposed targets for different building types. Although this study does recommend the use of targets for all building types, these targets are however, useful as benchmarks.

Understanding current and future costs and non-cost factors

Reducing the upfront and life cycle embodied carbon of a building does not necessarily mean higher capital costs. Adopting strategies such as lean and circular economy design can reduce capital costs and many of the strategies that a contractor might propose to reduce upfront and life cycle embodied carbon will have little or no material impact on cost.

These might include:

- Resource efficiency and circularity measures that reduce wastage, entail the selection of reused materials or those containing higher levels of recycled content.
- Effective co-ordination of designs and management of site teams to reduce wastage.
- Designing for effective maintenance and disassembly, for example through use of mechanical fixings in cladding systems.

Some specification changes may result in additional costs, however, it is critical to determine those that are likely to persist over the long term and those where any cost premium should dissipate over time as the supply chain becomes more mature and scale increases.

In much of England timber frame is considered a more expensive solution than the more typical masonry construction, yet in Scotland timber frame is predominant and is cost competitive on this basis. It is therefore important to distinguish between cost premiums that arise due to historic market practice rather than due to an underlying difference in cost base.

While material cost is an important component influencing the viability of a construction method, there are also a range of other factors that are important and should be considered. These include: the ability of a low carbon construction or material solution to meet demand; transition/duplication of costs for organisations with refined existing supply chains; and risk for smaller companies to provide warranties for example.

Finally, encouraging (but not mandating) the use of natural building materials in Stockport will lead to increased market demand and provide opportunities for new businesses and supply chains to develop in response. Additional scale and local supply chains will help to reduce cost as well as transport related emissions while also supporting economic growth within the region.

Implementation and delivery of embodied carbon policy

The preconception is that the introduction of embodied carbon policy could be challenging and costly to adhere, while representing an additional burden to applicants and complexity to the submission process. This need not be the case. A Local Plan can introduce policy that encourages the use of smart design to reduce embodied carbon, without an overly onerous impact on applicants. Policy can be streamlined to work hand in hand with a submission process that:

- rewards quality and clarity over quantity of submission
- uses guidance to apply policy proportionately across development scales.

Streamlining policy and process

The use of RICS Whole life carbon assessment [reporting templates](#) (the industry standard methodology for calculating embodied carbon) would help align with industry outputs, to save results being presented more than once by applicants. Stockport could adopt the use of these standard templates.

Technical summary – Upfront carbon modelling and cost assessment (1/3)

Purpose of upfront carbon and cost modelling

Upfront carbon and cost modelling constitutes the core of this technical evidence base. The purpose of this modelling analysis was to investigate the upfront carbon in kilograms of carbon equivalent per square meter of floor space (kgCO₂e per m² of the Gross Internal Area (GIA)), across various building typologies under different construction scenarios. The results inform the proposed upfront carbon targets in this study, which aim to support the development of a planning policy requirements for reducing embodied carbon emissions from new developments in Stockport. Capital cost modelling has been carried out to understand the likely cost and viability impact of the policy. It identifies the capital cost uplift for each scenario against the baseline, which represents a prevalent construction approach specifying commonly construction materials and developed without upfront carbon emissions in mind.

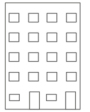
Building typology selection

A total of three residential building typologies and one non-residential have been modelled. These have been identified as being relevant locally in Stockport:

- Terrace house
- Apartment block below 11 meters in height
- Apartment block above 11 meters in height
- Commercial use Class E building

Modelling considerations:

- The terrace house and apartment block <11 m typologies are assessed separately from the apartment block >11 m, with distinct policy targets being proposed reflecting their differences in materiality options due to fire regulations restrictions.
- For this evidence base, the outline specifications for all the scenarios modelled have been aligned with the performance parameters used to meet operational energy performance (see Operational Energy Policy Study).

	Residential			Non-residential
	<11 m in height		≥11 m in height	
				
	Terrace house	Apartment block (<11 m)	Apartment block (>11 m)	Commercial use Class E
Number of storeys	3	3	13	10
GIA (m ²)	114	1,019	5,800	5,400
Ground to height of top floor (m)	9.2m	9.5m	41.5	3.8m (floor to floor height)
Form factor	2.1 (3-terraced houses) 1.9 (6-terraced houses)	2	0.8	0.9

Building typologies modelled, general information.

Modelled scenarios

Four scenarios have been developed across all four typologies modelled to understand their resultant upfront carbon emissions:

- **Baseline** – represents a combination of commonly specified and ‘business as usual’ construction materials. It has been established as a reference point for comparison against the other scenarios examined in this study.
- **Scenario 1** and **scenario 3**– represent the highest and lowest upfront carbon option, respectively.
- **Scenario 2** – represents a cost and carbon optimised specification scenario.

For each typology, scenarios comprise different combinations of materials, components and design strategies. For more information see the main report or [Appendix 6.3](#).

Technical summary – Upfront carbon modelling and cost assessment (2/3)

Upfront carbon modelling results

Residential (<11m height) - This study found that the total upfront carbon emissions of a terraced house can be around 40% less, and for the low-rise apartment block can be around 30% less when compared to traditional masonry construction (scenario 1); . This is through the use of timber frame construction, raft foundations and timber weatherboard cladding. (scenario 3).

Residential (>11m height) - This study found that the total upfront carbon emissions of a mid-rise apartment block can be more than 20% lower, when compared to business as usual (scenario 1). This is through a 50-60% cement replacement (with Ground Granulated Blast-furnace Slag (GGBS)), and the replacement of a rainscreen cladding system to brick face (scenario 3).

Commercial use Class E – The total upfront carbon emissions of a commercial use Class E can be approx. 40% lower, when compared to a large grid concrete frame construction (scenario 1). This is through the use of higher cement replacement rates, Cross Laminated Timber (CLT) combined with steel frame, smaller grids and spans and more efficient form factors.

Cost analysis

The percentage impact on overall build costs of each of modelled scenario compared to the baseline representing a prevalent construction approach has been shown below the graph on the following page.

Meeting an upfront carbon target of <500kgCO₂e/m² GIA for residential <11m height or <700 kgCO₂e/m² for residential >11m height and non-residential will add very little if any capital cost. This is because the majority of scenarios tested, including some of the baselines, are below the recommended policy targets, or can be designed out without additional cost (e.g. scenario 1 of non-domestic), or with very little cost (e.g. scenario 2 for the mid-rise block of flats).

The setting of these targets has the advantage promoting good building design and form, typology and low carbon material selection in a cost effective way. It allows for a transition period for embodied carbon modelling to become normalised in Stockport without policy targets becoming unreasonably onerous for applicants. The targets also allow for use of a non-combustible wall build-ups (fire regulations), variation in ground conditions (affecting depth of foundation) and a well-considered and practical transition to net zero carbon.



Upfront carbon (kgCO ₂ e/m ² GIA)	Terrace house	Apartment block (<11 m)	Apartment block (>11 m)	Commercial use Class E
Baseline	455	469	729	649
Scenario 1	489	484	729	908
Scenario 2	424	412	641	649
Scenario 3	304	335	552	509

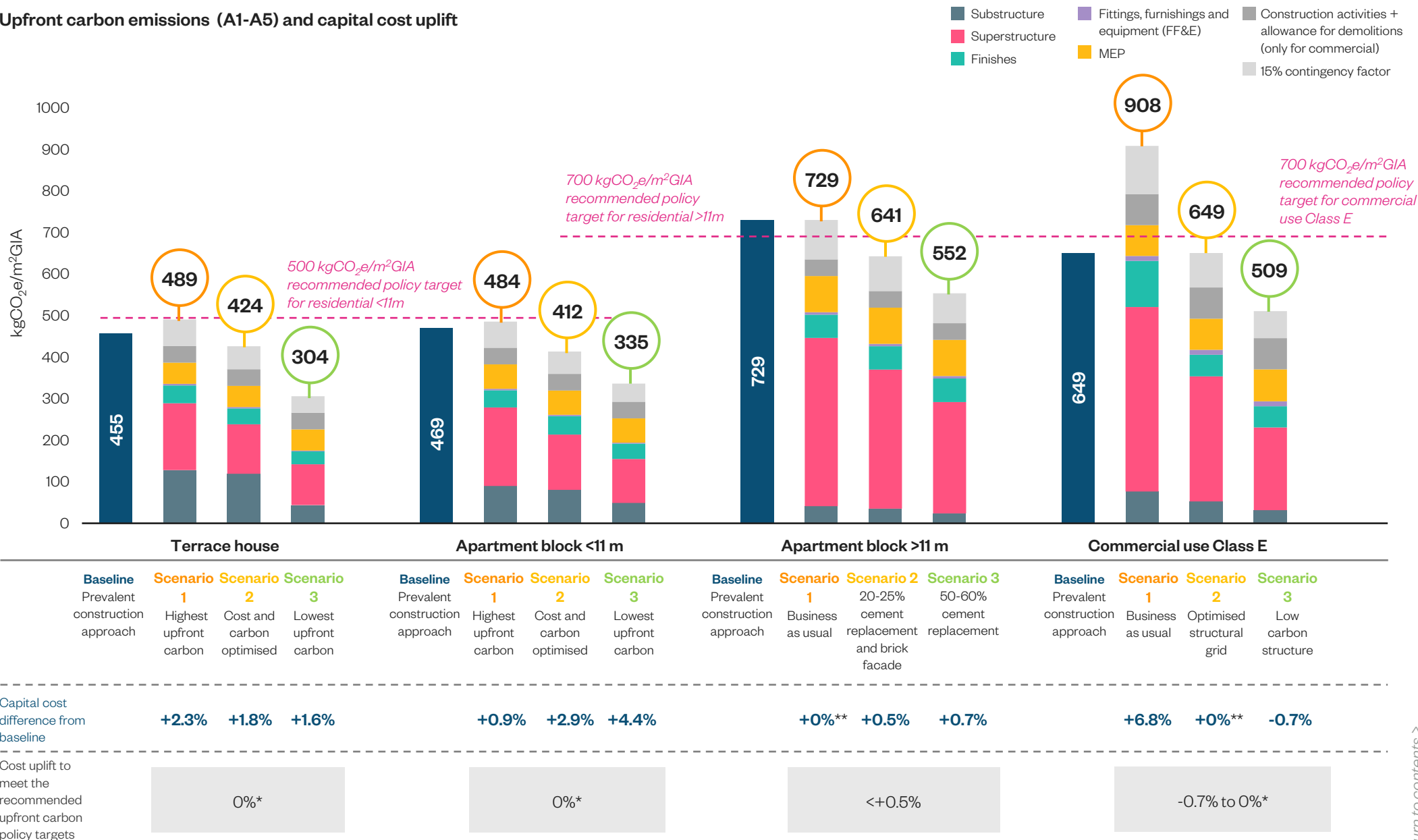
Capital cost uplift difference from Baseline (%)	Terrace house	Apartment block (<11 m)	Apartment block (>11 m)	Commercial use Class E
Scenario 1	+2.3%	+0.9%	+0%	+6.8%
Scenario 2	+1.8%	+2.9%	+0.5%	+0%
Scenario 3	+1.6%	+4.4%	+0.7%	-0.7%

	Residential buildings (<11 m)	Residential buildings (>11 m)	Commercial use Class E
Upfront carbon recommendation policy target (kgCO ₂ e/m ² GIA)	500	700	700
Cost uplift to meet the recommended upfront carbon policy targets (%)	+0%*	<+0.5%	-0.7% to 0%*

*The policy can be met using a scenario that has no uplift in capital cost.

Technical summary – Upfront carbon modelling and cost assessment (3/3)

Upfront carbon emissions (A1-A5) and capital cost uplift



*The policy can be met using a scenario that has no uplift in capital cost.
** The same building elements and material components have been used as the baseline

Technical summary – Policy conclusions and recommendations

A summary of the recommended targets for policy is shown opposite.

Residential (<11m) - 500 kgCO₂e/m² GIA

Setting the upfront target for residential typologies <11 m at < 500 kgCO₂e/m²GIA has the advantage of preventing poor performance while ensuring there is some consideration of building form, typology and material selection, without seeking to exclude specific materials or designs. A target of 400 kgCO₂e/m² GIA or below is potentially achievable, but would require partial or total timber construction and begin to restrict the use of brick façades.

Residential (≥11m) - 700 kgCO₂e/m² GIA

Setting the target for low-rise housing (above 11m for purposes of building regulations Part B) at <700 kgCO₂e/m² GIA is a pragmatic level that can be realistically achieved on schemes. A target of around 600 kgCO₂e/m² GIA is potentially achievable, but would rely heavily on very high proportions of cement replacement products in concrete elements, which could present practical challenges such as uncertainty on availability.

Use Class E shell and core Cat A fit-out - 700 kgCO₂e/m² GIA

On the basis that two of the tested scenarios are technically feasible while still allowing a range of design responses, the recommendation is to adopt a target of < 700 kgCO₂e/m² GIA in policy for use Class E shell and core and Cat A fit out. This allows a typical palette of materials to be used but requires some thought about material efficiency and lean structural design measures to meet the target. This also provides a cost neutral outcome.

While a simple shell and core commercial building should be able to meet an upfront carbon target of <600 kgCO₂e/m² GIA, there are likely to be multiple other performance and contextual factors that suggest a higher target should be used at the introduction of the policy with a mechanism to reduce the target during the policy period.

Future targets for consideration

We recommend reviewing the target every 3-5 years to determine if it can be lowered or should be altered to match decarbonisation of the materials industry and design solutions for low carbon buildings.

	Residential buildings (<11 m)	Residential buildings (>11 m)	Commercial use Class E
Upfront carbon recommendation policy target (kgCO ₂ e/m ² GIA)	500	700	700

Setting ambitious but practical upfront carbon targets in planning

The recommended targets of 500–700 kg/m² should be understood as a significant step in the built environment industry’s journey toward net-zero development. While these may appear to be large figures to those new to carbon accounting, they represent an ambitious yet pragmatic shift from standard industry practice.

Environmental goals should also be balanced with the reality of modern construction. Currently, developers must adhere to strict building regulations, including fire safety requirements that often restrict the use of low-carbon alternatives, such as timber frames, in buildings over 11-18m in height. Furthermore, the industry is still maturing in its ability to consistently calculate and reduce embodied carbon.

Consequently, these targets focus on 'mainstream' interventions - changes that can be implemented today using conventional techniques and lean building design (smoothed building forms and reduced materials in structures) . By adopting these standards, Stockport is not just asking for change; they are creating a clear, deliverable policy that challenges the industry to perform at its best, while positioning the Council as a forward-thinking leader in sustainable development.

Note:

Detached and semi-detached dwellings are closely comparable in construction to terraced houses, with variation largely limited to unit size and the extent of exposed envelope. Their embodied carbon performance can therefore be reliably extrapolated from the terraced house typology, with appropriate uplifts to reflect increased material use associated with additional external walls.

At this point in time, upfront carbon targets are complex to introduce into planning policy for a wider range of non-residential typologies, other than use class E.

Technical summary – Implementation

To ensure transparency and delivery against the intent of policy, applicants should be required to submit upfront carbon data (as a summary) with an explanation of how new development has achieved the level of performance (in a standardised way).

Streamlining planning submission requirements will save the applicant and Stockport Council time and resource. A simpler submission process will also hopefully divert time away from the 'reporting part' submission towards of the analysis underpinning the submission, thereby increasing its quality

Achieving quality

A well-thought through submission is more than vast amounts of data and onerous verification in the quest for quality. To achieve quality submissions and outcomes Stockport Council should consider:

- Providing updated guidance and tools
- Carrying out spot checks on carbon calculations
- Forming an expert Stockport energy and carbon panel

Simplified submission process

In order to make submission process more simple and effective, it could be split into two parts:

- **Energy and Carbon Proforma** - A summary Excel tool for applicants to complete and submit as part of outline and full planning applications with final results. The data entered into the proforma would be expected to be backed by further detail included in an Energy and Carbon Statement.
- **Energy and Carbon Statement** - An Energy and Carbon Statement using a standardised contents list to describe how a development meets the energy and carbon policies.

Bringing proportionality to policy and planning submissions

The scale of submission requirements should be proportionate to the scale of the development (minor/major/referable). Submission requirements should also vary depending on the stage/type of application (outline planning application or full/reserved matters application), and by sector.

Pre-app	Description	• Presentation of building retention (where relevant) and low carbon strategies employed so far. Structural and façade optioneering, justifying choices proposed.
	Format	• Presentation covering standard checklist.
	Governance	• Pre-application could be mandatory where over 50% of an existing building by GIA is proposed to be demolished.
Planning submission	Description	• Calculations carried out in line with current RICS WLCA PS 2nd ed. and CIBSE TM65 aligned with relevant inclusions and exclusions as determined by guidance to be developed.
	Format	• Completion of pro-forma including relevant figures proving that the targets have been met as well as providing project information.
	Governance	• Officers can request resolution with the applicant/ design team if results vary significantly from the targets. • Third party verification options can be considered, if required • Where an abnormal site means a scheme can not meet the targets, an agreed upfront carbon threshold can be set through negotiation and monitored via conditions and post-completion analysis. Potentially, a set of reduction measures could be agreed.
Discharge of pre-commencement condition (LA discretion)	Description	• Confirmation that low carbon solutions that are required for the project to meet targets submitted for planning are to be adopted through construction.
	Format	• Statement of confirmation with re-submission of updated planning information/proforma.
	Governance	• Where site abnormalities mean a scheme cannot meet the targets, the agreed upfront carbon threshold must be met. Potentially, a set of reduction measures could be agreed.
Post-completion reporting	Description	• Confirmation that the as-built building meets the required policy target.
	Format	• Resubmission of data in a proforma using as-built information. • Data entry to BECD
	Governance	• Third party verification options can be applied, if required. • Penalty or public disclosure if targets or pre-agreed upfront carbon threshold has not been met.

1

The justification for embodied carbon policies

The need for embodied carbon policy in the UK

Global climate emergency

There is overwhelming scientific consensus that significant climate change is happening. This is evidenced in the latest assessment of the Intergovernmental Panel on Climate Change (IPCC AR6). The IPCC Synthesis Report, published in 2023, summarises five years of reports on global temperature rises, fossil fuel emissions and climate impacts. To keep within the 1.5°C limit, emissions need to be reduced by at least 43% by 2030 compared to 2019 levels, and at least 60% by 2035. This is the decisive decade to make that happen.

National commitment

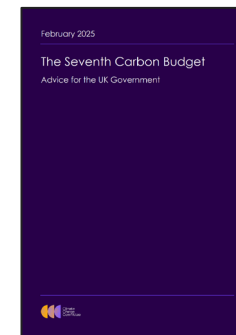
The UK's national commitment is set through the Climate Change Act 2008, which was updated in 2019. It legislates that the UK must be net zero carbon by 2050 and sets a system of carbon budgets to ensure that the UK does not emit more than its allowance in the next 27 years. This legal requirement is underpinned by the Climate Change Committee's (CCC) report 'Net Zero: The UK's Contribution to Stopping Global Warming'. Net Zero is not only about a destination: a very significant and fast decarbonisation pathway is needed. The Climate Change Committee's Seventh Carbon Budget (Feb 2025) highlights that the embodied carbon from materials features in the top three highest emitting UK sectors ('surface transport' to move materials, 'residential buildings' to influence the performance of the fabric, and 'industry' in the making of the materials). The scope of the budget includes the reduction of emissions associated with products manufactured in the UK but not those used in the UK and manufactured elsewhere. By including embodied carbon (emissions from construction process, maintenance and demolition of the building) in planning policy it will not only assist local authorities in meeting the CCC's carbon budget, but could also positively influence the decarbonisation efforts of other countries manufacturing building materials for the UK.

The CCC's Key actions for the Seventh Carbon Budget suggests that minimum standards should be set for the whole-life carbon impact of products that are at risk of increasing the UK's imported emissions. This could include new rules to measure and limit the embodied carbon of buildings.

As part of the Sixth Carbon Budget the CCC called on government to agree a standard for the 'whole-life' carbon footprint of buildings and infrastructure with industry; introduce mandatory disclosure of whole-life carbon in buildings and infrastructure; and introduce a mandatory minimum whole-life carbon standard for both buildings and infrastructure which strengthens over time. To date, no building regulations have been introduced to tackle embodied or whole life carbon.



Net Zero: The UK's Contribution to Stopping Global Warming (Source: [CCC, 2019](#))

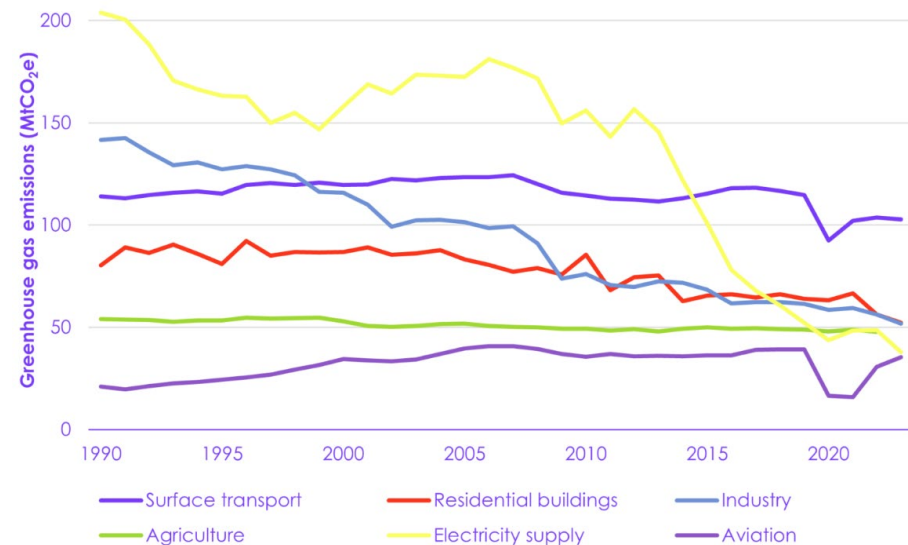


The seventh carbon budget (Source: [CCC, 2025](#))

The UK's path to Net Zero

"By the middle of the Seventh Carbon Budget, on our pathway, emissions in the UK will be only a quarter of the level they are today, and 87% lower than levels in 1990"

(a) Today's six highest-emitting sectors



Climate Change Committee – Seventh Carbon Budget – The residential building sector has been the second highest emitter of greenhouse gas emissions by sector since 2017. The emissions from these buildings are closely linked to their operational energy use, which relies on the building fabric to be effective. Embodied carbon is inherently locked up in the building fabric and therefore affects the ability to bring building emissions down. Embodied carbon also features in the first and third highest emitters – surface transport and industry, from which materials are moved and processed.

Building regulation is not addressing embodied carbon, creating a policy gap (1/2)

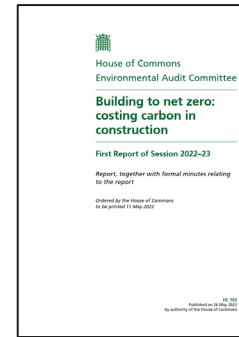
National policy and regulation does not address embodied carbon

In May 2022, the Environmental Audit Committee (EAC) published a report, urging the government to start acting now on the impact of embodied carbon by stating "if the UK continues to drag its feet on embodied carbon, it will not meet net zero or its carbon budgets". The report examines and proposes the best routes to achieve net zero, including:

1. Introducing a mandatory requirement to undertake whole life carbon (WLC) assessments for new buildings as part of the Future Homes Standard.
2. Establishing the RICS methodology as the UK industry standard for WLC assessments and develop a centralised national database of environmental product declarations (EPDs).
3. Learning from international best practice embodied carbon regulation.
4. Investing in research and incentivising low-carbon and re-used materials.
5. Evaluate and inform the impact of permitted development rights on retrofit.
6. Requiring circular economy statements, including pre-demolition audits in planning applications when it entails demolition of existing buildings.

On 13th December 2023, the government published a consultation on the Future Homes and Buildings Standard, which claims that new buildings built from 2025 will produce 75-80% less carbon emissions than buildings delivered under the 2021 Building Regulations. However, the consultation does not address embodied carbon even though the CCC recommended that a whole life carbon standard for homes should be included within the Future Homes Standard as part of the Sixth Carbon Budget.

Subsequently Part L 2026 has been released with no reference to embodied carbon and the Seventh Carbon Budget continues to champion for embodied carbon emissions to be curtailed. The advice from the EAC is unheeded, therefore an interim measure in-lieu of regulation is to include embodied carbon in planning policy.



Costing carbon in construction (Source: [Environmental Audit Committee](#) (EAC))

EAC- Building to net zero: Costing carbon in construction

"We recommend that the Government introduce, not later than December 2023, regulations to mandate whole-life carbon assessments for buildings above a gross internal area of 1,000m², or which create more than 10 dwellings.

This requirement should be established in Building Regulations, and ought to be reflected in the planning system through national planning policy. Local authorities should be encouraged and supported to include this requirement within their Local Plans ahead of the introduction of national planning requirements."

Building regulation is not addressing embodied carbon, creating a policy gap (2/2)

Policy position paper

In February 2024, the UK's leading embodied carbon experts issued a paper to political leaders requesting the inclusion of embodied carbon regulation as part of their manifesto for the 2025 general elections. This champions the use of the industry proposed Part Z, which is a proposed addition to the UK Building Regulations that would require developers to measure and limit whole-life carbon emissions of buildings. See [Appendix 6.2](#) for more information on Part Z.

Consideration of measuring and reducing embodied carbon in new buildings

AECOM were commissioned by the Ministry of Housing, Communities and Local Government (MHCLG) in summer 2025 to understand the sector-wide technical, practical, and economic impacts of carbon assessments. *“Overall, the widespread measurement and reduction of embodied carbon in new buildings will not only help achieve net zero aims but also help to increase employment in green jobs and give people the ability to up-skill in an emerging market.”*

Some of the considerations identified in the conclusion include:

- Standardising approaches and assumptions to drive consistency
- Improving carbon data quality and availability.
- Drive consistency within carbon tools
- Instil tracking of carbon assessments
- Upskilling the whole construction industry in low carbon design
- Addressing challenges within the insurance market for new and innovative materials.

Creating policy incentives for low carbon design measures is also a key recommendation in the conclusion of this research. It is expected to drive action and improvement on all the above considerations.

The report also included an indication of process costs for the various levels of embodied and whole life carbon reporting.



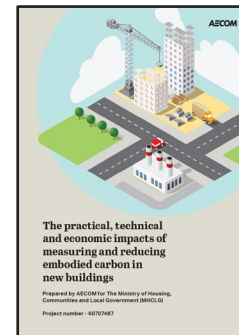
January 2024: [Policy paper by Part Z group of experts](#)

Policy position paper – a call to the party leaders

“The undersigned groups call on party leaders to make the following manifesto commitments

Key ask: *Our government will move to reduce embodied carbon emissions in building construction within two years of taking office.*

Specific steps: *Within six months of taking office: Policy signalled confirming the dates and interventions below. By 2026: Mandate the measurement and reporting of whole-life carbon emissions for all projects with a gross internal area of more than 1,000m² or that create more than 10 dwellings. By 2028: Introduce legal limits on the upfront carbon emissions of such projects, with a view to future revision and tightening as required.”*



July 2025: [Consideration of measuring and reducing embodied carbon in new buildings](#)

MHCLG and AECOM research paper

“The aim of this research into the sector-wide practical, technical, and economic impacts of measuring and reducing embodied carbon is to inform policy driven embodied carbon reductions and better understand the cost of building with reduced embodied carbon.”

The powers and duties of local authorities to address climate change

The role of local authorities

Both operational and embodied carbon must be reduced to address the climate crisis. However, upfront carbon is emitted as part of the construction process, this means the client/developer has control over emissions. As embodied carbon is not addressed at the national level it is left for local authorities to fill the gap in their planning policies and decision making. The role of local authorities in mitigating climate change in the UK and delivering sustainable development is articulated in statute and guidance.

A Local Plan would be expected to address:

- **Section 19(1A) of the Planning and Compulsory Purchase Act 2004**, which requires local planning authorities to include in their Local Plans *“policies designed to secure that the development and use of land in the local planning authority’s area contribute to the mitigation of, and adaptation to, climate change”*.
- The **Climate Change Act 2008**, which establishes a legally binding target to reduce the UK’s greenhouse gas emissions by 100% in 2050 from 1990 levels. To drive progress and set the UK on a pathway towards this target, the Act introduced a system of carbon budgets.
- The **Planning and Energy Act 2008**, which empowers local planning authorities to include policies in their development. plans that impose "reasonable requirements" for energy efficiency and generation.
- The **National Planning Policy Framework (NPPF)**, updated 2024, states that a main objective of the planning system is environmental, and that *“using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy”* form part of this objective. Paragraph 20 sets an expectation that *“strategic policies ... make sufficient provision for” “conservation and enhancement of the natural, built and historic environment including landscapes and green infrastructure...to address climate change mitigation and adaptation”* Footnote 61, para 162 also requires local plans’ approach to climate change to be in line with the objectives and targets of the Climate Change Act 2008.

The Dec 2025 NPPF Consultation proposed to remove the powers of local authorities to set their own energy efficiency standards through PM13, particularly if they were already covered by regulation. However, this proposal lacked justification and evidence, it was also not made sufficiently clear if this would extend to embodied carbon emissions. Determination on the updates to the NPPF are pending at the time of writing this evidence base.

By setting an embodied carbon policy in Local Plans, authorities would be responding appropriately to the relevant statutes. Local authorities have primary powers to act on their duty to mitigate climate change.

To this end, there is a growing number of local authorities requiring embodied carbon and/or whole life carbon in policy (see [page 23](#) and [Appendix 6.2](#) for examples).



Planning and Compulsory Purchase Act 2004

2004 CHAPTER 5

An Act to make provision relating to spatial development and town and country planning; and the compulsory acquisition of land.
[13th May 2004]



Climate Change Act 2008

2008 CHAPTER 27

An Act to set a target for the year 2050 for the reduction of targeted greenhouse gas emissions; to provide for a system of carbon budgeting; to establish a Committee on Climate Change; to confer powers to establish trading schemes for the purpose of limiting greenhouse gas emissions or encouraging activities that reduce such emissions or remove greenhouse gas from the atmosphere; to make provision about adaptation to climate change; to confer powers to make schemes for providing financial incentives to produce less domestic waste and to recycle more of what is produced; to make provision about the collection of household waste; to confer powers to make provision about charging for single use carrier bags; to amend the provisions of the Energy Act 2004 about renewable transport fuel obligations; to make provision about carbon emissions reduction targets; to make other provision about climate change; and for connected purposes. 9
[26th November 2008]



Department for Levelling Up,
Housing & Communities

National Planning Policy Framework

Relevant statutes and guidance for planning policy

Planning policy that focuses on both embodied carbon and operational carbon

The need to reduce embodied carbon emissions

According to the Low Energy Transformation Initiative (LETI) Climate Emergency Design Guide the UK building construction industry is responsible for approximately 49% of total UK carbon emissions. These are the sum of operational energy emissions (heating, hot water, lighting, ventilation and plug loads) and the embodied carbon emissions associated with materials, components and systems. To date, reductions in operational energy has been the main focus. It is essential to consider operational energy and embodied carbon in tandem, as measures implemented to reduce operational carbon emissions can affect the embodied carbon and vice versa.

According to Net Zero Whole Life Carbon Roadmap technical report published by the UK Green Building Council in 2021 “Embodied carbon emissions contribute to some 40-50 million tonnes of CO₂ annually, more than emissions from aviation and shipping combined”. Therefore, addressing embodied carbon is vital to meet national and local climate targets.

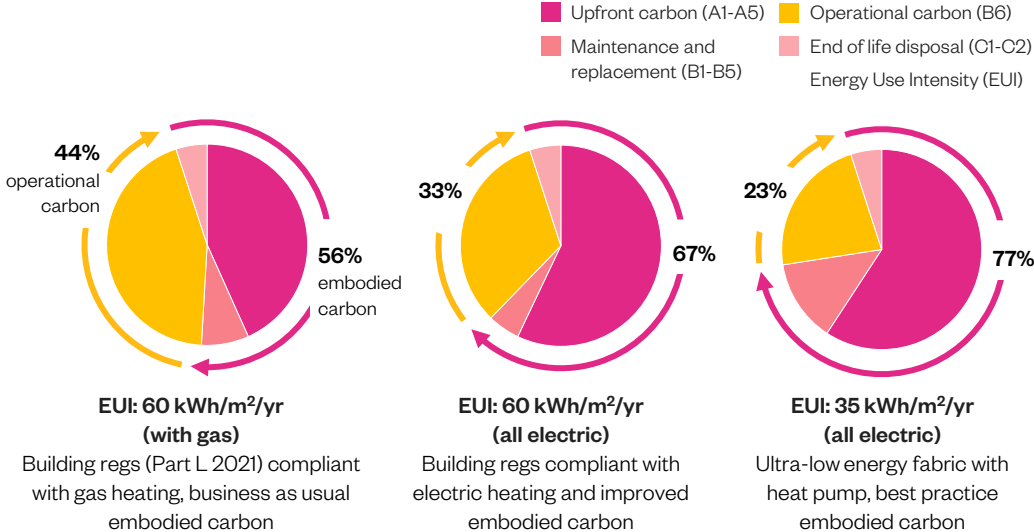
Embodied carbon vs operational carbon

As new buildings become more efficient, operational carbon emissions increasingly reduce. As a result, embodied carbon emissions make up a greater proportion of the total building whole life carbon. Therefore, it is important that the life cycle carbon emissions are considered, to make sure the built environment industry is designing, constructing and operating buildings that have overall low carbon emissions. The pie charts on the right demonstrate the whole life carbon emissions breakdown for three residential buildings with different energy use intensities (EUIs) for operational carbon.

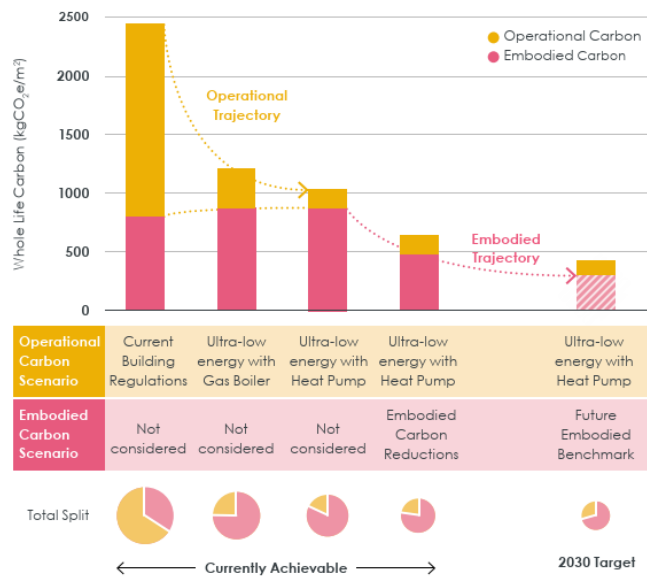
The importance of embodied carbon emissions

Addressing embodied carbon through legislation and policy is vital to meet local and national climate targets. As embodied carbon relates to materials, it is also important to develop policies that help to transition to a circular economy, in which the resource intensive linear process of use and disposal is stopped.

Proportion of embodied carbon emissions in new-builds increases as operational emissions reduce



Comparison of three options for a residential building, showing the reductions in whole life carbon that may be possible with different reduction targets (decarbonised scenario).



The LETI operational and embodied carbon trajectories demonstrate that as operational emissions are reduced in new buildings, the proportion of embodied carbon emissions becomes higher. (Source: [LETI](#))

Stockport Council's climate change commitments

Stockport Climate Emergency commitments

Stockport Council declared a climate emergency in March 2019 and has set two key targets:

- To be operationally net zero emissions by 2030 in their own activities
- To be carbon neutral by 2038, also in line with the commitments made in the 2025 [5-year Environmental Plan for Greater Manchester](#);

Climate and Nature Strategy 2025-2030

The Climate and Nature (CAN) Strategy, formerly known as the Climate Action Now Plan, was developed in 2025 by the council and local partners to tackle climate change, protect biodiversity and create a healthier environment for residents. It sets out a long-term vision to achieve carbon neutrality by 2038 and net zero council emissions by 2030, while improving green spaces, supporting wildlife, and promoting sustainable development and transport. It is also part of the broader [One Stockport: One Future plan](#).

The CAN Strategy sets out key objectives for Stockport's built environment:

- Improve energy efficiency to reduce energy demand and fuel poverty;
- Design and build high quality buildings for good internal thermal comfort , air quality and resilience against extreme weather events;
- Maximise opportunities for renewable energy generation, and
- Implement nature-based solutions to improve biodiversity

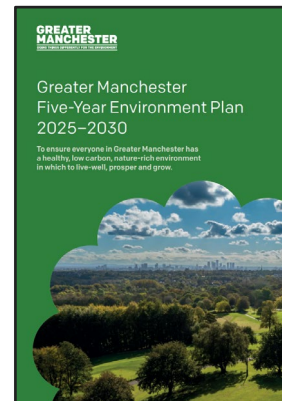
Greater Manchester Five-Year Environment Plan 2025-2030

Greater Manchester's Five Year Environmental Plan aims to create a sustainable, low-carbon region while supporting economic growth. As the building sector accounts for 42% of emissions, key priorities include:

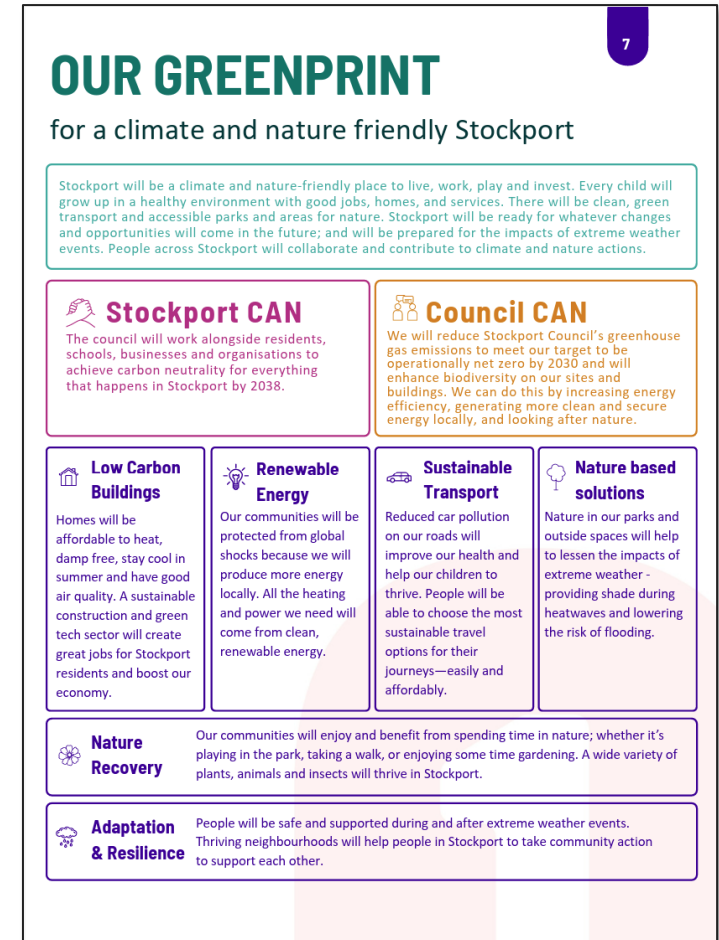
- **Improving efficiency:** Reducing energy demand for heating and cooling buildings to meet carbon-neutral goals by 2038.
- **Housing:** Supporting the "Housing First" standards to ensure all residents have access to safe, affordable, and sustainable homes.
- **Net-Zero Development:** Delivering operational net-zero new builds in line with Places for Everyone and national standards, alongside the development of "Truly Affordable Net-Zero Housing" (TANZ).
- **Environmental Planning:** Incorporating the assessment of embodied carbon into the regional planning system.



[The Climate and Nature \(CAN\) Strategy 2025-2030](#) document. The green print key objectives on the right hand side.



[The Greater Manchester Five Year Environment Plan 2025-2030](#)



2

Embodied carbon explained

Embodied carbon in the wider carbon context

The making of materials, their transport, repair and deconstruction informs how much carbon emitted. Embodied carbon is assessed through a series of boundaries. This page provides a summary of the key boundaries.

Upfront carbon

Upfront carbon refers to the greenhouse gas emissions associated with material and construction stages: raw material supply, manufacture, transport and construction of all building elements.

Upfront carbon and lifecycle embodied carbon is measured in tonnes (tCO₂e) and is reported and normalised by kilogram of carbon equivalent per square meter of development (kgCO₂e/m²[GIA](#)). For example, where the volume of concrete is the same in two buildings, they will emit the same total tCO₂e. However, if one building is twice the area, when normalised by area, it will become clear that the smaller building has higher emissions per square meter.

Life cycle embodied carbon

Life cycle embodied carbon includes both upfront carbon and the embodied carbon associated with:

- In-use - maintenance, replacement and refrigerant leakage.
- End of life - waste processing of demolition/deconstruction and disposal of any products.

Operational carbon

Operation carbon refers to the emissions associated with energy and water use during operation.

User carbon

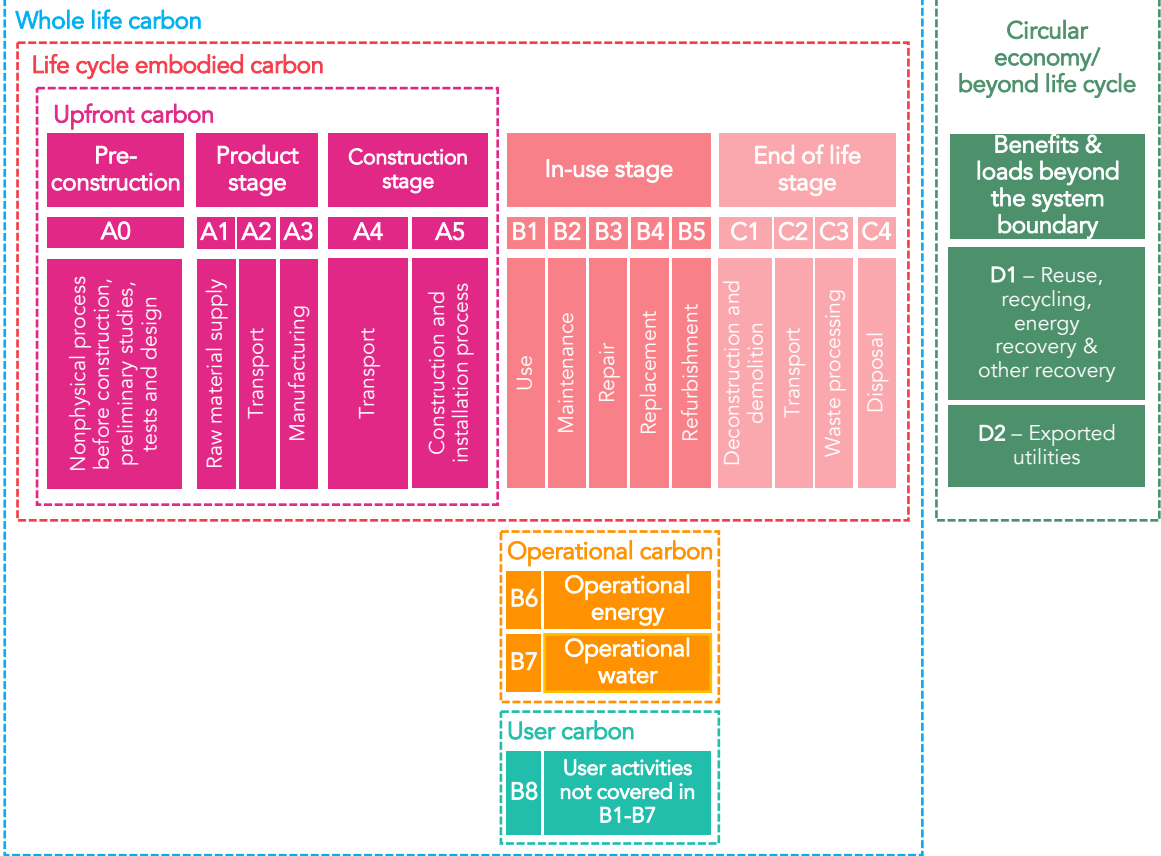
User carbon covers the emissions from user activities, outside of the use of energy and water emissions from the operation of the building. An example includes transport or vehicle charging. This module is typically outside the remit of building design.

Whole life carbon (WLC)

For buildings, whole life carbon is the sum of **life cycle embodied carbon** and **operational carbon**.

Circular economy/beyond life cycle

A circular economy seeks to ensure materials can be re-used again and again and are ultimately diverted from landfill or incineration. This builds on embodied carbon principles, such as material re-use, recovery and recycling.



Modular information for the different boundaries of the building assessment. This version of the diagram is adapted from a combination of the diagram from the BS EN 15978, RICS 2023 and LETI.

RICS 2023 definitions:

Greenhouse gases (GHGs) (often referred to as 'carbon emissions')

"Constituents of the atmosphere, both natural and anthropogenic (human-created), that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds."

Carbon dioxide equivalent (CO₂e)

"A metric for expressing the impact of all greenhouse gases on a carbon dioxide basis."

Upfront and life cycle embodied carbon explained further

Upfront carbon

Upfront carbon refers to the greenhouse gas emissions associated with material and construction stages: raw material supply, manufacture, transport and construction of all building elements.

Designers have the greatest ability to reduce upfront carbon pre/post-planning by considering how a new building can be optimally designed and through the materials specified. This lends itself to benchmarking or target setting through planning policy, as it is the area most effectively influenced by policy and addressed by client and design teams during the planning process.

Industry targets such as LETI and the UK Net Zero Carbon Building Standard are framed around upfront carbon (modules A1-A5) and some recently adopted planning conditions across the UK also focus on these modules. See [Section 3](#) for further information.

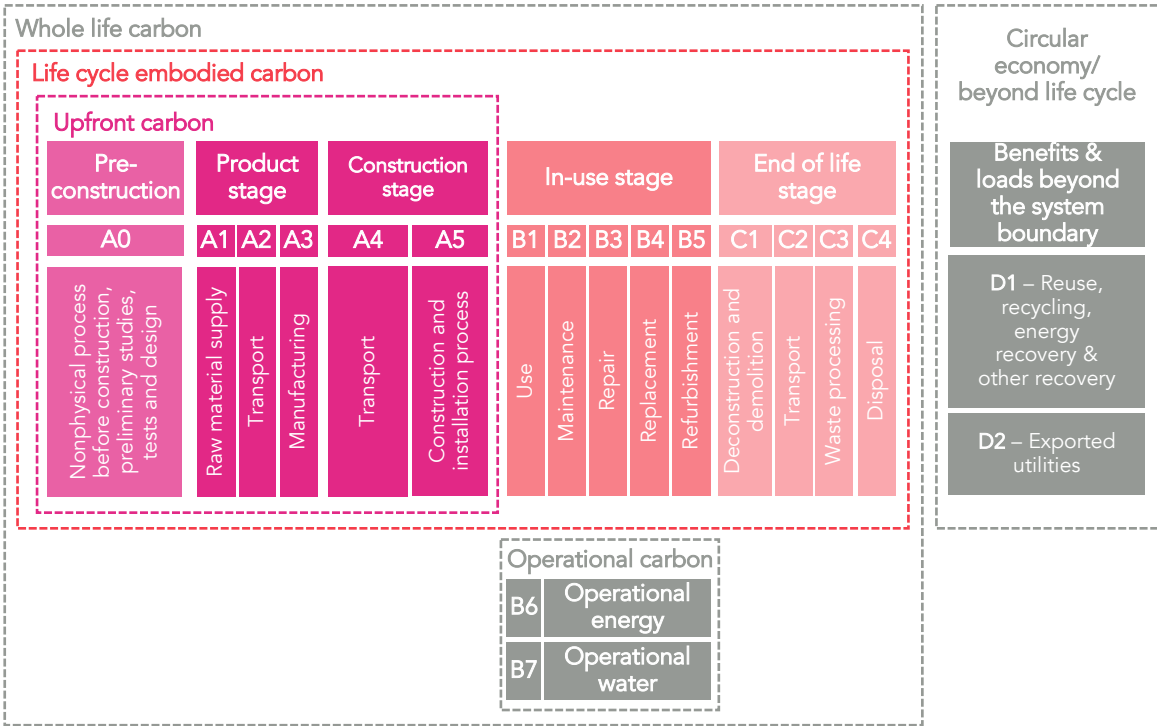
Module A0 (pre-construction stage) covers non-physical pre-construction activities, such as surveys and activities associated with the design of the asset. For buildings, these emissions do not normally have a significant environmental impact and therefore, are assumed to be negligible. Module A0 has a greater significance for larger infrastructure projects.

To have the greatest immediate influence on the design and construction of buildings in Stockport, the primary focus for this evidence base will be on upfront carbon.

Life cycle embodied carbon

Life cycle embodied carbon includes both upfront carbon (above) and the embodied carbon associated with the building in-use and at the end of life.

While design teams have some influence of the B and C modules in new build (through robust design, specification, and design for deconstruction), building owners and occupiers who will maintain and refurbish the building will have the most influence. This makes life cycle embodied carbon more complex to integrate into planning policy through target setting or benchmarking. Planning policies set around life cycle carbon may benefit from being more qualitative than quantitative. However, examples exist of planning policies and industry targets that consider life cycle carbon.



Building assessment modules with a focus on life cycle and upfront carbon. This version of the diagram is adapted from a combination of the diagram from the BS EN 15978, RICS 2023 and LETI.

RICS 2023 definition:

Life cycle embodied carbon

"The embodied carbon emission of an asset are the total green house gas (GHG) emissions and removals associated with materials and construction processes, throughout the whole life cycle of an asset (modules A0-A5, B1-B5, C1-C4, with A0 assumed to be zero for buildings)."

Upfront carbon

"Upfront carbon emissions are GHG emissions associated with materials and construction processes up to practical completion (modules A0-A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion."

Areas of influence for Stockport's embodied carbon planning policy for new buildings

A metric aiming to reduce upfront carbon emissions in new buildings will allow Stockport to work towards its climate commitment of becoming carbon neutral by 2038. These should be combined with additional metrics aiming to reduce operational energy to ensure a holistic approach in Stockport's planning policy for new buildings.

Operational energy has been addressed in a separate document.

This page outlines the policy areas that can have the greatest effect on the design, construction and performance of a new building:

Operational energy metrics

1 Energy efficient fabric and ventilation

Space heating demand (kWh/m²GIA/yr)

The building should achieve an ultra-low level of space heating demand.

2 Low total energy use

Energy Use Intensity (EUI) (kWh/m²GIA/yr)

The predicted level of total energy use of the building (regulated and unregulated) should be less than a limit.

See also the [definition of EUI](#)

3 On-site renewable energy generation

% of building footprint covered by PVs

The building should seek to generate on-site renewable energy generation by covering a percentage of the building's roof with Photovoltaic panels (PVs).

4 Fossil fuel free

Yes/No

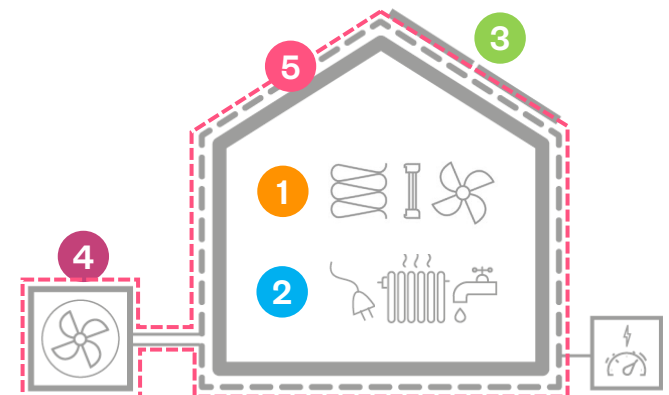
The building must not connect to the gas network or, more generally, use fossil fuels on-site. It must use a low carbon heating system (e.g. heat pump).

Embodied carbon metric

5 Upfront carbon

Upfront embodied carbon limit (kgCO₂e/m²GIA)

Building design should also minimise embodied carbon in materials throughout their lifecycle.



3

Industry guidance and policies on embodied carbon

Industry standards and supporting guidance for upfront carbon

RICS - Whole Life Carbon Assessment for the Built Environment

The Royal Institute of Chartered Surveyors (RICS) 'Professional Statement: Whole Life Carbon (WLC) assessment for the built environment' is the industry standard methodology for WLC assessments and provides supporting guidance in line with BS EN 15978 principles. The second edition (RICS Professional Statement (PS) v2 2023) is the most widely understood and comprehensive method for calculating embodied carbon emissions.

The document outlines the minimum scope required for a WLC assessment, including demolition, facilitating works, substructure, superstructure (structural element, building envelope, internal elements), finishes, fittings, furnishing and equipment (FF&E), services (MEP) and external works within the building's boundary. The RICS methodology accounts for sequestered carbon in materials separately but does not account for biogenic carbon losses from the existing site (existing plants, habitats, etc.).

The evidence generated in this study has followed the RICS Professional Statement (PS) v2 2023 methodology, to correlate with industry standards. It is also recommended that policy should align with this methodology too.

Industry guidance and standards

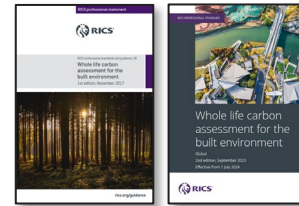
Built environment industry bodies have provided guidance and standards to raise awareness, improve performance and build upon more technical documents (such as RICS) for a wider group of professionals. This includes:

- LETI (Low Energy Transformation Initiative) Embodied Carbon Primer (2020)
- UKGBC Net Zero Carbon Net zero whole life carbon roadmap (2021)
- LETI Embodied Carbon Alignment work (2021)
- RIBA 2030 Challenge (2022)
- CIBSE TM 65 – Embodied carbon in building services (2022)
- The UK NZOBS v1 - a science-based methodology for achieving net zero carbon buildings in the UK (2026).

Other useful guidance and industry proposals

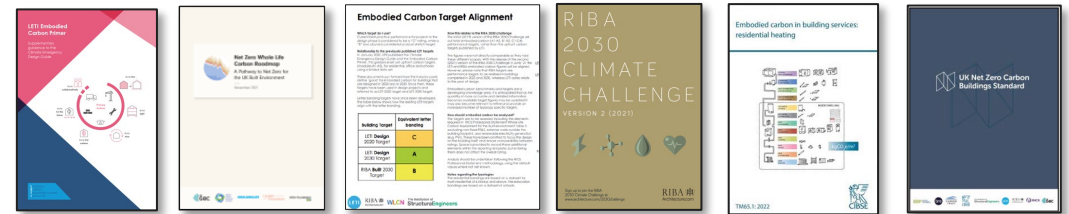
Other useful guidance also exists to assist consultants with calculating the embodied carbon of materials. In addition, the industry has also set out a national campaign to mandate for WLCA in building regulations, called Part Z.

Professional standard assessment methodology:



RICS 2017 (left) and 2023 (right) professional statements: [Whole Life Carbon assessment for the built environment](#). The industry standard methodology for calculating embodied carbon emissions.

Industry guidance and standards:



LETI
[Embodied Carbon Primer](#)

UKGBC – [Net zero whole life carbon roadmap](#)

LETI [embodied carbon alignment](#)

RIBA [2030 climate challenge](#)

CIBSE [TM 65 – Embodied carbon in building services](#)

[UK Net Zero Carbon Building Standard \(v1\)](#)

Other useful guidance:



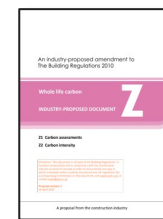
IStructE – [How to calculate embodied carbon](#)

CWOT – [How to calculate embodied carbon of facades](#)

The concrete centre – [Sustainable concrete](#)

BAMB – [Material passports](#)

Industry proposal:



[The Part Z proposal](#) sought to provide a framework for bringing whole life carbon assessments and embodied carbon into building regulations.

Industry standards continued - Net Zero Carbon Building Standard

Of the standards explored on the previous page, the most current and relevant is the UK Net Zero Carbon Building Standard :

UK Net Zero Carbon Building Standard (UK NZCBS) – well evidenced targets

Following a pilot testing period the UK NZCBS Version 1 was released in March 2026. It is a science-based standard, aligned with the 1.5deg Paris Agreement and achieving Net Zero in the UK by 2050. It was developed collaboratively by prominent industry bodies to form a single agreed definition of Net Zero Carbon and conclude a Standard for demonstrating whether it has been met.

As part of this, limits (energy use and embodied carbon) have been set using case study data submitted by the industry and correlated with technical feasibility and the national carbon budget. Following the release of Version 1, projects are now able to verify that they conform to the as-built/in-use metrics in the Standard.

The UK NZCBS sets limits for upfront carbon (A1-A5, kgCO₂e/m²) by year, from 2025 to 2050, for new build and retrofit projects across a range of sectors. For new build residential schemes the limits between now and 2030 are as follows:

Date of commencement	Upfront carbon (kgCO ₂ e/m ² GIA)					
	2025	2026	2027	2028	2029	2030
Single family homes	403	400	375	345	320	290
Flats	565	525	490	450	420	380

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. The limits also assume/account for steep decarbonisation of material industrial processes.

In comparison to the to modelling carried out for this study the above figures are deemed to be particularly ambitious for use in planning policy and therefore, have not been relied upon, instead alternative limits are recommended to be set with review every 3-5 years.

Use of the Standard in policy

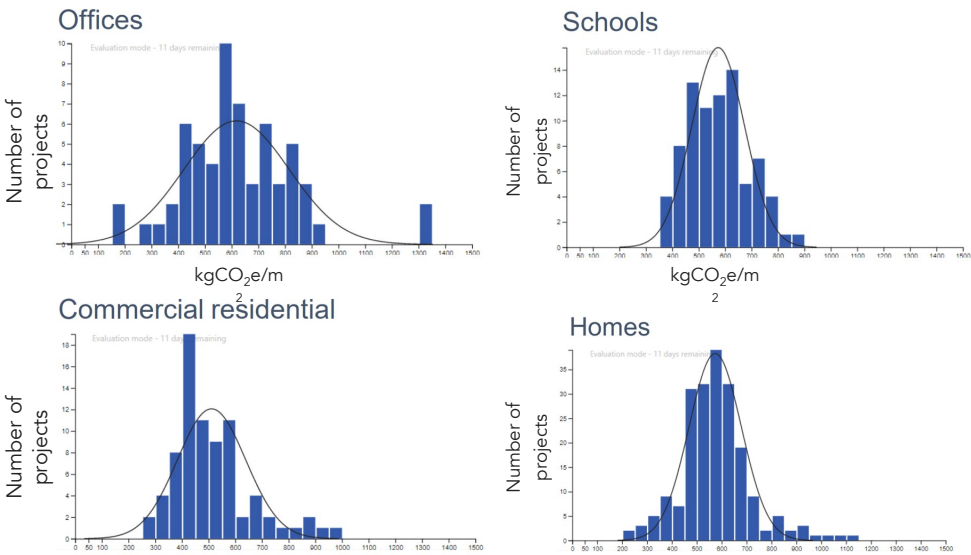
In January 2026, the UK NZCBS published a note regarding use of the Standard in Planning Policy, it noted that *“the Standard may provide a useful reference point that policy officers can compare against”* but that *“it is not yet appropriate for policy to state that buildings need to be verified to meet the Standard”* because it *“is based on in-use performance [after 12 months], which sits outside the time period currently considered at Planning stage”*.



UK Net Zero Carbon Building Standard (UK NZCBS) (Source: [NZCbuildings](#)) developed collaboratively by Better Buildings Partnership, Building Research Establishment (BRE), Carbon Trust, Chartered Institute of Building Services Engineers (CIBSE), Low Energy Transformation Initiative (LETI), Royal Institute of British Architects (RIBA), Royal Institute of Chartered Surveyors (RICS), Institute of Structural Engineers (IstructE), and UK Green Building Council (UKGBC).



Using the UK NZCBS in Planning Policy
(Source: [NZCbuildings](#))



Upfront carbon case study data submitted by industry - The Standard's limits were developed based on analysis of in-use data collected from across the UK built environment industry, alongside an energy and carbon balancing exercise to define what building performance was needed to stay within the UK's carbon budget. The EUI limits and upfront carbon limits for new buildings depend on when the building work commences on site, and get more onerous over time. (Source: [Net Zero Carbon NZCBS](#))

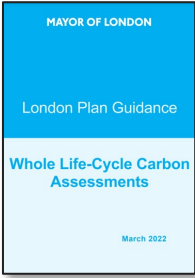
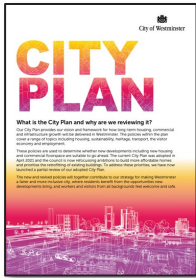
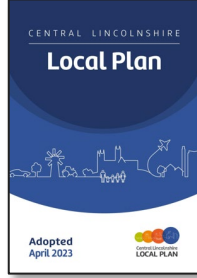
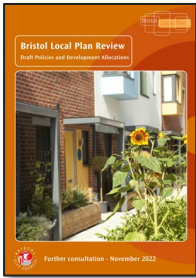
Summary of adopted embodied carbon policies and approaches in UK

Adopted planning policy

In the absence of national regulation, planning authorities across the UK have developed their own evidence bases and policy proposals that are in varying stages of adoption, public consultation and examination.

These new policies commonly utilise an upfront carbon metric ($\text{kgCO}_2\text{e/m}^2$) with the expectation that other policies are in place to require reporting and limiting of operational energy in $\text{kWh/m}^2\text{yr}$.

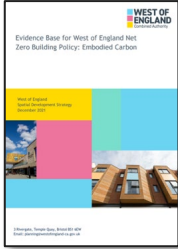
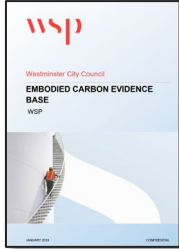
This page summarises the adopted embodied carbon approaches to policy in the UK. With many more emerging policies currently in consultation. See [Appendix 6.2](#) for further information.

						
	Greater London Authority	City of London Council	City of Westminster Council	Central Lincolnshire Council	Bath and North East Somerset Council (B&NS)	Bristol City Council
Presumption against demolition	✗	✓	✓	✓	✗	✗
Embodied carbon assessment + reporting	✓ (whole life carbon assessment)	✓ (whole life carbon assessment)	✓ (whole life carbon assessment)	✗ (Seek to reduce embodied carbon only)	✓ (upfront carbon)	✓ (upfront carbon)
Meet embodied carbon target/limit/benchmark	✓ (benchmarks)	✓ (benchmarks)	✓ (either upfront of life cycle embodied carbon)	✗ (no targets/limits/benchmarks)	✓ (limits for substructure, superstructure and finishes only)	✓ (upfront carbon targets)
Applies to	Referrable schemes	Major developments must submit a whole life-cycle carbon assessment	Major developments	All developments	Large scale new- build developments	Major developments
Other requirements	Demonstrate actions taken to reduce life-cycle carbon emissions	Development proposals should minimise whole life-cycle carbon emissions.	Demonstrate the maximum embodied carbon reductions deliverable without affecting the delivery of affordable housing	Take opportunities to reduce the development's embodied carbon	If the development is not compliant with the policy, a valid justification must be provided with the appropriate reasons and evidences.	Demonstrate actions taken to reduce life-cycle carbon emissions

Summary of embodied carbon evidence base studies in the UK

Evidence bases developed for planning policy

This page summarises the results from published evidence bases used to develop planning policy. The table below includes the upfront carbon emissions modelling results and limit/ target recommendations. See [Appendix 6.2](#) for further information on these evidence bases.

			
	Evidence-base for West of England net zero building policy: embodied carbon	Westminster embodied carbon evidence-base	Essex embodied carbon policy study
Domestic buildings – results	Semi-detached house (<11 m in height): 310-520 kgCO ₂ e/m ² Low to mid-rise apartment block (<18 m in height): 240-350 kgCO ₂ e/m ²	Mid to high-rise apartment block (>18 m in height): 685-893 kgCO ₂ e/m ²	Semi-detached house (<11 m in height): 405-480 kgCO ₂ e/m ² Terrace house (<11 m in height): 375-440 kgCO ₂ e/m ² Low-rise apartment block (<11 m in height): 360-430 kgCO ₂ e/m ²
Mixed-use buildings – results	✗ n/a	Mixed use - 45% Office, 45% Residential, 10% Retail (>18 m in height): 583-781 kgCO ₂ e/m ²	✗ n/a
Non-domestic buildings - results	Office (<18 m in height): 320-610 kgCO ₂ e/m ² School (<18 m in height): 305-550 kgCO ₂ e/m ²	Office (>18 m in height): 579-802 kgCO ₂ e/m ²	✗ n/a
Limit/ target recommended	All building typologies: achieve LETI band C (residential 6+ storeys and education: <500 kgCO ₂ e/m ² , office: <600 kgCO ₂ e/m ²) as a minimum target and set LETI band A (residential 6+ storeys and education: <300 kgCO ₂ e/m ² , office: <350 kgCO ₂ e/m ²) as an aspirational target.	All building typologies: adopt NZOBS limits.	- Low rise residential (up to 11m): 500 kgCO ₂ e/m ² - Mid and high rise residential (over 11m): 500 kgCO ₂ e/m ² - Non-domestic buildings: adopt NZOBS limits.

4

Upfront carbon policy evidence-base

Upfront carbon targets – carbon and cost modelling purpose and buildings typologies

Purpose of upfront carbon and cost modelling

Upfront carbon and cost modelling constitutes the core of this technical evidence base. The purpose of this modelling analysis was to investigate the upfront carbon in kgCO₂e/m²GIA of various building typologies under different construction scenarios. The results inform the proposed upfront carbon targets in this study, which aim to support the development of a planning policy requirement for reducing embodied carbon emissions from new developments in Stockport. Capital cost modelling has been carried out to understand the likely cost and viability impact of the policy. It identifies the capital cost uplift for each scenario against the baseline, which represents a prevalent construction approach specifying commonly construction materials and developed without upfront carbon emissions in mind.

Building typology selection

A total of three residential building typologies and one non-residential have been modelled. These have been identified as being relevant locally:

- Terrace house
- Apartment block below 11 meters in height
- Apartment block above 11 meters in height
- Commercial use Class E building

How height affects upfront carbon in residential typologies

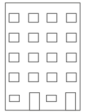
Upfront carbon is shaped by both design and material choices. In the UK, residential buildings ≥11 m (typically apartment blocks) are subject to fire regulations under Approved Document B that restrict the use of combustible materials in external walls, whereas buildings <11 m (such as houses and low-rise flats) are generally exempt. Consequently, the terrace house and apartment block <11 m typologies are assessed separately from the apartment block >11 m, with distinct policy targets being proposed reflecting these differences in materiality options.

Commercial buildings scale

A commercial use Class E building has been included within this study to provide a point of reference and to contextualise the scale of upfront carbon targets that commercial buildings could be expected to achieve.

Operational energy performance

In this case, the outline specifications for all the upfront carbon scenarios modelled have been aligned with the performance parameters used to meet operational energy performance (see Operational Energy Policy Study).

	Residential			Non-residential
	<11 m in height		≥11 m in height	
				
	Terrace house	Apartment block (<11 m)	Apartment block (>11 m)	Commercial use Class E
Number of storeys	3	3	13	10
GIA (m ²)	114	1,019	5,800	5,400
Ground to height of top floor (m)	9.2m	9.5m	41.5*	3.8m (floor to floor height)
Form factor**	2.1 (3-terraced houses) 1.9 (6-terraced houses)	2	0.8	0.9

Building typologies modelled, general information.

*This typology is required to have non-combustible materials in the construction of all its external walls, balconies and spandrel panels in accordance with Approved Document B (2019), due to its height being above 18m.

**An efficient building form (lower form factor) is more likely to have reduced construction costs and emit less upfront carbon than a complex building form (higher form factor), while also supporting reduction in operational energy as part of wider policy. Where other home typologies are built (e.g. detached and or bungalows), they will likely require more careful consideration of the materials used to ensure they are low carbon to build within policy targets.

Upfront carbon targets – relationship between upfront carbon and capital cost

Many of the strategies that a contractor might propose to reduce upfront carbon will have little or no material impact on cost. These might include:

- Resource efficiency and circularity measures that reduce wastage or entail the selection of reused materials or those containing higher levels of recycled content.
- Effective co-ordination of designs and management of site teams to reduce wastage.
- Designing for effective maintenance and disassembly, for example through use of mechanical fixings in cladding systems

Some specification changes may result in additional costs being incurred (for example niche environmental products), however, it is critical to determine those that are likely to persist over the long term and those where any cost premium should dissipate over time as the supply chain becomes more mature and scale increases.

Understanding both current and future costs

A good example of this issue is the use of timber frame solutions for domestic superstructures. In much of England timber frame is considered a more expensive solution than the more typical brick and block construction, yet in Scotland timber frame is the predominant form of structural solution and is cost competitive on this basis. It is therefore important to distinguish between cost premiums that arise due to historic market practice rather than due to an underlying difference in cost base.

Importantly, where a low carbon product or supply chain is currently more expensive because it is relatively small scale or immature, then there is an opportunity to achieve both economic development and carbon savings by incentivising the use of these solutions within the market. As these products scale they become more cost competitive in other locations (outside Stockport) and will be increasingly deployed even where there is no formal embodied carbon requirement.

In this study we aim to identify the cost implications of the different upfront carbon specification options and also the longer term costs and potential for economic benefits linked to scale. Although the future costs of any product or technology are inherently uncertain there can be potential for cost reductions using the principles of learning rates / experience curves and, where appropriate, by reference to other locations where these solutions are more mature (for example open or close timber frame systems).

Non-cost factors

While material cost is an important component influencing the viability of a construction method, a range of other factors are also important and should be considered. These include:

- Ability to meet demand – some low carbon solutions could not immediately be deployed for a large proportion of new construction and so their use would need to be incentivised / encouraged in a way that provides the opportunity for capacity to develop.
- Transition / duplication costs for organisations with refined existing supply chains – this is particularly the case with large developers who have well developed delivery processes and regional / national supply chains. Even if lower carbon products are not more expensive there is additional cost associated with adding to or changing these existing practices particularly where their installer base may be less familiar with the new approach.
- Risk – these might take many forms but would include the ability of smaller companies to provide the necessary warranties or assurance for their products.

These additional factors should be considered when appraising how an applicant might seek to meet an upfront carbon target in planning.

Upfront carbon targets – calculation methodology and lifecycle stages modelled

Carbon measurement standard

This evidence-base has adopted RICS Whole Life Carbon Assessment (RICS WLCA) standard, 2nd edition, which is the industry’s supported standard.

Upfront carbon (A1-A5) is the focus of this evidence-base

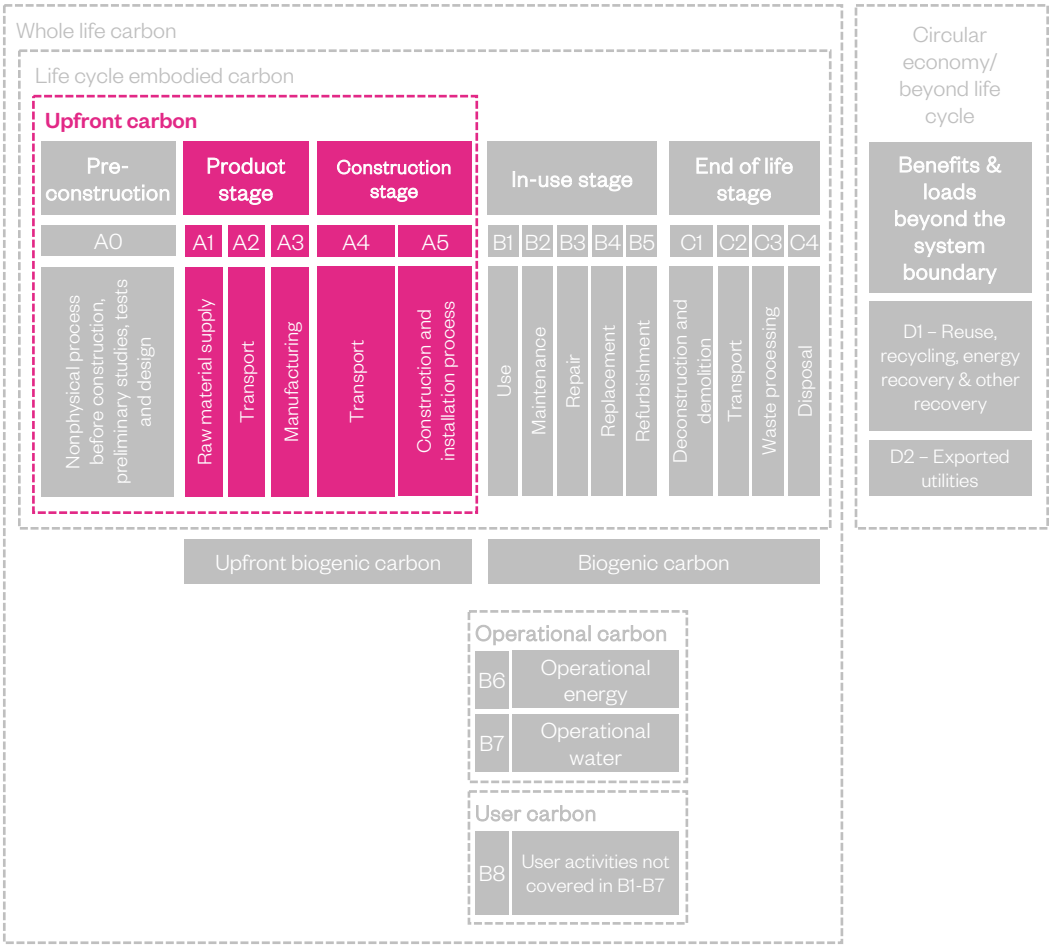
Upfront carbon (stages A1-A5) is the focus of this modelling exercise with a main aim to inform upfront carbon targets as part of the new Stockport local plan energy and carbon policies. Upfront carbon has the most influence over the design of buildings, with early design decisions being locked in through planning approvals. To date, upfront embodied carbon has more stable material databases available for the industry to use in the UK, in contrast with lifecycle data (B1-B5 and C1-C4) , which has limited and variable data sets available.

As there was no site-specific data available a 40 kgCO₂e/m²GIA was assumed as a baseline for RICS module ‘A5.2 Construction Activities’ for all typologies modelled. A 35 kgCO₂e/m²GIA for RICS module ‘A5.1 pre-construction demolition’ was assumed for the non-residential typology. These have been applied following RICS WLCA PS 2nd ed. 2023 methodology.

Finally, following the UK NZCBS assessment methodology, A0 Pre-construction module was excluded from the calculation of the upfront carbon results.

Biogenic carbon and lifecycle embodied carbon

Both biogenic carbon and lifecycle embodied carbon sit outside the scope of this technical evidence-base.



KEY

Upfront carbon - Main focus of modelling results for policy	Out of scope of modelling
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Life-cycle stages inside and outside of the scope of the embodied carbon modelling. This version of the diagram is adapted from a combination of the diagram from the BS EN 15978, RICS 2023 and LETI.

Residential upfront carbon targets – building elements modelled and carbon datapoints used

To determine which building elements were part of the exercise, the building element categories from RICS WLC A PS 2nd ed. 2023 were used.

Sub-structure, superstructure and finishes

The modelling has covered the upfront carbon emissions from the sub-structure, super-structure and finishes. Since the residential typologies modelled are real projects (ranging from RIBA Stages 2-5) taken from the consultancy team's portfolio, calculations of these three building elements were based on actual material quantities extracted from their respective BIM models. For the non-residential typology the substructure modelling was based on BIM extracted quantities, whereas super-structure and finishes quantities have been assumed using VERT: Visionary Emissions Reduction Tool.

Fittings, furnishings and equipment (FF&E) and services (MEP)

FF&E emissions have been assumed and applied based on the GLA benchmark value from the GLA's Guidance on Whole-life carbon assessment, which assumes a 1% of the total upfront carbon. For the residential typologies services (MEP) emissions have been assumed using internal project-based data with CIBSE TM65 methodology used (sanitaryware not included), whereas for the non-residential typology emissions have been assumed using VERT: Visionary Emissions Reduction Tool data.

Out of scope

Following the UK NZOBS assessment method, external works (8), loose FF&E products /materials (4.4, 4.5, 4.6) and renewables (5.1) should not be included in the calculation of upfront carbon.

Source of carbon datapoints

The materials used in the study were mostly sourced from the OneClick database (software used for this study) or Inventory of Carbon and Energy (IOE), a free to access database. Datapoints are considered to represent the typical UK performance for each material or product. Where a typical value was not available, a more bespoke environmental product declaration (EPD) was used.

An EPD sets out the environmental impacts of a product/ material over its lifecycle, helping inform procurement decisions. EPDs provide detail on several environmental indicators, with the most relevant to this study being 'global warming potential' which provides a standard way of declaring the amount carbon emission equivalent. While useful for comparison, EPDs can vary in quality and quantity and are still not available for all construction products, though their use is increasing.

RICS WLC A PS 2nd ed. Category	Scope	Methodology
0.1 Treatment and demolition works Facilitating works	x	Not applicable
1 Sub-structure	✓	Modelled - BIM extracted quantities
2 Superstructure	✓	Modelled - BIM extracted quantities for resi typologies, assumed for non-resi typology using VERT
3 Finishes	✓	Modelled - BIM extracted quantities for resi typologies, assumed for non-resi typology using VERT
4 Fittings, furnishings and equipment (FF&E)	✓	Assumed - GLA Benchmark of 1%
5 Services (MEP)	✓	Assumed - CIBSE TM65 data for resi typologies, VERT for non-resi typology
5.1 Renewables	x	Not included
6 Pre-fabricated buildings and units	x	Not applicable
7 Works to existing buildings	x	Not applicable
8 External works associated with the project	x	Not included

RICS WLC A PS 2nd ed. building elements included and excluded from the calculation.

Contingency factor

Following RICS WLC A PS 2nd ed., to account for uncertainty and lack of detailed or complete information, an early design contingency factor of 15% has been applied to all modules before reporting the final figure.

Project phase	Scope	Default contingency factor
Early design	✓	15%
Technical design and construction	N/A	6%
Post completion	N/A	0%

RICS WLC A PS 2nd ed. contingency factors included and excluded from the calculation.

4.1

Residential typologies

Residential <11 m height – upfront carbon modelling scenarios and results



Modelled scenarios

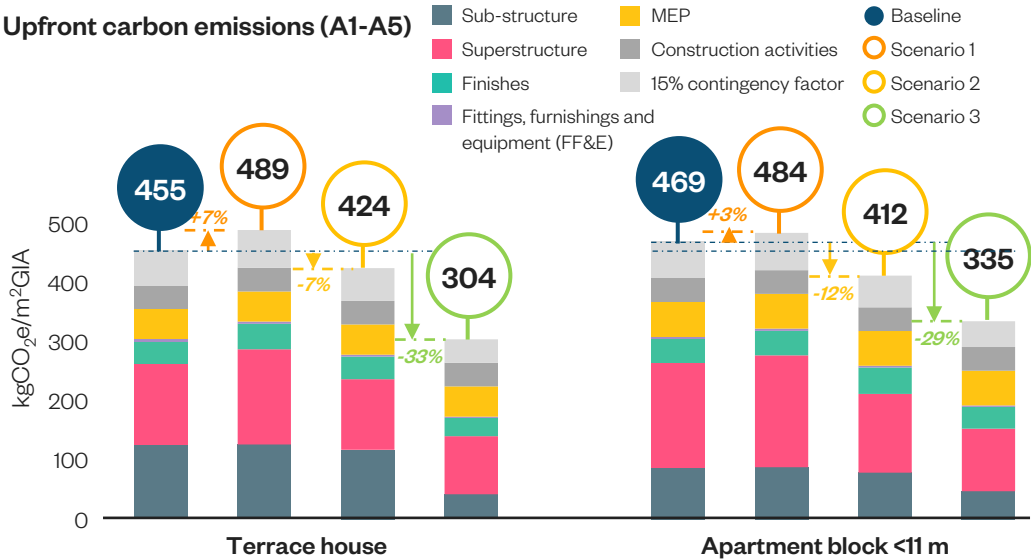
Four scenarios have been developed across the terrace house and the apartment block below 11m typologies to understand their resultant upfront carbon emissions:

- **Baseline** – represents a combination of commonly specified and ‘business as usual’ construction materials. It has been established as a reference point for comparison against the other scenarios examined in this study.
- **Scenario 1** and **scenario 3** – represent the highest and lowest upfront carbon option, respectively.
- **Scenario 2** – was created based on a combination of cost and carbon optimised materials.

Upfront carbon results for residential <11m in height

- The graph opposite illustrates that under baseline and scenario 1, both typologies achieve upfront carbon results of <500 kgCO₂e/m²GIA. There is an upfront carbon uplift from the baseline to scenario 1 for both typologies, mainly attributed to the higher upfront carbon materials consisting the superstructure of scenario 1 (metal studs rather than timber, metal ceiling system and aluminium frame windows). However, due to the baseline and scenario 1 adopting more traditional construction methods, there are few materials selected in scenario 1 that have a lower overall environmental impact compared to the baseline. These include the aluminium framed windows and the use of mineral wool insulation in the roof, compared to the UPVC windows and phenolic insulation, both being petroleum-based products.
- Under scenario 2, both typologies achieve an upfront carbon of <450kgCO₂e/m²GIA, mainly by switching to a lower-carbon timber structure while maintaining a brick outer leaf.
- Under scenario 3, both typologies achieve an upfront carbon of <350kgCO₂e/m²GIA, by switching to a lower-carbon timber structure, combined with a timber weatherboard cladding or render system, wooden frame windows and raft foundations. An upfront target set at this level would preclude the use of brick façades.
- Scenarios 2 and 3 contain combustible materials in external walls. While this is acceptable under [Part B fire regulations](#) for residential buildings <11m, this can be problematic for some funders and insurers. For further detail on how upfront carbon can interact with fire regulation see [Appendix 6.5](#).

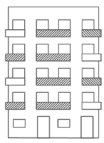
Upfront carbon emissions (A1-A5)



Upfront carbon emissions in kgCO₂e/m² (GIA) per scenario for residential typologies below 11m height.

	Sub-structure	Superstructure				
		External wall	Party and internal wall	Internal floor	Roof	Windows
Baseline prevalent construction approach	Strip foundations + in-situ concrete slab	Brick and block + glass wool	Block and block + glass wool, timber studs	Timber i-joists (terrace)/ pre-cast concrete planks (apt)	Timber rafters + phenolic (terrace)/ mineral wool (apt) insulation	UPVC frame
Scenario 1 highest upfront carbon	Same as Baseline	Same as Baseline	Block and block + glass wool, metal studs	Timber joists + metal ceiling system	Timber rafters + mineral wool	Aluminium frame
Scenario 2 cost-carbon optimised	Strip foundations + beam & block floor	Timber frame + cellulose + brick	Timber frame + glass wool, timber studs	Timber I-joists / CLT slab	Timber rafters + phenolic (terrace)/ cellulose (apt) insulation	UPVC frame
Scenario 3 lowest upfront carbon	Raft foundations	Timber frame+ wood fibre & hempcrete + timber weatherboard	Same as Scenario 2	Same as Scenario 2	Same as Scenario 2	Wooden frame

Key building elements forming the baseline, scenarios 1, 2 and 3 for the residential typologies <11 m in height. Mechanical ventilation with heat recovery and individual air sourced heat pumps have been assumed as the heating and hot water strategy for all the scenarios. See [Appendix 6.3](#) for the full set of materials and building elements tested.



Residential >11 m height – upfront carbon modelling scenarios and results

Modelled scenarios

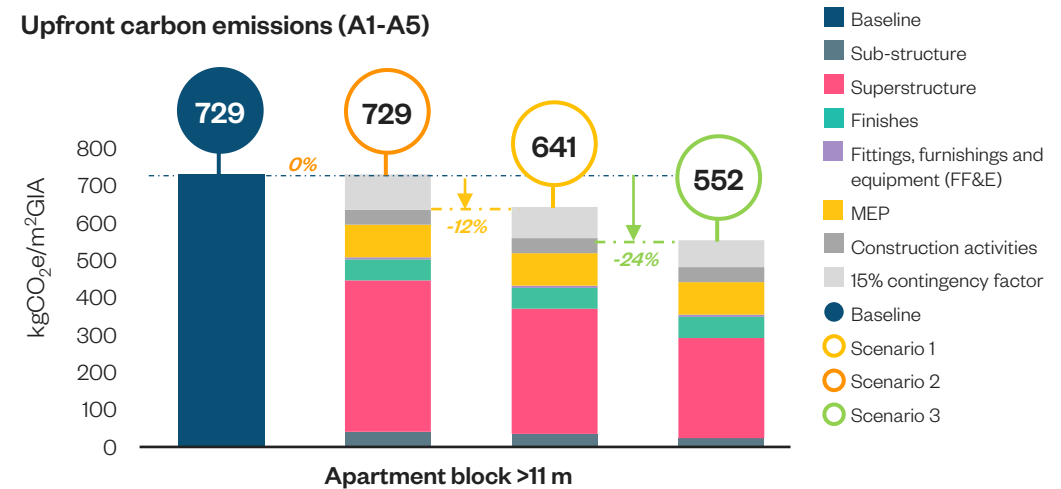
Four scenarios have been developed for the apartment block above 11 m typology modelled to understand their resultant upfront carbon emissions:

- **Baseline** – represents a combination of commonly specified and 'business as usual' construction materials. It has been established as a reference point for comparison against the other scenarios examined in this study.
- **Scenario 1** - represents business as usual fabric and systems. In this case, it consists of the same building elements and components as the baseline.
- **Scenario 2** – replaces the glass fibre reinforced concrete (GRC) rainscreen system with a brick façade and assumes a 20-25% cement replacement product in the substructure and superstructure concrete elements.
- **Scenario 3** – assumes a 50-60% cement replacement product in substructure and superstructure concrete elements.

Upfront carbon results for residential >11m in height

- The graph opposite illustrates that under baseline and scenario 1 the apartment block above 11 meters achieves an upfront carbon of <750 kgCO₂e/m²GIA. There is no change in the upfront carbon from the baseline to scenario 1 since they consist of the same combination of construction materials.
- Under scenario 2, an upfront carbon of <700 kgCO₂e/m²GIA is achieved, by switching to a brick façade and assuming a 20-25% cement replacement product in the substructure and superstructure concrete elements.
- Under scenario 3, an upfront carbon of <600 kgCO₂e/m²GIA is achieved, by maintaining a brick façade but increasing the cement replacement product assumption to 50-60%.
- Options like timber structure are limited to residential typologies <11 m due to fire regulations. Therefore, the use of cement replacement plays a critical role in reducing their upfront carbon. However, there are a few considerations regarding these products discussed on the [following page](#).
- The potential for further significant reductions in upfront carbon beyond Scenario 3 is limited. This could be further investigated as part of projected material decarbonisation and any future changes to Approved Document B.

Upfront carbon emissions (A1-A5)



Upfront carbon emissions in kgCO₂e/m² (GIA) per scenario for the apartment block below 11m height.

	Substructure	Superstructure – structural elements	Superstructure – building envelope
Baseline prevalent construction approach	Concrete piles 0% cement replacement + 96% recycled steel reinforcement	RC concrete frame and slabs, 0% cement replacement + 96% recycled steel reinforcement	Steel frame/ lightweight concrete blocks, GRC rainscreen cladding, composite window framing
Scenario 1 business as usual	Same as Baseline	Same as Baseline	Same as Baseline
Scenario 2 20-25% cement replacement and brick facade	Concrete piles 20% cement replacement + 96% recycled steel reinforcement	RC concrete frame and slabs, 20-25% cement replacement + 96% recycled steel reinforcement	Steel frame/ lightweight concrete blocks, brick facing, composite window framing
Scenario 3 50-60% cement replacement	Concrete piles 60% cement replacement + 97% recycled steel reinforcement	RC concrete frame and slabs, 50-60% cement replacement + 96-97% recycled steel reinforcement	Same as Scenario 2

Key building elements forming the baseline, scenarios 1, 2 and 3 for the apartment block >11m typology. Mechanical ventilation with heat recovery and an ambient loops system have been assumed as the heating and hot water strategy for all the scenarios. See [Appendix 6.3](#) for the full set of materials and building elements tested.

Residential typologies – practical implementation of upfront carbon targets



This page evaluates the practical implementation of each scenario in relation to two key considerations, to understand which potential upfront carbon targets set in policy for residential typologies are both ambitious and implementable in practice:

1. The combustibility of materials used in external walls, and
2. The availability of cement replacement products.

Combustibility of materials used in external walls

The consideration of the combustibility of materials used in external walls is equally important for residential buildings below and above 11m in height, as fire safety affects both typologies. Part B of the Building Regulations requires that residential buildings between 11-18m use non-combustible materials for external surfaces and any insulation product in the external walls, and for those ≥18m all external walls components are to be non-combustible. Given these requirements, understanding the composition of external wall-build-ups per modelled scenario is critical to assess compliance with current and potential future fire safety restrictions. This is shown on the table opposite.

Cement replacement products

Fire safety regulations, affecting residential buildings >11m, restrict the use of lower-carbon materials (e.g. timber), increasing the importance of lower carbon concrete as a strategy for reducing structural upfront carbon. This means that the availability of cement replacement largely affects residential buildings >11m. One way to reduce carbon in concrete is to use cement replacement products. The most commonly used is ground granulated blast-furnace slag (GGBS), a co-product of the blast furnaces used in iron and steel production. Cement replacement products present some practical challenges such as:

- **Uncertainty on availability:** In the UK, blast furnaces have been closing down, shrinking the local supply of GGBS.
- **Global impact:** globally, GGBS is a fully-utilised and limited resource. Increasing its use in one location is highly likely to displace it from another location, negating the global impact on carbon emissions.

Since the future supply of GGBS is not guaranteed, until other cement replacements such as limestone fines and calcined clays become available at scale, structural lean design to reduce the amount of concrete in buildings should remain the main design strategy for reducing the upfront carbon of any buildings typology.

External wall build-ups per scenario and their combustibility and the % of cement replacement (if relevant)	Residential (<11 m in height) kgCO ₂ e/m ² (GIA)			Residential (≥11 m in height) kgCO ₂ e/m ² (GIA)		
	Scenario	Scenario	Scenario	Scenario	Scenario	Scenario
	1	2	3	1	2	3
Brick and block with glasswool insulation (non-combustible)	✓	✗	✗	N/A	N/A	N/A
Timber structure with cellulose insulation and brick outer leaf (combustible)	✓	✓	✗	N/A	N/A	N/A
Timber structure with hempcrete and wood fibre insulation and timber cladding or render finish (combustible)	✓	✓	✓	N/A	N/A	N/A
0% cement replacement concrete structure with SFS/ concrete blocks infill, mineral and glasswool insulation and GFCR rainscreen cladding (non-combustible)	N/A	N/A	N/A	✓	✗	✗
0% cement replacement concrete structure with SFS/ concrete blocks infill, mineral and glasswool insulation and brick facing (non-combustible)	N/A	N/A	N/A	✓	✓	✗
20-25% cement replacement concrete structure with SFS/ concrete blocks infill, mineral and glasswool insulation and brick facing (non-combustible)	N/A	N/A	N/A	✓	✓	✗
50-60% cement replacement concrete structure with SFS/ concrete blocks infill, mineral and glasswool insulation and brick facing (non-combustible)	N/A	N/A	N/A	✓	✓	✓

The achievability of the upfront carbon residential scenarios by different composition of external walls and how this relates to their combustibility and the amount of cement replacement present (if relevant).

Residential typologies – capital cost analysis

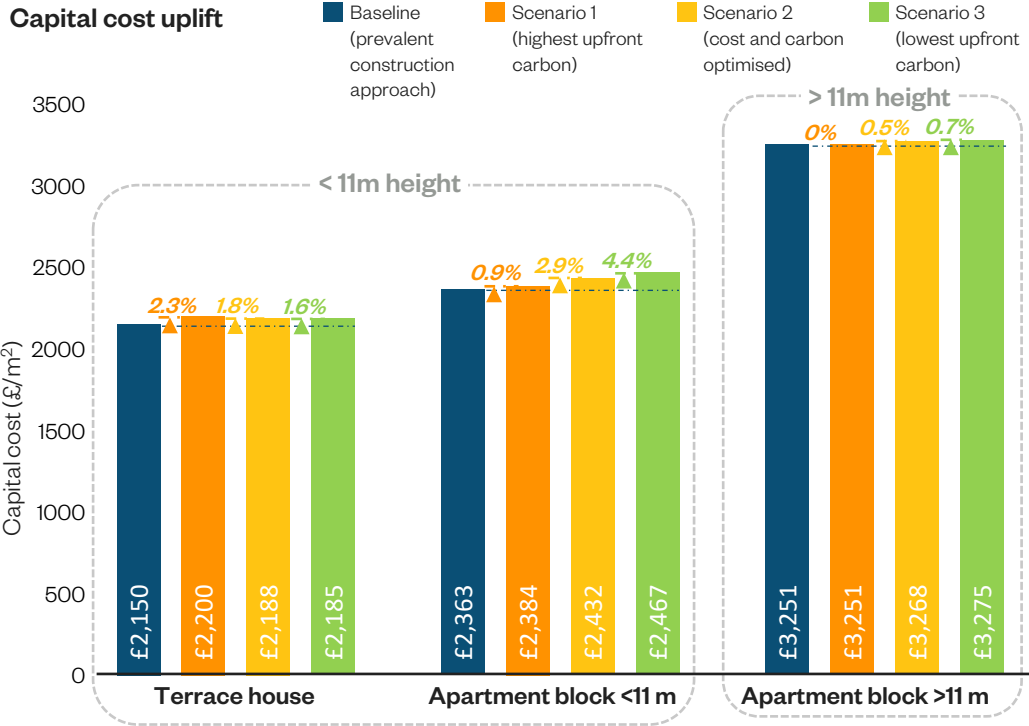
Capital cost analysis of each of the scenarios modelled has been carried out for all residential typologies. The capital cost analysis draws on locally applicable cost data from Q1 2026.

Capital cost analysis results – terrace house and apartment block <11 m

- For the terrace house, the variation in cost across the different scenarios is equivalent to <2.3% of the total build cost of the baseline scenario.
- For the terrace house, scenario 3 (lowest upfront carbon) represents the lowest capital cost uplift from the baseline, while for the apartment block this is scenario 1 (highest upfront carbon). This is because the cost uplift associated with external walls and window upgrades is less prominent in the terrace house under scenario 3.
- If a target of <500 kgCO₂e/m²GIA is set in policy for residential typologies <11 m this would result in a cost neutral outcome since all scenarios including the baseline are achieving upfront carbon emissions below this.

Capital cost analysis results –apartment block >11 m

- For the 13-storey block, the impact of adopting higher levels of GGBS in in-situ concrete together with brick rather than Glass Fibre Reinforced Concrete (GRC) rainscreen cladding to the façade results in a capital cost uplift of <0.7%.
- For buildings > 11m cost data has been compiled based on analysis of the implications of changing the specifications of in-situ concrete items on the supply cost of these materials and also on the substitution of rainscreen cladding materials with a brickwork alternative. It should be noted that the cost analysis of in-situ concrete options exclusively considers the implications of substituting a portion of the cement within a concrete design with an alternative material such as GGBS. In practice there may be alternative ways in which lower carbon concrete can be achieved, for example, through careful design of the specification to reduce overall cement content.

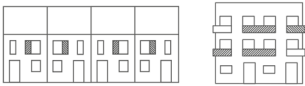


Capital costs for the four upfront carbon scenarios on residential typologies modelled. Relative costs (%) compared to the baseline cost (prevalent construction approach).

Capital cost uplift per scenario from the baseline			
	Terrace house	Apartment block <11 m	Apartment block >11 m
Baseline	£2,150/m ²	£2,363/m ²	£3,251/m ²
Scenario 1	+2.3% (+£50/m ²)	+0.9% (+£21/m ²)	0% (£0/m ²)
Scenario 2	+1.8% (+£38/m ²)	+2.9% (+£70/m ²)	+0.5% (+£17/m ²)
Scenario 3	+1.6% (+£35/m ²)	+4.4% (+£104/m ²)	+0.7% (+£24/m ²)

Variation in capital costs from baseline for upfront carbon scenarios 1, 2 and 3. Relative costs (%) or £/m² of each scenario compared to the baseline (prevalent construction approach).

Residential <11m height – upfront carbon modelling and cost assessment conclusions



Further parameters to be considered

When setting targets for upfront carbon through policy, there are a few considerations to take into account:

- An upfront carbon target has the ability to encourage lower embodied carbon buildings, but as a consequence can inadvertently restrict material choice. For example, the lowest upfront carbon scenario (3) prevents the use of brick facades.
- The substructure can form a significant portion of the upfront carbon of a home/building. Therefore, the depth of foundations, which is reliant on ground conditions, can make the building appear higher or lower embodied carbon. However, applicants may not have much choice over which foundations are most suited to the site.
- While the modelling demonstrates what is reasonably achievable for given typologies, the materials chosen in calculations could inflate or deflate the outcomes for applicants. Design and size of dwelling can also alter the perception of results.
- The capital cost difference between the baseline and scenarios 1, 2 and 3 for both typologies is rather small (0.9-4.4%). Therefore, when developers/builders are selecting their construction type, the choice is likely due to other factors, like speed of build, supply chain or construction skills of workforce.

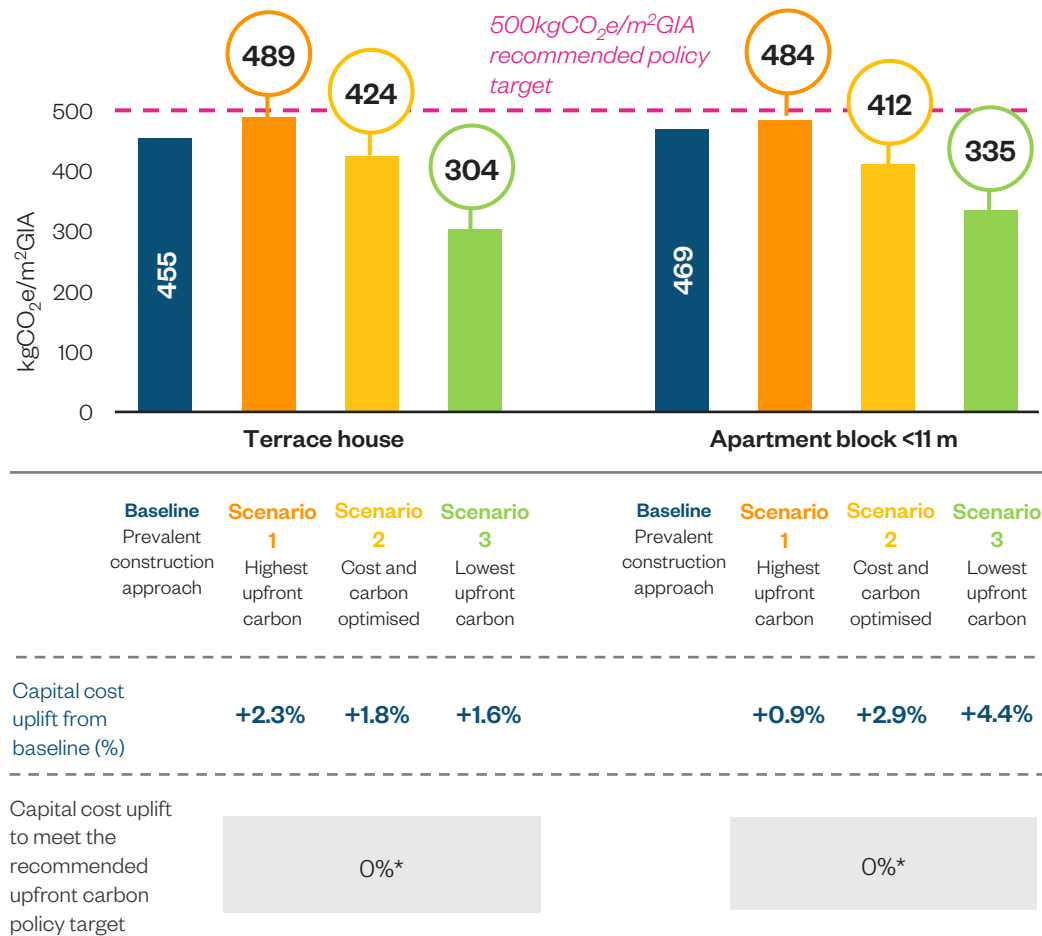
Recommended target for policy - 500 kgCO₂e/m² GIA

Setting the upfront target for residential typologies <11m at <500kgCO₂e/m²GIA would allow applicants and planning officers in Stockport to get used to carrying out or reviewing upfront carbon calculations and preventing poor performance while ensuring there is some consideration of building form, typology and material selection, without seeking to exclude specific materials or designs.

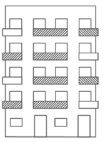
Future targets for consideration

We recommend reviewing the target every 3-5 years to determine if it can be lowered or should be altered. A target of around <450 kgCO₂e/m²GIA would allow for a timber structure with brick face, while a target of <350kgCO₂e/m²GIA would likely exclude the use of brick.

Upfront carbon emissions (A1-A5) and capital cost uplifts



*The policy can be met using a scenario that has no uplift in capital cost.



Residential >11m height – upfront carbon modelling and cost assessment conclusions

Possible further reductions

Given the constraints imposed by Approved Document B (fire) (often requiring two staircases and the exclusion of combustible materials in external walls) and considering that lean design strategies have already been extensively implemented on the modelled typology (optimised form factor, grid spacing and window to wall ratio), the potential for further reductions in upfront carbon is limited. However, examples that may offer further savings include:

- Replacing ambient loop heating and hot water system with a communal air sourced heat pump (~15 kgCO₂e/m²GIA reduction) or switching to direct electric (~30 kgCO₂e/m²GIA reduction) – note this will have operational energy use and running cost implications.
- Using lower-carbon bricks or alternative lower carbon façade systems.
- Removing false ceilings and wall service zones, although these often accommodate services and protect the airtightness layer from damage.

As it stands, Approved Document B (2022) inadvertently poses limitations to upfront carbon emissions of residential buildings >11 m, therefore any future changes to regulations could have an impact on further reductions.

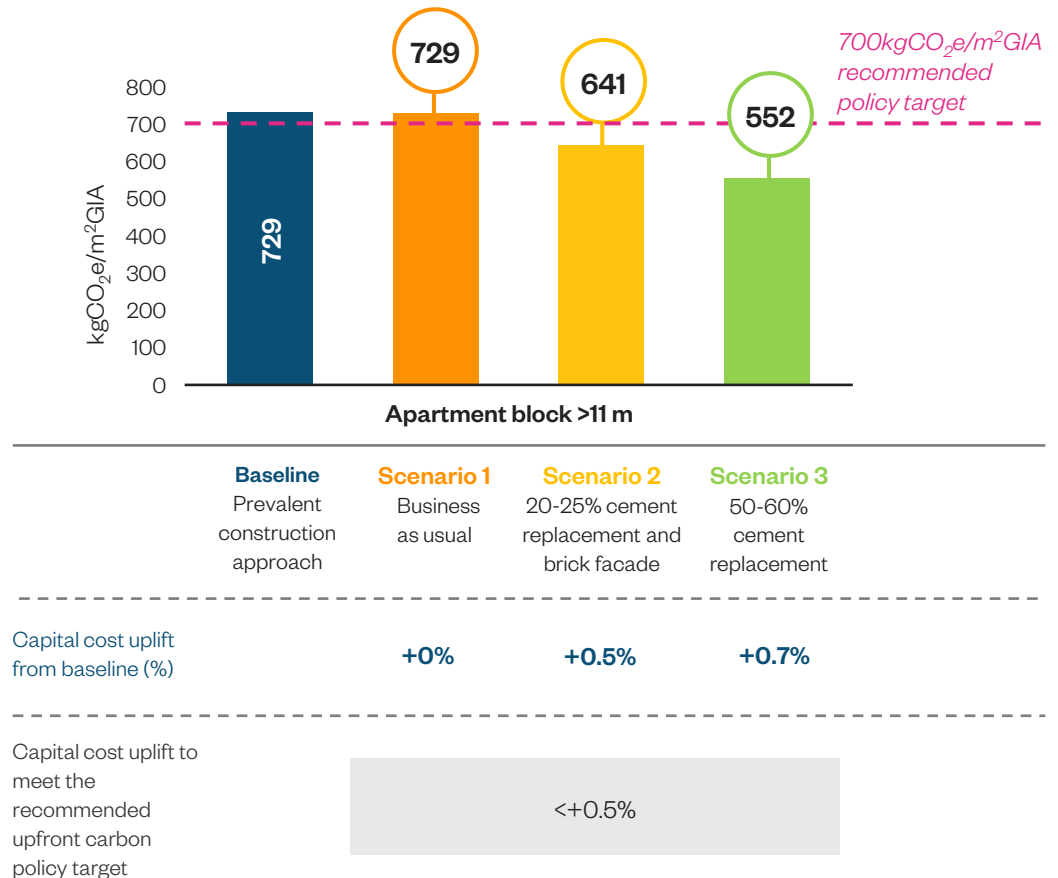
Recommended target for policy - 700 kgCO₂e/m² GIA

Setting the upfront target for residential typologies >11 m at <700kgCO₂e/m²GIA would allow applicants and planning officers in Stockport to get used to carrying out or reviewing upfront carbon calculations without adding significant design constraints. It has the advantage of preventing poor performance while ensuring there is some consideration of building form, typology and material selection, without seeking to exclude specific materials or designs. It could be easily achieved through business as usual construction method (concrete frame) combined with either brick façade as an alternative to the glass fibre reinforced concrete (GRC) rainscreen system or up to 20-25% cement replacement product in substructure and superstructure concrete elements as an alternative to having 0%.

Future targets for consideration

We recommend reviewing the target every 3-5years to determine if it can be lowered or should be altered. A target of around 600 kgCO₂e/m²GIA would rely heavily on cement replacement, which could present practical challenges such as uncertainty of availability.

Upfront carbon emissions (A1-A5) and capital cost uplifts



4.2

Non-residential typologies

Commercial use Class E – upfront carbon modelling scenarios and results

Modelled scenarios

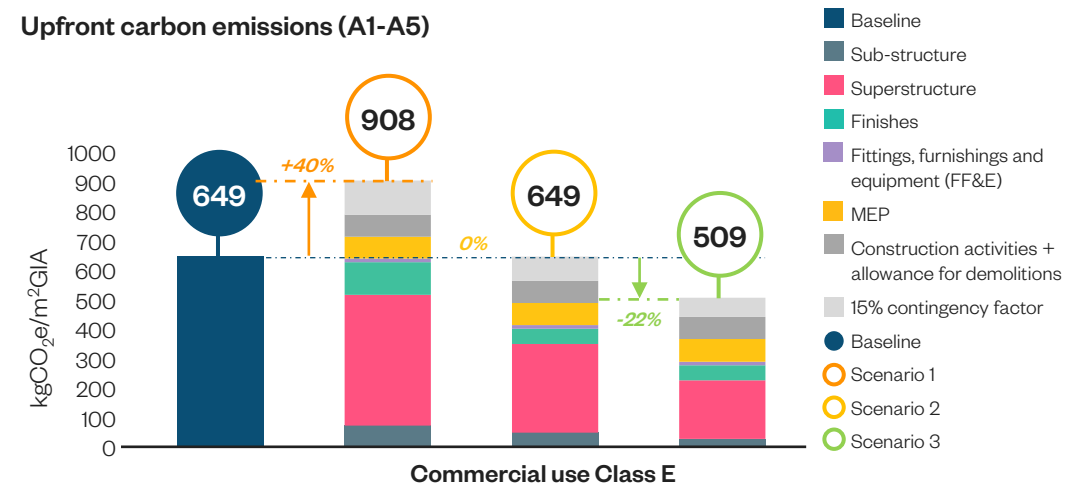
Through modelling of a Commercial building it was found that altering grid spans, slab depths, using different façades and changing the form factor of the building impacted upfront carbon emissions. Four scenarios have been developed to understand their resultant upfront carbon emissions:

- **Baseline** – represents a combination of commonly specified and ‘business as usual’ construction materials. It has been established as a reference point for comparison against the other scenarios examined in this study.
- **Scenario 1** - represents business as usual fabric and systems but with a non-optimal structural design.
- **Scenario 2** – uses the same building elements and components as the baseline and has a lean structural design, representing an improved upfront carbon scenario compared to scenario 1.
- **Scenario 3** – represents the lowest upfront carbon scenario consisting of improvements in structural grid spacing design, amount of cement replacement, systems sizing, form factor of the building and selection of lower upfront carbon materials such as cross laminated timber floor slabs.

Upfront carbon results

- The graph opposite illustrates that the upfront carbon emissions for the commercial use Class E typology are approx. 900kgCO₂e/m²GIA under scenario 1, <700 kgCO₂e/m²GIA under scenario 2 and around 500 kgCO₂e/m²GIA under scenario 3.
- Upfront carbon performance of each scenario heavily depends on massing decisions, structural grids, materiality and façade complexity.
- Designs will need to balance demands on the site. For example, smaller grids and lightweight structural solutions can help mitigate the impacts of sub-structure (reduced quantity) and challenging ground conditions.
- In combination with design choices resulting to material efficiency, the specification of cement replacements and recycled content can further reduce upfront carbon.

Upfront carbon emissions (A1-A5)



Upfront carbon emissions in kgCO₂e/m² (GIA) per scenario for the commercial use Class E non-residential typology.

	Substructure	Superstructure – structural elements	Superstructure – building envelope	Services (MEP)
Baseline prevalent construction approach	Concrete piles 70% cement replacement	Reinforced (RC) concrete frame and slabs 7.5 x 7.5m grid, 25% cement replacement	Brick, form factor 0.9, composite frame windows	Air-source heat pumps (ASHP) and chillers with fan coil units (FCUs) (reduced system sizing), mechanical ventilation
Scenario 1 business as usual	Concrete piles 50% cement replacement	RC concrete frame and slabs 9 x 9 grid, 0% cement replacement	Pre-cast concrete, form factor 1.2, aluminium frame windows	ASHP and chillers with FCUs (normal system sizing), mechanical ventilation
Scenario 2 optimised structural grid	<i>Same as Baseline</i>	<i>Same as Baseline</i>	<i>Same as Baseline</i>	<i>Same as Baseline</i>
Scenario 3 low carbon structure	Concrete piles 70% cement replacement	CLT slab and steel frame with 50% recycled content 6 x 6m grid	Rainscreen cladding, form factor 0.9, composite frame windows	ASHP with displacement mechanical ventilation (reduced system sizing)

Key building elements forming the baseline, scenarios 1, 2 and 3 for the commercial use Class E typology. See [Appendix 6.3](#) for the full set of materials and building elements tested.

Commercial use Class E – capital cost analysis

Cost analysis for each scenario has been carried out based on the specification options shown in the previous page and draws on locally applicable cost data from Q1 2026.

A typical construction Baseline has been established as a reference point for comparison against all three scenarios reviewed in this study. The Baseline and Scenario 2 share the same specifications - these specifications rely on utilising lean structural and architectural design, for which this would be both a cost and carbon saving.

Cost analysis for commercial use Class E buildings

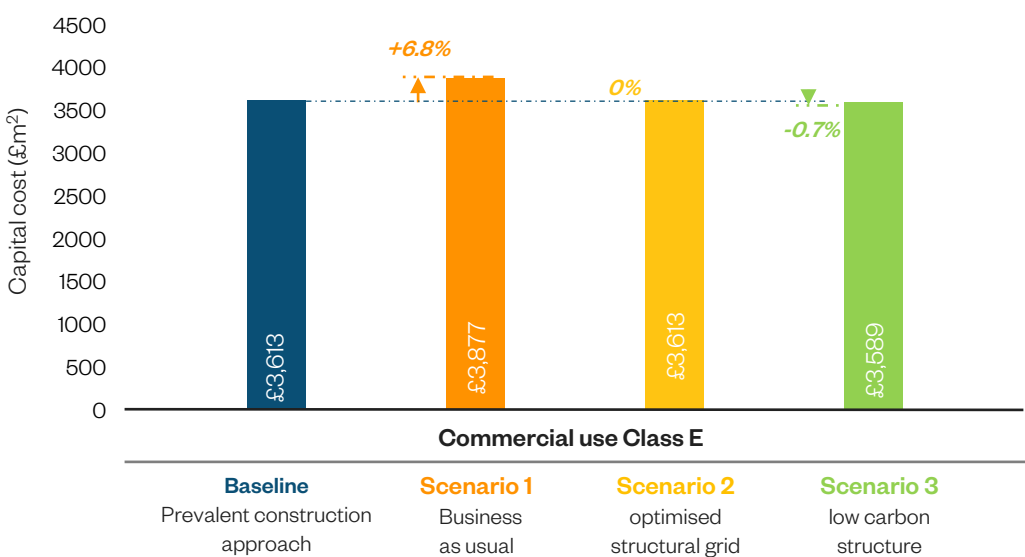
Across the scenarios some of the design changes to reduce upfront carbon deliver cost savings resulting from reduced material quantities (e.g. less concrete and rebar) resulting from structural optimisations and form factor efficiencies, while others such as use of composite windows rather than aluminium windows result in cost increases.

Some of the low carbon finishes selected for Scenarios 2 and 3 are less expensive than premium finishes that might be specified for a large prime office, for example vinyl, linoleum or ceramic tile finishes instead of marble or encaustic tiles. In other instances, the lower carbon finish may be slightly more expensive than an equivalent 'standard' product for example low carbon vs standard metal ceiling tiles.

The analysis shows that Scenarios 2 and 3 achieve an upfront carbon < 700 kgCO₂e/m² GIA without increasing overall development costs and that the cost in £m² is lower for the lower carbon solutions (Scenario 3). This reduction in cost is delivered, in part, through the selection of lower carbon materials but also less expensive façade and finish materials, reduction of glazing area and adoption of reduced spans between columns in the structural grid. These changes would result in a less glassy look and feel of the building externally and smaller open spans internally.

Upfront carbon results show a trend on costs lowering, as carbon lowers too. This may feel initially counter intuitive, however, lower carbon solutions tend to use less material, and therefore, cost less. Lower carbon solutions are not necessarily costlier in practice, but they involved different construction methods that the contractor or developer may be less experienced in.

Cost uplift for commercial use Class E

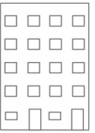


Capital costs for the four upfront carbon scenarios of the commercial use Class E typology. Relative costs (%) compared to the baseline cost (prevalent construction approach) .

Capital cost uplift per upfront carbon scenario from the baseline	
Commercial use Class E	
Baseline	£3,613/m²
Scenario 1	+6.8% (+£264/m²)
Scenario 2	+0% (£0/m²)
Scenario 3	-0.7% (-£24/m²)

Variation in capital costs from baseline for upfront carbon scenarios 1, 2 and 3 of the commercial use Class E typology. Relative costs (% or £/m²) of each case compared to the baseline scenario (prevalent construction approach) .

Commercial use Class E – upfront carbon modelling and cost assessment conclusions



Further parameters to be considered

When setting targets for upfront carbon through policy, there are a few considerations to take into account:

- Different performance targets for different commercial development scales are not recommended, so there needs to be a recognition that the targets will drive certain design decisions. For example, a larger building with a deeper plan will have more flexibility to design with larger structural grids and a wider material palette.
- Use Class E covers offices, retail, financial and professional services, restaurants/cafes, some primary health, creches, nurseries, and light indoor sports/recreation uses like yoga studios/ gyms (excluding swimming pools etc). In this evidence base the Shell & Core and Cat A* scopes for these commercial buildings are similar enough that a single target could be applied to them all. The Cat B** fit out will likely differ the most and therefore, the recommendation is to exclude this type of fit-out from the target. This aligns with the ethos of the recent introduction of planning use Class E, where occupants can adapt the space to suit their use through fit out rather than formal change of use.

Recommended target for policy - 700 kgCO₂e/m² GIA

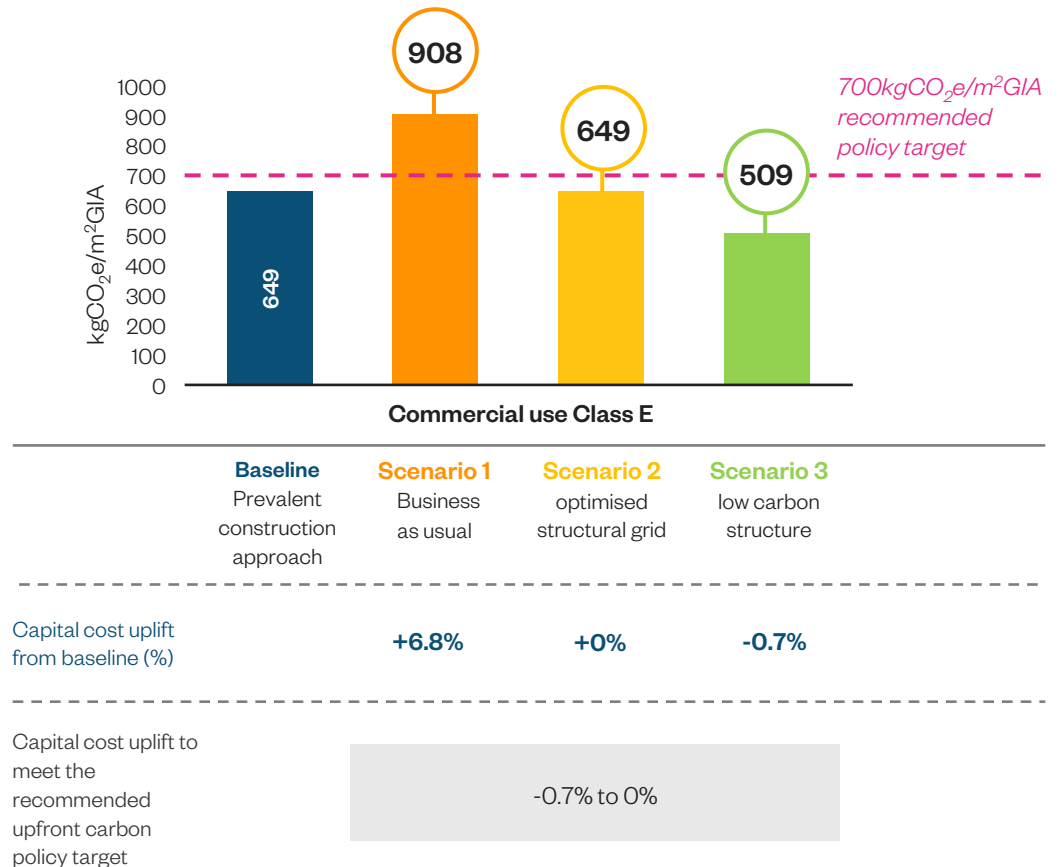
On the basis that all three tested scenarios are technically feasible while still allowing a range of design responses, the recommendation is to adopt a target of < 700 kgCO₂e/m² GIA in policy for use Class E shell and core and Cat A fit out. This allows a typical palette of materials to be used but requires some thought about material efficiency and lean design measures to meet the target. This also provides a cost neutral or even cost saving outcome.

While a simple shell and core commercial building should be able to meet an upfront carbon target of <600 kgCO₂e/m² (GIA), there are likely to be multiple other performance and contextual factors that suggest a higher target should be used at the introduction of the policy with a mechanism to reduce during the policy period.

Future targets for consideration

We recommend reviewing the target every 3-5 years to determine if it can be lowered or should be altered.

Upfront carbon emissions (A1-A5) and capital cost uplifts



*A Category A fit-out includes basic finishes to the floors, walls and ceilings: the space is finished but with no fixtures and fittings such as partitions, meeting rooms or individual offices laid out. The office space will be functional but not include the final specifications included in a Category B fit-out.

** A Category B fit-out follows on from a Category A fit-out and typically includes bespoke partitioning, finishes, carpeting, lighting, kitchen facilities, etc. that are specific to the requirements of the occupier.

5

Implementation and opportunities to streamline the process

Streamlining the process

Streamlining planning submission requirements for embodied carbon will save the applicant and Local Authority time and resource. A simpler submission process will divert time away from the submission and back towards the quality of the analysis underpinning the submission.

To ensure transparency and delivery against the intent of policy, applicants should be required to submit data (e.g. RICS template format) with an explanation of how development has achieved the level of performance (in a standardised way).

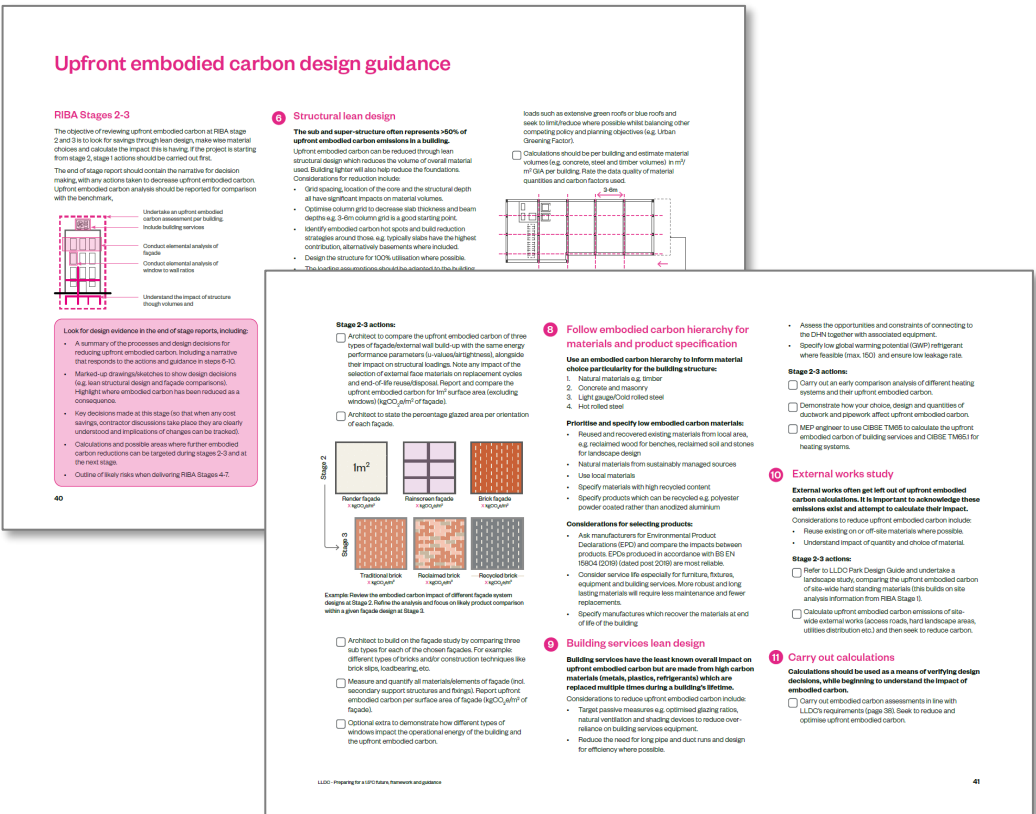
Combining policy with efficient processes to achieve outcomes

With clear policy requirements that are proportional to the scale of development, the focus can be placed on guidance to achieve the desired outcomes through lean design and material selection. This guidance should make it clear what is expected of applicants and provide simple tools for submission.

Achieving quality

A well-thought through submission process can replace the need for vast amounts of data and onerous verification in the quest for quality. To achieve quality submissions and outcomes Stockport should consider:

- Providing updated guidance and tools covering:
 - How to design low embodied and whole life carbon buildings
 - Submission requirements including simplified tools/proformas and existing templates.
 - Requirement for applicants to sign-off on the quality of submission by adding a signature from a senior member of staff who has reviewed it.
- Carrying out spot checks on embodied carbon calculations which require more detail to be shared with third parties for analysis.
- Building an expert carbon panel to:
 - Review planning applications with an eye for what good and poor embodied carbon performance looks like
 - Provide a forum to discuss challenging applications with applicants in detail, to seek a balance between policy and outcomes.



Examples of guidance from the London Legacy Development Corporation – [Preparing for a 1.5oC future](#) – guidance on how to design low embodied carbon buildings.

Project-level summary																						
Sub-asset Addition (sub-asset not necessary depending on project scope)	Key assessment information					Energy and water summary				Upfront carbon emissions not necessary				Carbon emissions non-decarbonated not necessary		Carbon emissions decarbonated not necessary						
	Life cycle stages included	Reference study period	Carbon data uncertainty factor % (N)	Quantities associated factor % (N)	Overall VLLCA uncertainty factor % (N)	GDA used in decarbonated unit	Energy consumption during use	Energy generated on site	Water consumption during use	Upfront embodied carbon (kg CO ₂ e/m ²)	Upfront embodied carbon (kg CO ₂ e/m ²)	Upfront embodied carbon (kg CO ₂ e/m ²)	Total operational carbon (kg CO ₂ e/m ²)	Whole life embodied carbon (kg CO ₂ e/m ²)	Potential benefits only beyond system boundary	Total operational carbon (kg CO ₂ e/m ²)	Whole life embodied carbon (kg CO ₂ e/m ²)	Potential benefits only beyond system boundary				
Sub-asset 1 (name)																						
Sub-asset 2 (name)																						
Sub-asset 3 (name)																						
Aggregated and normalised totals (optional)																						
Totals														kWh	m ³	kg CO ₂ e						

RICS WLCA PS 2nd ed. – reporting template

Simplified submission process

In order to make submission process simpler and more effective, it could be split into two parts:

- **Combined Energy and Embodied Carbon Proforma** - A summary Excel tool for applicants to complete and submit as part of outline and full planning applications. This summary tool would simply require the entry of final results, rather than form part of the processing/calculation of data to generate results. The data entered into the proforma would be expected to be backed by further detail included in the RICS WLCA PS 2nd ed. template.
- **Energy and Carbon Statement** - An Energy and Carbon Statement using a standardised contents list (covering operational and embodied carbon) to describe how a development meets the energy and carbon policies. It need not be more than a 20+ page report with appendices containing supplementary calculations such as the completed RICS template.

Bringing proportionality to policy and planning submissions

The scale of submission requirements should be proportionate to the scale of the development (minor/major/referable). Submission requirements should also vary depending on the stage/type of application (outline planning application or full/reserved matters application), and by sector.

Use of a simplified reporting proforma

In our work for Greater Manchester Combined Authority we found the introduction of a simplified proforma, completed by the applicant, is a useful way to streamline the planning application process (for both applicants and local authorities). A series of residential and non-residential proformas brought proportionality to the submission for different scales of development. The proforma collects results on key metrics for each building/block that can be compared back to policy to determine compliance.

Energy and Carbon Proforma

Residential

Small minor development (XL extensions & 1 home)

Project Name:

Application ref:

Date:

GMCA

GREATER MANCHESTER COMBINED AUTHORITY

	Ref. name	Alpha house
Area (m ² GIA)		90
Target values		Extension/home
Minimise energy demand	Form factor per home or extension	≤ 21.9
	Average glazing ratio per façade: North	~10-15%
	South	~20-30%
	East	~10-20%
	West	~10-20%
	Average external walls U-value (W/m ²)	≤ 0.15
	Wall thickness (mm)	> 400
	Average ground floor U-value (W/m ²)	≤ 0.10
	Average external doors U-value (W/m ²)	≤ 0.10
	Average external roofs U-value (W/m ²)	≤ 1.0
Average windows U-value (W/m ²) - (or double/triple glazed)	≤ 1 (triple)	
Air permeability rate (m ³ /m ² @ 50 Pa)	≤ 3	
Ventilation strategy (background only)	-	MVHR
Use renewable energy	PV footprint area (% of ground floor space)	≥ 40
Use low carbon energy	Fossil fuel free (yes/no)	Yes
	Heat source - Where the system for generating space heating and hot water is a heat pump and it achieves a SCOP of 2.5 or higher (then a Low Carbon Heat Approval not required)	Electric
Reduce overheating risk	Has the Good Homes Alliance overheating risk assessment tool been completed?	Yes
	Resulting score from the GHA tool?	<12
Minimise embodied carbon	Confirmation that a summary of the efforts made to design a lean, low carbon structure and building design has been submitted?	Yes

Energy and Carbon Proforma

Residential

Major development (>10 homes)

Project Name:

Application ref:

Date:

GMCA

GREATER MANCHESTER COMBINED AUTHORITY

	Ref. name				
	No. dwellings				
Area (m ² GIA)					
Target values	Building 1	Building 2	Building 3	Building 4	Building 5
Minimise energy demand	Space heating demand (kWh/m ² /yr)	≤ 15 (Rate)	≤ 20 (houses)		
	Calculation methodology used to calculate space heating demand and distribution heat loss across all homes/blocks	Predictive energy model			
	Form factor per building	≤ 2			
	Average external wall U-value (W/m ²)	≤ 0.15			
	Average window U-value (W/m ²)	≤ 1.0			
Air permeability rate (m ³ /m ² @ 50 Pa)	≤ 3				
Max internal energy efficiency	Energy use intensity (kWh/m ² /yr)	≤ 35			
	Calculation methodology used to calculate energy use intensity and confirmation that the scores all homes/blocks	Predictive energy model			
Use renewable energy	PV footprint area (% of ground floor space)	≥ 40			
	Annual renewable energy generation (kWh/m ² building footprint/yr)	-			
	Renewable energy balance (%)	-			
	Total energy used (kWh/yr)	-			
Use low carbon energy	Fossil fuel free (yes/no)	Yes			
	Heat source	Electric			
	Low Carbon Heat Approval completed	Yes			
	Heat network suitability	-			
Reduce overheating risk	Has a CIBSE TM59 assessment been carried out using DB12 and DB13 weather files? Have any additional passive measures been included as a result?	Yes			
	Uprift embodied carbon (kgCO ₂ e/m ² GIA)	≤ 800-600			
	Let top three materials with the highest up-front embodied carbon emissions (kgCO ₂ e/m ² GIA): Material 1	-			
	Material 2	-			
Minimise embodied carbon	Material 3	-			
	Lifecycle embodied carbon (kgCO ₂ e/m ² GIA) - for large major developments only	-			
U-Values	Overall contribution (L)	-			

[Greater Manchester Combined Authority, Places for Everyone Energy and Carbon Proforma](#). Three residential and three non-residential proformas bring proportionality to submissions and have been provided for applicants to complete as part of their planning application.

Policy implementation (1/2)

Deliverables

Key documentation can be based on a proforma to report key metrics, backed up by the analysis behind (e.g. RICS reporting template).

Third party verification

To ensure a level playing field and robust data, third party verification should be considered. It should be independent, but there are options to deliver it. These include:

- Requiring proof of an independent verification for each application, included in the application
- Setting up a Carbon Review panel for applicants to procure verification services from
- Allowing for spot checks on a proportion of applications by requiring more detail
- Requesting third party verification upon officer discretion based on a review of the data associated with each scheme

However, third party verification would also come with potential time and cost implications.

Stepped upfront carbon targets

Material decarbonisation means upfront carbon will naturally decrease over time. This predicted decrease means Stockport Local Plan policy should contain the mechanism to reduce upfront carbon targets so they retain their purpose and the policy does not get easier over time. A method for doing this could include:

- Ensuring the review of upfront carbon target at least 12 months prior to any adopted change within the policy to ensure applicant certainty
- Determining any change to the target based on data gathered from planning applications and post-completions for the previous years
- Comparing carbon factors for key materials over a 5 year period to track the trajectory

Pre-app	Description	• Presentation of building retention (where relevant) and low carbon strategies employed so far. Structural and façade optioneering against upfront carbon targets, justifying choices proposed.
	Format	• Presentation covering standard checklist.
	Governance	• Pre-application could be mandatory where over 50% of an existing building by GIA is proposed to be demolished.
Planning submission	Description	• Calculations carried out in line with current RICS WLCA PS 2nd ed. and CIBSE TM65 aligned with relevant inclusions and exclusions as determined by guidance to be developed.
	Format	• Completion of pro-forma including relevant figures proving that the targets have been met as well as providing project information.
	Governance	• Officers can request resolution with the applicant/ design team if results vary significantly from the targets. • Third party verification options can be considered, if required • Where an abnormal site means a scheme can not meet the targets, an agreed upfront carbon threshold can be set through negotiation and monitored via conditions and post-completion analysis. Potentially, a set of reduction measures could be agreed.

Policy implementation (2/2)

Pre-commencement and pre-occupation conditioning

Pre-commencement and/or pre-occupation conditions may be introduced on a discretionary basis. This can be mandated or used as a tool to aid reduction pathways and meeting of thresholds where pre-agreed at planning application stage.

Discharge of pre-commencement condition	Description	Confirmation that low carbon solutions that are required for the project to meet targets submitted for planning are to be adopted through construction.
	Format	Statement of confirmation with re-submission of updated planning information/proforma.
	Governance	Where site abnormals mean a scheme cannot meet the targets, the agreed upfront carbon threshold must be met. Potentially, a set of reduction measures could be agreed.
Pre-occupation reporting	Description	Confirmation that the as-built building meets the required policy target.
	Format	- Resubmission of data in a proforma using as-built information. - Data entry to BEOD
	Governance	- Third party verification options can be applied, if required. - Penalty or public disclosure if targets or pre-agreed upfront carbon threshold has not been met.

Consistency of reporting

Focussing on the key outputs from a WLC assessment

RICS WLCA PS 2nd ed. template – RICS has a standard reporting template that WLCA tools have matched their outputs to. It is recommended that this standard template is used for policy implementation.

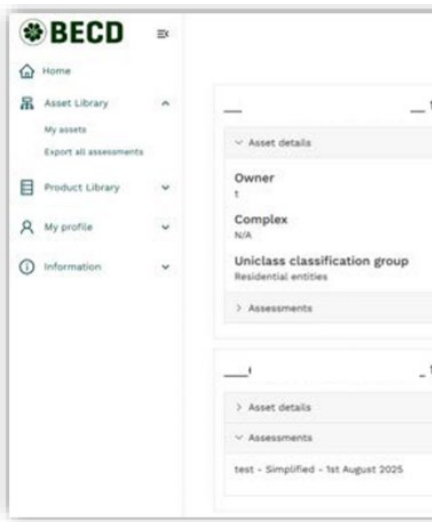
Other tools for consideration – beyond use of a proforma

In addition, results should be uploaded to a national centralised database, for example the Built Environment Carbon Database (BECD), which assists with carbon estimating and benchmarking for the industry. Alternatively, they could be processed through PACER a tool developed by Westminster City Council to automate the review process, planning officers can focus on enforcing carbon reduction policies quickly and effectively.

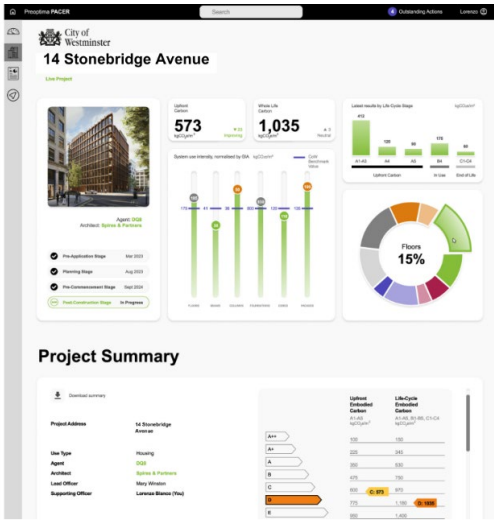
Using these tools would support the development of targets for other typologies to be set in the future and key trends can be better understood by policy makers.

Project-level summary																					
Sub-assets Reference sub-assets or resources depending on project scope	Life cycle stage included	Key assessment information					Energy and water summary				Upfront carbon emissions not uncertainty		Carbon emissions re-decarbonised and uncertainty				Carbon emissions decarbonised and uncertainty				
		Reference study period (yr)	Contingency factor % (up)	Carbon data availability factor % (up)	Quantities uncertainty factor % (up)	Overall WLCA uncertainty factor % (up)	GHG input normalisation unit	Energy consumption in during use	Energy generated on-site	Water consumption during use	Upfront embodied carbon not uncertainty (A1-A5)	Upfront operational carbon (A1-A5)	Total operational carbon (B6, B7, B8)	Whole life embodied carbon (A-C) not (B6, B7, B8)	Whole life carbon (A-C)	Potential benefits after regional system boundaries (B9)	Total operational carbon (B6, B7, B8)	Whole life embodied carbon (A-C) not (B6, B7, B8)	Whole life carbon (A-C)	Potential benefits after regional system boundaries (B1)	
Sub-asset 1 (name)							Units			Units	Units										
							kgCO2e/m2			kgCO2e/m2											
							kgCO2e/m2			kgCO2e/m2											
							kgCO2e/m2			kgCO2e/m2											
Sub-asset 2 (name)							Units			Units											
							kgCO2e/m2			kgCO2e/m2											
							kgCO2e/m2			kgCO2e/m2											
							kgCO2e/m2			kgCO2e/m2											
Sub-asset 3 (name)							Units			Units											
							kgCO2e/m2			kgCO2e/m2											
							kgCO2e/m2			kgCO2e/m2											
							kgCO2e/m2			kgCO2e/m2											
Aggregated and normalised totals (optional)							kWh/m2 unit			kgCO2e/m2 unit											
Totals							kWh		m3		kgCO2e										

Project Summary RICS WLCA PS 2nd ed



BECD – database assisting in carbon estimating and benchmarking



PACER – tool used by Westminster City Council to automate the application review process

6

Appendix

6.1

Glossary of terms, abbreviations and links

Glossary of terms

Biogenic/ sequestered carbon – ‘Carbon removals associated with carbon sequestration into biomass, as well as any emissions associated with this sequestered carbon. Biogenic carbon must be reported separately if reporting only upfront carbon, but should be included in the total if reporting embodied carbon or whole life carbon.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

CAT A – ‘A Category A fit-out includes basic finishes to the floors, walls and ceilings: the space is finished but with no fixtures and fittings such as partitions, meeting rooms or individual offices laid out. The office space will be functional but not include the final specifications included in a Category B fit-out.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

CAT B – ‘A Category B fit-out follows on from a Category A fit-out and typically includes bespoke partitioning, finishes, carpeting, lighting, kitchen facilities, etc. that are specific to the requirements of the occupier.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

Carbon sequestration – ‘The process by which CO₂ is removed from the atmosphere and stored within a material, for example by being stored in biomass as biogenic carbon by plants.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

Chartered institute of Building Services Engineers (CIBSE) TM65 methodology – ‘A calculation methodology (TM65) outlines the need for assessment of embodied carbon of products linked to building services engineering systems, to increase knowledge and facilitate research related to whole life carbon.’ Source: [CIBSE](#)

Circularity – ‘A process that considers the potential for recovery, reuse and recycling of items following circular economy principles.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

Circular economy – ‘An economy that is restorative and regenerative by design, and that aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

Disassemble and reuse – ‘Disassemble sections of a building and enable their direct reuse ideally on the site or, where this is not possible, off site (with nearby sites preferred). This approach also includes careful selective deconstruction of the building and material types i.e. taking apart each layer and material type as much as possible, minimising damage to parts and maintaining their value, and then reusing those elements and materials. If reuse is not possible, materials may be carefully and selectively separated for processing and recycling into new elements, materials and objects.’ Source: [QE Statement 2022](#)

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 A0–A5, B1–B5, C1–C4, with A0[2] assumed to be zero for buildings.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

Environmental Product Declaration (EPD) – ‘A document that clearly shows the environmental performance or impact of any product or material over its lifetime’. Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

Gross Internal Area (GIA): is the total usable floor space of a building contained within its external walls, measured to the internal face of the perimeter walls.

Inventory of carbon & energy (ICE) database – ‘The Inventory of Carbon and Energy (also known as the ICE database) is an embodied carbon database for building materials which is available for free on this page. It contains data for over 200 materials, broken down into over 30 main material categories.’ Source: [ICE](#)

Life Cycle embodied carbon – See ‘embodied carbon’

One Click LCA – ‘One Click LCA is an all-in-one software to automate Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD) generation. Schedule a time to get help for your LCA, EPD, and sustainability needs.’ Source: [One Click LCA](#)

Operational carbon – ‘Operational carbon – energy (module B6) refers to GHG emissions arising from all energy consumed by an asset in use, over its life cycle.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

Oriented Strand Board (OSB) – ‘Oriented strand board is a composite engineered wood panel made of long strands (also called wafers or flakes) of wood, bonded together with synthetic resin adhesive.’ Source: [Timber Development UK](#)

Photovoltaics (PV) – solar panels converting sunlight into electricity.

RICS – the Royal Institution of Chartered Surveyors

RICS Professional Standard (RICS PS v2 2023) – ‘Sets requirements or expectations for RICS members and regulated firms about how they provide services or the outcomes of their actions. RICS professional standards are principles-based and focused on outcomes and good practice. Any requirements included set a baseline expectation for competent delivery or ethical behaviour. They include practices and behaviours intended to protect clients and other stakeholders, as well as ensuring their reasonable expectations of ethics, integrity, technical competence and diligence are met. Members must comply with an RICS professional standard.’ Source: [RICS Whole life carbon assessment for the built environment, 2nd edition](#)

Glossary of terms

Upfront carbon – *'Upfront carbon emissions are GHG emissions associated with materials and construction processes up to practical completion (modules A0–A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion.'* Source: [*RICS Whole life carbon assessment for the built environment, 2nd edition*](#)

Whole life carbon (WLC) - *'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 A0–A5, B1–B7, B8 optional, C1–C4, all including biogenic carbon, with A0[2] assumed to be zero for buildings). Overall whole life carbon asset performance includes separately reporting the potential benefits or loads from future energy or material recovery, reuse, and recycling and from exported utilities (modules D1, D2).'* Source: [*RICS Whole life carbon assessment for the built environment, 2nd edition*](#)

Abbreviations

B&NS: Bath and North East Somerset

BAMB: Buildings as Materials Banks

CCC: Climate Change Act

CE: Circular Economy

CES: Circular Economy Statement

CIBSE: Chartered Institution of Building Services Engineers

CLT: Cross Laminated Timber

CO₂e: Carbon dioxide equivalent

CWCT: Centre of Window and Cladding Technology

EAC: Environmental Audit Committee

EPD: Environmental Product Declaration

EUI: Energy Use Intensity

FF&E: Fittings, furnishing and equipment

GGBS: Ground Granulated Blast-furnace Slag

GHG: Greenhouse gas

GIA: Gross Internal Area

IPCC: Intergovernmental Panel on Climate Change

IStructE: Institution of Structural Engineers

KPI: Key Performance Indicator

LETI: Low Energy Transformation Initiative

MEP: Mechanical, electrical and plumbing

NPPF: National Planning Policy Framework

NZCBS: UK Net Zero Carbon Buildings Standard

PAN: Planning Advice Note

RIBA: Royal Institute of British Architects

RICS: Royal Institute of Chartered Surveyors

RICS PS: RICS Professional Statement

SDS: Spatial Development Strategy

SPD: Supplementary planning document

UKGBC: The UK Green Building Council

WBLCA: Whole Building Life-Cycle Assessment

WLC: Whole life carbon

WLCA: Whole life carbon assesment

Useful links

- [B&NES - Sustainable Construction checklist SPD](#)
- [BAMB –Building as material passports](#)
- [BECD – Built Environment Carbon Database](#)
- [Bristol City Council draft Local Plan](#)
- [Building to net zero: costing carbon in construction: Government Response to the Committee’s First Report – Environmental Audit Committee](#)
- [Central Lincolnshire updated local plan](#)
- [CIBSE TM65 – Embodied carbon in building services](#)
- [CIRCulT](#)
- [City of London - Carbon Options Guidance](#)
- [City of London City Plan 2024](#)
- [City of Westminster - City Plan 2019-2040](#)
- [Climate action tracker 2023](#)
- [Climate Change Committee - the seventh carbon budget](#)
- [CWOT – How to calculate embodied carbon of facades](#)
- [Essex Embodied Carbon Evidence Base 2024](#)
- [European Union's Roadmap for Whole Life Carbon](#)
- [GLA - Whole Life-cycle carbon assessment guidance](#)
- [Greencore Homes – low carbon offsite construction](#)
- [IStructE – How to calculate embodied carbon 2nd edition](#)
- [IStructE Lean design: 10 things to do now](#)
- [LETI Circular economy 1 pager](#)
- [LETI Climate emergency design guide](#)
- [LETI opinion piece - Circular economy and carbon in construction](#)
- [LETI Embodied Carbon Primer](#)
- [LETI Embodied Carbon Target Alignment](#)
- [LETI opinion piece – operational carbon in whole life carbon assessments](#)
- [LETI The Whole Life Carbon Alignment paper](#)
- [Net Zero: The UK’s Contribution to Stopping Global warming](#)
- [Part B building Regulations Volume 1: Domestic](#)
- [Part Z proposed amendment to building regulations](#)
- [Policy paper by Part Z group of experts , January 2024](#)
- [RIBA 2030 climate challenge](#)
- [RICS Whole Life Cycle assessment 2017, 1st edition](#)
- [RICS Whole Life Cycle Assessment 2023, 2nd edition](#)
- [RICS Whole life carbon assessment implementation guides and supporting documents](#)
- [Southwest Net Zero Hub – Net Zero New Buildings Evidence and guidance](#)
- [The concrete centre– Sustainable concrete](#)
- [The construction material pyramid](#)
- [The London Plan 2021](#)
- [TM 65 – Embodied carbon in building services](#)
- [UK Net Zero Carbon Building Standard - Version 1 April 2026](#)
- [UK Net Zero Carbon Building Standard – Net zero whole life carbon technical study](#)
- [UKGBC - Circular economy guidance for construction clients](#)
- [UKGBC – Net Zero Whole Life Carbon Roadmap](#)
- [UKGBC - Circular economy metrics for buildings](#)
- [West of England Embodied Carbon Evidence Base 2021](#)
- [Westminster City Council Embodied Carbon Evidence Base January 2024](#)

6.2

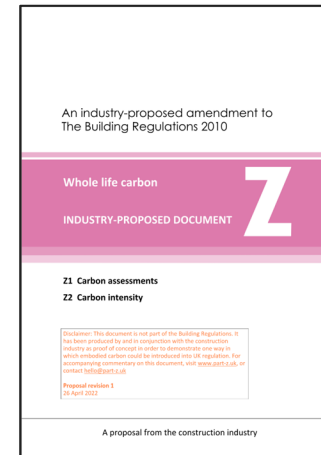
Additional information on industry standards, other carbon policies and evidence bases

Industry standards continued - Part Z and the Net Zero Carbon Building Standard

Part Z – how to regulate the construction industry at scale

The Part Z proposal sought to provide a framework for implementing whole life carbon assessments and embodied carbon targets, for all major development, by suggesting it is embedded into building regulations. The proposed Part Z uses whole life carbon assessment methods to provide a clear and tested way for developers to measure performance at the various stages of a project after planning, including the as-built stage.

The Part Z project was aimed at giving regulators a high-level template for implementing reasonable standards sooner rather than later, instead of a push towards best practice. Planning policy would still have a role in reducing whole life carbon emissions if the recommendations of Part Z were taken forward. As is the case with operational carbon regulation and policy, local authorities may choose to push policy further than the initial Part Z proposals.



Proposed Part Z (Source: [Part Z](#))

Industry targets and benchmarks for embodied carbon

LETI

In 2021, LETI reviewed how targets from different organisations could be reconciled with each other. To do so they consulted other industry groups including CIBSE, RIBA, IStructE, the GLA, and the Whole Life Carbon Network. The [Whole Life Carbon Alignment](#) paper set targets for upfront and life cycle embodied carbon and provided a set of reporting templates to help with consistency.

Upfront carbon, kgCO ₂ e/m ² (modules A1-A5, excluding upfront biogenic carbon)				
Band	Office	Residential (6+ storeys)	Education	Retail
A++	<100	<100	<100	<100
A+	<225	<200	<200	<200
A (LETI 2030)	<350	<300	<300	<300
B	<475	<400	<400	<425
C (LETI 2020)	<600	<500	<500	<550
D	<775	<675	<625	<700
E	<950	<850	<750	<850
F	<1100	<1000	<875	<1000
G	<1300	<1200	<1100	<1200

Upfront carbon targets for various building typologies. The residential targets have been set based on data from 6+ storey developments, therefore the applicability to low-rise housing is unknown (Source: LETI)

RIBA

RIBA developed voluntary performance targets for life cycle carbon which form the basis of the RIBA 2030 Climate Challenge published in 2021. The targets are based on a growing database of projects submitted by signatories who have committed to participate the data collection for the initiative.

RIBA 2030 Climate Challenge target metrics for domestic / residential

RIBA Sustainable Outcome Metrics	Business as usual (new build, compliance approach)	2025 Targets	2030 Targets
Embodied Carbon kgCO ₂ e/m ² 	1200 kgCO ₂ e/m ²	< 800 kgCO ₂ e/m ²	< 625 kgCO ₂ e/m ²

Full details of the RIBA 2030 Climate Challenge targets can be found [here](#). And LETI embodied carbon alignment can be found [here](#).

City of London Corporation - Retrofit and Whole life carbon policies summary



City of London
2024 draft
– [City Plan 2040](#)



City of London
2023- [Carbon Options Guidance](#)

Key requirements

The City of London's City Plan 2040 is anticipated to be adopted in summer 2026. It includes a policy on retaining and retrofitting existing buildings and on whole life carbon assessment for major developments.

Optioneering

To supplement the policy, a comprehensive Carbon Options Guidance document sets out a robust approach to evaluate options. This provides applicants with guidance on how to compare scenarios for retrofit and rebuild. This ensures a like for like comparison and enables consistency of reporting of carbon emissions.

The methodology establishes the minimum data set required at the pre-planning and planning stages, and the level of transparency to be disclosed to planning officers. The methodology aligns with the principles in the GLA's adopted guidance on Whole Life-Cycle Carbon Assessments (March 2022). The detailed WLC reporting for the applicant's chosen option is required to be provided as part of the planning application. Two dashboards have been created to equip planning officers with visual and quantified information that is clear and benchmarkable, enabling informed discussions between the applicants, planning officers and other stakeholders.

City of London Corporation – Draft Policy DE1: Sustainable Design

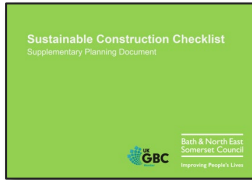
- '1. Development proposals should follow a retrofit first approach, thoroughly exploring the potential for retaining and retrofitting existing buildings as the starting point for appraising site options.'*
- '2. All major development must undertake an assessment of the options for the site, in line with the City Corporation's Carbon Options Guidance Planning Advice Note, and should use this process to establish the most sustainable and suitable approach for the site.'*
- '3. Development proposals should minimise whole life-cycle carbon emissions. Major developments must submit a whole life-cycle carbon assessment.'*

City of London - Carbon Options Guidance

'The planning advice note (PAN) is designed to provide guidance for development site WLC optioneering evaluations. The PAN is a first step of carbon evaluation and is designed to enable a consistent, early-stage approach to assessing options.'

'The optioneering exercise is a means of comparing a representative number of development options, in order to find the optimum balance in carbon emissions terms, prior to evaluating other considerations in the planning process.'

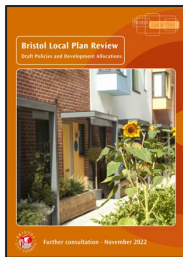
Bath and North East Somerset (B&NS) and Bristol - Upfront carbon policies summary



Sustainable
Construction
checklist SPD –
B&NES

Bath and North East Somerset Council (B&NS)

The UK's first Net Zero Carbon policy was introduced in January 2023 and covers both operational and embodied carbon. Policy SCR8 on embodied carbon states that all major developments must submit an upfront carbon assessment, demonstrating that less than 900 kgCO₂e/m² can be achieved. No offsetting is permitted and if the development is not compliant with the policy, a valid justification must be provided with appropriate reasons and evidence.



Bristol City
Council draft
Local Plan

Bristol City Council

The Bristol Local Plan sets an embodied carbon, materials and waste policy. Major developments will be required to undertake an upfront carbon assessment and are expected to achieve a set of minimum targets. Where policy is not met, carbon offsetting is used. It also provides general principles and guidance for reducing embodied carbon.

This policy has been based on the findings of the West of England Embodied Carbon Evidence Base.

B&NES - SCR8 - Embodied Carbon

"Large scale new-build developments (a minimum of 50 dwellings or a minimum of 5,000m² of commercial floor space) are required to submit an Embodied Carbon Assessment that demonstrates a score of less than 900kgCO₂e/m² can be achieved within the development for the substructure, superstructure and finishes."

Bristol City Council

"Embodied carbon – major applications

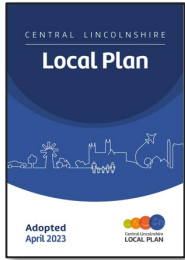
Major development will be required to undertake an embodied carbon assessment, submitted as part of the Sustainability Statement using a nationally recognised embodied carbon assessment methodology, and demonstrate actions taken to reduce life-cycle carbon emissions. New development will be expected to achieve the following targets as a minimum:

- *Residential (4 storeys or fewer) - <625 kgCO₂e/m²*
- *Residential (5 storeys or greater) - <800 kgCO₂e/m²*
- *Major non-residential schemes - <970 kgCO₂e/m²*

Where these targets for embodied carbon cannot feasibly be met, a full justification will be required as part of the embodied carbon assessment.

Any shortfall against the embodied carbon targets will be offset through a financial contribution towards council approved renewable energy, low-carbon energy and energy efficiency schemes elsewhere in the Bristol area. The value of a tonne of CO₂e is tied to the high scenario in the Valuation of Energy Use and Greenhouse Gas supplementary guidance to the Treasury's Green Book (currently £373)."

Central Lincolnshire - Embodied carbon policy summary



Central Lincolnshire
updated Local Plan
2023

Central Lincolnshire adopted local plan 2023

Central Lincolnshire updated their Local Plan in 2023 to include a policy on Embodied carbon. The policy encourages the reduction of embodied carbon, with no targets set, but instead requires a qualitative assessment. The policy does not only set immediate requirements but also future requirements from 2025.

Central Lincolnshire – S11 – Embodied Carbon

“All development should, where practical and viable, take opportunities to reduce the development’s embodied carbon content, through the careful choice, use and sourcing of materials.”

“Major development proposals:

All major development proposals should explicitly set out what opportunities to lower a building’s embodied carbon content have been considered, and which opportunities, if any, are to be taken forward. From 1 January 2025, there will be a requirement for a development proposal to demonstrate how the design and building materials to be used have been informed by a consideration of embodied carbon, and that reasonable opportunities to minimise embodied carbon have been taken.”

The West of England embodied carbon evidence base - Summary (1/2)

This document was commissioned by four local authorities in the West of England (i.e. Bath and North East Somerset Council, Bristol City Council, North Somerset Council and South Gloucestershire Council), and the Combined Authority. The purpose of this embodied carbon evidence-base study was to support policy makers in exploring options for setting embodied carbon planning policies and targets.

Upfront carbon modelling

The document sets out the upfront carbon achieved by various low-rise building typologies tested under different design scenarios. The building typologies include: office (4 storeys), school (3 storeys), apartment block (5 storeys <18 m in height) and semi detached house (2 storeys). The cost uplift is also considered for the different design scenarios. All the building typologies have a height of less than 18 meters, to ensure compliance with fire regulations in terms of material combustibility.

The RICS building elements modelled include (RIOS category numbers in brackets):

- Sub-structure (1), Super-structure (2) and Finishes (3).
- A percentage increase per building typology was applied to account for Building services (5) and External works (8) emissions (based on LETI's work 'Climate Emergency Design Guide' and 'Embodied Carbon Primer').
- Facilitating works (0), Furnishings fixtures and equipment (FF&E) (4), Prefabricated building and building units (6) and Work to existing buildings (7) emissions were excluded from the calculation.

An analysis of different structural, façade and finishes

As it can be seen on the adjacent table, different designs were compared for each building typology, ranging from a baseline assumed to represent standard practice all the way to a combination of the lowest embodied carbon choices.



West of England evidence-base for embodied carbon policy

Evidence-base for West of England Net Zero building policy: embodied carbon
Prepared by WSP (embodied carbon analysis) and Gardiner & Theobald (cost analysis)
December 2021

	S1 - BASELINE	S2 - HYBRID TIMBER	S3 - LOW CARBON CONCRETE	S4 - TIMBER FRAME	S5 - LOW CARBON FACADES	S6 - LOW CARBON INT. FINISHES
SEMI DETACHED HOUSE 	Load bearing masonry walls, timber floors and roof	-	40% cement replacement (foundation, GF slab)	Timber studs, floor and roof (Sawn timber)	Timber cladding on timber wall assembly Wood frame windows Glass wool insulation (replacing rockwool)	Linoleum floors (replacing vinyl)
APARTMENT BLOCK 	Concrete frame and hollowcore slabs	-	40% cement replacement (foundation, GF slab, frame, staircase)	Glulam frame, CLT walls CLT floors	Timber cladding on timber wall assembly Wood frame windows	Internal timber wall assembly Linoleum floors (replacing vinyl)
OFFICE / SCHOOL 	Steel frame and composite concrete-steel deck floor slabs	Steel frame and CLT floors/roof	40% cement replacement (foundation, GF slab, staircase)	Glulam frame - CLT floor	Timber cladding on timber wall assembly Wood frame windows	Internal timber wall assembly Linoleum floors (replacing vinyl) Exposed soffits

Summary of the different scenarios modelled in terms of embodied carbon (upfront and whole life) and costed by WSP and G&T

The West of England embodied carbon evidence base - Summary (2/2)

Modelling results

The results opposite show the carbon reductions per scenario of each building typology and the comparison with the LETI upfront carbon targets.

The baseline office scenario (Office_S1) almost complies with LETI 600 kgCO₂e/m² 2020 target, and the most challenging scenario (Office_S6) complies with the LETI 350 kgCO₂e/m² 2030 target. For the school typology, the results are similar to the office typology, given that these two typologies share the same baseline. The baseline apartment block scenario (ApartBlock_S1) complies with LETI 500 kgCO₂e/m² 2020 target and the most challenging scenario (ApartBlock_S6) complies with the LETI 300 kgCO₂e/m² 2030 target. On the other hand, the baseline semi-detached scenario (SemiDetached_S1) almost complies with LETI 500 kgCO₂e/m² 2020 target and the most challenging scenario (SemiDetached_S6) almost complies with the LETI 300 kgCO₂e/m² 2030 target.

Recommendations of the study

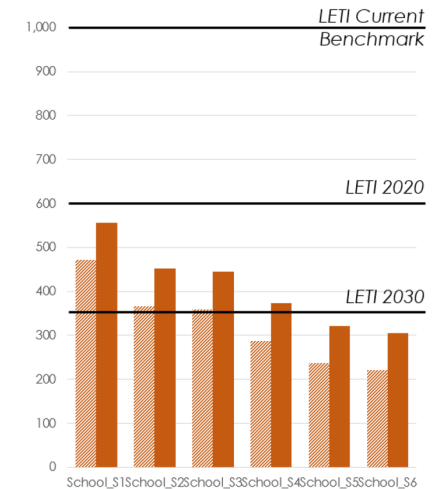
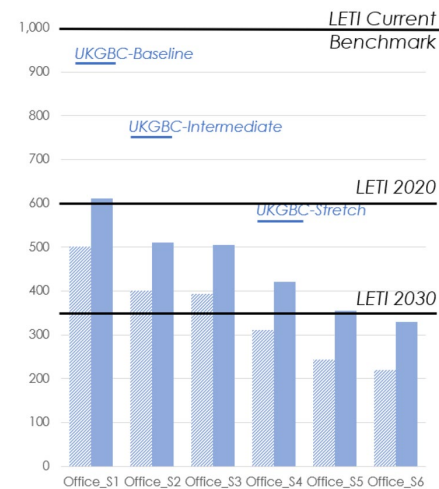
- Conduct and report whole life carbon assessment (including sequestration) and report upfront carbon (modules A1-A5) and circular economy (module D) separately.
- Set upfront (A1-A5) and lifecycle (A1-A5, B1-B5, C, including sequestration) embodied carbon targets.
- Careful investigation of an appropriate carbon offsetting price specific for providing advantage to low carbon alternatives is recommended.

Important limitations raised

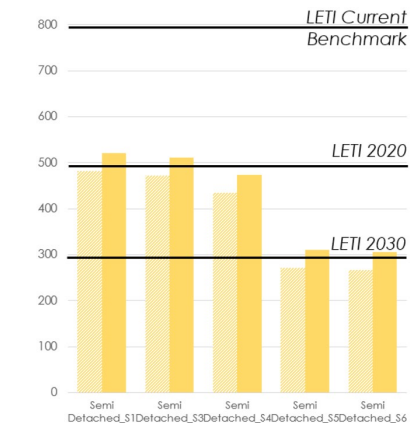
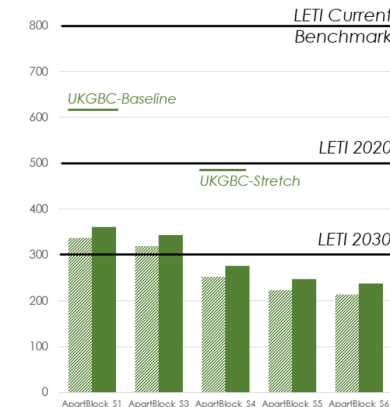
Some important limitations were noted:

- The embodied carbon benefits of alternative design choices (e.g. lean design) are not tested.
- As noted in the follow-on Westminster evidence base, the building services additional allowance assumed in this study (15%) consists of much less embodied carbon of building services, than by calculating them using the CIBSE TM65 methodology.

Upfront carbon emissions A1-A5



Non-domestic typologies (office-left and school-right): carbon reduction (kgCO₂e/m²) per scenario and comparison with LETI upfront carbon targets



Domestic typologies (apartment block-left and semi-detached-right): carbon reduction (kgCO₂e/m²) per scenario and comparison with LETI upfront carbon targets

- ▨ ▨ ▨ Detailed analysis Scope – RICS 1-3 (substructure/ superstructure/ finishes)
- ■ ■ Extended scope – RICS 1-3, 5, 8 (+ building services, external works)

The Westminster embodied carbon evidence base - Summary (1/2)

An embodied carbon evidence base was produced by WSP in September 2024 (version 2), aiming to inform Westminster City Council’s embodied carbon targets for new builds. It is framed around the WSP evidence-base report for West of England (WOE), completed in December 2021.

Upfront carbon modelling

This analysis explored the impact of common measures of reducing embodied carbon across four common building typologies in the City of Westminster; an office (7 and 3 storeys), a mixed-use (7-storeys) and a block of flats (8-storeys). They were all modelled with a single-storey basement as it was dimmed more representative of typical buildings currently in construction. RICS WLOA PS 2nd ed. methodology was used. The cost impact of these measures was analysed as well.

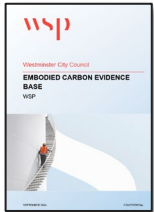
The modelling is based on a mixture of empirical data from previous WSP projects in London, along with material quantities developed from generated structural, MEP, façade and finishes design information per archetype. Internal elements were assumed based on WSP LOA data and fittings, furnishing and equipment (FF&E) were calculated using the GLA benchmark values referenced in the WLC guidance document. Impact of demolition works, renewables and external works were also included in the assessment. CIBSE TM65 methodology was used to calculate the carbon impact of MEP*.

*Methodology upgraded from previous WSP WOE evidence-base, which made allowances for MEP as opposed to calculating it. FF&E wasn’t included in WOE, whereas an allowance has been made here.

Scenarios modelled

The adjacent table shows the different design scenarios tested for each building typology, ranging from a baseline assumed to represent standard practice all the way to a combination of the lowest embodied carbon choices. The cost uplift of these scenarios were considered as well.

This evidence-base has considered the impact of lean design on upfront carbon through 2 tested scenarios: *1.not including a basement 2.reduction in grid spacing.*



Westminster City Council: embodied carbon evidence-base
Prepared by WSP
September 2024



	Large and small office	Mixed use	Residential
Alternative baseline without basement			
S1- baseline with basement	Steel frame and composite concrete-steel deck floor slabs	Steel frame and composite concrete-steel deck floor slabs	Concrete frame and reinforced concrete in-situ flat slabs
S2 – low carbon facade	Increase recycled aluminium content of window framing & replace terracotta rainscreen with timber cladding	Increase recycled aluminium content of window framing and review external wall build-up including bricks as finishing	Replace window aluminium framing with composite and review external wall build-up including bricks as finishing
S3 – low carbon finishes	Removal of ceiling tiles and use of reclaimed floor tiles for 50% of net internal area	Removal of ceiling tiles and use of reclaimed floor tiles for 50% of net internal area	Removal of ceiling tiles and use of reclaimed floor tiles for 50% of net internal area
S4- low carbon MEP	Replace 4 pipe fan coil with floor AHU	Replace ambient loop system with more typical heating only system	Replace ambient loop system with more typical heating only system
S5- reduced grid spacing	Reduction in grid spacing from 12m to 9m	Reduction in grid spacing from 12m to 9m	Reduction in grid spacing from 8m to 6m
S6 low carbon concrete	+25% cement replacement	+25% cement replacement	+25% cement replacement
S7- low carbon/ 50% GGBS	+10% steel reuse & +15% EAF steel	+10% steel reuse & +15% EAF steel	+50% cement replacement
S8- hybrid timer	Steel frame and CLT floors/ roof	Steel frame and CLT floors/ roof	-

Summary of the different scenarios modelled to investigate their upfront carbon and cost.

The Westminster embodied carbon evidence base - Summary (2/2)

Modelling results

The results align with the previous report by WSP, finding that all building typologies can improve upon the GLA benchmark embodied carbon target for upfront emissions using typical design practices. The analysis found that a mixture of adopting cost saving carbon reduction measures (such as reducing grid spans and optimising MEP systems) with more expensive carbon measures (such as optimising the façade and introducing a higher percentage of recycled materials, timber and cement replacement) can be adopted to deliver carbon reductions within 2% of traditional construction costs. To provide a more conservative estimate as well, cost is also shown without cost savings considered (see table opposite).

The study found that for residential typologies above 18 m in height, it is difficult to achieve any more reductions and meet the GLA aspirational benchmark due to current fire restrictions banning the use of low carbon combustible materials.

Planning considerations

- Reducing upfront carbon may compromise thermal performance, potentially increasing operational energy emissions. Adopting a WLC approach is key in achieving a balance between the two.
- Policy should discourage basements (high carbon contributors) where appropriate but offer financial incentives, such as reducing height restrictions.
- Encourage specification of cement replacement to stimulate demand and help accelerate the introduction of more available lower carbon technologies.
- Adopt design to disassembly principles to enhance reuse of materials in demolition processes.
- Develop WLC offsetting mechanisms to drive comprehensive carbon reductions.
- Consider BREEAM requirements for a holistic sustainability approach.

	Large office	Mixed use	Residential	Small office
Baseline without basement (excl. demolition, facilitating and external works) (kgCO ₂ e/m ² GIA)	746	716	875	789
Baseline with basement (excl. demolition, facilitating and external works) (kgCO ₂ e/m ² GIA)	802	781	893	1115
A1-A5 with all measurements applied (kgCO ₂ e/m ² GIA)	633	618	720	884
A1-A5 (excl. demolition, facilitating and external works) (kgCO ₂ e/m ² GIA)	579	583	685	849
Cost uplift (all measurements)	-1.5%	-2.4%	-0.7%	1.7%
Cost uplift (excluding savings)	1.9%	1.3%	4.1%	3.5%

Table shows carbon savings and cost uplift per typology. Carbon impact of renewables included in the results. Contingency factor not included in the results.

The Essex embodied carbon evidence base - Summary (1/2)

Essex County Council commissioned an embodied carbon policy study which provides evidence and guidance on planning policies that aim to reduce the embodied carbon of buildings in Essex.

Proposed policy requirements

Policy requirements have been proposed across four main embodied carbon areas, associated with: demolition; promoting a circular economy; efficient building design; material efficiency; reducing upfront carbon; and reporting whole life carbon. Upfront carbon and capital cost modelling was carried out to understand how cost and viability may affect the policy. Costs are based on a Q2 2025 base prices for Southeast England and reflect developer housebuilder costs, therefore, exclude separate overheads and profit associated with a main contractor delivery model.

Upfront carbon modelling

As part of this report, a modelling analysis was carried out to investigate the upfront carbon of three low-rise residential building typologies; a terrace house (3 storeys), a semi-detached house (3 storeys) and a low-rise block of apartments (3 storeys, 1 bed and 2 bed). All typologies modelled were also ultra-low operational energy homes.

Element library and set menus

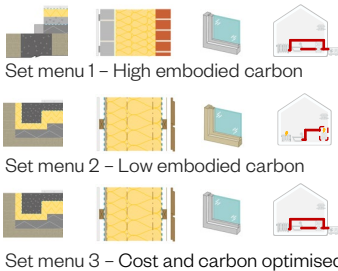
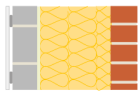
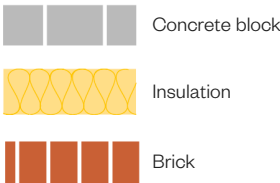
The modelling process used a 'materials database', which fed data to an 'element library' to create a range of building element build-ups, which was then used to construct three set menus for each building typology. The build-ups modelled represent construction from standard practice to best practice, this includes consideration of thermal performance and likely embodied carbon content.



Essex embodied carbon evidence base

Essex Embodied Carbon Policy Study
Prepared by Levitt Bernstein, Etude, Introba, Hawkins/
Brown and Currie and Brown.
May 2024

- 1 Material Database**
A1-A5 and upfront biogenic carbon datapoints (KgCO₂ per kg) for each material/product.
- 2 Element library**
Materials combined to create and calculate the upfront carbon of building elements.
- 3 Set menus per building typology**
Elements combined to create high, low and cost-carbon optimised upfront carbon set menus for each element and typology.
- 4 Building models**
Analyse the upfront carbon and cost results per set menu, per building typology.
↓
Policy recommendations
targets per typology.



Summary of modelling process applied in Essex Embodied Carbon Policy Study

The Essex embodied carbon evidence base - Summary (1/2)

Modelling results

The results opposite show the high, low and cost and carbon optimised upfront carbon and the cost uplifts from Part L 2021 for the three residential building typologies modelled. Cost uplifts from Part L 2021 were also listed below the set menus of each building typology.

Observations

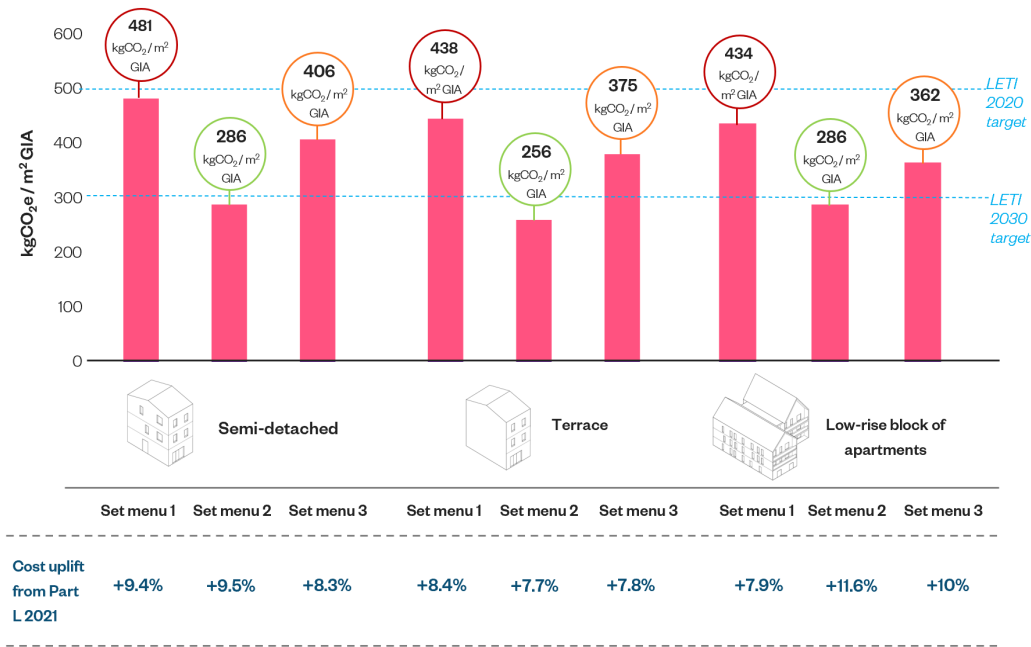
The high carbon (set menu 1) and cost and carbon optimised scenarios (set menu 3) both sit within the LETI 2020 target of 500kgCO₂e/m². Whilst the lowest carbon (set menu 2) sits within the LETI 2030 target of 300kgCO₂e/m². Lowest carbon (set menu 2) shows negligible variation in overall cost from the highest scenario (set menu 1) for the housing typologies. This is largely due to the cost savings delivered by the relatively shallow raft foundation in comparison to a deep strip foundation and floor slab. For the houses a construction cost saving could be achieved by specifying cost and carbon optimised building elements (set menu 3). For the low-rise block of apartments, both set menu 2 and set menu 3 are more expensive than the highest carbon scenario (set menu 1). This is due to the savings from the masonry structure in comparison to timber framing.

Recommended target for policy - 500 kgCO₂e/m² GIA

The report recommends setting the target for low-rise housing (under 11m) at 500 kgCO₂e/m² GIA. This would be a relatively loose target to begin with to allow applicants and planning officers in Essex to get used to carrying out or reviewing upfront carbon calculations. It has the advantage of ensuring there is some consideration of building form, typology and material selection, without seeking to exclude specific materials or designs. The report recommends reviewing the target every 3-5 years to determine if it can be lowered or should be altered. A target of around 400 kgCO₂e/m² GIA would allow for a timber structure with brick face, while a target of 300 kgCO₂e/m² GIA would likely exclude the use of brick.

	Foundations and ground floor	External wall	Party and internal wall	Internal floor	Roof	Windows
Set menu 1: highest embodied carbon	Strip foundations + in-situ concrete slab + screed	Traditional brick and block + glass wool	Traditional block and block + glass wool, metal stud structure	Timber joists + metal ceiling system	Timber rafters + mineral wool	Aluminium frame
Set menu 2: lowest embodied carbon	raft foundations + screed	Off-site timber + wood fibre & hempcrete + render	Timber frame + glass wool, timber stud structure	Timber I-joists	Timber rafters + phenolic insulation	Wooden frame
Set menu 3: cost and carbon optimised	Strip foundations + beam & block floor + screed	Stick timber frame + cellulose + brick	Same as set menu 2	Same as set menu 2	Same as set menu 2	UPVC frame

Table shows building elements forming set menu 1,2 and 3 for the houses.



Upfront carbon emissions A1-A5 and cost uplift per typology, for high, low and cost and carbon optimised scenario. The cost analysis shows that changing from a high carbon construction to a low carbon has negligible impact on capital cost.

Embodied carbon in building regulations in France



Réglementation
environnementale
(RE2020)

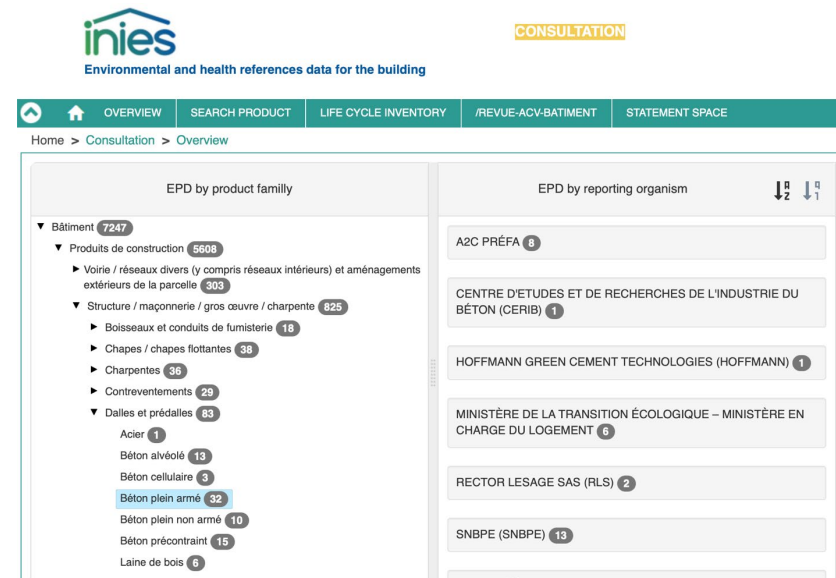
France's Réglementation environnementale (RE2020)

France's Building Regulations RE2020 was adopted in 2022 and applies to new residential, office and education buildings. This policy requires the calculation of the embodied carbon impact associated with materials, products and equipment in every new building. This is carried out in two stages of the process, at the 'construction permit' stage (equivalent to planning application) and at the end of the construction process.

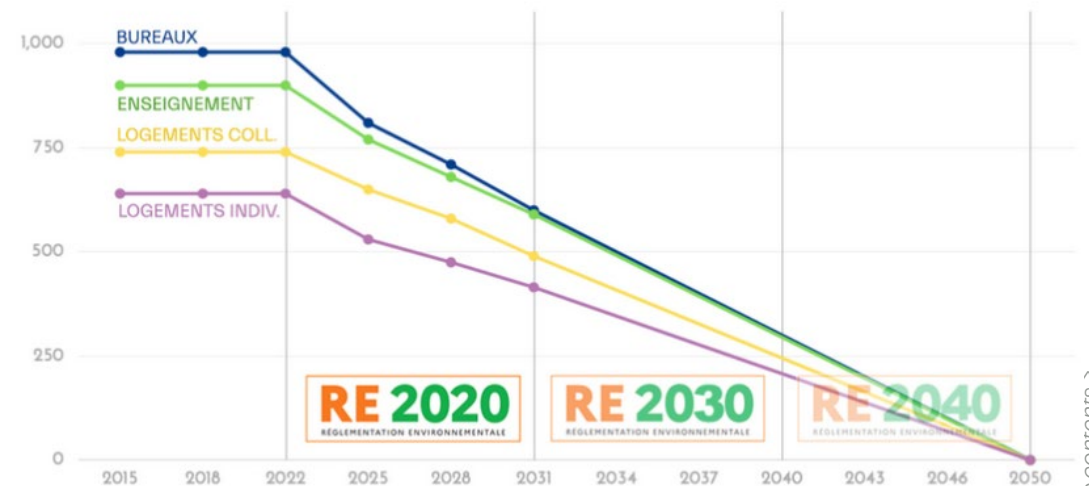
Threshold carbon emissions levels are set per typology and construction permit year. Specific levels of performance must be achieved that will be incrementally reduced (improved) with a new step every three years until 2031. These levels are being revised and reduced in line with France's low carbon economy transition plan.

A specific indicator ($IC_{\text{construction}}$ - Construction impact on climate change indicator) is calculated and applied to 13 component areas, as well as an optional one on refrigerants if they are used.

The calculation is based on project specific data for the volumes/quantities of materials, products and equipment which is multiplied by figures from the publicly and freely accessible embodied carbon INIES database. Default assumptions can be used when data on a material is not known or available. These assumptions are provided and are managed at the national level by the Government. The database is based on generic data, although product specific EPDs can also be used. No standardised calculation tool is in place, but a list of compliant tools exist.



The INIES database provides the information required for the calculation.



Requirements vary between building types. They are scheduled to be stepped down every three years.

Other countries with policies or regulation on embodied carbon

A number of other countries have introduced embodied carbon requirements into their regulatory environment. This page summarises some examples, highlighting that embodied carbon calculation of buildings is becoming more prominent and widespread in Europe. This is relevant to the UK as it may one day influence how and if embodied carbon comes into regulation.



Denmark's
National strategy
for sustainable
construction

Denmark's National strategy for sustainable construction

Introduced in 2021, Denmark's policy applies to all new buildings covered by existing energy regulation. It requires all buildings >1,000m² to comply with combined operational and embodied limit values (kgCO₂e/m²/year), while buildings below this threshold must only report results of their calculations. The limit is being reduced each year.

The life cycle analysis methodology is standardised with specific calculation requirements. There is no mandatory tool, although there is a public tool developed and accepted for compliance. Authorities provide a database of materials to be used for the calculations. The database is based on generic data, although product specific environmental product declarations (EPDs) can also be used.



MilieuPrestatie
Gebouwen
(MPG)

Netherlands' "Milieuprestatie Gebouwen" (MPG)

MPG (2022) applies to all new residential buildings and office buildings larger than 100m². 11 environmental impact indicators are calculated and combined into a single value.

Checks of the MPG are undertaken on the highest contributing building elements (walls, floors, installations). The final building is compared to the environmental declaration and spot checks can be carried out for more detailed features.



Vancouver
Building By-Law
Amendment

Vancouver Building By-Law Amendment

The Vancouver Building By-Law was updated in 2022 to increase the sustainability requirements of buildings. The changes regarding embodied carbon, effective since 2023, include the following:

- Completing a Whole Building Life-Cycle Assessment (WBLCOA) at the time of building permit to compare the embodied carbon against a standardised baseline.
- Demonstrate via the WBLCOA that the proposed building is not more than double that baseline. Starting in 2025, embodied carbon must be reduced by 10-20% compared to the baseline.
- Starting in 2025, buildings must also comply with one of three options for responsible materials, including sustainable sourcing standards, disclosure of material ingredients, or construction waste diversion and design for disassembly.



Finland's
"Ilmastoselvitys"

Finland's "Ilmastoselvitys"

Ilmastoselvitys (2016) will be substantially updated by 2025. This regulation covers all new buildings for which a building permit is needed, except single family homes, refurbishments and almost zero energy buildings. It mandates the reporting of Whole Life Carbon. The methodology is being standardised and has no mandatory tool, although OneClick LCA is widely used.

6.3

Additional information on modelling specifications

Typologies modelled

Residential typologies

The operational energy and embodied carbon studies consider slightly different development typologies to reflect the current state of available evidence and the relative maturity of assessment approaches.

The operational energy study assesses the main residential typologies planned across Stockport: detached, semi-detached, terraced houses, low and mid-rise apartments. This ensures a comprehensive understanding of operational performance across the full housing mix. In contrast, the embodied carbon study focuses on apartments and terraced houses. This reflects the more limited and evolving evidence base for embodied carbon in lower-density housing, where robust benchmarks and standardised assumptions are less well established.

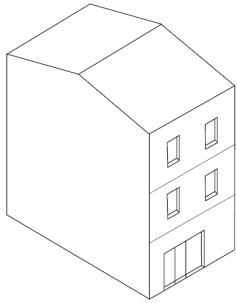
This difference in scope does not undermine the applicability of the findings. Detached and semi-detached dwellings are closely comparable in construction to terraced houses, with variation largely limited to unit size and the extent of exposed envelope. Their embodied carbon performance can therefore be reliably extrapolated from the terraced house typology, with appropriate uplifts to reflect increased material use associated with additional external walls.

Importantly, lower-density housing typologies are inherently less efficient in material and carbon terms, and also use land in a less efficient way. On this basis, it is appropriate to require detached and semi-detached dwellings to meet, as a minimum, the benchmarks demonstrated for terraced housing on a per square metre basis.

Non-residential typologies

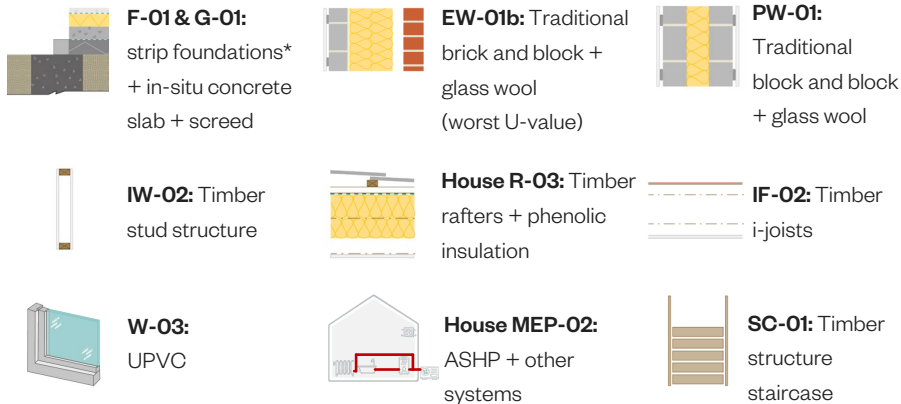
For non-residential buildings, the industry is still in a period of learning. There is a much wider variation in the building types, even within sectors for non-residential typologies. Therefore, upfront carbon targets are complex to introduce into planning policy at this point in time. Currently no other local plans have targets for non-domestic typologies other than offices/use class E and no other evidence bases exist for these typologies. Understanding the upfront carbon of a range of non-residential building types is an area the industry will likely strengthen in the next 5-10 years.

Residential <11m – terrace house technical specifications



Terrace house

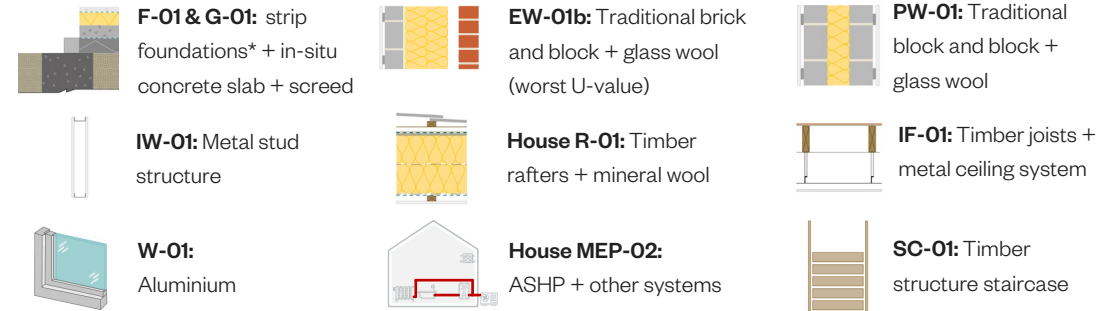
Baseline - Prevalent construction approach



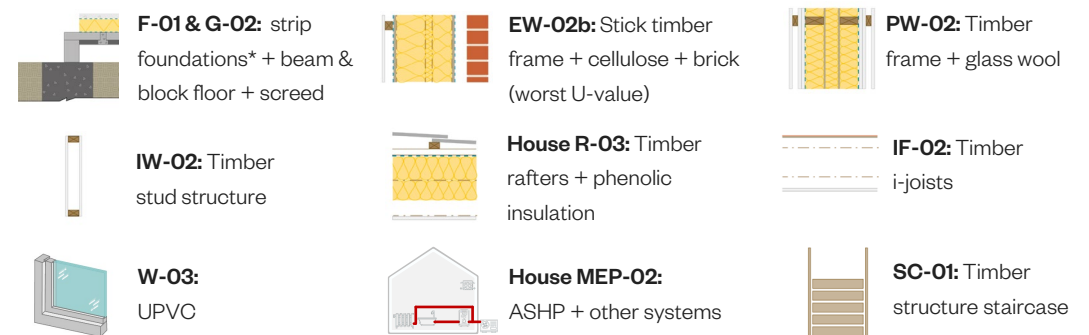
* Assumed concrete C40/50 with 20% GGBS and reinforced steel (97% recycled content). Assumed deep strip foundation depth of 1.4 m.

** Assumed concrete C40/50 with 20% GGBS and reinforced steel (97% recycled content). Assumed raft foundation depth of 350mm.

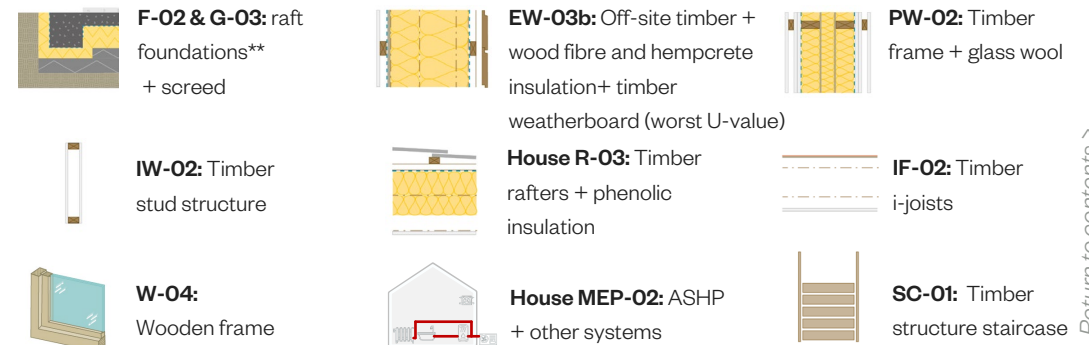
Scenario 1- Highest upfront carbon building elements:



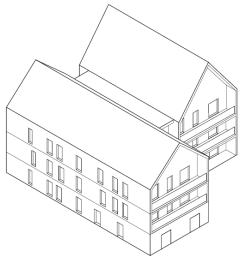
Scenario 2– Cost and carbon optimised building elements:



Scenario 3- Lowest upfront carbon building elements:

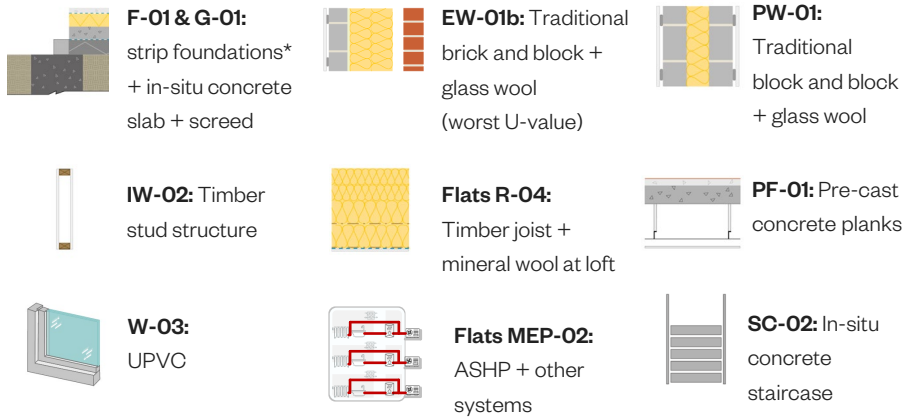


Residential <11m – apartment block below 11 m technical specifications



Apartment block <11 m

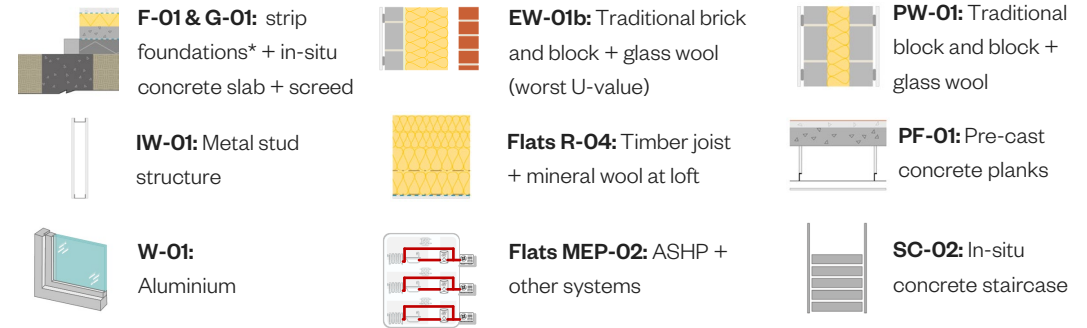
Baseline - Prevalent construction approach



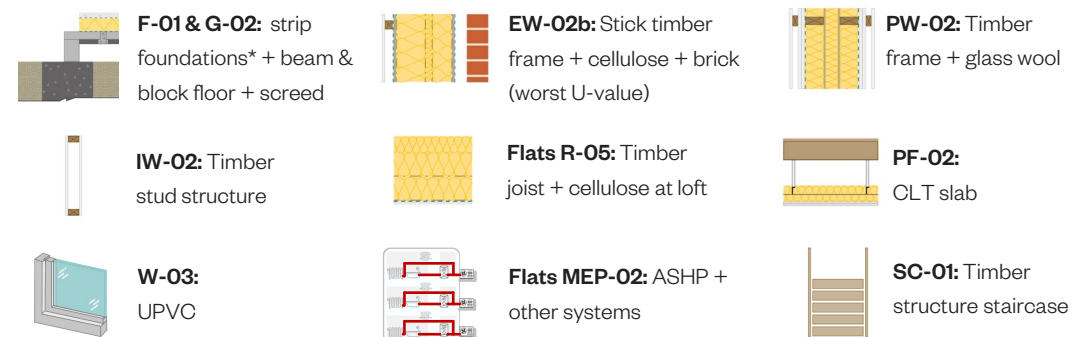
* Assumed concrete C40/50 with 20% GGBS and reinforced steel (97% recycled content). Assumed deep strip foundation depth of 1.4 m.

** Assumed concrete C40/50 with 20% GGBS and reinforced steel (97% recycled content). Assumed raft foundation depth of 350mm.

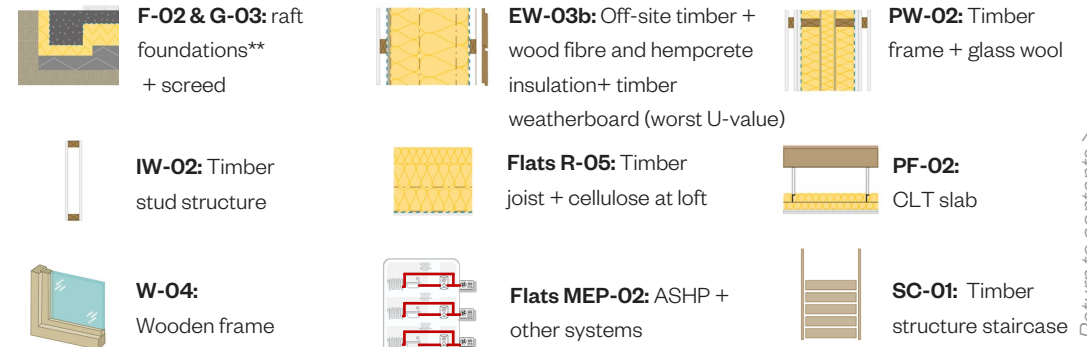
Scenario 1- Highest upfront carbon building elements:



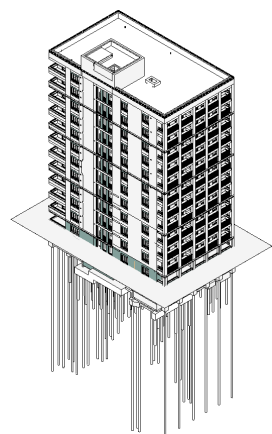
Scenario 2– Cost and carbon optimised building elements:



Scenario 3- Lowest upfront carbon building elements:



Residential ≥11m – apartment block above 11 m technical specifications (1/2)



The baseline scenario and scenario 1 modelled for apartment block above 11 m represent typical construction practices for residential typologies above 11 m in height, in line with approved document B (no combustibility in external façade):

- Concrete frame
- Light gauge steel or lightweight concrete block infill

All other materials/ products assumed in the baseline and scenario 1 are shown in detail on the table opposite.

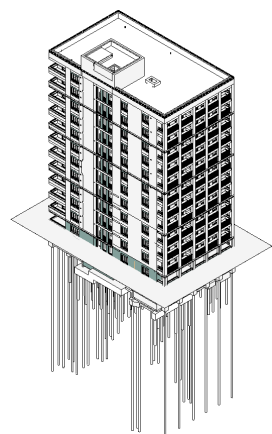
Balconies and associated fixtures were also included in the modelling.

The model included a second stair as part of updates to building regulations part B.

Baseline and scenario 1	
1 Sub-structure	
Foundation type	Concrete piles 0% cement replacement and 96% recycled steel reinforcement
Slab	Concrete slab 0% cement replacement and 96% recycled steel reinforcement
2 Superstructure	
Framing	Concrete columns and load bearing walls 0% cement replacement and 96% recycled steel reinforcement
Ground and upper floors	Concrete slabs 0% cement replacement and 96% recycled steel reinforcement, phenolic insulation on ground floor
Stairs	Concrete stairs 0% cement replacement and 96% recycled steel reinforcement
External walls	Glass fibre reinforced concrete (GRC) panels, aluminium alloy helping-hand system, steel frame/ lightweight concrete blocks, mineral/ glasswool insulation, metal studwork for services, gypsum plasterboard
Party walls	Lightweight concrete blocks, mineral/ glasswool acoustic insulation, metal studwork for services, gypsum plasterboard
Internal walls	
Roof	XPS/ PIR insulation and ballast finish
Windows	Triple-glazed composite frame
External doors	Solid hardwood and aluminium
Internal doors	Timber
3 Finishes	
Walls	Paint
Ceilings	Suspended metal frame, gypsum plasterboard, paint
Floors	Carpet (bedrooms), ceramics (bathroom floor and walls), wooden deck (balconies), linoleum (rest)
5 Services (MEP)	
Mechanical ventilation	Mechanical ventilation with heat recovery
Heating and hot water system	Active ambient loop

Table lists baseline and scenario 1 technical specifications per building element.

Residential ≥11m – apartment block above 11 m technical specifications (2/2)



- Level 2: addition of 20-25% ground granulated blast-furnace slag (GGBS) as a cement replacement product in sub-structure and structural elements & replacement of Glass fibre reinforced concrete (GRC) rainscreen cladding with brick façade.
- Level : an increase in the quantity of GGBS to 50-60%.

	Scenario 2 (20-25% cement replacement and brick facade)
1 Sub-structure	
Foundation type	Concrete piles 20% GGBS and 96% recycled steel reinforcement
Slab	Concrete slab 20% GGBS and 96% recycled steel reinforcement
2 Superstructure	
Framing	Concrete columns and load bearing walls 25% GGBS and 96% recycled steel reinforcement
Ground and upper floors	Concrete slabs 20% GGBS and 96% recycled steel reinforcement, phenolic insulation on ground floor
Stairs	Concrete stairs 25% GGBS and 96% recycled steel reinforcement
External walls	Brick facing, wall ties, steel frame/ lightweight concrete blocks, mineral/ glasswool insulation, metal studwork for services, gypsum plasterboard

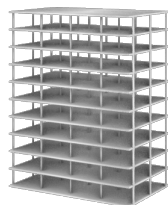
Table lists scenario 2 technical specifications per building element.

	Scenario 3 (50-60% cement replacement and brick facade)
1 Sub-structure	
Foundation type	Concrete piles 60% GGBS and 97% recycled steel reinforcement
Slab	Concrete slab 60% GGBS and 97% recycled steel reinforcement
2 Superstructure	
Framing	Concrete columns and load bearing walls 50% GGBS and 96% recycled steel reinforcement
Ground and upper floors	Concrete slabs 60% GGBS and 97% recycled steel reinforcement, phenolic insulation on ground floor
Stairs	Concrete stairs 50% GGBS and 97% recycled steel reinforcement

Table lists scenario 3 technical specifications per building element.

Non-residential – commercial use Class E technical specifications (1/3)

Referable development (GIA: 5,400 m²) - **Level 1**



Structural design	
Grid - primary span (m)	9
Grid - secondary span (m)	9
Framing material	Concrete 0% GGBS
Slab material	Concrete 0% GGBS
Foundation type	Piles (Concrete 50% GGBS)
Basement*	Yes
Ground floor transfer structure	Yes

*BASEMENT is an 'add on' not included in GIA

External envelope			
Opaque facade area (excl. party wall)	Precast concrete with int. plasterboard (0.15 W/m ² K)	m ²	1988
Roof area	Insulation & green roof (0.12 W/m ² K) – some full planted areas	m ²	648
Glazing area	Fixed Double glazed window aluminium frame, regular glass (1.55 W/m ² K)	m ²	2799
	Curtain walling Double glazed: aluminium frame, regular glass (1.55 W/m ² K)	m ²	182
Glazing ratio		%	60
External doors	Double glazed metal framed door (1.55 W/m ² K)	m ²	14
Form factor			1.2

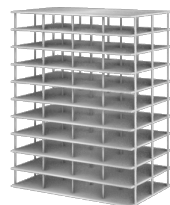
Internal assemblies and finishes				
Internal non-loadbearing wall	Metal stud with plasterboard		2417	
	Blockwork	m ²	604	3357
	Blockwork with plasterboard lining		336	
Internal doors	Solid timber	No.	68	85
	Glazed door		17	
Internal wall finish	Paint		5564	
	Marble	m ²	260	6714
	GRC decorative cladding		420	
	Encaustic tile		470	
Floor substrate	Separating floor with acoustic batten		1026	
	Non structural screed	m ²	257	5131
	Raised access floor		3848	
Floor finishes CAT A	Marble		103	
	Encaustic tile	m ²	977	1,080
Ceiling finishes CAT A	Suspended plasterboard		977	1,080
	Suspended SAS metal tile standard	m ²	103	

Building services	
Space heating system	ASHP with FCUs
Space cooling system	Chiller with FCUs
Ventilation type	Fully Mechanical ventilation
Refrigerant GWP	1000-2000 kgCO ₂ e/kg (R140A; R134A)

Tables list scenario 1 technical specifications for the commercial use Class E typology modelled.

Non-residential – commercial use Class E technical specifications (2/3)

Referable development (GIA: 5,400 m²) - **Level 2** and **baseline**



Structural design	
Grid - primary span (m)	7.5
Grid - secondary span (m)	7.5
Framing material	Concrete 25% GGBS
Slab material	Concrete 25% GGBS
Foundation type	Piles (Concrete 70% GGBS)
Basement*	Yes
Ground floor transfer structure	No

*BASEMENT is an 'add on' not included in GIA

External envelope			
Opaque facade area (excl. party wall)	Brick with int. plasterboard (0.15 W/m ² K)	m ²	1992
	Allowance for external shading		
Roof area	Insulation & green roof (0.12 W/m ² K)- with planters	m ²	270
	Insulation & Concrete pavers + pedestals		
Glazing area	Double glazed: composite frame, regular glass (1.55 W/m ² K) – 25% openable 75% fixed	m ²	1459
	Curtain walling Double glazed: aluminium frame, regular glass (1.55 W/m ² K)		
Glazing ratio		%	45
External doors	Double glazed metal framed door (1.55 W/m ² K)	m ²	14
Form factor			0.9

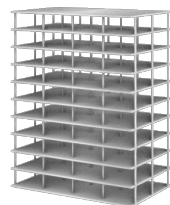
Internal assemblies and finishes				
Internal non-loadbearing wall	Metal stud with plasterboard		2417	
	Blockwork	m ²	604	3357
	Blockwork with plasterboard lining		336	
Internal doors	Solid timber	No.	68	85
	Glazed door		17	
Internal wall finish	Paint	m ²	6244	6714
	Ceramic tile		470	
Floor substrate	Separating floor with acoustic batten		1026	
	Non structural screed	m ²	257	5131
	Raised access floor		3848	
Floor finishes CAT A	Ceramic tile	m ²	488	1080
	Vinyl		488	
	Lino		103	
Ceiling finishes CAT A	Suspended plasterboard	m ²	488	1080
	Suspended grid tile SAS horizon		103	
	Exposed painted soffit		488	

Building services	
Space heating system	ASHP with FCUs – passive design reduced the sizing of systems
Space cooling system	ASHP with FCUs– passive design reduced the sizing of systems
Ventilation type	Mechanical ventilation
Refrigerant GWP	650-700 kgCO ₂ e/kg (R32)

Tables list scenario 2 and baseline technical specifications for the commercial use Class E typology modelled.

Non-residential – commercial use Class E technical specifications (3/3)

Referable development (GIA: 5,400 m²) - **Level 3**



Structural design	
Grid - primary span (m)	6
Grid - secondary span (m)	6
Framing material	Steel 50% recycled content
Slab material	CLT slab
Foundation type	Piles (Concrete 70% GGBS)
Basement*	No
Ground floor transfer structure	No

*BASEMENT is an 'add on' not included in GIA

External envelope			
Façade area (excl. party wall)	GRC with int. plasterboard (0.15 W/m ² K)	m ²	2189
	Allowance for external shading		
Roof area	Insulation & green roof (0.12 W/m ² K) – with planters	m ²	270
	Insulation & Concrete pavers + pedestals	m ²	270
Glazing area	Double glazed: composite frame, regular glass (1.55 W/m ² K) – 50% openable 50% fixed	m ²	1277
	Curtain walling Double glazed: aluminium frame, regular glass (1.55 W/m ² K)	m ²	182
Glazing ratio		%	40
External doors	Double glazed metal framed door (1.55 W/m ² K)	m ²	14
Form factor			0.9

Internal assemblies and finishes				
Internal non-loadbearing wall	Timber stud with fermacell		2417	
	Blockwork	m ²	604	3357
	Blockwork with plasterboard lining		336	
Internal doors	Solid timber	No.	68	85
	Glazed door		17	
Internal wall finish	Paint	m ²	6244	6714
	Ceramic tile		470	
Floor substrate	Separating floor with acoustic batten		1026	
	Non structural screed	m ²	257	5131
	Reclaimed Raised access floor		3848	
Floor finishes CAT A	Cork tiles		103	
	Ceramic tile	m ²	488	1080
	Lino		334	
	Paint		154	
Ceiling finishes CAT A	Suspended plasterboard	m ²	488	1080
	Exposed painted soffit		591	

Building services	
Space heating system	ASHP with radiators – passive design reduced the sizing of systems
Space cooling system	ASHP with displacement ventilation– passive design reduced the sizing of systems
Ventilation type	Mixed mode ventilation
Refrigerant GWP	<10 kgCO ₂ e/kg (R290, R1234-fy)

Tables list scenario 3 technical specifications for the commercial use Class E typology modelled.

6.4

Embodied carbon cost assessment methodology

Cost assessment methodology – additional information

The cost modelling carried out in this embodied carbon study used the following methodology:

Cost Sources

- **Baseline** - The reference baseline build costs were derived using the Building Cost Information Service (BCIS) 'mean' rate for the period of the last 5 years, with an uplift to reflect best practice operational energy improvements in line with the operational energy evidence base. This avoids double counting between the operational and embodied evidence bases.
- **Cost analysis** - Currie & Brown's internal cost-uplift database was used to derive the cost of building elements. For which the energy and carbon related elements were costed in detail.
- **Rebasing** – The Currie & Brown internal cost-uplift database was rebased to Q1 2026 using the BCIS indices localised for the Stockport area..

Cost uplift calculation methodology

- Capital costs have been calculated as incremental uplifts in pounds per square meter (£/m² GIA). Only the material-related elements were costed in detail, including changes to fabric and structure. The remaining capital costs associated with the building are captured through the baseline build cost £/m² allowance.
- It should be noted that total build costs can vary significantly dependent on design and specification choices to reflect target market requirements.
- The costed design and material-related elements have then been added to the baseline to express them as a percentage uplift against the baseline build costs stated above.
- The capital cost uplift calculations have been carried out for each of the building typologies and [specification scenarios modelled](#).

6.5

Additional information on Approved Document Part B fire regulations

Part B Fire Safety – conflicts and opportunities in upfront carbon

New residential buildings above 11m height

The embodied carbon of new residential buildings is significantly influenced by the UK Part B fire regulations V1. In 2020, Part B received significant updates which, in certain situations, limit material choice and specification.

For example, new residential buildings between 11-18m in height (measured to top occupied storey), the external surface of walls and any insulation product used in the external wall should be Class A2-s1, d0 or better (non-combustible). New residential buildings with a top occupied storey of 18m or more above ground should have non-combustible materials in the construction of all its external walls (with minor exceptions for cavity materials for specific types of masonry cavity walls). Balconies and spandrel panels should also be non-combustible over 11 m.

In such cases, certain low embodied carbon materials, like timber structure or wood fibre, hempcrete and cellulose insulation, are no longer allowable options above 11m. Bricks and concrete are the most used materials in high-rise residential, due to their high level of fire resistance and durability, but both typically carry a substantial carbon footprint.

New residential buildings below 11m height

For new residential buildings below 11m in height, Class B-s3, d2 materials can be used (combustible and non-combustible). Therefore, there is an opportunity to encourage the use of low embodied carbon natural materials in areas where low-rise residential types are most common.

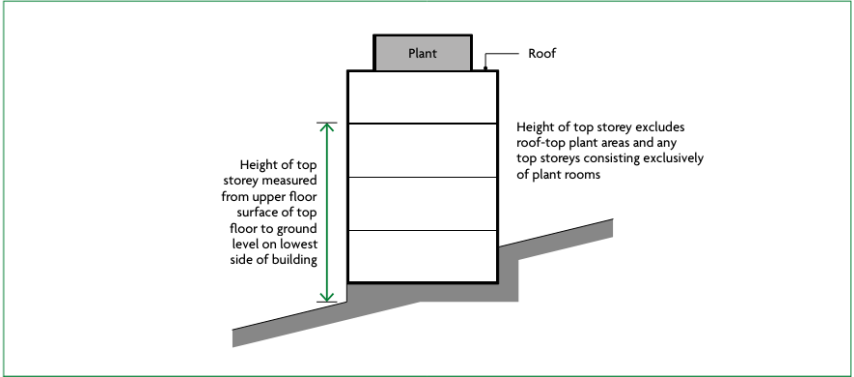


Diagram D6 Height of top storey in building

Building height measurement from Building regulations Part B volume 1, 2019 edition incorporating 2020 & 2022 amendments



Part B Building regulations, Volume 1: Dwellings, 2019 edition incorporating 2020 & 2022 amendments

Number of storeys and height of top storey in building

“To count the number of storeys in a building, or in a separated part of a building, count only at the position which gives the greatest number and exclude any basement storeys... Height of top storey measured from upper floor surface of top floor to ground level on lowest side of the building. Height of top storey excludes roof-top plant areas and any top storeys consisting exclusively of plant rooms.”

External wall build-ups	Structure	Insulation	Finish
Below 11 m in height	- Timber structure - Brick and block - Concrete structure + steel infill - Steel structure	- Petroleum based (e.g. phenolic insulation) - Wood fibre - Mineral and glass wool - Hemp/ hempcrete - Cellulose - Other natural insulations	- Brick - Render - Timber rainscreen - Metal rainscreen - Concrete panels - Other cladding systems
Between 11-18 m in height	- Timber structure - Brick and block - Concrete structure + steel infill - Steel structure	Mineral and glass wool	- Brick - Render - Metal rainscreen - Concrete panels - Other non-combustible cladding systems
Above 18 m in height	- Concrete structure + steel infill - Steel structure	Mineral and glass wool	- Brick - Render - Metal rainscreen - Concrete panels - Other non-combustible cladding systems

Example of materials within an external wall build-up, per building height (and according to Part B fire safety regulations)

6.6

Additional information on natural materials

The importance of natural materials

The importance of natural materials

The significance of using natural materials becomes particularly evident when considering their upfront (modules A1-A5), end of life (modules C1-C4) and beyond life cycle carbon emissions (module D). Wide environmental and health benefits of natural materials include the creation of healthy buildings in terms of indoor air quality and enhancing the breathability of the building.

Some natural building materials come from an abundant source (rammed earth) and others from a regenerative source due to their ability to be re-grown and capture and store atmospheric carbon dioxide (timber, straw, hemp, bamboo, cork, mycelium). Whereas, synthetic materials like petroleum-based insulation (PIR, phenolic and EPS) come from carbon intensive fossil fuels, which significantly contribute to climate change.

The importance of locally sourced materials

Using locally sourced materials, obtained from a defined radius around project sites, promotes sustainability principles by reducing transportation and energy carbon emissions and costs, while supporting local economies. However, it presents challenges such as variability in material quality and limited availability, which can complicate construction planning and increase construction costs.

Encouraging (but not mandating) use of natural building materials will lead to increased market demand and provide opportunities for new businesses and supply chains to develop in response. Additional scale and local supply chains will help to reduce cost as well as transport related emissions while also supporting economic growth within the region.

Encouraging the use of natural materials

The use of natural materials should be encouraged in supporting guidance of policy. However, it is challenging to mandate them due to fire regulation restrictions in certain parts and types of buildings.

Broader environmental and health benefits of using natural materials

- **Reduced upfront carbon:** natural materials typically require less energy for extraction, processing, and transportation compared to synthetic materials.
- **Sequestration of carbon:** specific natural materials (e.g. timber) have the ability to capture atmospheric carbon (biogenic carbon) within their structure, effectively sequestering it over their lifespan and helping to reduce overall greenhouse gas emissions, especially when used in place of carbon-intensive alternatives.
- **End-of-life embodied carbon:** unlike synthetic which end up in landfills, natural materials are often biodegradable or can be easily repurposed, minimizing landfill waste and reducing end-of-life emissions.
- **Enhanced circular economy integration:** natural materials, such as reclaimed wood, can be more effectively upcycled or reused, supporting the principles of the circular economy and reducing overall material waste. In contrast, synthetic materials like PVC often faces challenges in recycling due to contamination and degradation.
- **Improved indoor air quality:** natural materials like wool insulation emit fewer volatile organic compounds (VOCs) compared to synthetic alternatives like phenolic insulation, contributing to healthier indoor environments.
- **Improved building breathability:** natural materials allow for moisture to travel through the building elements, rather than being trapped within the construction, increasing the risk of condensation, mould growth and structural damage.

Calculation methodology of lifecycle embodied carbon often fails to show the benefits of natural materials

Confusion and conflict can arise where synthetic materials appear to have a lower embodied carbon than natural materials. This is mainly be due to the current calculation methodology (RICS WLCA PS 2nd ed.) which penalises natural materials due to their end of life scenario assumptions. For example, the benefit of timber structure to store biogenic carbon is negated within its C3 module, as the standard assumption is either its total or partial incineration at end of life. Industry stakeholders highlight the long-term reuse potential of mass timber, suggesting that end-of-life emissions could be reduced or omitted under circular models. Therefore, as more real-world reuse data becomes available the calculation methodology of lifecycle embodied carbon is expected to improve.

In the meantime, Stockport's planning policy focuses on upfront carbon, where data is more robust, accurate, and less dependent on uncertain long-term assumptions.

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