TOWARDS A NEW LONDON PLAN

Evidence base for embodied and whole life carbon policies

September 2025 I P06

Client and consultant team

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Contents

Key embodied carbon and whole life carbon definitions

The making of materials, their transport, repair and deconstruction affects how much carbon is associated with them. This is a summary of the key boundaries for embodied carbon and the terms associated with them. A more detailed explanation of the boundaries can be found in the appendix.

Upfront carbon (modules A1-A5)

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.

Life cycle embodied carbon (modules A1-A5, B1-B5 and C1-C4)

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 (modules B6 and B7)

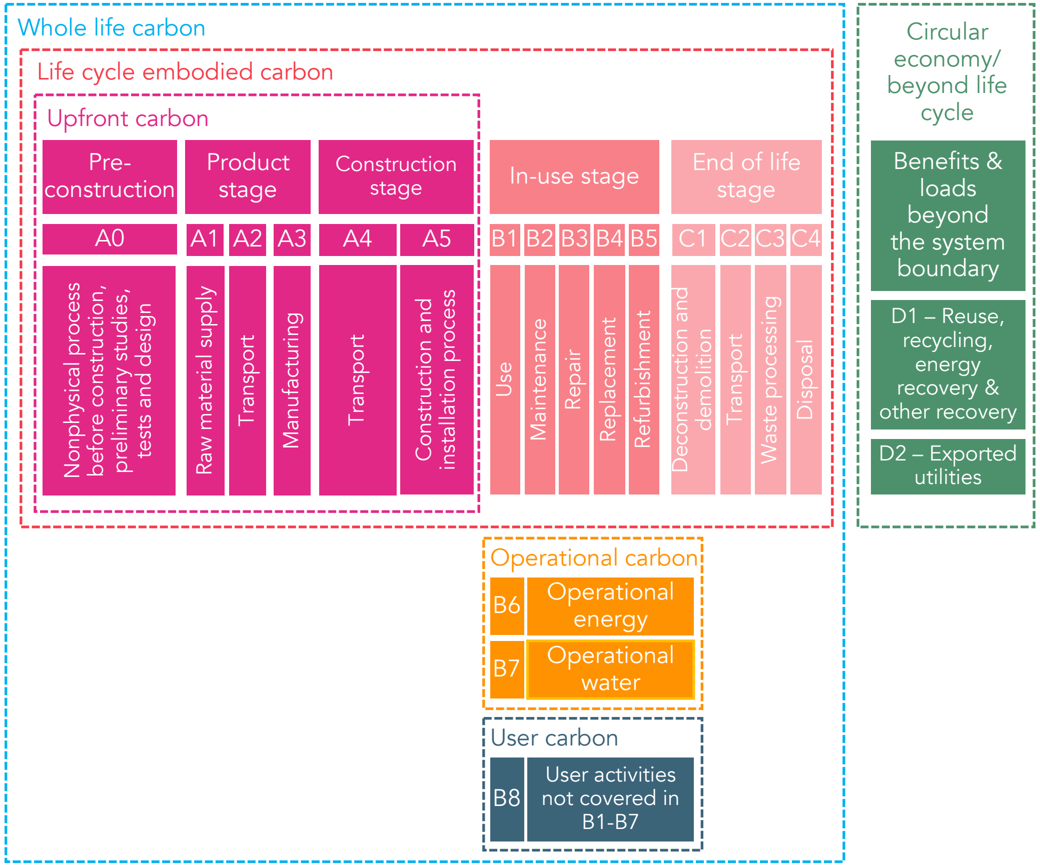
Operation carbon refers to the emissions associated with energy and water use during the in-use stage.

User carbon (module B8)

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, therefore will not be covered further in this report.

Whole life carbon (WLC) (modules A1-A5, B1-B8 and C1-C4)

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

Circular economy/beyond life cycle (modules D1 and D2)

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.

1.0

Embodied carbon and Whole Life Carbon requirements for new buildings in a streamlined, net zero compliant and just London Plan

This section introduces this evidence base in the context of the wider process and objectives of the London Plan update.

A streamlined, net zero compliant and just London plan

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A wider London Plan development process

This document is part of a wider process: the development of a new London Plan. A number of general objectives have informed the work summarised in this evidence base:

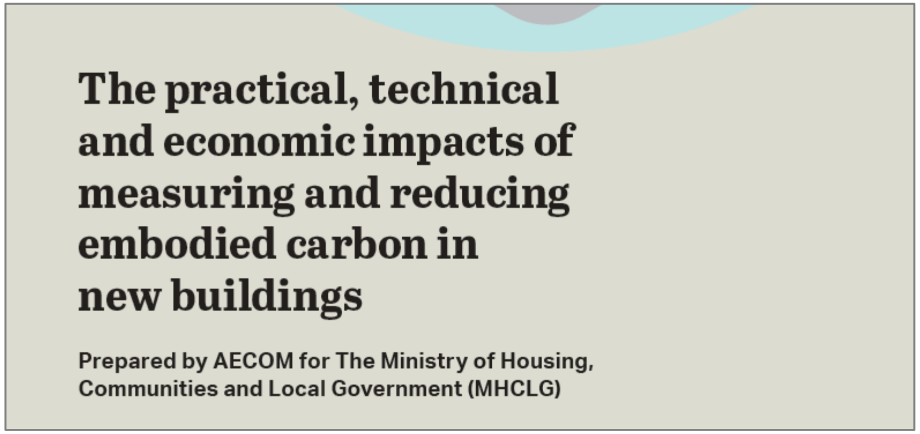
- **Environmental ambition**: the Mayor of London is committed to achieving Net Zero Carbon and the period 2027-2050 covers both the initial 2030 timescale and the 2050 horizon set by the Climate Change Act.
- **Viability and delivery**: planning requirements should help ensure that new buildings are low carbon, reducing the risks of extreme climate change and air pollution while supporting health and wellbeing. Policies should not negatively impact housing delivery objectives and other development need
- **Just transition:** the London Plan should benefit Londoners and reduce inequality.
- **Streamlined process:** environmental outcomes should be achieved while reducing complexity for applicants.

Building on successful policy in lieu of national regulations

The UK has no national regulatory mechanism for measuring or controlling embodied and whole life carbon emissions. The Greater London Authority (GLA) have addressed Whole Life Carbon (WLC) (operational + embodied carbon) in policy in the London Plan since 2021. As these emissions are significant in the built environment, this was considered a key step in understanding how to meet the requirements of the Climate Change Act. The policy was considered highly ambitious when launched and has been celebrated nationally and internationally as a method of acknowledging and understanding embodied and operational emissions through the levers available to the planning system, influencing other city and borough policies. It has since become a standard exercise to carry out embodied and whole life carbon assessments for applications in London.

The 'Towards a new London Plan' document has been published for consultation in June 2025

Part Z is a proposal developed by the industry for regulation of embodied carbon



Review of the impacts of embodied carbon by Government (July 2025)

Building an evidence base for embodied carbon and whole life carbon in the London Plan

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Helping the GLA make an informed decision

This evidence base has been developed to inform the GLA's policy development and decision-making process. Rather than seeking to demonstrate the technical feasibility and identify the cost of a single set of policy requirements. Overall it seeks to offer routes to drive down embodied carbon and whole life carbon in new buildings. The evidence base illustrates different levels of performance for upfront embodied carbon with varying benefits and cost implications. A series of 'PROs and CONs' pages have also been developed for potential new policy areas (e.g. lean design and material efficiency).

Working closely with London Boroughs

The planning framework in London is set jointly by the London Plan and each borough's Local Plan. This evidence base seeks to build on the work already completed by London boroughs, find common ground, and expand knowledge further.

Working with developers, housing providers and industry

A number of developers, housing providers and industry specialists have indicated during stakeholder engagement that the requirements discussed in this evidence base are technically feasible and viable. This research is also based on their work, and in particular the work underpinning the UK Net Zero Carbon Buildings Standard (UK NZCBS).

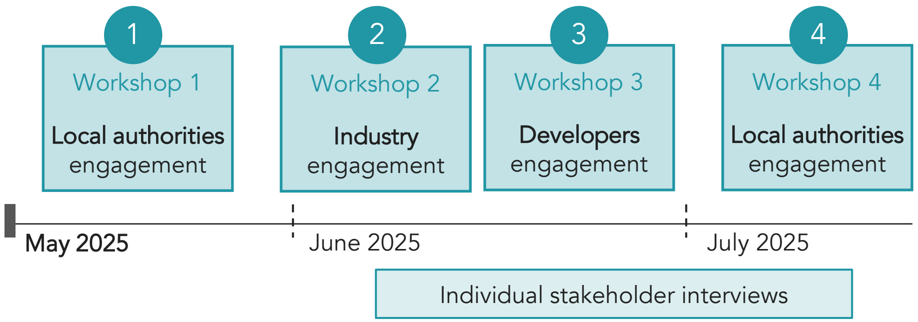
The approach is consistent with the recommendations of the Climate Change Committee, Environmental Audit Committee, UK Net Zero Carbon Buildings Standard, Low Energy Transformation Initiative (LETI), UK Green Building Council (UKGBC) and Royal Institute of British Architects (RIBA). This evidence base has sought to consider if and how this approach can be aligned to in the London context.

Implementation: an opportunity to streamline the process

Policy implementation options provide an opportunity to streamline the planning process. Policy implementation is summarised in the last section.

Proposed policy requirement	Summary requirements
1. Lean design and material efficiency	• Improved building design for lower upfront embodied carbon.
2. Upfront carbon requirement	• Adoption of this metric for lower upfront carbon. • Three potential performance levels for residential <11m: 500, 400, 300kgCO_2e/m^2 (GIA) • Three potential performance level options for residential ≥11m: 850, 700, 565kgCO_2e/m^2 (GIA) • Three potential performance level options for use class E: 950, 700, 605kgCO_2e/m^2 (GIA)
3. Life cycle embodied carbon and whole life carbon	• To ensure Whole Life Carbon is reported and the scale/number of projects doing so is expanded.
4. Administering upfront carbon limits	• PROs and CONs of a form of financial penalty or other mechanism to reinforce the upfront carbon policy or introduce flexibility where needed.

Stakeholder engagement



Stakeholders were engaged as part of this study. This included developers, housing providers and industry specialists. The feedback was that there was strong agreement, in principle, to setting limits for upfront carbon. The majority of stakeholders were comfortable with upfront carbon limits of 500 and 600 kgCO_2e/m^{2}GIA for residential and offices, respectively (pending clarity on scope inclusions and exclusions). There was also general support for continuing to report whole life carbon, with little adverse discussion about extending policies beyond referable projects only. Alignment with RICS WLCA PS 2nd edition *reporting was strongly supported.*

Proposed embodied carbon and whole life carbon framework

Embodied carbon is becoming a crucial part of the net zero puzzle for buildings, as carbon emissions from operational energy lessen. Therefore, it is important embodied carbon is not only reported but that design teams and clients work together to reduce upfront and life cycle carbon from the early stages of the project, while understanding the implications on whole life carbon.

Since the adoption of the 2021 London Plan, Greater London Authority (GLA) has taken a pioneering approach in addressing its climate change duties through the implementation of SI 2 Whole Life-Cycle policy. This forward-thinking policy positioned London as a leader in tackling and reducing embodied carbon in the built environment, setting a strong example for other local authorities.

Layering policy requirements up

There are a number of component pieces which bring together a complete picture of embodied carbon and whole life carbon on a development. These components build upon one another, allowing robustness in areas that have the most evidence available and a proportionate application of policy to development scale and sector.

The proposed policy framing is listed on the opposite table and outlined in later sections of this study:

1. Lean design and material efficiency
2. Upfront carbon
3. Life cycle embodied carbon and whole life carbon
4. Administering upfront carbon limits

Proposed policy requirement	Summary requirements
1. Lean design and material efficiency for low upfront carbon	To reduce embodied carbon in buildings through consideration of the key actions that can be taken to improve building design.
2. Reduce and limit upfront carbon – residential and use class E commercial buildings	Meet an upfront carbon limit. To reduce upfront carbon in buildings through design, modelling and meeting upfront carbon limits. Applicants have the greatest ability to meaningfully reduce upfront carbon. There is enough data for certain building sectors to be able to introduce limits.
3. Reduce life cycle embodied carbon and report whole life carbon	To reduce life cycle embodied carbon in buildings through design and modelling. To ensure Whole Life Carbon is reported and the scope of projects doing so is expanded.
4. Administering upfront carbon limits	Where upfront carbon has limits set, a form of financial penalty or other mechanism can be considered to reinforce the policy or introduce flexibility where needed.

Note: Operational energy policies have been included in a separate document.

Implementation of policy | An opportunity to streamline submissions

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Seeking outcomes

The principal purpose of updating policy is to continue to seek sustainable outcomes for London. However, the preconception is that updates to policy could be challenging and costly to adhere to while bringing more burden to applicants and the submission process. This need not be the case. Policy can be streamlined to work hand in hand with a submission process that:

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

Streamlining policy and process

As part of updates to the London Plan, there is an opportunity to review supplementary guidance and submission requirements, putting the focus on the need to achieve the desired policy outcomes while reducing the volume and types of information required to be submitted.

This could be done through the use of simple **proformas** (proportionate to the scale of development) to collect results from energy models, with the energy statement providing explanations.

The use of **ready made RICS WLCA PS 2nd ed. reporting templates** would also help align with industry outputs, to save results being presented more than once.

Current GLA position

- **Upfront and life cycle carbon benchmarks, with whole life carbon reporting**, using RICS WLCA 1st ed. calculation methodology.
- **Use of bespoke GLA reporting tool** requiring a GLA specific setting out of data and results.
- **Detailed embodied carbon reports**, with little guidance on expected content, resulting in long and complex reports being submitted.

A streamlined position

- **Upfront limits and life cycle carbon benchmarks, with whole life carbon reporting**, using current RICS WLCA 2nd ed. calculation methodology.
- **Use of RICS reporting template** to standardise the results reporting from consultants and avoid duplication.
- **Simplified embodied carbon reports**, due to reporting of results in RICS template. Simple guidance on expected content to seek only necessary information.

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How the proposed framework compares to the current London Plan and industry practice

Proposed policy requirement	How it compares with the current London Plan	Industry practice	Other comments
1. Lean design	• This builds on the London Plan 2021 policies, emphasising the benefit of lean design and material efficiencies as a means to lower embodied carbon.	• Industry guidance recognises the need to design for improved design and material efficiencies. This also supports a reduction in capital cost.	• This would be a low-effort and low-cost way to reduce embodied carbon though good design, without the need specialist consultants, that can be applied to all scales of new development.
2. Upfront carbon	• Replacement of upfront carbon benchmarks with limits set for two typologies (residential and use class E). Providing a more robust stance to achieving lower carbon buildings. • Uses the most current version of RICS Whole Life Carbon Assessment Professional Statement 2nd ed (RICS WLCA PS 2nd ed.) to improve the quality and granularity of assessments. • It has the potential to be expanded from referable schemes to major and referable schemes.	• Performance level 3 is in line with UK Net Zero Carbon Building Standard (UK NZCBS) and broadly in line with LETI.	• Many progressive developers have their own upfront carbon targets and track these metrics across projects. • Stakeholder engagement with local authorities, industry professionals and developers welcomed the setting of upfront limits in policy.
3. Whole-life carbon	• Same reporting requirement as the current London Plan, but using the latest RICS WLCA PS 2nd ed. • Stronger focus on some of the key aspects of the calculation that could help to drive lower carbon outcomes specifically for refrigerants, structure, façade and fit out and finishes.	• UK NZCBS does not set limits. • RIBA 2030 sets lifecycle carbon targets.	• Stakeholder engagement with local authorities, industry professionals and developers supported the continued calculation and reporting of WLC.
4. Administering the upfront carbon limits	• Option to use offsetting to administer and bring strength to the upfront carbon policy.	• Bristol City Council and Westminster City Council have offsetting mechanisms for upfront carbon. • Most adopted/draft local plans that introduce a policy and limits on embodied carbon, do not include any form of offsetting.	

Equalities impact summary | Embodied carbon and Whole life carbon

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Proposed policy requirement	Potential equality impact	EDI (Equity, Diversity and Inclusion) outcomes compared to current London Plan	
1. Lean design	High This affects population health and wellbeing through environmental factors including air quality, construction noise, transport and manufacturing emissions as well as social factors such as employment.	Up	The co-benefits of adopting lean design principles include the use of fewer resources for developments. In addition, there will be a greater emphasis on building and material re-use. Reduced construction times, transport journeys, noise and dust on site will lessen impacts on residents and local businesses. This is particularly true in dense urban settings where developments often occur on brownfield or infill sites in close proximity to existing buildings. For example, housing renewal in social housing estates can be particularly disruptive for social housing tenants who are disproportionately racialised, low-income, single-parent households or households with dependent children. Particular benefit will be seen in areas designated as Air Quality Management Areas. Material efficiency measures may drive a greater uptake of off-site construction, which may relocate noisier construction processes to industrial locations and reduce transport movements and waste disposal on-site. The policy should be balanced with support for construction workers to re-skill and opportunities to diversify the construction sector.
2. Upfront carbon	High This policy has the same effects as Lean Design with the added onus on applicants to meet specific limits. The introduction of limits should make the benefits more certain as they will be enforced.	Up, neutral	The introduction of upfront limits, over and above lean design principles will have further co-benefits in addition to those documented above. Upfront carbon assessments include the emissions from on-site processes. Greater focus on cleaner construction techniques including electrification, packaging and waste reduction and management will improve the environmental conditions for people living close to construction sites within London. Lower upfront carbon is often achieved with natural, re-used, recycled and locally supplied materials. The London Plan should consider the demand and need for local supply chains and industrial land to support these outcomes and balance this need with development needs. Potential risks when introducing upfront carbon limits relate to where the limit is set. Limits are needed to reduce emissions to control the impacts of climate change. However, given this is the first time an upfront limit will be set in London if it is too high it will not drive action, but if it is too low it could make schemes unviable or create perverse impacts on supply chains. One result could be reduced housing numbers, with fewer affordable homes delivered, or less commercial development, affecting supply of business premises within London. A balanced approach will be needed to setting the limit and administering the policy. Our evidence base has shown performance level options 2 and 3 are very similar in cost with level 1 being higher, so this risk is low.
3. Whole life carbon	Low This policy is not performance based, so is considered to have an overall low impact on EDI.	Up or neutral	The policy relates to Whole Life Carbon reporting but does not impose limits. Calculating and reporting data is intended to upskill the industry and focus efforts on reductions through transparent data sharing. There will be benchmarks indicating the performance expected, but minimal planning power to enforce specific action. Process costs will be the largest impact and as a % of construction costs, these are not expected to impact development quantum, location or vulnerable populations. Co-benefits of awareness raising of Whole Life Carbon are expected to drive better appreciation of life-cycle, replacement cycles and the harmful impacts of refrigerants in cooling systems. In the longer term, these impacts aim to improve population health and wellbeing.
4. Administering the upfront carbon limits	Low This policy is related to the governance of upfront limits and will only apply to those schemes where the policy is not met.	Neutral	Mechanisms are being considered to administer the introduction of upfront carbon limits. They should be adopted so they deliver the identified co-benefits for EDI. In the event of financial penalties for being over the upfront carbon limit, there is an opportunity to use funds raised to support some of the identified co-benefits such as investing in skills development or retraining programmes or delivering infrastructure to support local low carbon material supply chains.

Costs impact summary | Embodied and Whole Life Carbon

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Cost implications of embodied and whole life carbon policy interventions will affect capital and process costs to varying degrees.

This page summarises the capital costs and process costs.

Capital costs

The capital cost of implementing reductions embodied carbon is incredibly small.

- For residential schemes <11m there is a negligible increase in capital cost, due to material quantity savings balancing with lower carbon materials. Performance level 1 uses non-combustible materials in line with fire regulations for buildings taller than ≥11m, whereas, levels 2 and 3 include combustible materials.
- For residential schemes ≥11m there is a very minor increase in capital cost for performance levels 2 and 3. This is associated with the use of a brick façade (robust and low maintenance) instead of rainscreen cladding (higher carbon with shorter replacement cycles) and supports the use of cement replacement. All performance levels exclude combustible materials in line with fire regulations.
- For use Class E there is no increase in capital costs for level 2, due to optimisation of design to increase material efficiencies. Performance levels 1 and 2 allow a typical palette of materials to be used, while level 2 requires some thought about material efficiency measures to meet the limit.

There is no cost impact associated with lowering the upfront limits during the policy period when related to material decarbonisation.

Process costs

There is no anticipated process cost increase for referable schemes, which are already required to calculate and report embodied and whole life carbon as part of the current London Plan polices.

Any additional process costs would be from widening the scope of the embodied carbon polices to cover major development.

Proposed policy requirement	Capital cost uplift (upfront embodied carbon)			
	Residential (<11m) Terraced house	Residential (≥11m)	Use class E (5,400sqm)	Use class E (13.500sqm)
Indicative all in construction benchmark cost	£2,327/m²	£3,674/m²	£4,220/m²	£4,220/m²
Level 1	+0% (+£0/m²)	+0% (+£0/m²)	+7.3% (+£287/m²)	+5.0% (+£201/m²)
Level 2	-1.2% (-£28/m²)	+0.5% (+£20/m²)	+0% (+£0/m²)	+0% (+£0/m²)
Level 3	+0.1% (+£3/m²)	+0.7% (+£27/m²)	-0.7% (-£26/m²)	+2.3% (+£94/m²)

Variation in capital costs from baseline for Levels 1, 2 and 3 for Upfront Embodied Carbon Limits. Relative costs (% or £/m²) of each case compared to the '0' baseline

Proposed policy requirement	Mean process costs*	Potential process cost implication
1. Lean design	Negligible	• Negligible process costs for the design team to consider: effect of building materiality, design and form; review carbon heavy design features; and review basic analysis of wall and superstructure options.
2. Upfront carbon limits	Early design: £3,700 Design optioneering: £5,200 Upfront carbon: £7,500	• Process costs associated with specialist consultants for design to consider the topic in more depth and respond, including calculations and reporting. For referable schemes there will be **no increase in process costs from the 2021 London Plan**. Should the policy cover major schemes, there will be a process cost where there was not previously.
3. Whole Life Carbon reporting	Lifecycle embodied carbon: £8,100 or £600 uplift on upfront carbon assessment Whole life carbon: £9,600 or £2,100 uplift on upfront carbon assessment	
4. Administering upfront carbon limits		• Process costs only applicable if upfront carbon calculations and reporting are re-run at completion stage to in response to offsetting.

Process costs associated with policy proposals.
** Process costs based on 2025 AECOM research paper for MHCLG – process costs vary considerably based on building typology, size and complexity.*

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Scope | New buildings and major refurbishments

This evidence base focuses on the embodied carbon and whole life carbon of new buildings. It is assumed that major refurbishments and change of use applications which will be referable to the Mayor of London should be treated the same as new build for embodied carbon and whole life carbon.

This is due to the likely scale of works required but also to the scale of opportunity: it is reasonable to assume that major refurbishments and change of use renovations coming forward during the period covered by the new London Plan will be the only such opportunity before 2050. It will therefore be the only opportunity to reduce the impact of the materials used.

Lighter refurbishments are not covered by this evidence base.

What is considered to be a major refurbishment?

The Code of Construction Practice classifies major refurbishments as:

Those which are of such a scale that the impacts are equivalent to those arising from a new build. For example, where there is extensive demolition and rebuilding or significant new construction behind a retained façade. The planning obligations required by a major refurbishment will also be determined by the length of construction programme extending over 12 months.

Building regulations defines 'major renovation' as: the renovation of a building where more than 25% of the surface area of the building undergoes renovation.

The GLA could adopt or adapt one of these definitions. It is recommended that a definition be included in the London Plan for clarity regarding which schemes must comply with the targets.

New buildings

Major refurbishments

Change of use

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Themes not covered by this document

The London Plan (2021) includes a Sustainable Infrastructure chapter, which includes policies with requirements related to Whole Life Carbon emissions in new buildings (SI 2).

This document provides policy options and recommendations addressing key questions in how the current WLC policy could evolve. However, it is noted that some related elements fall outside the scope of this work. Broad recommendations, relates to out-of-scope items are summarised below:

Policy SI 7 – Reducing waste and supporting the circular economy

The requirements of this policy aim to reduce waste and encourage material efficiency, which are closely linked to WLCA reporting, but has not been included in the scope of this evidence base.

It is recommended that the polices are considered as linked in any revised iterations to streamline data collection and reporting.

Retrofit first

Since 2021 several local authorities and London Boroughs have introduced policies to encourage greater uptake of building retrofit.

While the WLC policies link to this topic, it has not been specifically researched for this piece of work.

Non major refurbishment

It has been assumed that the policies and evidence prepared in this document are relevant to new build and major refurbishment schemes. However, non major refurbishment has not been included in this scope of work.

- Policy SI 2 E and F – Minimising greenhouse gas emissions: Introduces the requirement for major developments to calculate and minimise carbon emissions and referable projects to calculate and report Whole Life-Cycle Carbon Assessment with demonstrable actions to reduce life-cycle carbon emissions.

A summary of the current policies included in the Sustainable Infrastructure chapter

2.0

Evidence of need

This section summarises why the new London Plan should include requirements to minimise embodied carbon emissions of new buildings.

Planning policy should focus on embodied carbon as well as operational carbon

Global climate emergency

There is overwhelming scientific consensus that significant climate change is happening. The Intergovernmental Panel on Climate Change report (IPCC AR6) confirms significant climate change, highlighting the need to reduce emissions within the next decade to stay within the 1.5°C limit.

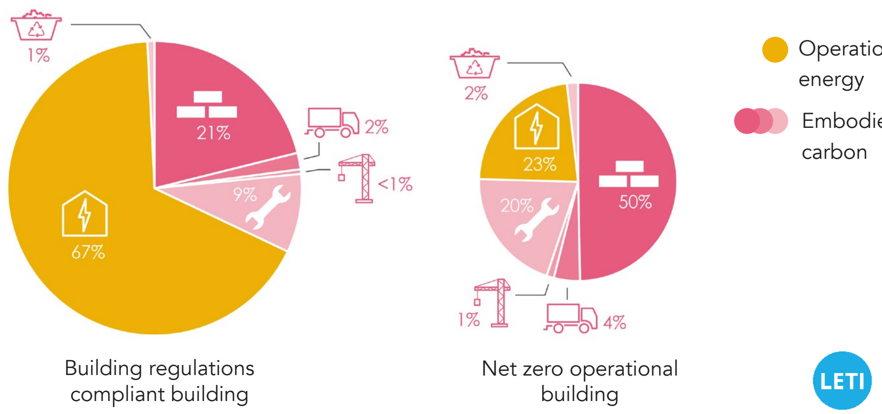
National commitment

The UK's Climate Change Act 2008, updated in 2019, mandates net zero carbon by 2050 and sets carbon budgets. The sixth carbon budget requires a 78% reduction in emissions by 2035 compared to 1990 levels, including reduction from the embodied carbon emissions of products manufactured in the UK. Local authorities, including the Greater London Authority are actively assisting in meeting the UK's commitments by implementing embodied carbon policies within their local plans. However, to date, national building regulations are not addressing embodied carbon.

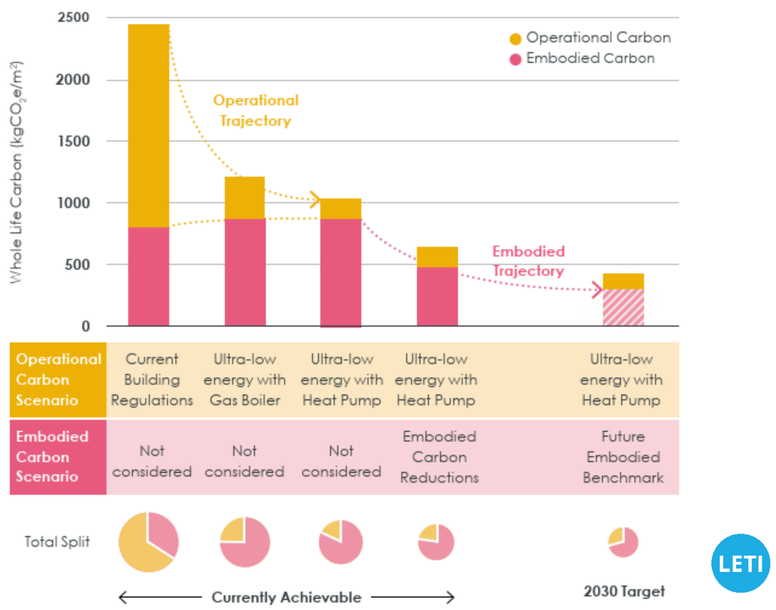
The need to regulate embodied carbon emissions of buildings

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 consumption emissions (heating, hot water, lighting, ventilation and plug loads) and the embodied carbon emissions associated with materials, components and systems. Reducing operational carbon emissions through regulation and planning policy has been the main focus. However, as buildings become more energy efficient, embodied carbon associated with the materials are becoming a greater portion of the total building emissions (see LETI pie charts to the right).

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 CO_2 annually, more than emissions from aviation and shipping combined''*.
Therefore, addressing embodied carbon is vital to meet national and local climate targets.



The LETI pie charts demonstrating that embodied carbon emissions could be representing almost 40-70% of the whole life carbon (WLC) emissions of a building (Source: LETI)



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)

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Building regulations are not addressing embodied and whole life carbon, creating a policy gap

The Future Homes and Building Standards do not cover embodied carbon

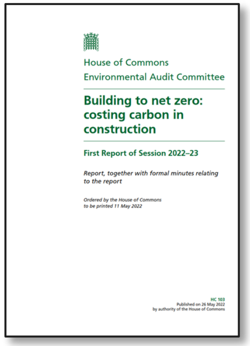
On 13th December 2023, the government published a consultation on the Future Homes and Buildings Standards scheduled to come into force from 2024. However, the proposed standards do not cover embodied carbon.

The policy gap must be filled

The Climate Change Committee recommended that whole life carbon assessment for new homes should be included within the Future Homes Standard, as part of the Policies for the Sixth Carbon Budget.

In May 2022, the Environmental Audit Committee (EAC) published a report, urging the government to start acting now. *"if the UK continues to drag its feet on embodied carbon, it will not meet net zero or its carbon budgets"*. The report was positive about the impact of the GLA London Plan 2021 in requiring WLCA and Circular Economy Statements and noted they had been introduced successfully with minimal barriers. It proposes further routes to achieve net zero, including:

1. Establishing the RICS methodology as the UK industry standard for WLC assessments and developing a centralised national database of environmental product declarations (EPDs).
2. The development of progressively ratcheting carbon targets
3. Learning from international embodied carbon regulation.
4. Investing in research; incentivising low-carbon and re-used materials.
5. Evaluating and informing permitted development rights on retrofit.
6. Requiring circular economy statements, including pre-demolition audits in planning applications that entail demolition


House of Commons
Environmental Audit Committee
Building to net zero: costing carbon in construction
First Report of Session 2022–23
Report, together with formal minutes relating to the report
Ordered by the House of Commons to be printed 11 May 2022
HC 103
Published on 26 May 2022
by authority of the House of Commons

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

Environmental Audit Committee - 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 regulations are not addressing embodied and whole life carbon, creating a policy gap

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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 upcoming 2025 general elections. This champions the use of the industry proposed 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) 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 considered this will 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."

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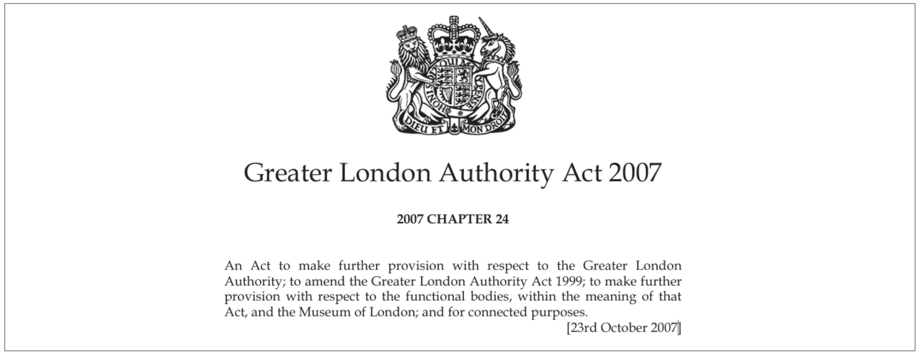
The powers and duties of local authorities to address climate change

There is no requirement at national level for embodied carbon to be addressed in planning policy or decision-making. However, 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 for London, enacted by the GLA, would be expected to address:

- The **Greater London Authority Act 2007,** where section 41 sets out matters that the Mayor must have regard to; section 41(4) was amended in 2007 such that climate change reference was added. *"Section 41(4) amends section 41 of the 1999 Act to require the Mayor to have regard to climate change and the consequences of climate change, when preparing his strategies. It also requires the Mayor to include such policies and proposals in his strategies which he considers best calculated to contribute towards the mitigation of, or adaptation to, climate change in the United Kingdom."*
- The **National Planning Policy Framework (NPPF)**, updated 2023, 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 158 also requires local plans' approach to climate change to be in line with the objectives and targets of the Climate Change Act 2008.
- The **Levelling Up and Regeneration Act 2023** has further prospective changes to the GLA Act s334 that make it more explicit. If introduced, this would amend the section of the GLA Act that relates specifically to the London Plan (i.e. s334 GLA Act 1999) to introduce a new power for the London Plan to specify or describe infrastructure that mitigates or adapts to climate change. However, this has not yet been brought into force.



Greater London Authority Act 2007

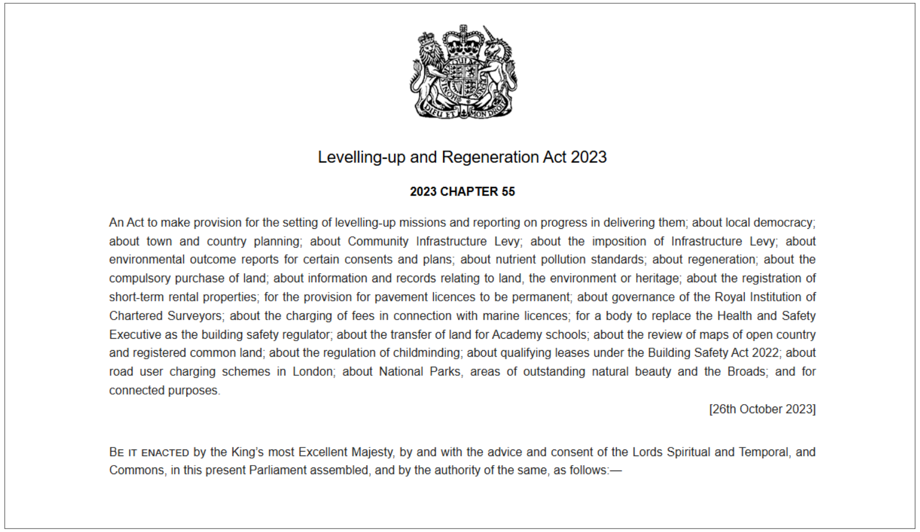
2007 CHAPTER 24

An Act to make further provision with respect to the Greater London Authority; to amend the Greater London Authority Act 1999; to make further provision with respect to the functional bodies, within the meaning of that Act, and the Museum of London; and for connected purposes.

[23rd October 2007]

Department for Levelling Up, Housing & Communities

National Planning Policy Framework



Levelling-up and Regeneration Act 2023

2023 CHAPTER 55

An Act to make provision for the setting of levelling-up missions and reporting on progress in delivering them; about local democracy; about town and country planning; about Community Infrastructure Levy; about the imposition of Infrastructure Levy; about environmental outcome reports for certain consents and plans; about nutrient pollution standards; about regeneration; about the compulsory purchase of land; about information and records relating to land, the environment or heritage; about the registration of short-term rental properties; for the provision for pavement licences to be permanent; about governance of the Royal Institution of Chartered Surveyors; about the charging of fees in connection with marine licences; for a body to replace the Health and Safety Executive as the building safety regulator; about the transfer of land for Academy schools; about the review of maps of open country and registered common land; about the regulation of childminding; about qualifying leases under the Building Safety Act 2022; about road user charging schemes in London; about National Parks, areas of outstanding natural beauty and the Broads; and for connected purposes.

[26th October 2023]

Be it enacted by the King's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

Relevant statutes and guidance for planning policy

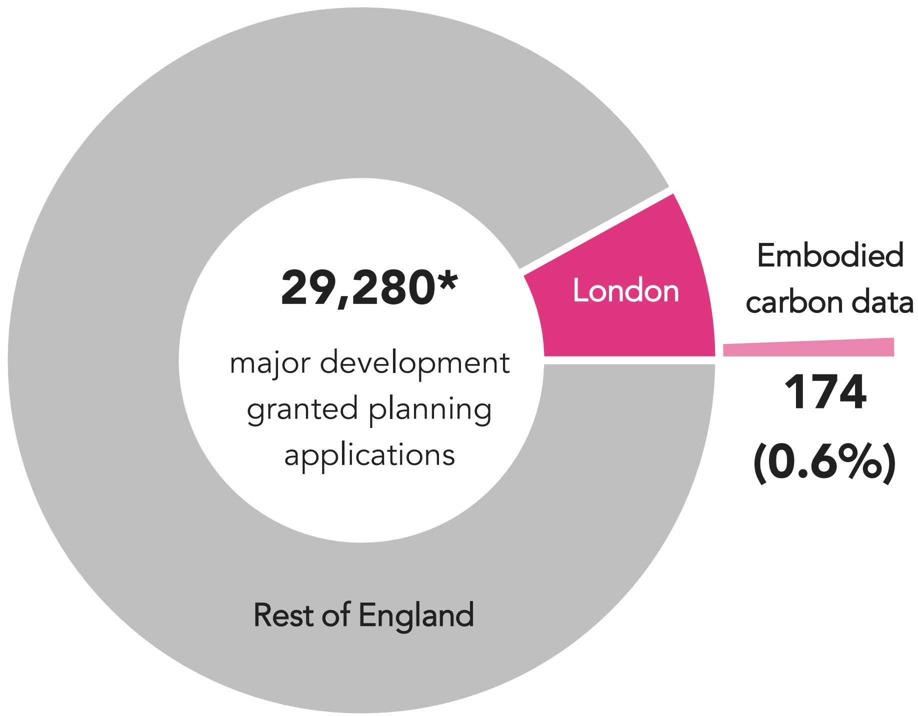
Current national planning policy not driving embodied carbon reductions

Recent data highlights the limited influence of national planning policy in driving reductions in embodied carbon. Statistics from the Ministry of Housing, Communities & Local Government (Planning Applications PS2) show that between January 2021 and December 2023, a total of 29,280 major planning applications were granted across England. Of these, 2,345 were in London. Within London, 366 were referable applications to the Mayor, yet only 174 of these included embodied carbon data.

This means that across England, embodied carbon data was provided for just 0.6% of total granted major applications during this period. Despite the Greater London Authority's progressive Whole Life-Cycle Carbon policy (Policy SI 2), which has established London as a frontrunner in addressing embodied carbon, the data reveals that there is still significant progress to be made.

The current referable threshold applies only to a limited subset of developments, such as those with over 150 residential units, buildings over 30 metres in height (outside the City of London), or schemes on Green Belt or Metropolitan Open Land. As a result, a number of applications are not subject to any embodied carbon reporting requirements.

While reporting and benchmarking results is an important first step, it is not sufficient. To meaningfully reduce emissions, embodied carbon requirements must be expanded to cover all major applications, not just those that meet narrow referable thresholds. The next urgent step is turning benchmark reporting into setting clear embodied carbon limits, mirroring the approach already adopted for operational carbon. This evidence base provides suggested limits for upfront carbon. These limits propose reduced emissions compared to the current London Plan benchmarks.



*Source: https://www.gov.uk/government/collections/planning-applications-statistics

Graph showing total number of applications granted permission in England (2021-2023). A very small percentage report on embodied carbon data.

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Embodied carbon and whole life carbon

This section introduces a series of embodied carbon and Whole Life Carbon policy recommendations.

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Embodied carbon and whole life carbon | Summary of requirements in the current London Plan

Existing policy and guidance

The Greater London Authority (GLA) uses policy SI 2 F in the London Plan (2020) to require large scale referable schemes to calculate embodied carbon and whole life-cycle carbon emissions.

The GLA published the associated Whole-Life Carbon (WLC) assessment guidance (2022) which includes life cycle carbon and upfront carbon benchmarks to compare against. It is important to note that they are just benchmarks, not targets to be met. A series of aspirational benchmarks have also been provided to encourage improved performance. A template is also provided to aid submission of WLC data. The aim of the policy was to collect enough data to allow future policy to set limits.

Reducing embodied carbon emissions

There has been an increase in overall quality of data but also an increase in the reported emissions over the policy period due to upskilling of analysts and changes in measuring methodology. While the policy has benchmarks for various building types, it does not enable planners to enforce performance requirements to reduce emissions. The granularity of results has also proved challenging when analysing the results and determining future policy direction.

Whole Life Carbon reporting

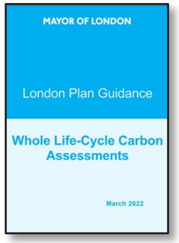
Referable buildings are required complete the detailed spreadsheet at key points in the planning system to meet the policy:

- Pre-planning
- Planning submission
- Post-completion

Applicants are required to complete a detailed GLA spreadsheet, as part of the planning submission, that covers reduction opportunities, material quantities and emissions per life cycle stage for each building element.

Verification

AECOM and Bioregional support the GLA in reviewing the data received.



Whole Life-cycle carbon assessment guidance - GLA

GLA Whole life carbon assessment guidance - SI 2 F - Minimising greenhouse gas emissions

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

Upfront carbon benchmarks (modules A1-A5 excluding upfront biogenic carbon):

- Residential <850 $kgCO_2e/m^2$ (<500 $kgCO_2e/m^2$ aspirational)
- Offices <950 $kgCO_2e/m^2$ (<600 $kgCO_2e/m^2$ aspirational)
- Schools <750 $kgCO_2e/m^2$ (<500 $kgCO_2e/m^2$ aspirational)
- Retail <850 $kgCO_2e/m^2$ (<550 $kgCO_2e/m^2$ aspirational).

Life cycle embodied carbon benchmarks (modules B-C excluding operational carbon B6 & B7):

- Residential <350 $kgCO_2e/m^2$ (<300 $kgCO_2e/m^2$ aspirational)
- Offices <450 $kgCO_2e/m^2$ (<370 $kgCO_2e/m^2$ aspirational)
- Schools <250 $kgCO_2e/m^2$ (<175 $kgCO_2e/m^2$ aspirational)
- Retail <200 $kgCO_2e/m^2$ (<140 $kgCO_2e/m^2$ aspirational).

Life cycle embodied carbon benchmarks (modules A-C excluding operational carbon B6 & B7, including biogenic carbon):

- Residential <1,200 $kgCO_2e/m^2$ (<800 $kgCO_2e/m^2$ aspirational)
- Offices <1,400 $kgCO_2e/m^2$ (<970 $kgCO_2e/m^2$ aspirational)
- Schools <1,000 $kgCO_2e/m^2$ (<675 $kgCO_2e/m^2$ aspirational)
- Retail <1,050 $kgCO_2e/m^2$ (<690 $kgCO_2e/m^2$ aspirational).

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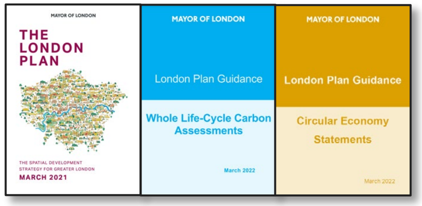
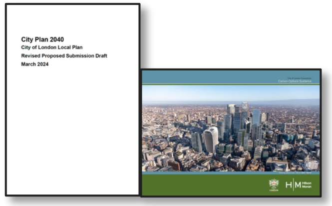
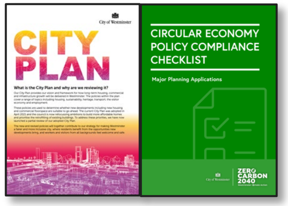
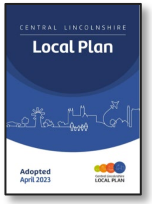
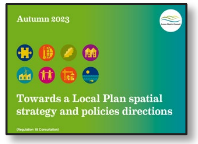
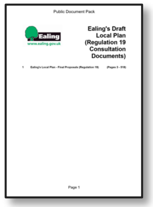
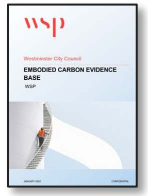
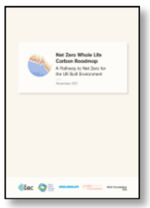
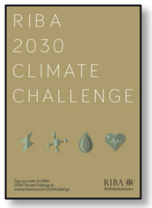
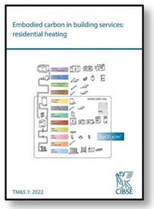
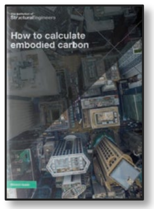
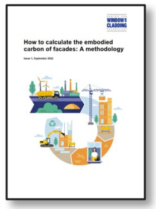
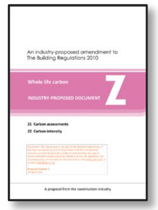
Embodied carbon and whole life carbon | Review of existing approaches

The table below summarises key sources that define existing approaches to reducing embodied carbon of buildings in the UK. The sources are categorized into two main areas: a) national and local regulations and b) industry guidance and best practice documents. They outline strategies for new and/or major refurbishments across various typologies, including residential and non-residential. All research on the below documents has been included in the appendix.

Embodied carbon	
Source	Document
National building regulations and existing/ emerging/ draft local plans	 *The London Plan 2021 and guidance on whole life-cycle carbon assessments and circular economy statements*  *City of London local plan draft policy and carbon options guidance*  *City of Westminster city plan draft policy and circular economy policy compliance checklist*  *Central Lincolnshire updated local plan*  *Lewes district council local plan*  *Bristol City Council draft local plan*  *Bath & North East Somerset sustainable construction checklist SPD*  *Camden draft new local plan 2024*  *Tower Hamlets draft new local plan 2024*  *Ealing draft new local plan 2024*  *Enfield draft new local plan 2024*  *Newham draft new local plan 2024*  *South Staffordshire Local plan (under examination)* *Evidence bases*  *West of England evidence-base for embodied carbon policy*  *Westminster embodied carbon evidence-base*  *Essex embodied carbon evidence base*
Industry documents	 *Committee on Climate Change*  *LETI embodied carbon primer*  *UKGBC Net zero whole life carbon roadmap*  *RIBA 2030 Climate Challenge*  *UK Net Zero Carbon Building Standard*  *RICS Whole life carbon assessment 2nd ed. 2023*  *CIBSE TM65 Embodied carbon in building services*  *IStructE How to calculate embodied carbon*  *CWCT How to calculate embodied carbon of facades*  *Part Z Industry proposed amendment to regulation*  *BREEAM UK New Constructionv6.1*

Embodied carbon and whole life carbon | Four areas of focus for the policy framing

Overarching embodied and whole life carbon policy

All new buildings should be designed with embodied carbon emissions minimised in order to comply with the Climate Change Act requirements and stay within the International 1.5deg Paris targets.

This study proposes four areas of focus for GLA policy framing that would minimise embodied carbon emissions:

Proposed policy requirement	Summary requirement
1. Lean design and material efficiency for low upfront carbon	Reduce embodied carbon through existing building retention, good design and material efficiency
2. Reduce and limit upfront carbon – residential and use class E commercial buildings	Meet upfront carbon limits for specific building typologies
3. Reduce life cycle embodied carbon and report whole life carbon	Report Whole Life Carbon emissions for specific development scales
4. Administering upfront carbon limits	Employing a mechanism to support policy enforcement.

Reducing embodied carbon emissions – lean design

Policy SI 2F has had a huge impact in upskilling teams and clients working on large scale development across London in the discipline of calculating, reporting and discussing embodied and Whole Life Carbon emissions. This impact has also been seen more broadly across the UK. The 'lean design' proposed policy requirement attempts to make meaningful reductions in emissions through consideration of the key actions that can be taken to improve building design. In addition, this type of policy can influence a greater range of projects, beyond referable development.

Reducing embodied carbon emissions – upfront carbon limits

In order to generate meaningful emission reductions, the evidence base has reviewed where and how to set upfront carbon limits. Applicants have the greatest ability to meaningfully reduce upfront carbon. There is enough data for residential and office building sectors to be able to introduce limits. The evidence base includes a review of pros and cons, the building typologies and scales of development.

Whole Life Carbon reporting

It is noted that since 2023 the RICS WLCA PS 2^{nd} ed. has standardised embodied and Whole Life Carbon reporting so the data collection spreadsheet can be aligned and reporting streamlined. It is considered that ongoing reductions can not be made if emissions calculation and reporting is not ongoing.

Administering upfront carbon limits

As a mechanism to support policy enforcement and status as well as allow some flexibility where it is agreed with planning officers that limits cannot be met, a financial payment could be considered. Post completion could be the fairest point to apply this as the upfront data represents the as-built scenario.

How the framework compares and/or aligns with industry definitions

Industry standards

The RICS WLCA PS 1st ed. (2017) was the first UK standardised measurement methodology for embodied and Whole Life Carbon. Subsequently, voluntary built environment industry bodies launched information and guidance to raise awareness and translate the technical documents for a wider group of professionals. This includes:

- UKGBC Net Zero Carbon framework (2019)
- LETI (Low Energy Transformation Initiative) Climate Emergency Design Guide and Embodied Carbon Primer (2020)
- LETI Embodied Carbon Alignment work (2022)
- RIBA 2030 Challenge (aligned metrics 2022)
- LETI Carbon Definitions (2022)
- Part Z national campaign to mandate WLCA (2022 onwards)
- The UK NZCBS Pilot (2024) - a science-based methodology for achieving net zero carbon buildings in the UK including embodied and operational emissions
- The current RICS WLCA PS 2nd ed. (2023) contains key definitions of metrics for embodied and Whole Life Carbon and how to calculate them. Policy should align with this methodology.

Evidence bases developed for planning policy

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

Key metrics these policies commonly refer to and align with those outlined opposite. The benefits of these metrics are documented and supported by the industry. Note, this is with the expectation that other policies are in place to require reporting and limiting of operational energy and water usage in kWh/m² and m³/person/day.

Carbon boundary	Life cycle stages/modules	Unit of measurement
Pre-construction carbon	A0 (where relevant)	$kgCO_2e$
Upfront biogenic carbon (sequestered biogenic carbon stored in any construction products incorporated into the asset)	A1–A5	$kgCO_2e$
Upfront carbon	A0–A5, excluding sequestered biogenic carbon stored in any construction products incorporated into the asset	$kgCO_2e$
Embodied carbon	A–C, excluding B6–B8	$kgCO_2e$
Operational energy, broken down by energy type and purpose	B6	kWh/yr
Operational water usage, broken down by water type and purpose	B7	m³/day
Operational carbon	B6 and B7	$kgCO_2e$/yr
User carbon	B8 (where relevant)	$kgCO_2e$/yr
Benefits and loads beyond system boundary	D1	$kgCO_2e$
	D2	$kgCO_2e$

Overview of carbon reporting with the life cycle modules and units used for assessment (Source RICS WLCA PS 2nd ed. (2023))

Metric	Benefit of reporting
Upfront carbon and sequestered carbon	Communicates the carbon emissions generated by constructing the asset. Communicates carbon storage benefits from bio-based materials.
Life cycle embodied carbon	Communicates the carbon emissions generated by constructing, maintaining and deconstructing the asset over a standard period of 60 years. Used to understand the benefit of specifying the original building for longevity.
Operational energy	Communicates energy intensity of the asset
Operational water	Communicates water usage within the asset
Operational carbon	Communicates the carbon emissions generated by using energy and water during operation

Key metrics often referred to by panning policy in local authorities across UK and London

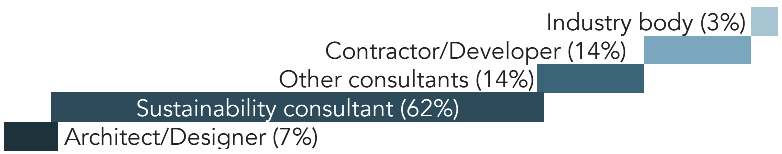
Survey on 2021 London Plan WLC reporting requirement | Findings

As part of a stakeholder engagement exercise a short online survey was undertaken to analyse how industry stakeholders perceive the performance of current WLC policy as introduced in 2021. It received 29 responses.

Key findings:

- Most respondents are quite favourable about policy's outcomes
- Almost everyone (93%) feels it has been a positive step towards producing a Net Zero Carbon built environment
- However, many cast doubt about its actual effectiveness in delivering lower-carbon built assets (79% unsure or disagreeing)
- The majority agrees that the policy improves project workflows towards more building retention and refurbishment, lower carbon design, and better client engagement
- Opinions are divided on the quality of the collected data
- The requirements for applicants, related to time and cost are not perceived as excessive considering its desired impact
- The planning deliverables for calculating and reporting WLC, are considered to be at about the right level
    - The consensus is especially strong for the planning stage (82%)
    - A significant portion consider the requirements to be insufficient (post-completion 32%, and pre-planning 20%)
    - While only 10% think these are excessive

Respondent's self-declared professional background:



The 2021 London Plan WLC reporting requirement:	Disagree	Unsure	Agree
Is a positive step towards a Net Zero Carbon built environment	0%	7%	93%
Supports building retention and refurbishment	7%	31%	62%
Incentivises design with lower upfront carbon	10%	31%	59%
Incentivises design with lower life cycle embodied carbon	17%	28%	55%
Incentivises design with lower whole life carbon	21%	28%	52%
Ensures clients engage with carbon emissions data for making informed decisions	14%	34%	52%
Supports good quality WLC and embodied carbon data for future benchmarking and limit setting	28%	31%	41%
Actually delivers lower carbon built assets	38%	41%	21%
Is not too costly when balanced against the desired impact	3%	35%	62%
Is not too time consuming when balanced against the desired impact	10%	28%	62%

Key: Strongly disagree, Disagree, Unsure, Agree, Strongly agree

Bearing in mind its intended environmental benefit, the 2021 London Plan's calculation and reporting requirements are:	Not enough	About right	Excessive
Pre-planning	20%		12%
At planning	4%		14%
Post-completion	32%		10%

Key: Not enough / Excessive, Somewhat not enough / somewhat excessive, About right

Results of the online survey analysing how industry stakeholders perceive the performance of WLC policy as introduced in 2021.

Stakeholder engagement summary | Embodied carbon and Whole life carbon

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Four stakeholder engagements were held between May and July 2025 inviting industry specialists, developers and housing providers and the local authorities to inform the development of this evidence-base. Feedback on embodied and whole life carbon has been summarised below:

Upfront Carbon limits

- Strong agreement, in principle, to setting limits for upfront carbon
- Majority were comfortable with upfront carbon limits of 500 and 600 $kgCO_2e/m^2$GIA for residential and offices, respectively (pending clarity on scope inclusions and exclusions)
- Alignment with UK NZCBS considered useful, even if this is the aspirational limit
- Support for applying limits to residential and office typologies with consideration of other sub-typologies including hotel, co-living and purpose built student accommodation (PBSA)
- Minimal resistance to extending policies beyond referable projects

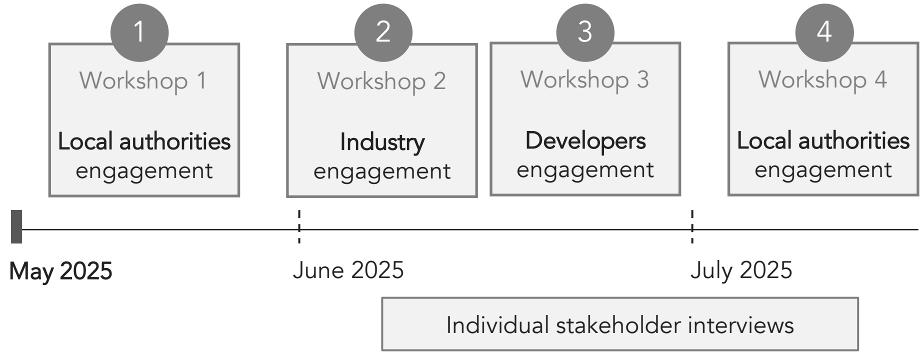
Whole Life Carbon

- General support for continuing to report whole life carbon.
- Minimal adverse discussion about extending policies beyond referable projects only
- Alignment with *RICS WLCA PS 2nd ed.* reporting strongly supported
- Long term goal of setting life cycle embodied carbon limits

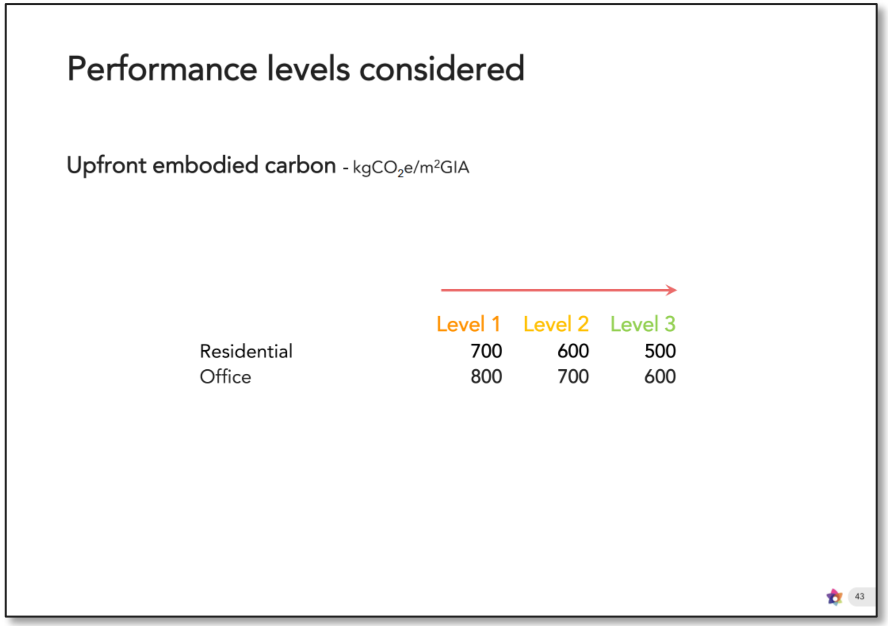
Governance

- Support for providing more emphasis on material efficiency for all buildings through the planning system
- Discussions touched on third party verification, enforcement of limits through consultation, pre-commencement conditioning and financial payments if performance is not met

Further detail on the stakeholder engagement can be found in the appendix.



Stakeholder engagement timeline.



Performance levels considered

Upfront embodied carbon - $kgCO_2e/m^2$GIA

	Level 1	Level 2	Level 3
Residential	700	600	500
Office	800	700	600

Early stage performance levels shared during stakeholder's engagement workshops

4.0

Lean design and material efficiency

This section sets out how lean design and material efficiency can be used by the design team to reduce embodied carbon, prior to the calculation of upfront carbon or whole life carbon.

This is considered a low-effort and low-cost way to reduce embodied carbon.

Lean design and material efficiency | Potential policy framing

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Why are we proposing this policy?

To reduce embodied carbon in buildings through consideration of the key actions that can be taken to reduce embodied carbon through improved building design. There are negligible to no process costs associated with this policy.

Reducing embodied carbon through design

Reducing embodied carbon begins with lean design, whether through efficient structure, architecture or building services. Reducing the quantity of materials is as important as the selection of low embodied carbon materials. Calculation of embodied and whole life carbon should come after embodied carbon has been reduced as part of iterative design and material selection. Design can be appraised through four simple steps implemented without additional specialist consultancy, to:

- Consider the effect of building materiality and design
- Review features that have the potential to increase embodied carbon
- Understand the efficiency of the building form
- Review wall and superstructure options to understand their impact

This would be a low-effort and low-cost way to reduce embodied carbon though good design, without the need specialist consultants, that can be applied to all scales of new development. Information could be collected in a simple proforma or as part of a design and access statement.

Supplementary design guidance should be created to support this policy's recommendations. This could include:

- An explanation of what good design for material efficiency, material selection and low embodied carbon outcomes look like. Include information on why material efficiency and form factor are important and how this compares to material selection.
- Examples of upfront embodied carbon figures for various wall and structure types in a GLA 'pattern book'.

The implementation section of this report explores the guidance submission areas further.

Our research suggests framing a policy with the following requirements and outcomes:

Lean design and material efficiency for low upfront carbon

All new buildings should demonstrate that upfront carbon has been considered and reduced where possible through existing building retention, good design and material efficiency. As part of the planning process applicants should submit a summary of the efforts made to reduce upfront carbon. This should include:

- *A summary of the construction type and the efforts made to design a lean, low carbon structure and building design. This should take into account efficiency of material use and types of material used.*
- *State any non-typical features that might add to the upfront carbon. Provide justification where large volumes of material are proposed to be used due to specific design features (such as basements, podiums, large cantilevers, non-typical structural interventions).*
- *A calculation of the building form factor (exposed external surface area/gross internal floor area).*
- *Compare the upfront carbon ($kgCO_2e/m^2$) of external wall and superstructure proposals with standard build ups provided in a GLA produced 'pattern book'. This should included justification for the selected wall and structure type. Standard material specifications (e.g. RICS defaults) can used in the pattern book.*

5.0

Upfront carbon

This section sets out the different levels of performance considered for setting upfront carbon limits. It demonstrates their technical feasibility and summarises the cost associated with achieving them.

Upfront carbon | PROS and CONS of setting upfront carbon limits

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Context

Many local authorities and London boroughs have created evidence bases and emerging local plans including upfront embodied carbon limits, targets or benchmarks. These often share the same metrics but are often nuanced and the targets and reporting requirements can differ.

Options

There are options for how to introduce upfront carbon limits into policy; this is not an 'all or nothing' proposal. These options include:

- Specify particular building scales and typologies
- Setting an achievable and viable limit while still driving emissions reductions
- Setting a baseline limit and aspirational target
- Gradually increasing the requirements during the period of the next policy along a pre-agreed trajectory to protect against rapid advances and material decarbonisation

Summary

Upfront carbon limits will place a strong emphasis on the importance of embodied carbon in the context of Net Zero Carbon.

Data quality

Our research and modelling has shown that calculation and reporting of embodied carbon is still maturing. However, due to the number of datasets available, the A1-A5 data for residential and use class E commercial typologies covering major and referable scale schemes is the most certain. Existing datasets for less represented sectors have been based on RICS WLCA PS 1st ed. which produced less granular and lower quality results than RICS WLCA PS 2nd ed. Going forwards data quality will improve, but reported emissions may rise as calculations get more accurate.

Upfront embodied carbon limits

Major and referable residential and use class E commercial projects should meet upfront carbon limits (A1-A5).

If upfront embodied carbon limits are set

PROS	CONS
✓ Can be consistent with a Net Zero Carbon built environment, through use of an science-based limit	X Current data quality makes it harder to know where to set the limits
✓ Enhances importance of embodied carbon	X Policy will not be able to set limits for all building typologies, however benchmarks could be used for other typologies.
✓ Simple, clear and measurable	X Greater onus on analysis and potential addition of third party verification
✓ Less onus on officers, if a limit is set its easier to assess compliance with the policy by officers rather than determining if sufficient attention has been paid to reducing embodied carbon	

If upfront embodied carbon limits are NOT set

PROS	CONS
✓ Simpler, policy structure with reduced process costs	X Not consistent with Net Zero Carbon built environment
	X Reduces the potential of the policy to reduce embodied carbon
	X Does nothing to solve the inconsistent local policy landscape evolving around this issue

Upfront carbon | Summary of methodology, ideas and suggestions

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Strengthening upfront carbon performance

As new buildings become more energy 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 limits are set on upfront carbon emissions, to make sure the built environment industry is designing, and constructing buildings that have overall low carbon emissions. This evidence base provides options for upfront carbon limits, which aim to strengthen the current London Plan upfront carbon benchmarks that in current policy are used for comparison only.

Setting limits around two typologies

The quality of reporting and data used during the assessments for upfront carbon is constantly being improved by the industry. The measuring methodology written by RICS has also developed. Therefore, this evidence-base seeks to recommend limits for the two building typologies where confidence in data is highest - residential and commercial buildings; use class E.

Use Class E

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). Therefore the limits proposed in this study will apply to these uses.

Typologies not covered

Sub-sectors of residential, including co-living, hotels, later living and student residential are beyond the scope of this study. Lab-enabled offices as a sub-sector are also not covered. It is suggested that further investigation is required before specific limits can be set for these typologies..

Development of performance levels

The technical feasibility of upfront carbon limits has been tested in this evidence base through the introduction of a range of performance levels. This was carried out through carbon modelling using the *RICS WLCA PS 2nd ed.* methodology and use of OneClick carbon tool. A cost assessment of achieving the performance levels was also undertaken simultaneously.

Major refurbishment

In this chapter it is assumed that major refurbishment will adhere to the same requirements as new build.

Comparing upfront carbon requirements

Performance levels in UK NZCBS, LETI, implemented and/or emerging local plans have been compared against the performance levels developed for the two typologies. This allows an understanding of the range of levels currently being used.

Informing future limits

The GLA should consider having a mechanism in policy to decrease the limits during the plan, as certainty around the limits are firmed up and grid and material decarbonisation take effect. Some of this has ben covered in the Implementation section of this report.

Upfront carbon | Industry alignment on embodied carbon limits

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UK Net Zero Carbon Building Standard (UK NZCBS)

The UK NZCBS Pilot Version was launched in September 2024. It is a science-based system, aligned with the 1.5deg Paris Agreement and achieving Net Zero in the UK by 2050. Therefore, the limits (including energy use and embodied carbon) are correlated with technical feasibility and the national carbon budget.

The UK NZCBS sets out the technical details and evidence required for meeting the requirements. In the future, following the release of Version 1, projects will be able to verify that a project conforms to the Standard.

The UK NZCBS sets limits for upfront carbon (A1-A5, $kgCO_2e/m^2$) by year, from 2025 to 2050, for new build and retrofit projects across a range of sectors.

Using UK NZCBS limits as aspirational targets

Stakeholders are keen that the London Plan acknowledges the ambition and science based limits in the UK NZCBS. This evidence base proposes that the limits are referenced in policy as best practice and aspirational.

Using UK NZCBS limits to set benchmarks for sectors where this study does not propose limits

The UK NZCBS covers multiple sectors, which could be referenced to allow the setting of performance requirements across sectors other than those proposed to have limits in policy by this evidence base. Given the modelling suggests that the higher upfront limit is approximately 25% higher (worse performing) than the UK NZCBS limits these boundaries could be set as the upper and aspirational lower upfront carbon performance parameters.

There is a decision to be made regarding whether to adopt the stepped nature of the UK NZCBS limits and this is covered on a later page.

↓ Date of commencement on site	Commercial Residential	Culture, Worship & Entertainment		Data Centres	Healthcare	Higher Education	Homes		Hotels	Offices		Retail	School	Science & Technology	Sport & Leisure	Storage & Distribution
	-	General	Performance Spaces	-	-	-	Single family homes	Flats	-	Whole building	Shell and core limit	-	-	-	-	-
	kgCO₂e/m²GIA															
2025	580	570	855	745	790	640	430	565	670	735	475	715	530	755	820	635
2030	435	425	640	555	590	480	290	380	500	550	355	535	395	565	610	475
2035	285	280	420	365	390	315	190	250	330	360	230	350	260	370	405	315
2040	185	180	270	235	250	205	125	160	215	235	150	225	170	240	260	200
2045	105	105	155	135	145	115	70	95	125	135	85	130	100	140	150	115
2050	45	45	70	60	65	50	30	40	55	60	35	60	45	60	65	50

Example of the 2025, 2030, 2035, 2040, 2045 and 2050 UK NZCBS pilot version upfront carbon limits for new developments.

Upfront carbon | Performance levels | Methodology

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Performance levels have been developed for upfront carbon (A1-A5) for new build residential and use class E commercial buildings. This provides a range of performances suitable for the new London Plan.

The upfront carbon of a building depends on its form, structural grid, materiality, fabric and extent of finishes and fit out. Material efficiency processes can be applied as an exercise to reduce the quantity of material used in a building. However, material selection is often defined by fire regulations, and specific solutions (such as cement replacement). These considerations partially define where limits can be set. An added consideration is the decarbonisation of materials through a cleaner electricity grid and improved processes, which will lead to natural decreases over time. The direction of this change is certain; the speed of this change is more uncertain.

The proposed levels represent:

- **Level 1:** Business as usual construction methods and materials.
- **Level 2:** A carbon and cost optimised option sitting between level 1 and level 3.
- **Level 3:** Targets taken from UK NZCBS (2025 limits) could be used as an aspirational level for the London Plan.

The modelling carried out as part of this evidence base shows that all of the levels are technically feasible. **This report recommends the adoption of Level 1 for <11m residential, and Level 2 for >11m residential and use class E.**

Aligning with the UK Net Zero Carbon Building Standard

The upfront carbon limits set by the UKNZCBS reflect the most recent widely supported performance levels by a number of leading industry bodies – BBP, BRE, CIBSE, IStructE, the Carbon Trust, LETI, RIBA, RICS and the UKGBC. Therefore, level 3 – which represents best practice - is aligned with these limits. Specifically, for residential buildings <11 m, it aligns with the 2030 limit for single-family homes, for ≥11 m, it aligns with the 2025 limit for flats, and for use class E it aligns with the 2025 Shell & Core limit with an addition for Cat A. Further details can be found later in this section of the report.

$kgCO_2e/m^2$ (GIA)	Level 1	Level 2	Level 3
Residential (<11 m in height)	500	400	300
Residential (≥11 m in height)	850	700	565
Use class E	950	700	605

Upfront carbon – performance level options

Recommended performance levels

- Residential (<11 m in height) – Level 1 – allows for the use of non-combustible external wall build-ups. Whereas level 2 and 3 require the use of combustible materials.
- Residential (≥11 m in height) – All levels allow for non-combustible external wall build-ups to be used. Level 2 favours brick (robust and low maintenance) over rainscreen cladding (higher carbon content than brick with shorter replacement cycles) and supports the use of standard levels (approx. 25%) of cement replacement.
- Use class E – Level 1 and Level 2 allows a typical palette of materials to be used. Level 2 requires some thought about material efficiency measures to meet the limit.

The development of the performance levels

The performance levels have been developed by understanding the:

- Current London Plan benchmarks and submission data collected to date.
- Embodied carbon data published as part of other local policy evidence-bases.
- Bespoke embodied carbon modelling carried out for this project.
- A review of technical specifications and corresponding material quantities and upfront carbon for real projects in the design or construction phase.
- A review of the LETI and UK NZCBS targets/ limits and an understanding of their development.

Upfront carbon | Analysis of submission to date against GLA benchmarks

Analysis of data from past GLA submissions

The team have received the data from AECOM on behalf of the GLA, representing applications from RIBA Stages 2-4 from years 2021–2023, including Outline, Detailed and Hybrid Planning Applications.

The data for offices and residential schemes has been analysed as part of this evidence base. The upper bar chart shows the performance of residential schemes compared against the GLA benchmarks. The majority of projects (93%) are achieving the GLA benchmark, with a considerable amount (35%) achieving the aspirational benchmark.

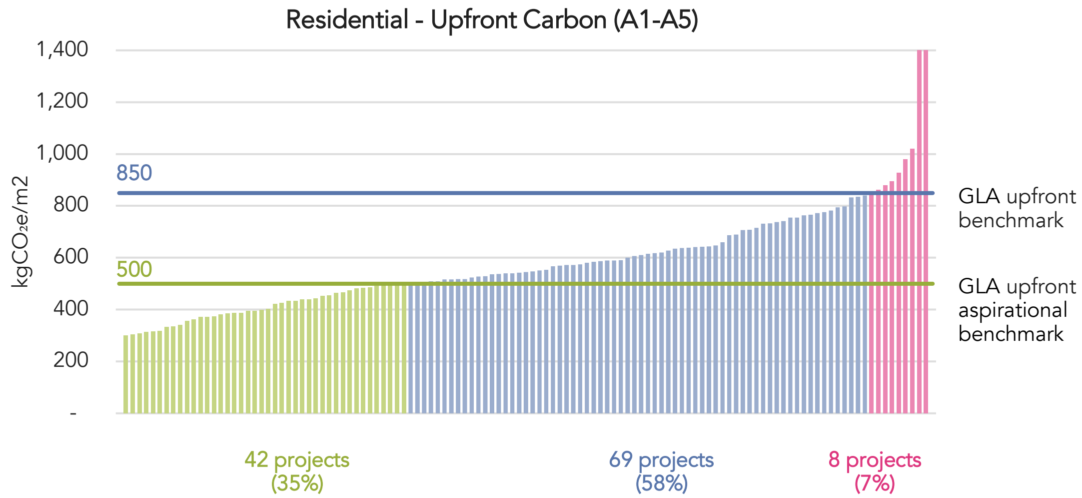
The lower bar chart shows the performance of office buildings compared against the GLA benchmarks. Just under half of the projects (47%) are achieving the aspirational benchmark, with the majority (92%) under the upper benchmark.

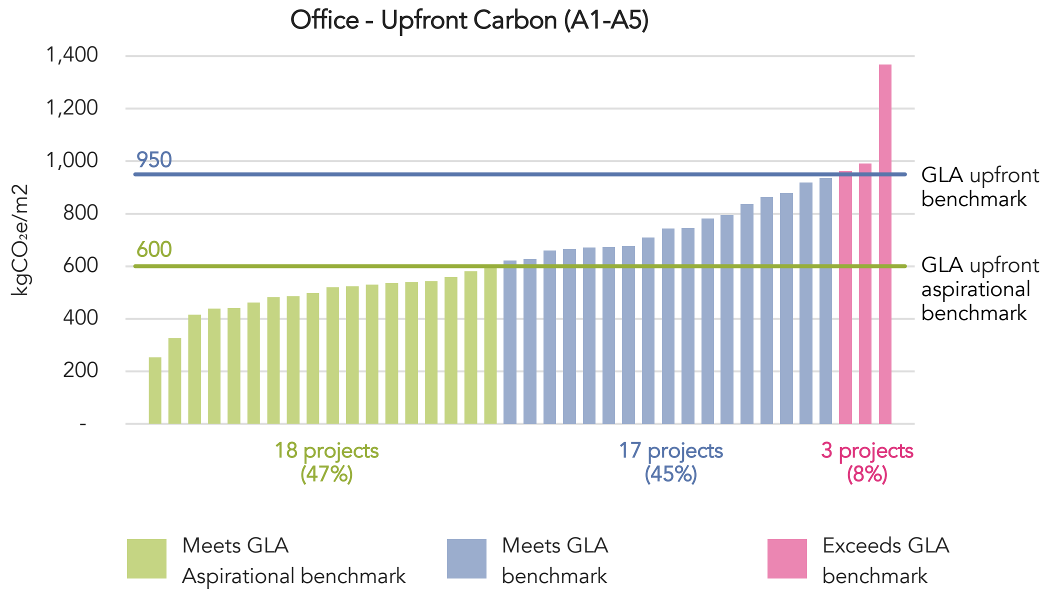
Getting more from the numbers

The current GLA guidance requires WLC assessments to be carried out at a development scale, rather than building scale. One of the learnings from the collection and review of WLC assessment submissions to the GLA is that there is a lack of granularity and transparency making it very difficult to compare the embodied carbon emissions from one development to another. It is advised that the GLA refer to the most current version of the RICS WLCA PS, with the current version being *RICS WLCA PS 2nd ed*. This improves the granularity, consistency and transparency of calculations.

Beyond the numbers

While it is useful to analyse the upfront carbon data received as part of planning applications, the planning submissions also contain qualitative data which would provide a picture of how the projects are performing. This is time consuming and not practical to analyse at scale. Therefore, consideration should be given to how much data (qualitative and quantitative) should be collected in future and for what purpose. This could assist in streamlining the submission and review of planning applications.





GLA planning application data representing applications from Stages 2-4 from years 2021–2023, including Outline, Detailed and Hybrid Planning Applications.

Upfront carbon | The impact of material decarbonisation

Upfront carbon changes over time

The UK NZCBS limits decrease over time. From 2025-2030 this is a combined effect of expected material efficiency measures and material decarbonisation. From 2030 beyond it is expected upfront carbon savings will be mainly achieved through material decarbonisation.

Material efficiency

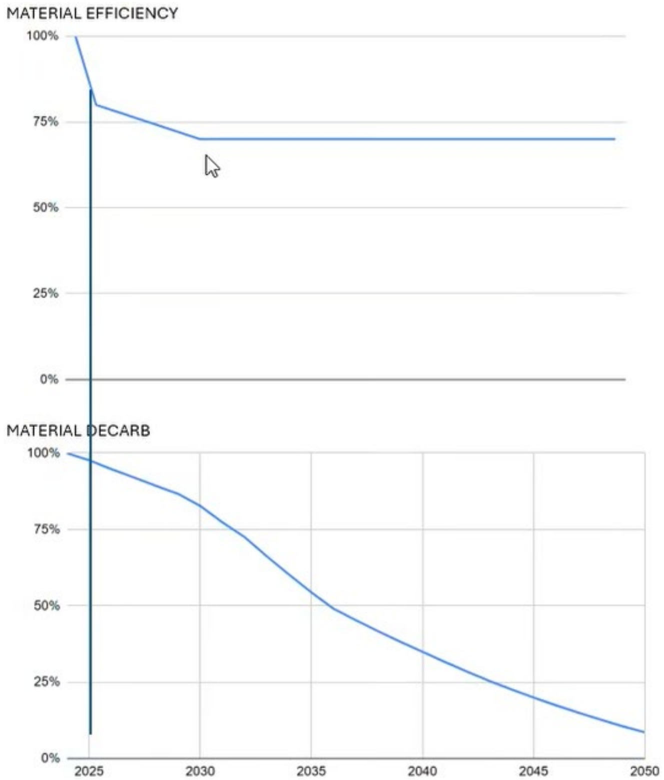
UK NZCBS work predicted there would be some embodied carbon savings achieved via improvements in the efficient use of materials. These would be identified through carrying out more frequent and higher quality embodied carbon analysis. This has been quantified at 20% initially with an additional 10% achieved until 2030 when the opportunities plateau.

Material decarbonisation

The trajectory for material decarbonisation is based on industry commitments, largely derived from the 2021 UKGBC Roadmap. Each major building material industry has their own net zero plan and timescale for transferring to clean energy, extraction, manufacturing processes and transport. This data has been aggregated into an expected decarbonisation trajectory.

Stepped upfront carbon limits for the new London Plan

The predicted material decarbonisation means London Plan policy should contain the mechanism to reduce upfront carbon limits so they retain their purpose and the policy does not get easier over time. Options for this are covered in the implementation section



Data from UK NZCBS to illustrate the % of material efficiency and decarbonisation allowed for in the pilot limits

Upfront carbon $kgCO_2e/m^2$ (GIA)	2025	2026	2027	2028	2029	2030	2040	2050
UK NZCBS limit	735	700	660	625	590	550	235	60
UK NZCBS limit (excl. material decarbonisation)	735	713	690	669	655	643	643	643

Table demonstrates extracted UK NZCBS pilot limits for offices (whole building) with and without material decarbonisation included

Reduce and limit upfront carbon | Potential policy framing

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Why are we proposing this?

To reduce and limit upfront carbon in buildings through design, modelling and meeting of limits. Applicants have the greatest ability to meaningfully reduce upfront carbon. There is enough data for specific building sectors and use classes to be able to introduce limits

Applies to

Major and referable developments including major refurbishments in the residential and use class E commercial sectors.

Performance recommendations

The proposed performance levels and their technical feasibility and cost implications have been provided in this section and the appendix. The implementation section proposes that if exemplary upfront carbon performance is achieved, officer discretion could relax other criteria. This might be the case for major refurbishment for example. Alignment with the UK NZCBS was deemed positive in the stakeholder engagement. Based on the data analysis and modelling our recommendation is not to directly apply the UK NZCBS limits but to refer to them as representing aspirational performance. For sectors without limits set in policy, an upper (poorer performing) and aspirational benchmark can be set. Based on the UK NZCBS aspirational benchmarks for the majority of sectors now exist and the upper benchmark can be set at a defined % above the aspirational.

Future-proofing

As embodied and Whole Life Carbon reporting and limits are changing so rapidly, the policy should be flexible to allow for the limits to decrease during the policy term. As described in a previous section, material decarbonisation is expected to drive much of this decrease.

Where future versions of RICS WLCA PS are released, the methodology should be appraised for the typologies and against the limits set in policy. Ideally the most current RICS methodology should be adopted unless it conflicts or dramatically alters the policy limits set.

Our research suggests framing a policy with the following requirements and outcomes:

Reduce and limit upfront carbon

- *Major and referable residential and use class E commercial projects, including major refurbishment (Shell & Core and Cat A), should meet upfront carbon limits (life cycle stages A1-A5), measured in kgCO_2e/m^2*
- *Use Class E project should also report the expected Cat B emissions separately*
- *Photovoltaics electricity generation systems should be limited in regard their upfront carbon per unit of generation, measured in kgCO_2e/kWp*
- *Limits should decrease during the policy period to reflect the effect of expected material decarbonisation*
- *Calculations should use* **RICS WLCA PS 2nd ed 2023** *and* ***CIBSE TM65 for MEP*** *and provide commentary against the low carbon approaches employed.*

Sectors without specific upfront limits

- *Major and referable projects within sectors not governed by the upfront limit setting policy should still be captured by the Whole Life Carbon reporting policy*
- *Calculations should use* **RICS WLCA PS 2nd ed 2023**
- *Upfront carbon is calculated as part of Whole Life Carbon analysis*
- *Therefore, it is possible to set benchmarks for upfront carbon for the majority of sectors and limits in the future*
- *This will allow officers to interrogate further if a project sits above an expected level of performance*

Reduce and limit upfront carbon | Estimated cost impact of policy

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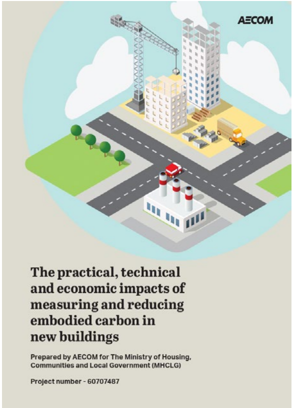
A survey of around 150 carbon modelling practitioners undertaken by AECOM for the UK Government[1] identified that early design stage performance estimation and design optioneering can typically be undertaken for a process cost of under £10k per project (depending on size and complexity). While upfront carbon calculation and reporting could be undertaken for approximately £7,500 per project.

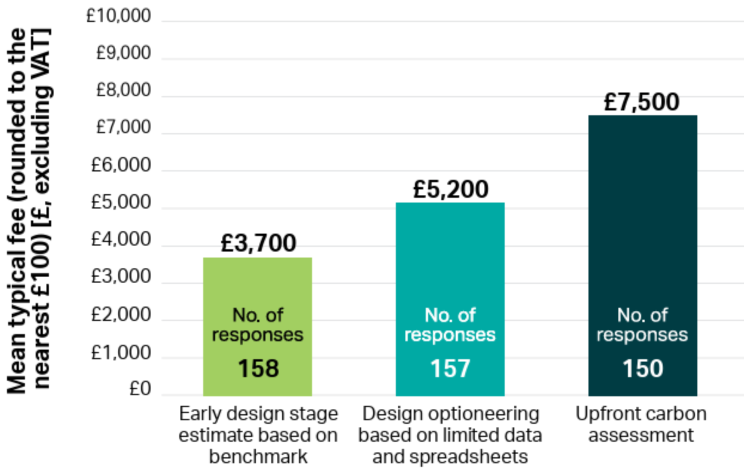
Undertaking these design optioneering activities will increase the likelihood of cost-effective lean design opportunities being identified. It would be expected that a requirement to undertake lean design reviews would increase the uptake of these cost-effective solutions, especially where a carbon limit is introduced. A method of integrating this into building design is covered in BS8895, also referenced within the BREEAM MAT 06 credit. When material efficiency principles are followed, there is usually a cost reduction co-benefit. See the cost studies undertaken for this evidence base as an example. The most cost-effective embodied carbon optimisations were found to be:

- Optimised column grid in lieu of standard column grid.
- Pad foundations based on ground conditions in lieu of pile foundations.
- Optimised rectangular mezzanine office layout in lieu of standard mezzanine office layout.
- Exposed ceiling in lieu of suspended ceiling.
- Hybrid Variable Refrigerant Flow (VRF) system in lieu of VRF with VRF serving Air Handling Unit (AHU) coils.
- Electric arc furnace steel in lieu of blast furnace steel.
- Reused steel in lieu of new steel.
- Hybrid timber steel structure in lieu of steel structure.
- Air Source Heat Pump (ASHP) with fan coil units and mixed mode operation in lieu of VRF with VRF serving AHU coils.

The above or alternative measures would naturally only be implemented where they can be shown to be cost effective for the project in question. Therefore, the main cost of a lean design, material efficiency and upfront carbon limit in policy would be the relatively modest cost of undertaking the assessment with further costs only being incurred where the associated benefits are sufficient to justify the investment.



AECOM's work for the government in 2025 – including process costs



AECOM report – Figure 5.4 - Estimated fee of undertaking carbon assessments based on assessment scope. *Early design stage improvements and design optioneering are estimated to have a consultancy cost of under £10,000. While upfront carbon calculations and reporting is estimated to have a cost of £7,500.*

Note: process costs vary considerably based on building typology, size and complexity.

[1]MHCLG, 2025. The practical, technical and economic impacts of measuring and reducing embodied carbon in new buildings.

5.1

Upfront carbon

Residential

Upfront carbon | Recommended performance levels | Houses and flats <11 m

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Upfront carbon emissions in residential buildings are influenced both by design strategies and materiality choices. In the UK, residential buildings ≥11m in height (typically block of flats) face material restrictions under Approved Document B (fire), which prohibits the use of combustible materials in external walls. Residential buildings <11m (typically single-family houses and low-rise block of flats) are generally not affected by the same fire restrictions. However it is noted that all GLA funded projects require the use of non-combustible materials in line with requirements for buildings ≥11m. Refer to the Appendix for more information on Approved Document B. As a result, separate performance level options have been defined for homes above and below 11m to reflect these fundamental differences in materiality options.

Performance options for residential typologies <11 m

The performance options for this typology are shown on the table opposite. They have been developed using modelled data from existing evidence-bases (e.g. Essex Embodied carbon study). The technical feasibility of these proposed level options is discussed on later pages.

Comparing with local plans and industry performance levels

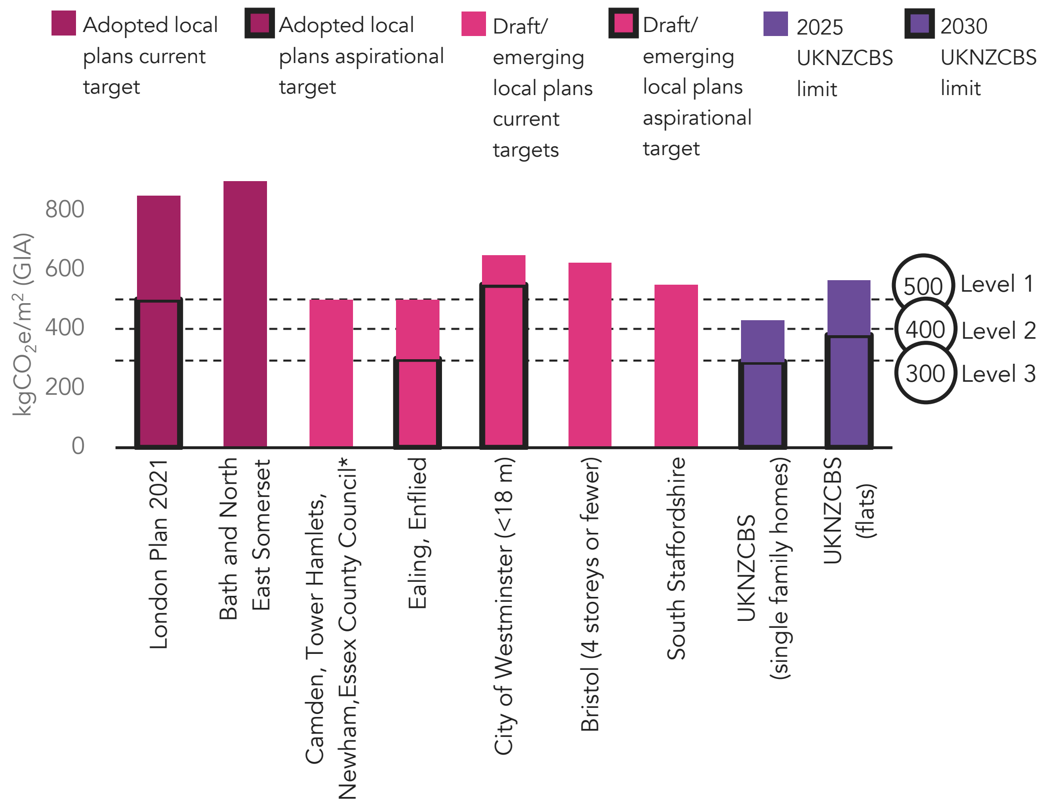
The performance options have been compared against the targets set by existing and emerging local plans and industry documents.

London Plan 2021 current benchmark and Bath and North East Somerset adopted target have been developed for all residential typologies, however, compared with the proposed Level 1 limit, they are relatively high for the <11 m typology, ultimately slowing the progressions towards reduced upfront carbon emissions.

Level 1 business-as-usual scenario aligns with the target for six London-based local plans and closely matches with City of Westminster (<18 m), Bristol, South Staffordshire's targets, London Plan 2021's aspirational benchmark and the UK NZCBS 2025 limit for flats. Level 2 closely matches with the UK NZCBS 2025 limit for single family houses and the 2030 limit for flats. Level 3 best practice scenario aligns with the aspirational 2030 target proposed by Ealing and Enfield's draft local plans and the UK NZCBS 2030 limit for single family homes.

$kgCO_2e/m^2$ (GIA)	Level 1	Level 2	Level 3
Residential (<11 m in height)	500	400	300

Upfront carbon - performance level options



***Residential upfront carbon** targets and limits from various sources, compared with the performance level options. Targets, except City of Westminster and Bristol City Council's, apply to residential typologies regardless of their height.*

**preferred policy option*

Upfront carbon | Recommended performance levels | Flats ≥11 m

Performance options for residential typologies ≥11 m

The performance options for residential typologies ≥11 m in height are shown on the table opposite. They have been developed using the 13-storey block of flats modelled as part of this evidence-base. More on the modelled data can be found in the Appendix.

Comparing with local plans and industry performance options

The performance options have been compared against the targets set by existing and emerging local plans and industry documents.

The Level 1 limit aligns with the current London Plan's benchmark and closely aligns with Bath and North East Somerset's adopted target and Bristol's target for residential developments of 5 storeys and above (~15m in height).

Level 2 is less onerous than the targets suggested by the rest of the draft local plans and industry documents. However, these targets - except City of Westminster and Bristol's - apply to all residential typologies, not necessarily acknowledging that carbon profiles tend to be higher for buildings above 11m due to fire regulations.

The UKNZCBS 2025 limit of 565 $kgCO_2e/m^2$ (GIA) for flats is suggested as the level 3 figure as it represents industry's latest best practice performance level. This closely aligns with current London Plan's aspirational benchmark, seven London-based local authorities proposed target, including recently published City of Westminster's city plan partial review examination document for residential buildings ≥18 m in height, and the target proposed by South Staffordshire's local plan.

$kgCO_2e/m^2$ (GIA)	Level 1	Level 2	Level 3
Residential (≥11 m in height)	850	700	565

Upfront carbon - performance level options

***Residential upfront carbon** targets and limits from various sources, compared with the performance level options. Targets, except City of Westminster, Bristol city Council and LETI's, apply to residential typologies regardless of their height.*

**preferred policy option*

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The modelling of residential buildings <11m in height references the Essex Embodied Carbon 2024 evidence base.

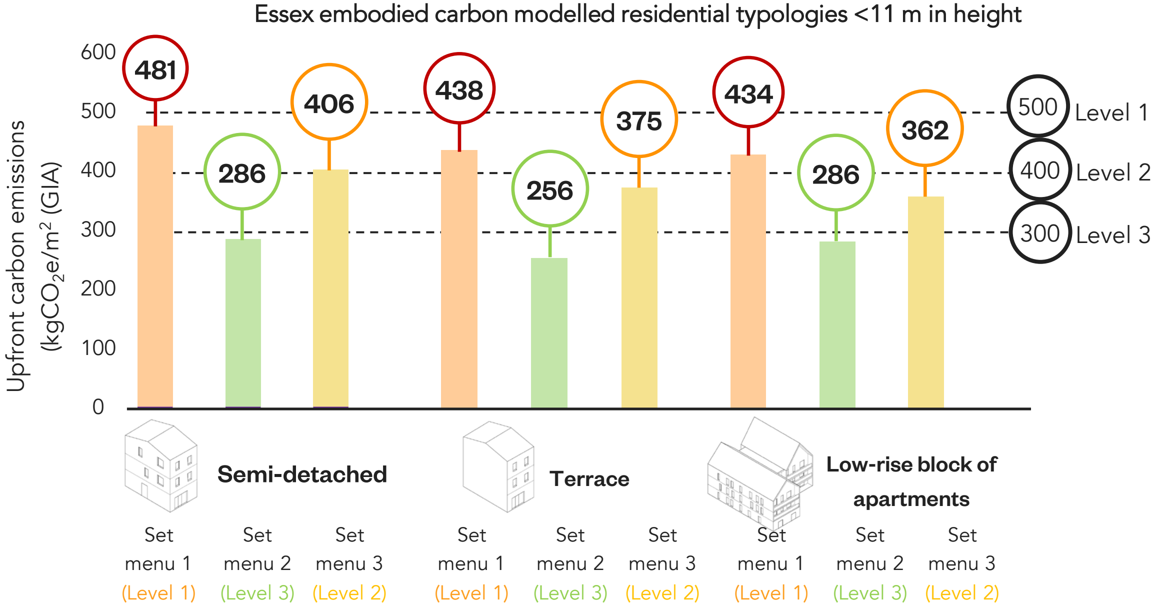
The similar West of England evidence base modelled data was derived using the older RICS Whole Life Carbon methodology (WLCA PS 1st ed.). Relying on outdated methodology could introduce inaccuracies and lead to misleading conclusions, therefore, this evidence-base was excluded from the technical feasibility analysis. Instead the Essex Embodied Carbon Evidence base was analysed, where the most recent RICS methodology (WLCA PS 2nd ed.) has been used.

Essex Embodied Carbon results

The Essex Embodied Carbon results (opposite) demonstrate that for the semi-detached house, terrace house and the low-rise block of flats all three proposed performance level options (as part of this study) are shown to be technically feasible:

- Under set menu 1 (highest embodied carbon), where typical brick and block construction and aluminium-framed windows are assumed, all three low-rise typologies achieve between 435-480 $kgCO_2e/m^2$ (GIA), demonstrating that Level 1 can be met using a 'business as usual' construction approach.
- In the cost and carbon-optimised set menu 3, Level 2 is achieved by nearly all typologies by switching to lower-carbon timber structure, UPVC-framed windows while maintaining a brick outer leaf.
- Level 3 is proven technically feasible for all typologies under set menu 2 (lowest embodied carbon), which assumes timber structure, wooden-framed windows and render or timber cladding.

However, set menus 2 and 3 contain combustible materials in the external walls. While this is acceptable under Part B fire regulations for residential buildings <11m, this would mean the homes would not be eligible for GLA funding.



Upfront carbon emissions in $kgCO_2e/m^2$ (GIA) per typology, for high, low and cost and carbon optimised scenario, compared against the three performance options for residential typologies <11 m in height.

	Foundations and ground floor	External wall	Party and internal wall	Internal floor	Roof	Windows
Set menu 1: highest embodied carbon (Level 1)	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 (Level 3)	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 (Level 2)	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

Detailed building elements forming set menu 1,2 and 3 for the houses. Mechanical ventilation with heat recovery and individual air sourced heat pumps have been assumed as the heating and hot water strategy for all the set menus and typologies.

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As part of this evidence-base the modelling of a 13-storey block of flats was undertaken to inform the technical feasibility of the performance options for residential typologies ≥11 m in height, and ultimately understand where this typology's upfront carbon limit should be set.

London Plan embodied carbon evidence-base results

The graph opposite demonstrates all three performance options are technically feasible for this typology:

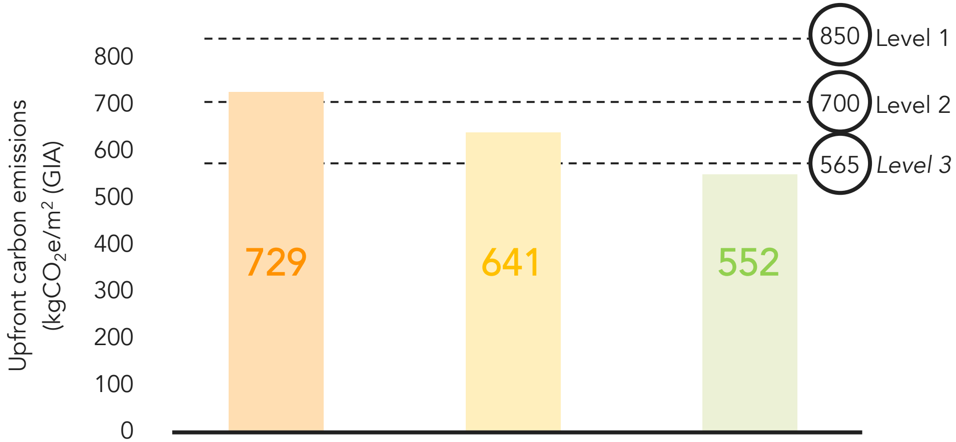
- Level 1 (850 kgCO_2e/m^2) business as usual fabric and systems. No particular effort needs to be made to achieve this performance level.
- Level 2 (700 kgCO_2e/m^2) where glass fibre reinforced concrete (GFRC) rainscreen system is replaced with a brick façade and with the addition of at least a 20% of cement replacement product in substructure and superstructure concrete elements.
- Level 3 (565 kgCO_2e/m^2), best practice performance option, building on level 2 and aligning with UKNZCB 2025 limit for flats. It is achieved using further cement replacement (at a rate of 50-60%) for substructure and superstructure concrete elements.

In this building type, where options like timber structure are limited due to fire regulations, the use of cement replacement plays a critical role in reducing its upfront carbon. However, there are a few considerations regarding these products, including their availability, which are discussed further on the following page.

Possible further reductions beyond level 3

Given the constraints imposed by Approved Document B (fire) (mandatory inclusion of two staircases and the exclusion of combustible materials) the potential for further significant reductions in upfront carbon beyond level 3 is limited. This could be further investigated as part of projected material decarbonisation and any future changes to Approved Document B.

London Plan embodied carbon evidence-base, 13-storeys block of flats



Scenarios specifications	Level 1 (baseline)	Level 2 (20-25% cement replacement and brick façade)	Level 3 (50-60% cement replacement)
Substructure	Concrete piles 0% cement replacement	Concrete piles **20%** cement replacement	Concrete piles **60%** cement replacement
Superstructure	Concrete frame and reinforced concrete slabs 0% cement replacement	Concrete frame and reinforced concrete slabs **20%-25%** cement replacement	Concrete frame and reinforced concrete slabs **50%-60%** cement replacement
Superstructure - Building envelope	Steel frame/ lightweight concrete blocks, GFRC rainscreen cladding, composite window framing	Steel frame/ lightweight concrete blocks, **brick facing**, composite window framing	Steel frame/ lightweight concrete blocks, **brick facing**, composite window framing
Services (MEP)	Active ambient loop system and mechanical ventilating with heat recovery	No change	No change

Upfront carbon emissions (excluding biogenic carbon) in kgCO_2e/m^2 (GIA) per scenario compared against the three proposed performance level options for residential typologies ≥11 m in height. For more details on the scenario specifications refer to the Appendix.

Upfront carbon | Recommended performance levels – Residential <11 m and ≥11 m

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While the previous pages provide evidence for the performance options' technical feasibility, this page evaluates their practical implementation in relation to two key considerations:

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

Understanding this ensures that any upfront carbon limits set in policy for residential developments are both ambitious and implementable in practice.

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:

- GLA funding mandates that all residential developments must use non-combustible materials in externals walls.
- 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 performance option 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 replacements. The most commonly used is ground granulated blast-furnace slag (GGBS), a co-product of the blast furnaces used in iron and steel production.

External wall build-ups and their combustibility and the % of cement replacement (if relevant)	Residential (<11 m in height) $kgCO_2e/m^2$ (GIA)			Residential (≥11 m in height) $kgCO_2e/m^2$ (GIA)		
	Level 1 500	Level 2 400	Level 3 300	Level 1 850	Level 2 700	Level 3 565
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 performance options by different composition of external walls and how this relates to their combustibility and the amount of cement replacement present (if relevant).

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.
- **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.

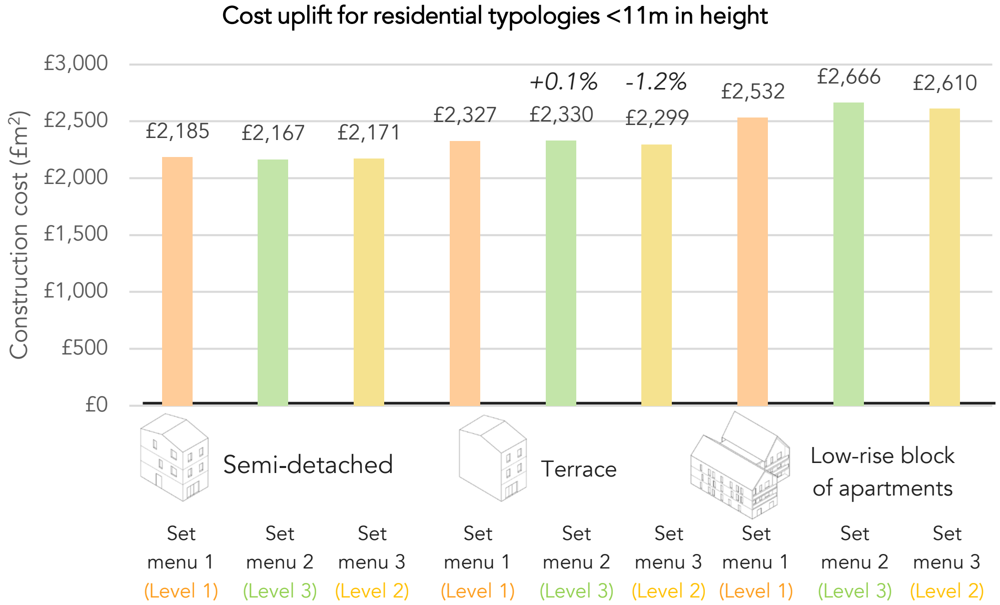
Upfront carbon | Cost implications of limit values – Houses and flats <11 m

Cost analysis of the implications of the specifications changes was conducted for buildings <11m (semi-detached and terrace houses and low-rise apartment block). The cost analysis is based on the specification options shown in the preceding 'evidence of technical feasibility' pages.

Cost analysis for residential buildings <11m

This draws from previously published detailed elemental cost analysis for Essex County Council which has been reviewed and updated for Q2 2025 and for an outer London location. Outer London has been selected as more representative of low-rise housing.

For the semi-detached and terraced houses, the variation in cost across the different specifications is equivalent to 1% or less of the total build cost with the lower carbon specifications less expensive than the highest carbon (Level 1) option. Although the total construction cost is similar across the range, there are variations at an elemental level with external wall costs higher for Levels 2 and 3 offset against lower costs for substructure, separating floors and windows (for Level 2 only) in comparison to Level 1. For the low-rise apartment block, the lowest embodied carbon option (Level 3) has a cost premium of around 5% in comparison to Level 1, this is largely a result of the timber structure and windows and CLT intermediate floors. For Level 2 the uplift cost is lower at around 3%, a result of the specification of uPVC windows instead of the timber windows used in Level 3.



Capital costs for Levels 1, 2 and 3 for Upfront Embodied Carbon Limits. Relative costs (%) of each case compared to the '0' baseline (Level 1)

Proposed policy requirement	Capital cost uplift (upfront embodied carbon)		
	Residential (<11m) Semi-detached house	Residential (<11m) Terraced house	Residential (<11m) Low-rise apartment block
Indicative all in construction benchmark cost	£2,185/m²	£2,327/m²	£2,532/m²
Level 1	+0% (+£0/m²)	+0% (+£0/m²)	+0% (+£0/m²)
Level 2	-0.6% (£14/m²)	-1.2% (-£28/m²)	+3.1% (£78/m²)
Level 3	-0.8% (£18/m²)	+0.1% (+£3/m²)	+5.3% (£134/m²)

Variation in capital costs from baseline for Levels 1, 2 and 3 for Upfront Embodied Carbon Limits. Relative costs (% or £/m²) of each case compared to the '0' baseline

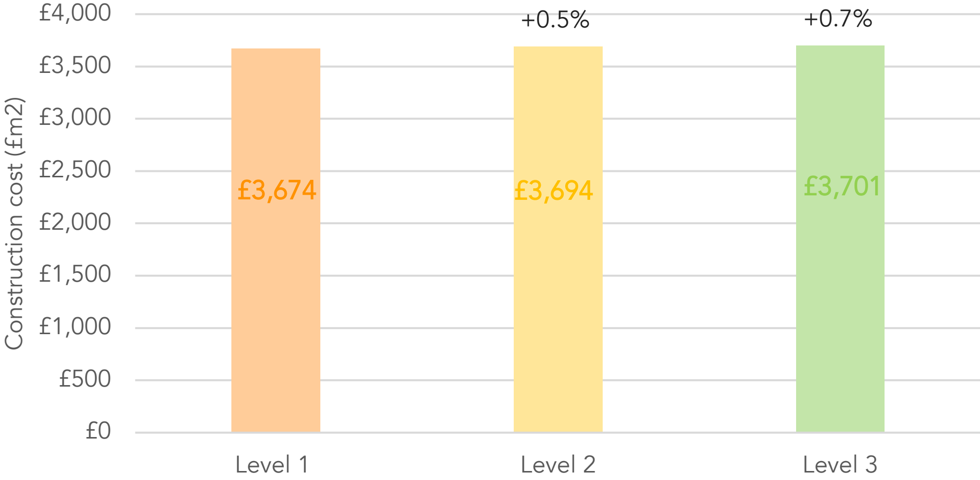
Upfront carbon | Cost implications of limit values – Flats ≥11 m

Cost analysis of the implications of the specifications changes was conducted for buildings ≥11m (13 storey block of flats). The cost analysis is based on the specification options shown in the preceding 'evidence of technical feasibility' pages.

Cost analysis for residential buildings ≥11m

For buildings ≥ 11m new 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 GRC 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.

For the 13-storey block, the impact of adopting higher levels of GGBS in in-situ concrete together with brick rather than GRC cladding to the façade is small at <0.5% of construction cost at Level 2 and 0.7% of construction cost at Level 3 (from Level 1). Further due to the lack of post tensioning or need for rapid structural loading, there should be no material impact on programme from the cement replacement at rates of 20-25% for Level 2 and 50-60% for Level 3.



Capital costs for Levels 1, 2 and 3 for Upfront Embodied Carbon Limits. Relative costs (%) of each case compared to the '0' baseline (Level 1)

Proposed policy requirement	Capital cost uplift (upfront embodied carbon)
	Residential (≥11m)
Indicative all in construction benchmark cost	£3,674/m^2
Level 1	+0% (+£0/m^2)
Level 2	+0.5% (+£20/m^2)
Level 3	+0.7% (+£27/m^2)

Variation in capital costs from baseline for Levels 1, 2 and 3 for Upfront Embodied Carbon Limits. Relative costs (% or £/m²) of each case compared to the '0' baseline

5.2

Upfront carbon

Non-residential

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Comparing upfront embodied carbon limits

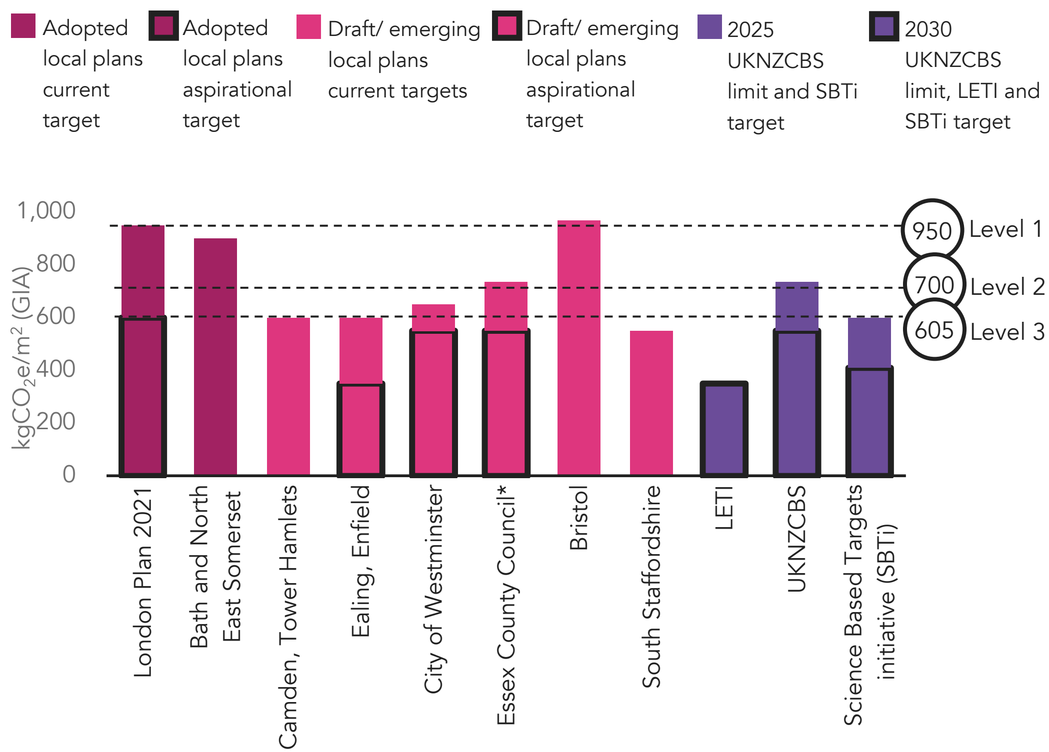
The performance options have been compared against the targets set by existing and emerging local plans and industry documents.

Inclusions and exclusions

There is a further breakdown required in this building typology as owner occupiers will deliver a whole building, but landlords and speculative developers typically deliver shell and core (S&C) and/ or Cat A but allow tenants to deliver a Cat B fit out based on lease arrangements to suit their bespoke needs. It has been noted that current industry benchmarks and performance levels vary in their scope for this typology. The non-residential, use class E commercial limit would also exclude external works and PV installation.

Defining the Level 3 performance level

A blended use class E, S&C and Cat A figure, and Level 3 limit has been created from the UK NZCBS Pilot release (2024). The 2025 Office S&C limit of 475kgCO_2e/m^2 (GIA) has an allowance of 130kgCO_2e/m^2 (GIA) for a Cat A added to it. This therefore totals 605kgCO_2e/m^2 (GIA). Further iterations of the UK NZCBS may determine where this aspirational benchmark should be set in the future. See the Appendix for information about S&C, Cat A and Cat B scopes.



Commercial use Class E upfront carbon targets and limits from various sources, compared with the proposed performance level options.

**preferred policy option*

kgCO_2e/m^2 (GIA)	2025	2027	2030
Whole building – UK NZCBS	735	660	550
S&C and CAT A – GLA current	950		600
S&C – UK NZCBS	475	425	355
Cat A and B – UK NZCBS	260	235	195
Cat A – UK NZCBS	130	117	98
Cat B – UK NZCBS	130	117	98

Commercial use Class E upfront carbon limits collected and compared across industry, by scope.

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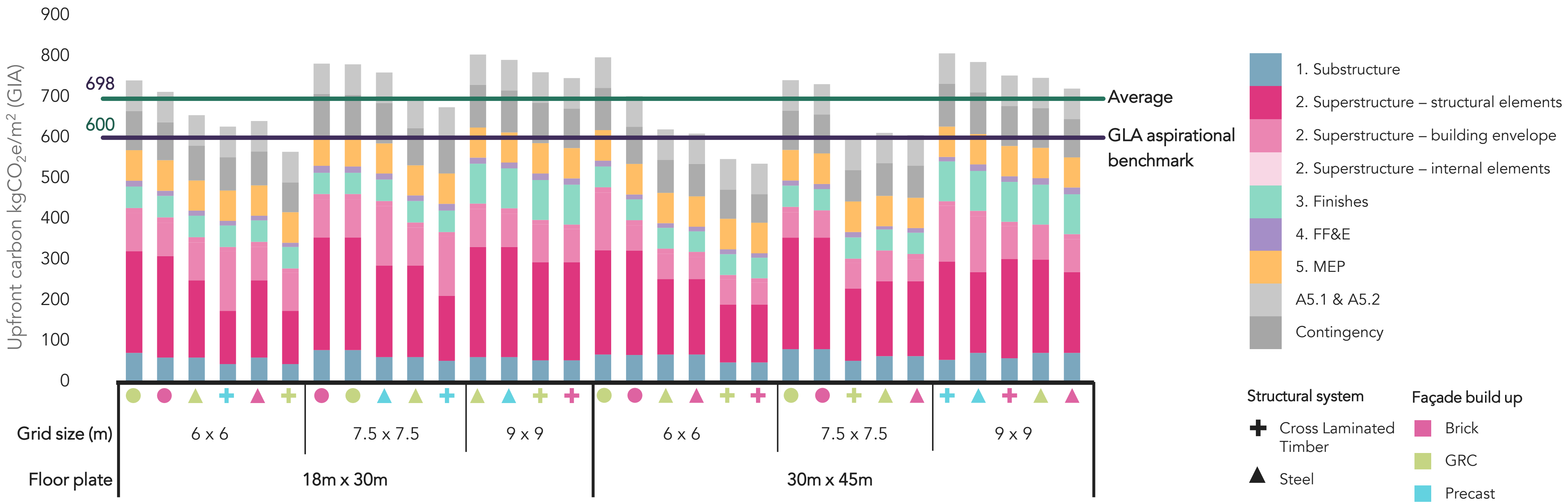
Methodology

Gaps were identified in evidence bases and datasets to date. Two commercial baseline scenarios were developed. Shell and core and a typical Cat A scope were modelled with no basements. The specifications for these are in the Appendix and align with performance level option level 2 for EUI and SHD. Sensitivity studies were carried out:

- Size of grid span
- Structural materials choices and efficiency
- Façade types and complexity

It should be noted that the average upfront carbon of this dataset was 698 $kgCO_2e/m^2$ (GIA), very close to the performance level option 2 at 700 $kgCO_2e/m^2$ (GIA).



Office modelled data upfront carbon Shell and Core, CAT A only, with no basements

Upfront carbon | Evidence of technical feasibility | Modelled data | Commercial use Class E

Upfront embodied carbon sensitivity

These items have reduced sensitivity to upfront carbon:

- Sub-structure in London is less variable due to the ground conditions.
- The impact of basements on intensity reduces as building scale increases.
- Façade weight impacts on the super-structure are not significant enough to determine variance in where to set a limit.

Certainty

The study has investigated a number of factors that will impact the numbers so we consider it to be robust. This includes:

- Allowances for demolitions or enabling works
- Grid spans, slab depths and impact of non-stacking ground floors
- Basement works
- Complex facades with high form factors and shading devices

It was found that some elements like fully planted roof terraces, façade weight and form factor had negligible impact on upfront intensity.

Conclusion

While a simple office building should be able to meet an upfront carbon limit of 605 $kgCO_2e/m^2$ (GIA), there are likely to be multiple other performance and contextual factors that suggest a higher limit should be used at the introduction of the policy with a mechanism to reduce during the policy period.

Proposed performance levels for use Class E (Shell & Core and Cat A)

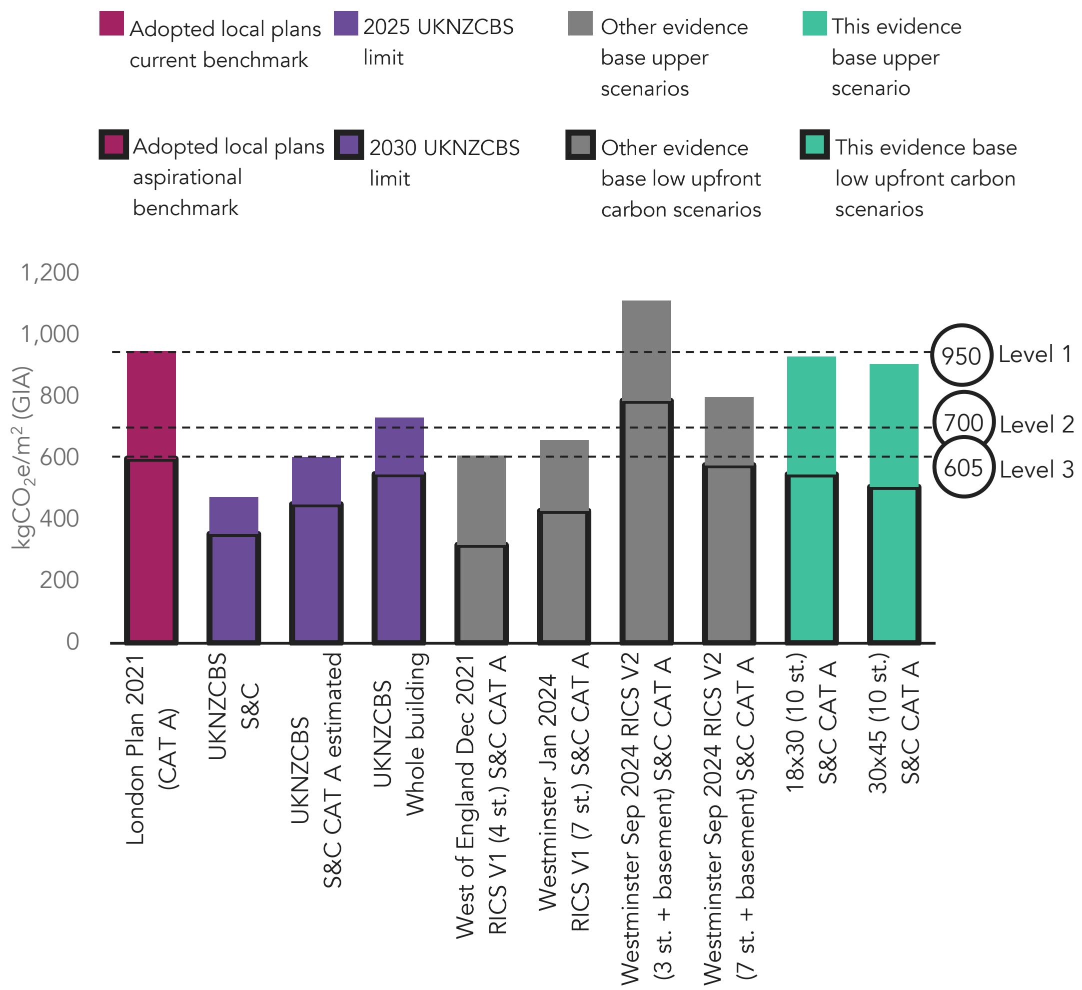
Level 1: 950 $kgCO_2e/m^2$ (GIA) – the proposed upper limit based on a higher upfront embodied carbon design solution

Level 2: 700 $kgCO_2e/m^2$ (GIA) – aligning with the average of the modelling to date, including contingency for design variances

Level 3: 605 $kgCO_2e/m^2$ (GIA) – aligning with the UK NZCBS 2025 limit (475) plus the average for Cat A emissions (130)

$kgCO_2e/m^2$ (GIA)	Level 1	Level 2	Level 3
Use class E commercial (S&C and Cat A)	950	700	605

Upfront carbon – proposed performance levels



***Office upfront carbon** targets and limits from various sources, compared with the proposed performance level options.*

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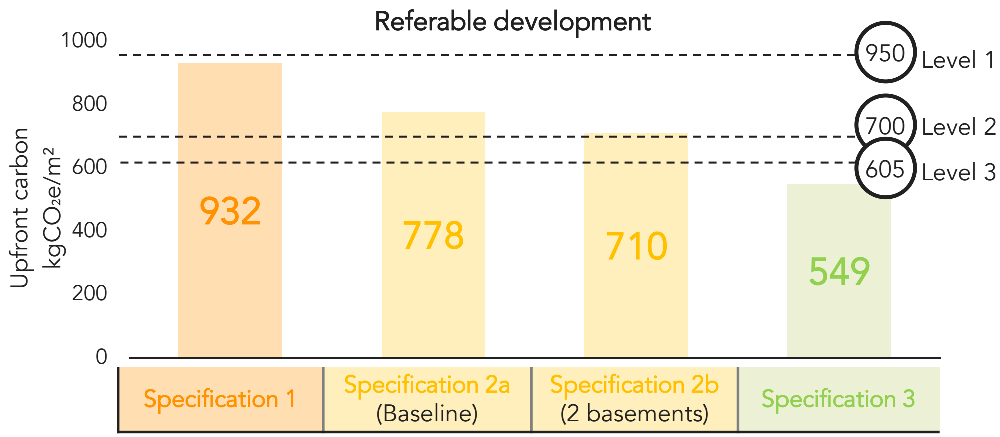
Finalising the performance levels

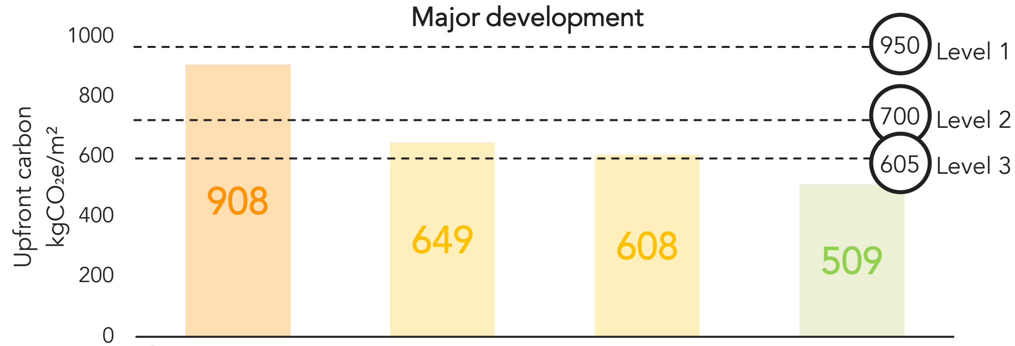
Following the modelling of multiple options, outline specifications and specific modelling were produced. These have been used to inform the cost analysis. Each of these specifications has been proposed to align with performance level 2 for EUI and SHD as detailed in other chapters. The detailed specifications are available in the Appendix.

The results are shown opposite. The purpose was to test example specifications, drawn from the sensitivity analysis, against the level 1, 2 and 3 performance limits.

Key observations include:

- Achieving all levels of performance is technically feasible but the introduction of the level 2 limits will drive some design decisions, particularly when designing with shallower floorplates and introducing basements.
- Performance is contingent on massing decisions, structural grids and materiality and façade complexity. Sub-structure is also impacted by the structural material choice with more lightweight dead load reducing sub-structure quantities.
- 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 and challenging ground conditions
- Following material efficiency measures being undertaken within the design, the specification of cement replacements and recycled content can further contribute to meeting the performance levels.
- Upfront carbon intensity increases as the depth of the floorplate reduces compared to the envelope so it is actually easier to achieve intensity for deeper plan developments.
- In addition, a double basement reduces the carbon intensity as the emissions are distributed across a larger GIA. Therefore, where the policy limit is set is not likely to affect the decision to omit a basement or not. The inclusion of a basement will drive up total emissions.





Outline specifications	Specification 1	Specification 2a (Baseline)	Specification 2b (2 basements)	Specification 3
Substructure	Concrete piles **50%** cement replacement	Concrete piles **70%** cement replacement	Concrete piles **70%** cement replacement. 2 additional basement levels (GIA adjusted*)	Concrete piles **70%** cement replacement
Superstructure	RC concrete frame and slabs 9 x 9 grid, **0%** cement replacement	RC concrete frame and slabs 7.5 x 7.5m grid, **25%** cement replacement	RC concrete frame and slabs 7.5 x 7.5m grid, **25%** cement replacement	CLT slab and steel frame, **50%** recycled 6 x 6m grid
Superstructure - Building envelope	Pre-cast concrete, form factor 0.9-1.2	Brick, form factor 0.7-0.9	Brick, form factor 0.7-0.9	GRC rainscreen, , form factor 0.7-0.9
Services (MEP)	ASHP, FCUs, mech led	ASHP, FCUs, mixed mode	ASHP, FCUs, mixed mode	ASHP, FCUs, mixed mode

Upfront carbon | Cost implications of limit values | Commercial use class E

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Cost analysis was conducted for the major (5,400m2) and referable (13,500m2) office developments based on the embodied carbon specifications detailed in the Appendix.

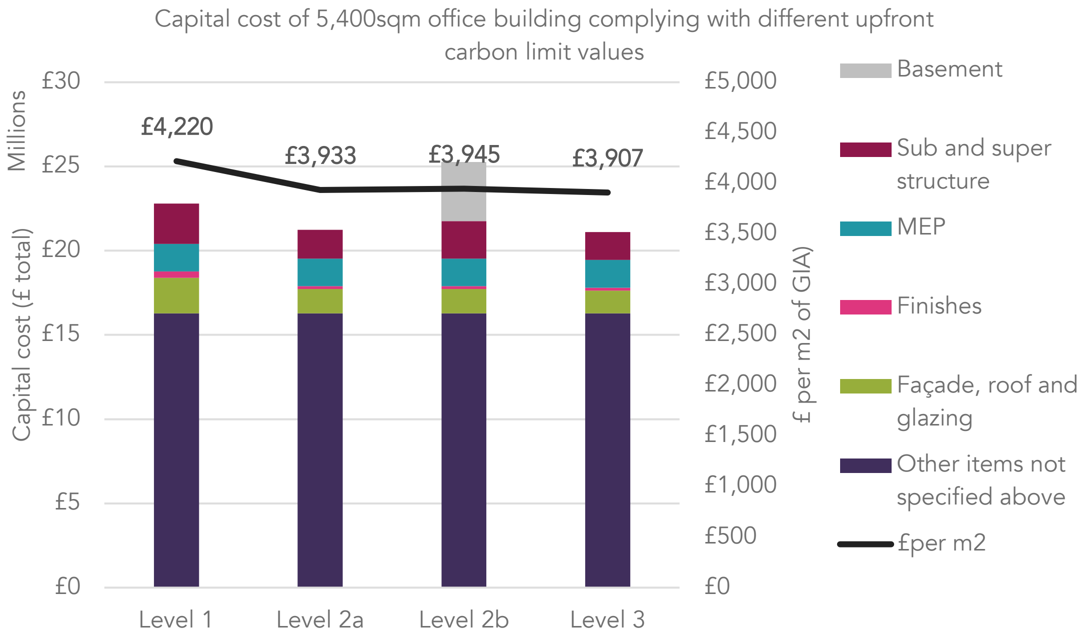
The specifications varied the size and composition of the building structure (grid size, form factor and structure type) and also the percentage glazing, MEP strategy, façade and Cat A finishing materials.

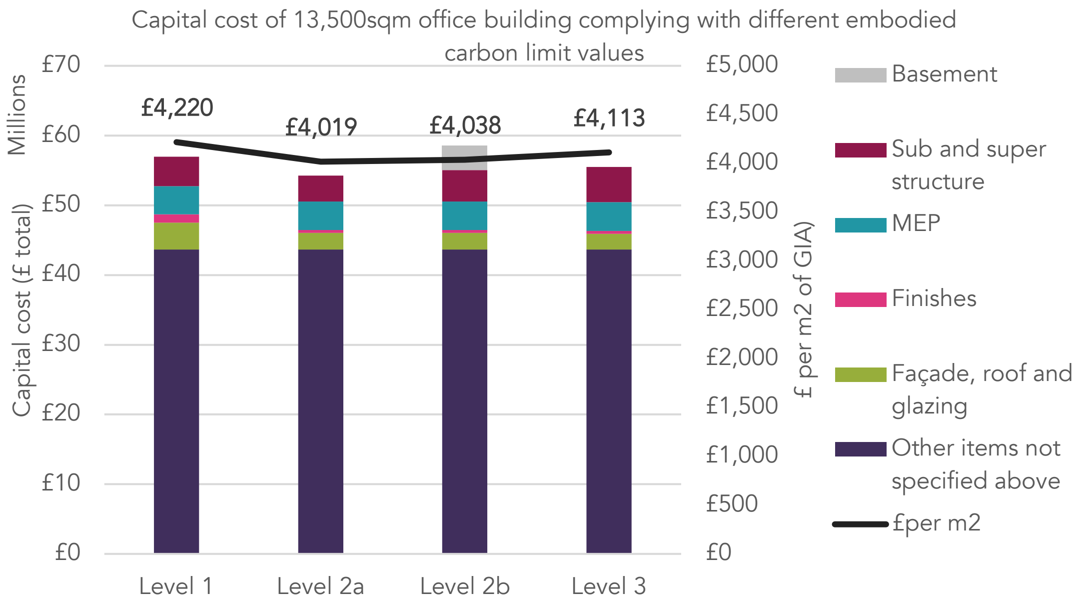
Some of the design changes to reduce upfront carbon deliver cost savings resulting from reduced material quantities (e.g. less concrete and rebar) resulting from structural optimisations and form factor efficiencies, while others such as use of composite windows rather than aluminium windows result in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

Some of the low carbon finishes selected for Levels 2 and 3 are less expensive than premium finishes that might be specified for a 'standards' 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 have be slightly more expensive than an equivalent 'standard' product for example low carbon vs standard metal ceiling tiles.

The net impact on overall build costs are shown in the adjacent charts, two options are shown for Level 2 performance, 2a excludes and basement whereas in 2b two storey basement is included (500m^2 for each level), the cost for option 2b includes the cost of the basement but also includes the additional floor area delivered by the basement.

The analysis shows that in all instances it is possible to achieve the carbon limit values without increasing overall development costs and that the cost in £m2 is lower for the lower carbon solutions. This reduction in cost is delivered, in part, through the selection of lower carbon 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 will affect the look and feel of the building both externally and internally.





Upfront carbon I Evidence of technical feasibility I Conclusion I Commercial use Class E

Finalising the performance levels

It is not recommended to have different performance limits for different commercial development scales so there needs to be a recognition that the limits will drive certain design decisions. For example, a larger building with a deeper plan will have more flexibility to design with larger structural girds and a wider material palette.

Applying upfront carbon limits to use Cass E

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 it is considered that the Shell & Core and Cat A scopes for these commercial buildings are similar enough that the performance levels can be applied to them all. It is considered that the Cat B fit out differs the most and the current proposal is to exclude this from the limit. This aligns with the ethos of introducing use Class E as it was deemed to make it easier to flex assets through fit out means rather than formal change of use.

Conclusion

On the basis that the levels are technically feasible while still allowing a range of design responses, the recommendation is to adopt performance level 2 for the initial upfront limit for use Class E shell and core and Cat A. Level 2 allows a typical palette of materials to be used, but requires some thought about material efficiency measures to meet the limit.

$kgCO_2e/m^2$ (GIA)	Level 1	Level 2	Level 3
Use class E	950	700	605

Upfront carbon – proposed performance levels

5.3

Upfront carbon

Photovoltaics

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The importance of PV

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. According to the Climate Change Committee, the UK's solar capacity needs to increase by around six times to achieve net zero. At current build rates this will take 40 years, so these rates must increase. Building mounted PV represents one of the quickest and lowest cost ways to meet this need. Carbon impact of PVs has been excluded from the proposed upfront carbon performance levels to avoid any direct conflict with operational carbon reductions. However, their embodied carbon impact is important and should be reduced.

Low embodied carbon PV panels

Solar PV is quite energy intensive to manufacture, hence factories that use renewable electricity to power their factories produce lower embodied carbon PV panels. Embodied carbon is also reduced by maximising the efficiency of the PV panel, and specifying microinverters or DC optimisers, this increases the energy generation per panel.

As an aside, building mounted solar is often lower embodied carbon than ground mounted solar as less material is required to structurally support the panels. In addition, solar panels can substitute roof materials, further reducing embodied carbon.

Lifecycle carbon impact of PVs

The *'Whole life carbon of photovoltaic installations'* 2022 technical report by Introba (former Elementa) found that the lifecycle carbon (A1-A5, B1-B5, C1-C4) of PV installations (including accessory equipment) are to be between 520-780 $kgCO_2e/kWp$, which is less than the operational carbon savings over a 25-year study period based on a UK grid. The study concludes that rooftop solar PV can be a valuable investment of embodied carbon, however, the employment of simple embodied carbon assessments per project are essential to ensure that their embodied carbon impact is minimised through intelligent lean design and specifications decisions.

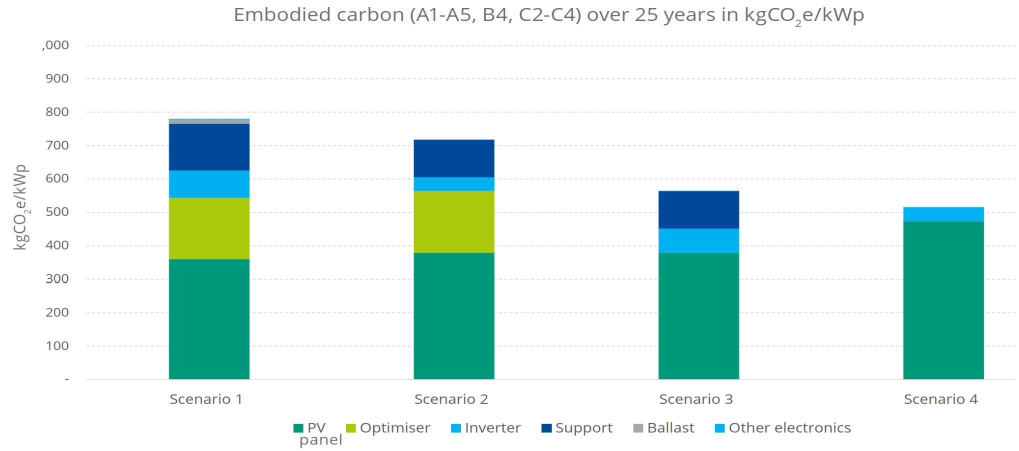

Figure 4 - Embodied carbon over 25 Years
Scenario 1: Project A, Flat roof, PV monocrystalline, Optimisers
Scenario 2: Project B, Pitched roof, PV monocrystalline, Optimisers
Scenario 3: Project B, Pitched roof, PV monocrystalline, No optimisers
Scenario 4: Project B, Pitched roof, PV thin-film, No optimisers

Lifecycle carbon results of photovoltaic systems by scenario. Source: Whole life carbon of photovoltaic installations.

Main takeaways from the 2022 Introba study

- A 'payback' approach for PV installations, i.e. embodied carbon impact compensated by the operational carbon savings, is not the right metric during an energy transition towards 100% renewables. Embodied carbon will have to be invested to achieve full grid decarbonisation and rooftop solar PV should continue to play a vital role in supporting this transition.
- Design choices highly influence the embodied carbon of PVs (roof type, pitch, orientation). Scenario modelling is essential to identify optimal solutions.
- While embodied carbon is relatively fixed, operational savings vary by project. Comparing different PV module types against their whole life carbon performance can reveal trade-offs, such as lower efficiency modules potentially having lower embodied carbon.
- PV modules are the largest source of embodied carbon, but infrastructure (mounting, inverters, etc.) also contributes significantly and should be optimised.
- The industry must innovate to produce lower-carbon PV panels and improve transparency through better EPDs.

6.0

Lifecycle embodied carbon and whole life carbon

This section summarises how Whole Life Carbon reporting can play a role in to driving better design, material choices and operational decisions informed by long-term thinking.

Life cycle embodied carbon and WLC | Summary of ideas and suggestions, PROS and CONS

It is important to calculate and report life cycle and whole life carbon as it is the only metric that brings together the full impact of upfront, life cycle and operational carbon.

The main goal of calculating and reporting embodied and whole life carbon emissions in architecture projects is to drive better design, material choices and operational decisions informed by long-term thinking. WLCA is currently the best tool with which to interrogate the balance between long-term and short-term impacts.

While calculations are becoming more robust, continued improvements to communication around carbon emissions are necessary. Asking the right questions and discussing the multiple impacts of each life cycle module increases understanding and enables better decisions across all stakeholders. By establishing more effective communication between designers, clients, and asset management teams, the potential of WLCA can become recognised, fully understood and used to best effect.

By encouraging longer term thinking and giving visibility of specific life cycle impacts (especially specific in-use stages and end-of-life) WLCA can incentivise maintaining and refurbishing rather than full replacement of assets and systems.

It is recognised that current data maturity means limits can not be set for life cycle embodied carbon but with greater consistency this will be possible. However, within the continuation of the WLC policy there is a proposal to focus on some of the key aspects of the calculation that could help to drive lower carbon outcomes specifically for:

- Refrigerants
- Structure
- Façade
- Fit out and finishes

Whole Life Carbon reporting

Major and referable developments should report emissions for A1-A5, A-C excluding B6/B7, and A-C including B6/B7.

If life cycle embodied carbon and whole life carbon are reported

PROS	CONS
✓ Consistent with Net Zero Carbon built environment	X Process costs
✓ Enhances importance of thinking about life cycle emissions alongside upfront	X Large number of assumptions made for the operational and end of life stages, especially at the early design stages – results can be variable
✓ Upskilling industry in measuring, reporting, understanding and reducing all built environment emissions	
✓ Less pressure on officers, determining if sufficient attention has been paid to reducing embodied carbon	
✓ Drives good decision making	

If life cycle embodied carbon and whole life carbon are NOT reported

PROS	CONS
✓ Simpler policy structure with reduced process costs	X Not consistent with Net Zero Carbon built environment
	X Reduces importance of life cycle embodied carbon and WLC
	X Does nothing to solve the inconsistent local policy landscape evolving around this issue

Life cycle embodied carbon and WLC | Evidence that the industry is already using these metrics

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The importance of life cycle embodied carbon

Life cycle embodied carbon is an important consideration in the context of overall built environment emissions and upfront carbon performance. Without this being interrogated the industry risks focussing on immediate emissions while not recognising high emissions that can be locked into a building lasting decades.

Existing life cycle embodied carbon recommendations

There are existing life cycle embodied carbon benchmarks and bandings that exist for certain typologies:

- Current GLA benchmarks
- LETI embodied carbon alignment
- RIBA 2030 Challenge

The current GLA benchmarks are documented above.

The LETI embodied carbon target alignment work (released 2021) includes both upfront and life cycle embodied carbon performance bandings and to emphasise the importance of considering both metrics, as well as give guidance as to good and best practice at the time.

The RIBA 2030 Challenge target metrics (released 2021) do not include upfront carbon and only reference life cycle embodied carbon. This is because the key focus of RIBA was to reduce overall emissions. To receive a National RIBA Award it is mandatory to report upfront carbon, life cycle embodied carbon and whole life carbon.

RICS WLCA PS 2nd ed. also provides evidence that the industry is familiar with measuring and reporting life cycle embodied carbon and full WLC.

Life Cycle Embodied Carbon, A1-5, B1-5, C1-4

	Band	Office	Residential (6+ storeys)	Education	Retail
	A++	<150	<150	<125	<125
	A+	<345	<300	<260	<250
	A	<530	<450	<400	<380
RIBA 2030 Build Target	B	<750	<625	<540	<535
	C	<970	<800	<675	<690
	D	<1180	<1000	<835	<870
	E	<1400	<1200	<1000	<1050
	F	<1625	<1400	<1175	<1250
	G	<1900	<1600	<1350	<1450

RIBA 2030 Climate Challenge target metrics for non-domestic (new build schools)

RIBA Sustainable Outcome Metrics	Business as usual (new build, compliance approach)	2025 Targets	2030 Targets
Embodied Carbon $kgCO_2e/m^2$	1400 $kgCO_2e/m^2$	< 675 $kgCO_2e/m^2$	< 540 $kgCO_2e/m^2$

RIBA 2030 Climate Challenge target metrics for non-domestic (new build offices)

RIBA Sustainable Outcome Metrics	Business as usual (new build, compliance approach)	2025 Targets	2030 Targets
Embodied Carbon $kgCO_2e/m^2$	1400 $kgCO_2e/m^2$	< 970 $kgCO_2e/m^2$	< 750 $kgCO_2e/m^2$

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 $kgCO_2e/m^2$	1200 $kgCO_2e/m^2$	< 800 $kgCO_2e/m^2$	< 625 $kgCO_2e/m^2$

Full details of the RIBA 2030 Climate Challenge targets can be found here. And LETI embodied carbon alignment can be found here.

Life cycle embodied carbon and WLC | Analysis of submission to date against GLA benchmarks

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The team have received the data from AECOM on behalf of the GLA, representing applications from RIBA Stage 2-4 from years 2021–2023, including Outline, Detailed and Hybrid Planning Applications.

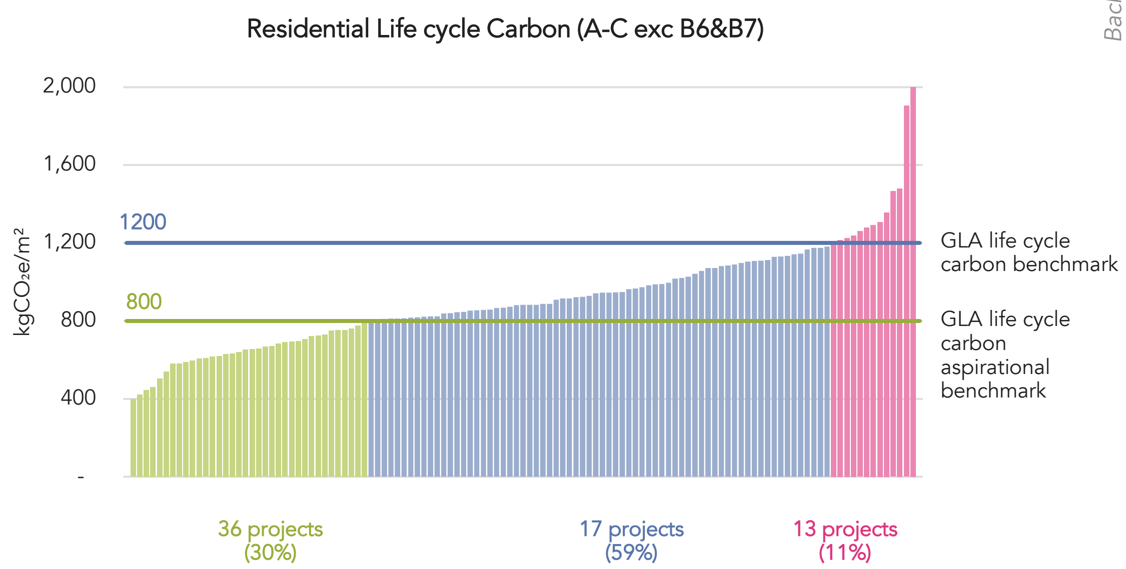
Analysis of data from past GLA submissions

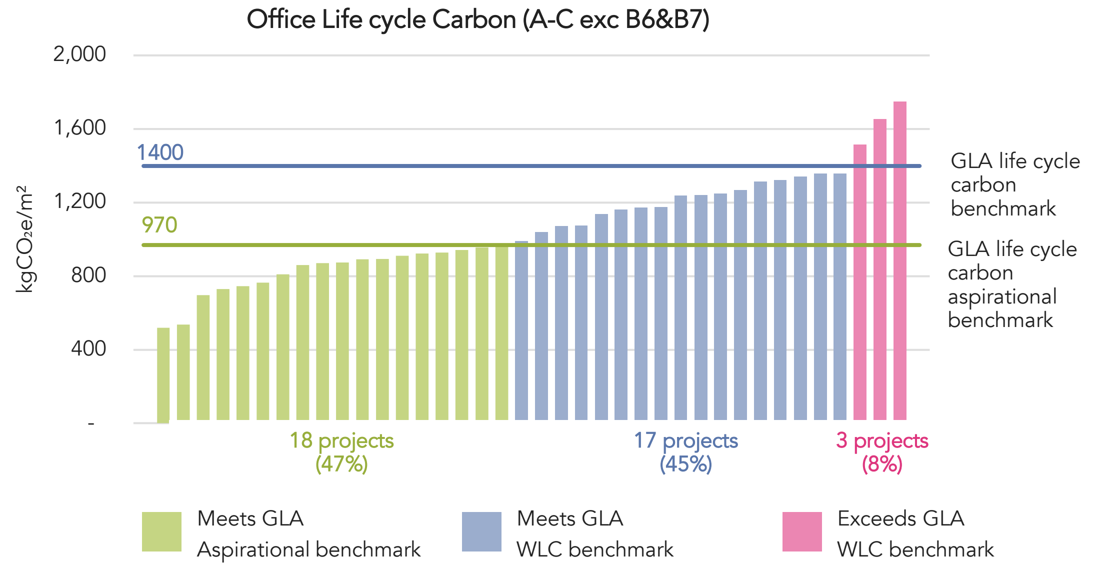
The data for offices and residential schemes has been analysed as part of this evidence base. The upper bar chart shows the performance of residential schemes compared against the GLA benchmarks. The majority of projects (89%) are achieving the GLA benchmark, with a considerable amount (30%) achieving the aspirational benchmark.

The lower bar chart shows the performance of office buildings compared against the GLA benchmarks. Just under half of the projects (47%) are achieving the aspirational benchmark, with the majority (92%) under the upper benchmark.

Beyond the numbers

While it is useful to analyse the most recent life cycle carbon data received as part of planning applications, it is recognised that data maturity means limits can still not yet be set in policy for life cycle embodied carbon or WLC. However, where the WLC policy is continued there is the opportunity to continue to learn from the data being received as part of planning applications, with a view to determine whether limits could be set in future.





GLA planning application data representing applications from Stages 2-4 from years 2021–2023, including Outline, Detailed and Hybrid Planning Applications.

Lifecycle embodied carbon and WLC | Reporting of additional design decisions and elements

As part of the stakeholder engagement a survey was undertaken with industry stakeholders, this found that while there was support to continue WLC reporting, many (79%) cast doubt about its effectiveness in delivering lower carbon built assets. Beyond the reporting of whole life carbon to give an overall picture of performance, there are a few specific areas that applicants can have a greater impact if the carbon associated with them could be reduced.

Understanding and reducing the impact of demolition and rebuild

Where demolition is proposed, its impact on carbon emissions through building retention or new construction should be understood and reported. Where substantial or total demolition is proposed, there are options to interrogate this:

- By initially, incentivising majority retrofit solutions which are inherently lower in embodied carbon through less onerous conditions or planning submission requirements.
- By gradually increasing the evidencing requirements or study contents, dependent on the % of demolition required; so the lower the demolition, the less onerous the analysis or documentation.
- When accounting for any planned use class change where it is determined that the site should have a different use as part of strategic planning. The pre-planning process may accept a higher percentage of demolition is necessary in the context; this could also be linked to whether the change has a clear public benefit.
- Use of an optioneering study to compare whole life carbon scenarios for each retrofit vs rebuild scenario.
- Through third party verified WLCA for a reasonable refurbishment option versus new build that proves the new build option results in lower emissions over the standard 60 year WLCA Reference Study Period.

Balancing upfront carbon, replacement cycles and end of life expectations

To increase both the understanding and impact that design decisions can make in reducing life-cycle embodied carbon, building element analysis should be undertaken to understand replacement and end of life for proposed external cladding, finishes, and hard landscaping. The lifespans of these elements can vary significantly, meaning some choices would last longer and require fewer replacement cycles than others. An example of this would be that rainscreen cladding has a shorter lifespan and higher replacement rate than a brick façade.

Understanding the impact of commercial Cat B fit outs

While the use class E commercial upfront limit proposed includes shell and core and Cat A works, policy should also ensure Cat B (fit-out) is reported, understood and replacement cycles limited. The most effective point in the building life cycle to collect this information for a commercial typology is likely to be Pre-commencement and Post Completion.

Further detail could be requested if desired including:

- Planned replacement cycles which would document upfront Cat B impacts and life cycle impacts (this would be hard to govern but serve as an awareness building exercise)
- Proof that the Cat A installation was sufficiently planned and installed so there is zero waste generated by any Cat B fit out

Reducing emissions from refrigerants

Refrigerant leakage and replacement can have a higher or lower carbon intensity depending on the refrigerant chosen. By using refrigerants with a lower global warming potential their impact can be reduced.

Reduce life cycle embodied carbon and report whole life carbon | Potential policy framing

Why are we proposing this?

To reduce life cycle embodied carbon in buildings through design and modelling. To ensure Whole Life Carbon is reported and the scope of projects doing so is expanded.

Our research suggests framing a policy with the following requirements and outcomes:

Reduce life cycle embodied carbon and report whole life carbon

- *Whole Life Carbon should be calculated and reported for all life cycle stages, for all major and referable developments using the current WLCA PS 2nd ed.*
- *A series of good practice and aspirational benchmarks should be provided for guidance.*

Highlight specific elements of the WLCA calculation to improve decision making and balance life cycle emissions

- ***Balancing of upfront carbon, replacement cycles and end of life expectations*** *- A building element analysis for life cycle embodied carbon (kgCO_2e/m^2) associated with replacement (A1-A5 and B4) and end-of-life plan for:*
    - *Two façade cladding options*
    - *Two of each finishes (walls, floors and ceilings)*
    - *Two hard landscaping options*
- ***Reducing emissions from Cat B fit outs for use Class E*** *- Report the upfront and expected life cycle embodied carbon of proposed fit out works at pre-commencement and post completion, demonstrate how they coordinate with Cat A works and how associated impacts will be reduced.*
- ***Reducing emissions from refrigerants*** *- Report the embodied carbon of refrigerants in building services and assess how their associated impacts can be prevented/reduced. Meet a global warming potential (GWP) limit for refrigerant systems =* ***677 kgCO_2e/kg.***

Reduce life cycle embodied carbon and report whole life carbon | Estimated cost impact of policy

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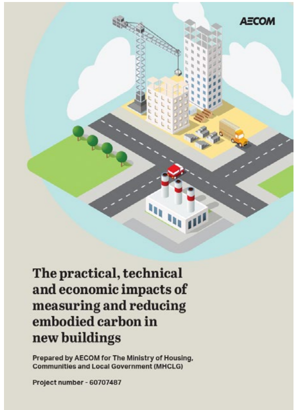
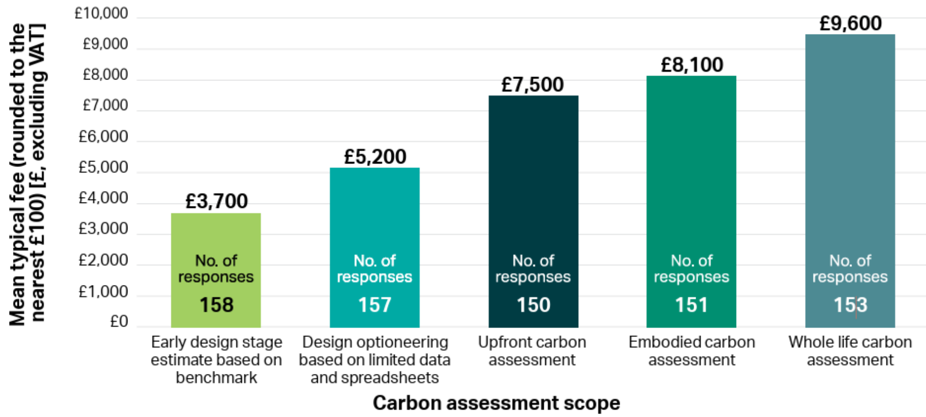
The AECOM research for the UK Government[1] also identified that a mean typical process cost fee for a whole life carbon assessment was £2,100 more expensive than an upfront carbon assessment. And an embodied carbon assessment was £600 more than an upfront carbon assessment

This is likely because the calculations build on one another for an embodied carbon assessment when covering all modules (A1-A5 + B1-B5 + C1-C4).

[1]MHCLG, 2025. The practical, technical and economic impacts of measuring and reducing embodied carbon in new buildings.



AECOM's work for the government in 2025 – including process costs



AECOM report – Figure 5.4 - Estimated fee of undertaking carbon assessments based on assessment scope.

Note: process costs vary considerably based on building typology, size and complexity.

7.0

Offsets and administering upfront carbon limits

This section considers the potential role of offsetting in enabling applicants to comply with London Plan embodied carbon requirements.

Offsets | Potential approaches

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This page focuses on the topic of carbon offsets, related to planning policy requirements on embodied carbon as well as meeting Net Zero Carbon.

Three options for a carbon offsetting mechanism

1. **Offsetting residual upfront embodied carbon to zero:** This involves meeting the upfront limit and offsetting all upfront carbon. We strongly recommend that this is not included in policy as this would result in a significant cost to the applicant. It is our view that it is better to spend money reducing the embodied carbon, and prioritising setting more stringent upfront limits.
2. **Flexible optional mechanism to achieve compliance with embodied carbon limit**: If a building exceeds its upfront limit within the planning submission, offsetting could be required to offset the difference. We strongly recommend that this is not included in policy as there is a risk of undermining the purpose of the limit.
3. **Using offsetting as financial penalties to ensure the importance of upfront carbon is recognised:** If the upfront limit is not met at post-completion stage. An offset payment could be required as a financial penalty made on the difference between the limit and the final results. More commentary is provided in the implementation. section.

Approaches are other local authorities taking

Some local authorities have implemented offsetting. Bristol City Council has introduced a policy similar to option 2 above[1], whereas, Westminster has a policy that trades offsets between operational and embodied emissions. However, most adopted/draft local plans that introduce a policy and limits on embodied carbon, do not include any form of offsetting.

1 It should be noted that the Bristol City Local plan was one of the first local plans to set upfront embodied carbon limits. At the time of the examination there was a much smaller pool of evidence of technical feasibility, so it may have been thought that the offsetting mechanism was required.

Net Zero Carbon

There are various definitions relating to net zero carbon, especially when it relates to embodied carbon.

UK NZCBS: Offsetting is not a mandatory requirement. Buildings that meet the mandatory requirements can claim that their building is a 'Net Zero Carbon Aligned Building '. If a building owner wishes to achieve net zero carbon at the asset level (within the boundary of the site, then in addition to the mandatory requirements, upfront embodied carbon, operational energy and refrigerant leakage must be offset. The owner can then claim that the building is Net Zero Carbon Aligned Building (plus offsets)'

LETI:"A 'Net Zero Upfront Carbon' asset is one where the sum total of GHG emissions, excluding 'biogenic carbon', from Modules A0- A5 is minimized, which meets local carbon targets or limits (e.g. kgCO2e/m2), and with additional 'offsets', equals zero" (LETI, 2022).

The most onerous (and robust) definition relating to claims made that a building is Net Zero Carbon within the boundary of the site, would mean that offset payments would need to be made for at the residual upfront embodied carbon emissions to zero (as well as for operational energy) once the building has been built, and payments annually to offset the in-use emissions.

It is understood that the GLA is not seeking to implement policy where each building achieves Net Zero Embodied Carbon within the boundary of the site, thus offsetting residual emissions is not necessary.

Administering upfront carbon limits | Options, PROS and CONS

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To ensure the importance of upfront carbon limits is emphasised it is important to consider how the policy will be administered

Options for administration

If a project is meeting the limits at planning and evidences this at post-completion there is no need for action. However if the post-completion is larger than the agreed limit, there are options for how to administer limits in policy.

1. **Financial penalties** for the difference between a limit and the post-completion upfront carbon result. This could be charged on the difference between the limit and the final results, priced against the market rate for a tonnage of carbon. The funds could be reintroduced back into the system and used to pay for additional third party verification to improve data quality and ultimately drive further reductions
2. **Process-based mechanisms** could include reviewing performance at pre-planning or planning application stage and if the project is not meeting the limits, agreeing a process with the applicant for iterative review (pre-negotiated threshold). This will reduce emissions as far as possible, potentially coupled with a pre-commencement condition. It is less clear what action should be taken if the post-completion upfront carbon is higher without a pre-agreement.
3. **Disclosure**: Requiring the applicant to undertake public disclosure of the embodied carbon results as well as a publicly accessible lessons learnt report, similar to the Be Seen policy for operational energy.

There is a further opportunity of adapting policy administration over time. The first period could be focussed on upskilling and managing. When applicants are familiar with limits and how to achieve them, financial penalties could be applied as a last resort.

If financial penalties are set

PROS	CONS
✓ Helps acknowledge the importance of the policy and meeting the limits	X Unclear pricing mechanism
✓ Less onus on officers; if you don't meet the limit there is a clear market-based payment to be made	X Embodied carbon is still a maturing calculation; how can we be sure financial penalties are fair
	X As embodied carbon is a maturing calculation, there will always remain a risk that on occasion the limit will be unachievable for the building due to site abnormalities (e.g. unusual structure or particularly large basement)
	X Financial penalties can end up the default option, countering the original intent, which is to reduce emissions
	X Not all building typologies will have an upfront limit, thus some typologies face penalties where others don't.

If policy is managed via a process based mechanism

PROS	CONS
✓ Helps acknowledge the importance of the policy and meeting the limits	X More time for officers (or their advisors) to administer and review iterative results
	X Less clear route through planning system for applicants in the event they can't meet a limit; sometimes as a result of the site conditions and out of their control
	X Less clear what action should be taken if the planning application meets the limits but the post-completion results do not

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8.0

Equalities impact

This section considers the complex question of the potential impact on these policies on Londoners and particularly on their impact on equality.

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Key Equality, Diversity and Inclusion (EDI) definitions

Climate justice: Climate justice recognises that the effects of climate change are unequally distributed and disproportionately impact people who are marginalised due to their identities. A climate justice approach argues that those who have contributed the most to climate change have a responsibility towards those most affected by it.

Disability: Refers to a physical or mental impairment that has a substantial and long-term negative effect on a person's ability to do daily activities.

Equality: A human rights issue that refers to the equal rights, treatment, responsibilities and opportunities for all people.

Equity: Refers to equal outcomes, which may require specific interventions (such as benefits, opportunities and resources) for those who have historically been marginalised.

Ethnicity: A self-defined large group of people with shared identities such as culture, language, heritage or religion.

Gender: The socially constructed roles, behaviours, expressions and identities of girls, women, boys, men, and gender diverse people. It influences how people perceive themselves and each other, how they act and interact, and the distribution of power and resources in society.

Intersectionality: A concept that describes how systems of inequality based on gender, race, ethnicity, sexual orientation, gender identity, disability, class and other forms of discrimination 'intersect' with one another to create unique dynamics and effects

Just Transition: Refers to a transition to a zero-carbon economy in a way that it is fair and inclusive for everyone.

LGBTQIA+: An abbreviation for Lesbian, Gay, Bisexual, Transgender, Queer (or Questioning), Intersex, Asexual. The plus at the end refers to the many other communities and gender/sexual identities that exist.

Marginalise: The act of treating a group as unimportant, insignificant or peripheral.

Pregnancy: Pregnancy is the condition of being pregnant or expecting a baby.

Racialise: The act of attributing social meaning to people's 'racial' identity.

Religion and religious belief: Religion refers to any religion, including a lack of religion. Belief refers to any religious or philosophical belief and includes a lack of belief.

Sex: A set of biological characteristics, primarily categorised as female or male, associated with physiological features including chromosomes, gene expression and reproductive anatomy. There is variation in the biological attributes that comprise sex and how those attributes are expressed in any given individual

Structural inequality: Refers to the biases in social structures such as businesses, social networks and public institutions, which produce advantages for some groups at the expense of others.

Systemic and structural racism: These terms describe the ways in which racism is embedded in systems, laws and other structures that perpetuate unfair treatment of people of colour.

Considering EDI in our approach to the research and developing the evidence base

Equity, diversity and inclusion (EDI) was considered in parallel to the development of the evidence base and policy proposals. A literature review and stakeholder engagement were carried out to understand the direct and indirect impacts net zero building policies could have on groups with protected characteristics or otherwise marginalised populations, such as low-income households. This baseline research informed a more detailed review of the potential impacts for each policy proposal. The chapter ends with a summary of what the equitable outcomes of each new net zero policy should be to support policy-makers to write policies that achieve these outcomes and support a Just Transition.

Both positive and negative potential impacts were identified. In most cases, the actual policy impacts will depend on the specific ways in which the proposed policies are enforced and adhered to by planning applicants. A series of questions and considerations were developed and posed to the wider consultant team to ensure that EDI was considered as the evidence base and policy recommendations were being compiled. These questions, and the answers to them, can be found in Appendix 10.6 and have informed the research as a whole.

It is important to acknowledge that any actions taken to reduce carbon emissions and mitigate climate change will be particularly beneficial to marginalised and disadvantaged communities, who may be at greater risk of experiencing the negative impacts of climate change. Likewise, many of the proposed policies will also support climate adaptation and improve the living conditions of those at greatest risk of experiencing overheating or fuel poverty. However, there is the potential risk that the cost of development rises as a result of these policies, making schemes less viable or less able to provide affordable housing or social amenities. Any consideration of EDI will have to balance these general benefits and potential risks.

Ensuring people with protected characteristics, and the organisations that support and advocate for their needs, are included in the development of policies and programmes can help to ensure that policy outcomes do not adversely impact marginalised groups.

Short interviews were carried out with the following organisations to understand and discuss the potential direct and indirect impacts of net zero planning policies on populations in London with protected characteristics:

- The Runnymede Trust
- The Young Foundation
- The Greater London Authority
- C40 Cities
- Citizens Advice

These organisations were selected as they have either conducted research or advised policy-makers about net zero policies for the built environment or because they research and advocate for policies to address inequalities and discrimination faced by people with protected characteristics. The transcripts from these calls can be found in Appendix 2.

Supporting a Just Transition

The concept of a Just Transition recognises that the pathway to net zero needs to be carefully managed to ensure that investments in new jobs, warmer homes and cleaner energy distribute costs and benefits fairly. There is a risk that new policies and programmes exacerbate and worsen current inequalities, leaving marginalised communities paying more or benefitting less as a result of the transition to net zero.

A focus on equity and justice will ensure that those who have contributed the least to emissions and who currently experience the most negative outcomes due to climate change see the most benefits from new policies and investments. Oxfam (2025) proposes four distinct approaches to secure a Just Transition:

Recognition justice: recognises existing inequalities and takes account these in policy decisions

Procedural justice: supports democratic and participative decision-making

Distributive justice: ensures that costs, benefits and climate actions are fairly distributed

Remedial justice: seeks fair and effective remedy for any harms related to the transition (or a failure to enact an effective transition)

This work supports policy-makers to consider opportunities to support distributive and recognition justice. Further stakeholder engagement with advocacy groups will support greater procedural justice, ensuring that marginalised voices and the experiences of people with protected characteristics shape policy decisions. As policies are developed and consulted on, there will be further opportunities for participative and deep engagement with marginalised groups to ensure that any potential negative impacts are fully discussed and addressed. There are therefore future opportunities to support additional procedural and remedial justice as the London Plan is drafted and adopted.

Distributive justice

A focus on distributive justice recognises that the costs and benefits of a transition to net zero will not necessarily be uniformly or equitably distributed. New jobs created by an energy transition or the widespread adoption of low-carbon building materials may not be available to lower-skilled workers or may be concentrated in sectors that are disproportionately male-dominated for example (Oxfam, 2025).

Likewise, the cost and energy savings associated with better insulated homes, more flexible energy use and dynamic pricing may be more significant for higher income households, who may heat larger homes and may have the resources to take advantage of flexible energy pricing. The Joseph Rowntree Foundation (2014) predicted that "by 2020, the richest 10 per cent [of households] should see an average reduction of 12 per cent on their energy bills compared to a 7 per cent reduction for the poorest 10 per cent" due to the decarbonisation of energy and sustainable domestic energy production.

In their 2025 research on the barriers to retrofitting in London, The Young Foundation found that "energy schemes, home adaptation programmes and energy and home retrofit policies are often designed around the 'average' consumer, which misses adaptation necessary for households with protected characteristics and households with complexity around energy usage".

Potential equalities impacts identified by protected characteristic (1 of 2)

Recognition justice

The table aside and on the next page summarises findings from a grey literature review of recent research exploring the implications of a Just Transition in the context of housing and the built environment.

It extracts findings and statistics that illustrate current inequities facing people with protected characteristics, as defined by the Equalities (2010) Act.

Although findings are split according to protected characteristics, it is important to note that these characteristics intersect with one another, and other factors outside of the list of protected characteristics such as income and housing tenure, to create unique, and in some cases stronger and more negative, effects.

Protected characteristics	Equalities considerations	Why this matters?
Age	**Time spent indoors** • Children and retired people typically spend more time at home and indoors than the working age population.	• Extended time spent indoors at home can increase exposure to poor indoor air quality resulting from issues such as mould or volatile organic compounds from high embodied carbon building materials.
	Industrial land • Young Londoners represent a higher share of the populations living near designated Strategic Industrial Land (SIL).	• Young people may be more impacted by changes that impact industrial land and the industrial activities that take place.
Disability	**Construction industry** • 6% of the construction industry workforce is disabled.	• The 2021 census found that 17.7% of people in the UK are disabled compared to only 6% of the construction workforce.
	Poor quality housing • 91% of the existing housing stock does not provide the most basic accessibility features. • There are currently 104,000 disabled people on councils' waiting lists for accessible and adaptable homes in the UK and an estimated 400,000 wheelchair users in England are living in unsuitable accommodation. • 18% of households with a disabled resident say they need at least one adaptation but cannot afford to make the adaptation.	• Households with at least one disabled person are less able to access suitable housing.
Religion or belief	N/A	
Sex	**Construction industry** • Women make up 14% of the construction industry workforce in the UK. This drops to 2% of on-site staff. • The construction industry has the largest gender pay gap of any industry in the UK. Women earn 76p for every £1 men earn.	• Women are under-represented in the construction sector, particularly in on-site roles, and experience a substantial pay gap.
	Time spent indoors • Women are more likely to provide unpaid care than men. Of the 5 million people providing unpaid care in England and Wales, 59% are female. Unpaid caregivers tend to spend more time indoors.	• Extended time spent indoors at home can increase exposure to poor indoor air quality resulting from issues such as mould or volatile organic compounds from high embodied carbon building materials.

Potential equalities impacts identified by protected characteristic (2 of 2)

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Protected characteristics	Equalities considerations	Why this matters?
Gender reassignment	**Unemployment** • The 2021 Census shows that adults in England and Wales with a gender identity that does not match their sex registered at birth had higher rates of unemployment and economic inactivity. Trans people are 81% more likely to be unemployed compared to cisgender peers. Unemployed people tend to spend more time indoors.	• Extended time spent indoors at home can increase exposure to poor indoor air quality resulting from issues such as mould or volatile organic compounds from high embodied carbon building materials.
Pregnancy/ maternity	**Air quality** • Exposure to air pollution can have adverse health impacts and pregnancy outcomes.	• Extended time spent indoors at home can increase exposure to poor indoor air quality resulting from issues such as mould or volatile organic compounds from high embodied carbon building materials. • Exposure to air pollution during pregnancy can have adverse pregnancy outcomes such as premature and low birth weights.
Race	**Air quality** • Communities of colour are over three times more likely to live in areas with very high levels of air pollution than their white counterparts. • People of colour are more likely to live near highly polluting infrastructure and industry.	• These factors worsen both indoor and outdoor air quality. • Whole life carbon and embodied carbon policies can have a long-term benefit driving cleaner construction practices both on- and off-site.
	Overcrowding • 28% of Bangladeshi British, 21% of Pakistani British and 21% of Black African households are overcrowded.	• Overcrowding leads to poorer indoor air quality and poorer educational and mental health outcomes.
	Access to green space • Alongside a lack of access to communal green spaces, households of colour lack access to private green spaces. 37% of Black people have no access to a private garden, private communal garden, balcony, or a patio of four yards or more in length, compared with 10% of white people.	• Cleaner construction methods should aim to redress these inequities and ensure new buildings provide access to green space to support active lives, improve air quality, mitigate climate risks such as overheating and flooding and improve health.
Sexual orientation	N/A	
Marriage/civil partnership	N/A	

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Additional potential equalities impacts and intersections with low-income

Low-income households

Although not a protected characteristic, there are specific risks to consider for low-income households. Some of the protected characteristics listed in the table above overlap closely with low-income populations. For example, women are more likely to experience low pay, part-time work and undertake unpaid work than men. After paying for housing costs, more than half (55%) of Bangladeshi and 47% of Pakistani households in the UK experience poverty. For Black African, Black Caribbean and Black British households, the rate is 40%. 34% of LGBTQ+ over-50s surveyed by Tonic have a household income below £15,000. Trans people are 81% more likely to be unemployed compared to cisgender peers.

These factors intersect to heighten risks such as increased exposure to internal air pollution and resulting poor health outcomes. The lowest fifth of households by income are more likely to live by a major trunk road or main road (19%) than the highest fifth (14%). Low-income households in London also tend to live in more airtight homes with fewer external façades leading to a lower rate of removal of indoor air pollution. The increased airtightness of low-income homes does not offset disparities in outdoor air pollution and low-income households continue to experience higher levels of indoor air pollution in London. Policies that impact the delivery and viability of affordable housing will have an impact on low-income households who benefit from access to affordable housing.

Poor indoor air quality is strongly linked to smaller or overcrowded homes, both of which are associated with low-income households. The English Housing Survey's estimate of the risk of damp and mould is higher in the lowest quintile income groups (29.1%) than in the highest (7.7%). Furthermore, 25% of those living in the most deprived neighbourhoods are unemployed compared with just 2% of those in the least deprived neighbourhoods. Unemployment is a significant predictor of more time spent at home.

- **28%** of Bangladeshi or Bangladeshi British households,
- **21%** of Pakistani or Pakistani British household, and
- **21%** of Black African households are overcrowded, compared to just 2% of white British households. Living in overcrowded housing is strongly linked to poorer indoor air quality

Rates of respiratory disease are higher in low-income areas, exacerbating the impacts of poor air quality on health in these places.

Equity impact identified for the proposed policies (1 of 3)

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Proposed policy requirement	Potential impacts	Evidence
1. Lean design	Co-benefits This policy will incentivise building retention, retrofit, re-use of building materials and material efficiency to meet the lean design requirements. This will: • Support more efficient building design to reduce the quantity of materials used • Reduce the amount of demolition on-site and waste from projects, improving local air quality and reducing disruptions to local residents • Reduce construction times, further reducing disruptions for local residents • Retain buildings and support the preservation of neighbourhood identity and character • Reduce the amount of new materials used on sites, thereby reducing transport journeys and emissions to construction sites Risks Implementing the policy will require new skills in the construction sector (currently 90% of construction in the UK uses 'business-as-usual' materials and methods). The policy may increase the pressure on industrial land in London and within the wider region to support the storage and processing of re-used and salvaged building materials. This may increase costs of industrial spaces in London or conflict with housing targets and the release of industrial and brownfield land for housing.	*"A developer can assess the embodied carbon of the [building] materials and structure proposed, [develop] options for reducing carbon and options for reusing and retrofitting components of the existing building."* London Assembly Planning and Regeneration Committee (2024) *"There needs to be an improvement in the infrastructure for storing and transporting low embodied carbon materials across London."* C40 Cities (2024) *"There was little evidence, outside of a specialist niche, that there was widespread awareness, understanding or skill to deliver a low-embodied carbon built environment."* House of Commons Environmental Audit Committee (2022)

Equity impact identified for the proposed policies (2 of 3)

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Proposed policy requirement	Potential impacts	Evidence
2. Upfront carbon	<u>Co-benefits</u> The policy may encourage the widespread adoption of low embodied carbon building materials and building techniques. Many of these have co-benefits including: • Opportunities for off-site pre-fabrication • Quicker build times and less disruptions in and around building sites • Fewer transport journeys to building sites and improved external air quality • Improved internal air quality of properties built with low embodied carbon materials The policies will encourage the use of locally sourced materials and may support local supply chains. Jobs in the manufacturing of pre-fabricated materials that are low embodied carbon may provide better working conditions than existing on-site construction jobs and allow for more flexible working to support increased diversity in the sector. This is particularly beneficial in a sector with the largest gender pay gap in the UK and where women, racialised and disabled people make up only 14%, 6% and 6% of the workforce respectively. The gender disparity in the construction sector is starker for on-site roles where women make up only 2% of the workforce (CIOB, 2024). There may therefore be opportunities for increased off-site work to support more women and disabled people into the sector. Any internal air quality improvements will be beneficial for people with caring responsibilities (who are primarily women), older people, children, pregnant people and unemployed people who all spend longer indoors than other populations or may be at risk of adverse health impacts from exposure to poor air quality. <u>Risks</u> The use of low embodied carbon materials, many of which may be manufactured off-site, may potentially reduce employment numbers and workloads for construction workers on-site. There is a risk that new jobs, skills training and opportunities are disproportionately accessed by white men already in the construction sector, further entrenching gender inequalities in the construction sector. There may be financial or other barriers for current employees to access new skills and training, reducing the employability of workers. Many of the new jobs will require qualifications, which may be expensive to obtain and take considerable time to acquire. This may impact low-income and older workers who may be less able to re-train. Employers in the construction sector, particularly SMEs, may be less able to support continued professional development of their workforce. Where workers are upskilled, labour costs may go up. There is a potential 'green rental premium' leading to higher rental costs for buildings constructed with low embodied carbon materials. This may negatively impact low-income renters, including women, single-parents, disabled people, LGBTQ+ people, older adults, young people and racialised populations, all of whom are disproportionately represented in low-income populations, as well as small businesses. The policy may make it harder for applicants to comply when they design specific building typologies or features such as podiums. These policies may impact the layout, scale and density of sites or result in loss of open space, play space or other residential amenities where these would be delivered at podium level. This could have an impact on families, children and young people or the density of new housing developments. Careful limit setting can mitigate this risk.	*"With benefits such as quicker construction schedules and reduced labour onsite from a shift towards more offsite jobs, bio-based materials could become a cheaper option. Moreover, construction using bio-based materials provides additional benefits including reduced transportation impacts, less dust, and fewer vehicle movements onsite."* C40 Cities (2024) *"The construction sector has consistently reported the largest gender pay gap of any sector in the UK, increasing to 21.2% in 2022/23 with women earning 76p for every £1 men earn"*. C40 Cities (2024) *"Women have historically been underrepresented in the technological workforce. Ensuring they have fair access to the opportunities of well-paid, high-skilled 'green jobs', which women risk being locked out of, requires sufficiently gender-sensitive policy design."* Oxfam (2025) *"Over 50% of green jobs will require degree-level qualifications, yet more than half of the current training provision in construction is at level 2."* Skyline Skills Hub (2024) *"The common practice of hiring labour on an as-needed basis (..), limit the capacity for strategic workforce planning."* C40 Cities (2024) *Bio-based buildings capture a rental premium compared to conventional buildings."* C40 Cities (2024)

Equity impact identified for the proposed policies (3 of 3)

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Proposed policy requirement	Potential impacts	Evidence
3. Whole life Carbon	<u>Co-benefits</u> Requiring applicants to account for whole life carbon will promote the use of cleaner construction methods, encourage the widespread use of local materials and encourage the use of electric tools and machinery on site, with potential reductions in air and noise pollution in and around construction sites as a result. A focus on whole life carbon will also promote building longevity, reduce replacement and refurbishment cycles and reduce refrigerant emissions. <u>Risks</u> The policy will require building material suppliers and manufacturers to provide robust and up-to-date carbon calculations and certifications for their products. This will incur a cost for businesses, many of which will be SMEs in London, who may be less able to absorb these costs or may pass on costs to developers through material price rises. There will also be cost implications for applicants to conduct a whole life carbon assessment.	*"The cost of developing EPDs (environmental product declarations) remains a barrier and their adoption is limited."* C40 Cities (2024) *"For small housing projects (…) whole life carbon assessments were more expensive to undertake than energy performance certificate (EPC) assessments."* House of Commons Environmental Audit Committee (2022) *"London's construction landscape is predominantly characterised by small and medium-sized enterprises (SMEs), which contrasts with other regions in the UK where larger bulk builders dominate."* C40 Cities (2024)
4. Administering the upfront carbon limits	<u>Co-benefits</u> Mechanisms are being considered to administer the introduction of upfront carbon limits. This could be financial or process-based where limits are not being met. These mechanisms would formalise the process for calculating contributions from developers that could go towards improving the local environment and addressing inequities. <u>Risks</u> Planning applicants that do not meet upfront limits will develop housing and commercial spaces that do not provide end-users with the co-benefits identified (such as improved internal air quality, construction sites that are less disruptive and less polluting, the use of local materials). There may be an opportunity to ensure that offsetting funds are used to secure local long-term benefits for residents of new schemes such as air quality monitoring or improvements to open spaces or support the re-training and diversification of the construction sector.	

Steps to ensure policies deliver equitable and just outcomes

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Proposed policy requirement	Steps to ensure policies deliver equitable and just outcomes
1. Lean design	The co-benefits of implementing lean design principles, such as reduced construction times, reduced transport journeys to construction sites and lessened impacts from construction on local residents and businesses should be emphasised as a key beneficial policy outcome. The benefits will be particularly significant where development proposal include infill housing or housing renewal in social housing estates as these schemes are disruptive for social housing residents who are disproportionately racialised, low-income and include a higher proportion of households with dependent children or lone parents, who are primarily women. The policy should encourage building practices that shift more construction to off-site, industrial locations to further reduce noise impacts and disruptions for local residents and businesses. The policy should consider the demand and need for industrial land to support these outcomes (such as storage to support material re-use and industrial locations for off-site construction) and balance this need with the need for new affordable housing and the development of brownfield land to meet housing targets. The risks of the policy reducing employment opportunities for on-site construction workers should be noted and the policy should have as a stated positive outcome the delivery of green jobs and skills. Opportunities to re-train construction workers should be considered to mitigate risks of the policy reducing the employability of existing workers. Where new skills are needed, these should be seen as a way to bring new people into the sector and increase the sector's diversity.
2. Upfront carbon	The upfront carbon policy sets performance limits for applicants to meet. Lower upfront limits will maximise the identified co-benefits and drive cleaner construction practices and reduce on-site emissions. The electrification of tools, reduced transport journeys, waste and demolition will improve local air quality and tackle air pollution, which disproportionately impacts racialised and low-income groups. This will be particularly beneficial in areas designated as Air Quality Management Areas, where air quality is currently at dangerous levels. The policy will also promote the use of locally sourced materials and the recycling and re-use of materials, which will support local supply chains. There is a risk that lower upfront carbon limits will be challenging to meet and reduce the viability of schemes by raising construction costs, and therefore the costs of delivering affordable housing.
3. Whole life carbon	Ensuring applicants measure and report on whole life carbon emissions will support the delivery of buildings that reduce their in-use and end-of-life carbon emissions. The policy will ensure emissions are considered across the building lifecycle to increase building longevity, reduce refurbishment and replacement cycles and reduce refrigerant emissions. The outcomes of these policies should further support and allow for the retention of buildings and improve the environmental conditions of construction sites in the long-term as buildings that comply with the policy reach their end-of-life stage.
4. Administering the upfront carbon limits	Mechanisms to administer the upfront carbon limits will ensure that the policies are enforced and that schemes that do not comply with new limits are penalised. There is an opportunity to use any penalties from developers to secure some of the identified co-benefits and outcomes identified above by funding skills and retraining programmes for construction workers for example.

9.0

Implementation and opportunities to streamline the process

This section covers implementation and identifies opportunities to make the requirements for applicants easier and less time consuming.

Embodied and whole life carbon policies | Streamlining the process

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Streamlining planning submission requirements for embodied and whole life carbon will save the applicant and Local Authority/GLA 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).

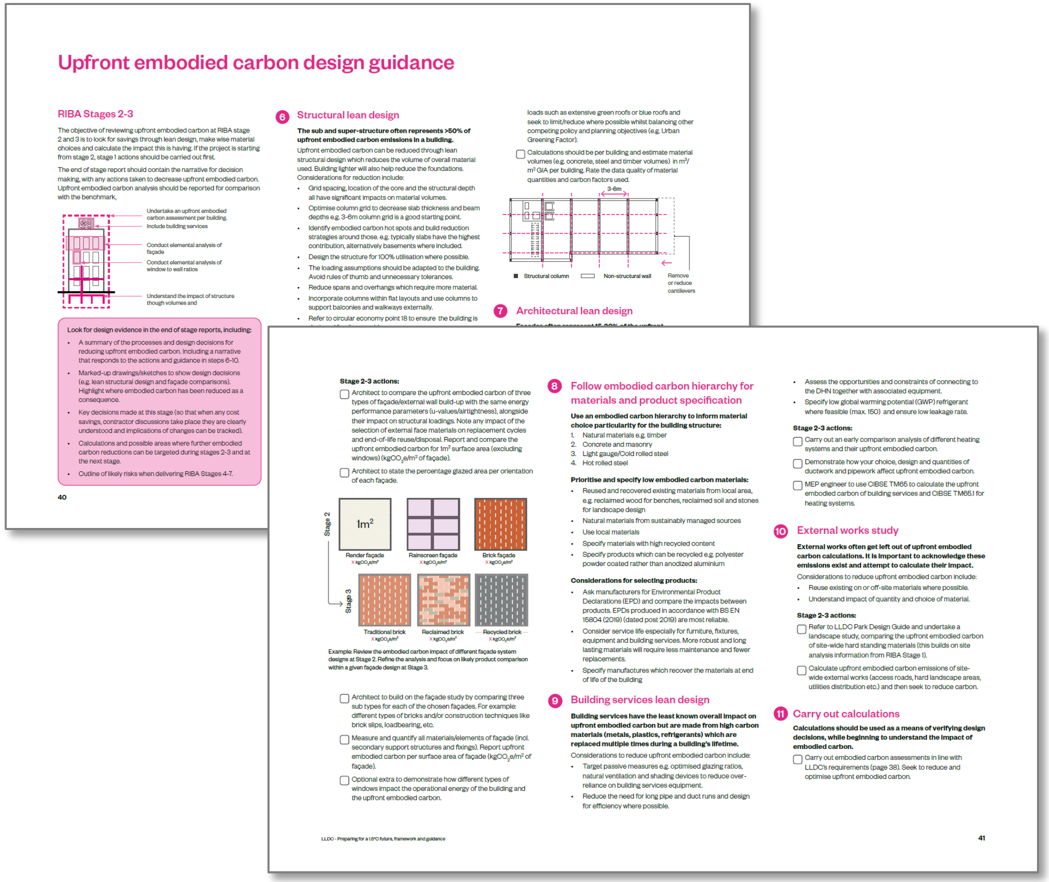
Combining policy with efficient processes to achieve outcomes

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.

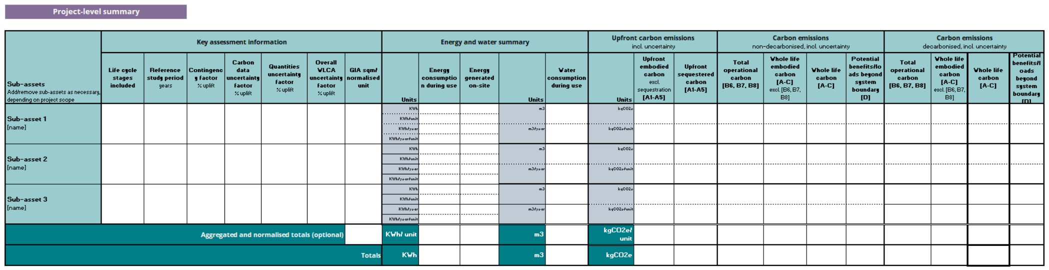
Achieving quality

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 the GLA 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 London 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 LLDC – Preparing for a 1.5°C future – guidance on how to design low embodied carbon buildings.



RICS WLCA PS 2nd ed. – reporting template

Embodied and whole life carbon policies | Simplified submission process

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In order to make submission process more simple and effective, it could be split into two-three 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.
- **GLA proforma for lean design** – Instead of a length embodied and whole life carbon report. Lean design could be explained in a basic proforma, with drop downs and free text boxes. Giving applicants a chance to explain key interest areas in a simplified way.
- **Energy and Carbon Statement -** An Energy and Carbon Statement using a standardised contents list (covering operational and embodied and whole life 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.

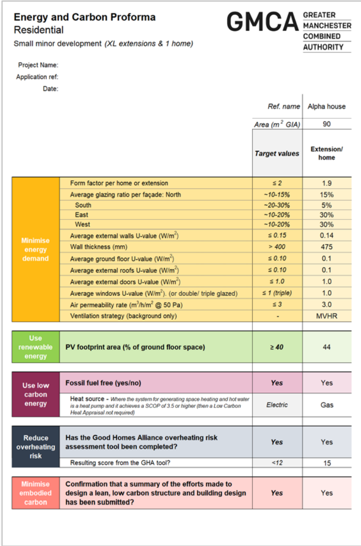
Bringing proportionality to policy and planning submissions

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.

Proposed policy requirement	Opportunity for simplified submission process
1. Lean design	Basic GLA proforma with pre-set dropdowns and free text boxes where more detail is required. Could be integrated into the energy and carbon proforma (example below).
2. Upfront carbon limits	Completion of RICS WLCA PS 2nd ed. template for full results of calculations. Completion of energy and carbon proforma (combined with operational energy) to summarise results.
3. Whole Life Carbon reporting	As for upfront carbon above.

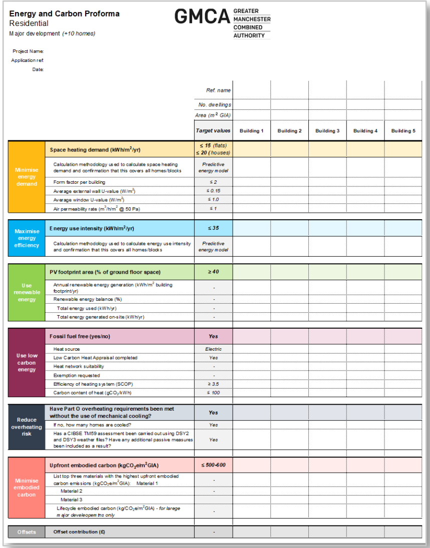


Energy and Carbon Proforma
Residential
Small minor development *(XL extensions & 1 home)*

GMCA GREATER MANCHESTER COMBINED AUTHORITY

Project Name:
Application ref:
Date:

		Ref. name	Alpha house
		Area (m^2 GIA)	90
		Target values	**Extension/ home**
Minimise energy demand	Form factor per home or extension	≤ 2	1.9
	Average glazing ratio per façade: North	~10-15%	15%
	South	~20-30%	5%
	East	~10-20%	30%
	West	~10-20%	30%
	Average external walls U-value (W/m^2)	≤ 0.15	0.14
	Wall thickness (mm)	> 400	475
	Average ground floor U-value (W/m^2)	≤ 0.10	0.1
	Average external roofs U-value (W/m^2)	≤ 0.10	0.1
	Average external doors U-value (W/m^2)	≤ 1.0	1.0
	Average windows U-value (W/m^2). (or double/ triple glazed)	≤ 1 (triple)	1.0
	Air permeability rate ($m^3/h/m^2$ @ 50 Pa)	≤ 3	3.0
	Ventilation strategy (background only)	-	MVHR
Use renewable energy	**PV footprint area (% of ground floor space)**	≥ 40	44
Use low carbon energy	**Fossil fuel free (yes/no)**	Yes	Yes
	Heat source - *Where the system for generating space heating and hot water is a heat pump and it achieves a SCOP of 3.5 or higher (then a Low Carbon Heat Appraisal not required)*	Electric	Gas
Reduce overheating risk	**Has the Good Homes Alliance overheating risk assessment tool been completed?**	Yes	Yes
	Resulting score from the GHA tool?	<12	15
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	Yes



Energy and Carbon Proforma
Residential
Major development *(+10 homes)*

GMCA GREATER MANCHESTER COMBINED AUTHORITY

Project Name:
Application ref:
Date:

		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 (flats) ≤ 20 (houses)					
	Calculation methodology used to calculate space heating demand and confirmation that this covers 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 ($m^3/h/m^2$ @ 50 Pa)	≤ 1					
Maximise energy efficiency	**Energy use intensity ($kWh/m^2/yr$)**	≤ 35					
	Calculation methodology used to calculate energy use intensity and confirmation that this covers 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)	-					
	Total energy generated on-site (kWh/yr)	-					
Use low carbon energy	**Fossil fuel free (yes/no)**	Yes					
	Heat source	Electric					
	Low Carbon Heat Appraisal completed	Yes					
	Heat network suitability	-					
	Exemption requested	-					
	Efficiency of heating system (SCOP)	≥ 3.5					
	Carbon content of heat (gCO_2/kWh)	≤ 100					
Reduce overheating risk	**Have Part O overheating requirements been met without the use of mechanical cooling?**	Yes					
	If no, how many homes are cooled?	Yes					
	Has a CIBSE TM59 assessment been carried out using DSY2 and DSY3 weather files? Have any additional passive measures been included as a result?	Yes					
Minimise embodied carbon	**Upfront embodied carbon ($kgCO_2e/m^2$GIA)**	≤ 500-600					
	List top three materials with the highest upfront embodied carbon emissions ($kgCO_2e/m^2$GIA): Material 1	-					
	Material 2	-					
	Material 3						
	Lifecycle embodied carbon ($kg/CO_2e/m^2$GIA) - *for larege major develeopem ths only*	-					
Offsets	**Offset contribution (£)**	-					

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.

Embodied and whole life carbon policies | Policy versus guidance

While policy is fixed during the operational period of the London Plan, Guidance can be updated during the term. The importance of and knowledge regarding embodied and Whole Life Carbon has changed rapidly since 2021 when the current London Plan was launched and is likely to evolve equally quickly over the coming years.

There are numerous changes that could impact the topic of embodied and whole life carbon in the built environment:

- Government
- Part Z adopted
- London borough local plans
- RICS WLCA PS updated
- EN 15978 updated
- UK NZCBS limits evolve
- Material and supply chain decarbonisation allows embodied carbon decreases faster than currently expected
- Approach to national/ city wide sectoral carbon budgets
- Cost of carbon
- VAT rules
- Costs related to climate resilience need faster and more reductions within the timescale of the policy period

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Deliverables

Key documentation can be based on the completion of a GLA proforma with pre-set dropdowns and free text boxes where more detail is required.

The proforma could also be set up with a simple embodied carbon tool to report building element options for those without access to paid tools, alternatively a pattern book of pre-made construction build-ups could be provided. This serves the added benefit of industry upskilling and aims to balance driving action with excessive workload and process cost.

Supplementary design guidance should be created by the GLA to support this policy recommendations. This could include:

- An explanation of what good design for material efficiency, material selection and low embodied carbon outcomes look like. Include information on why material efficiency and form factor are important and how this compares to material selection.
- Examples of upfront embodied carbon figures for various wall and structure types.

Pre-app	Description	• Summary of efforts made to reduce upfront carbon through existing building retention, material efficiency and design.
	Format	• Short presentation at pre-app against a checklist of topics.
	Governance	• Pre-apps can be strongly encouraged at all scales of development to ensure that are planning the policies are understood and aligned to. This will include façade and structural choices and decisions to undertake significant demolitions.
Planning submission	Description	• Documentation of efforts made to reduce upfront carbon, including building retention. • Comparison to pattern book of construction build-ups and structural design • If chosen new façade and structural solutions applicant to note change and why, or provide justification of design and why.
	Format	• Drawings and diagrams with commentary. • Excel based proforma with pre-set dropdowns and free text where more detail required.
	Governance	• Officer discretion if the applicant has offered a satisfactory solution.
Discharge of pre-commence ment condition	Description	• Confirmation that low carbon solutions submitted for planning are to be followed through construction.
	Format	• Statement of confirmation with re-submission of planning information showing all amendments.
	Governance	• Officer discretion as to whether lean design has been adhered to if the applicant has made significant changes.

Reduce and limit upfront carbon | Policy implementation (1 of 2)

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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 London side Carbon Review panel for applicants to procure verification services from
- Allowing for Local Authority 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 limits for the new London Plan

Material decarbonisation means upfront carbon will naturally decrease over time. This predicted decrease means London Plan policy should contain the mechanism to reduce upfront carbon limits 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 limit at least 12 months prior to any adopted change within the policy to ensure applicant certainty
- Determining any change to the limit based on data gathered from planning applications and post-completions gathered by the GLA 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 limits, justifying choices proposed.
	Format	• Short slide show 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 limits** have been met as well as project information.
	Governance	• If limits are met the path through planning will require less consultation and evidence. • Officers can request consultation and resolution with the applicant/ design team if results vary significantly from the **limits.** • Third party verification options can be applied, if required • Where site abnormal mean a scheme can't meet the limits, 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 alongside.

Reduce and limit upfront carbon | Policy implementation (2 of 2)

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Pre-commencement conditioning

As part of engagement for this study, stakeholder consultees raised pre-commencement conditioning as a method to monitor design changes and carbon impacts between the planning application stage and before the project starts on site. This could drive more focus on reducing carbon emissions during the critical technical and construction stages of a project.

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

Not meeting the upfront limit at post-completion stage

Refer to section regarding offsetting and administering the upfront limits found here.

Discharge of pre-commencement condition (LA discretion)	Description	• Confirmation that low carbon solutions **that are required for the project to meet limits** submitted for planning are to be followed through construction.
	Format	• Statement of confirmation with re-submission of planning information showing all amendments.
	Governance	• If third party verification is brought forwards to support implementation, it will be actioned at this point • Where site abnormals mean a scheme can't meet the limits, the agreed upfront carbon threshold must be met. Potentially, a set of reduction measures could be agreed alongside.
Post-completion reporting	Description	• Confirmation that the as built meets the required policy limit.
	Format	• Resubmission of data using as built information. • Data entry to BECD.
	Governance	• Third party verification options can be applied, if required. • Penalty or public disclosure if limits or pre-agreed upfront carbon threshold has not been met.

Upfront carbon and report whole life carbon | Consistency of reporting

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Focussing on the key outputs from a WLC assessment

Bespoke GLA tool - The GLA data collection spreadsheet is very comprehensive and bespoke. However, it might be that there is a way of communicating the data so that applicants and planning authorities, potentially unfamiliar with the assessment process, but with decision-making power and influence could be focussed on key findings. The bespoke nature of the GLA tool means that in future, consultants would likely complete the RICS WLCA PS 2nd ed template prior to completing the GLA tool. Resulting in duplicated efforts

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. A standard data submission platform could be developed for planning offers to unify the process across the London Boroughs, which would be welcomed by applicants. This will streamline requirements as results will not need to be presented in multiple formats.

Other tools for consideration

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 limits for other typologies to be set in the future and key trends can be better understood by policy makers.

Estimated WLC emissions
N.B. This forms the WLC baseline for the development. The green cells will automatically populate from the tables below

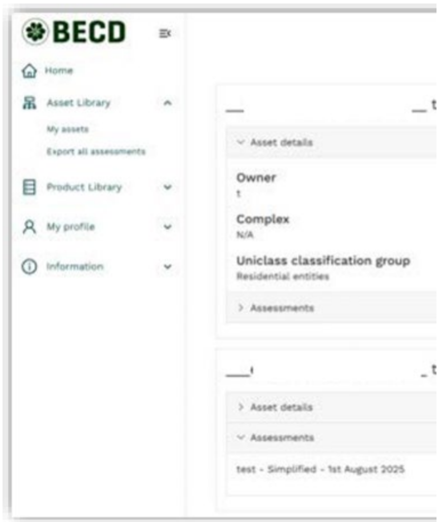
	Module A1-A5 (excluding sequestered carbon)	Modules B-C (excl B6 & B7)	Modules A-C (excl B6 & B7; including sequestered carbon)	Module B1-B5	Module B6-B7	Module C1-C4	Module D
TOTAL kg CO_2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	#VALUE!	0 kg CO2e	0 kg CO2e
TOTAL kg CO_2e/m^2 GIA	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#VALUE!	#DIV/0!	#DIV/0!
Please select most appropriate benchmark from drop-down menu	Residential						
WLC Benchmark	<850	<350	<1200				
Aspirational WLC Benchmark	<500	<300	<800				
Comparison with WLC benchmarks (see Appendix 2 of the guidance)	[Explain the reasons for any divergences from WLC benchmarks, including against the WLC aspirational benchmarks]						

Current London Plan WLCA summary reporting

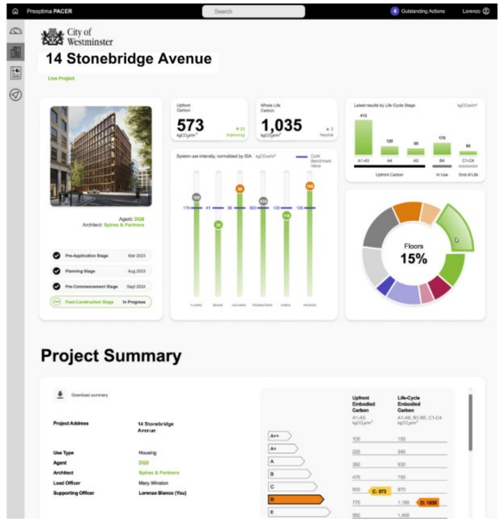
Project-level summary

Sub-assets Add/remove sub-assets as necessary, depending on project scope	Key assessment information: Life cycle stages included	Reference study period (years)	Contingency factor (% uplift)	Carbon data uncertainty factor (% uplift)	Quantities uncertainty factor (% uplift)	Overall WLCA uncertainty factor (% uplift)	GIA sqm/ normalised unit	Energy and water summary: Units	Energy consumption during use	Energy generated on-site	Units	Water consumption during use	Upfront carbon emissions (incl. uncertainty): Units	Upfront embodied carbon excl. sequestration [A1-A5]	Upfront sequestered carbon [A1-A5]	Carbon emissions (non-decarbonised, incl. uncertainty): Total operational carbon [B6, B7, B8]	Whole life embodied carbon [A-C] excl. [B6, B7, B8]	Whole life carbon [A-C]	Potential benefits/loads beyond system boundary [D]	Carbon emissions (decarbonised, incl. uncertainty): Total operational carbon [B6, B7, B8]	Whole life embodied carbon [A-C] excl. [B6, B7, B8]	Whole life carbon [A-C]	Potential benefits/loads beyond system boundary [D]
Sub-asset 1 [name]								KWh KWh/unit KWh/year KWh/year/unit			m3 m3/year		kgCO2e kgCO2e/unit										
Sub-asset 2 [name]								KWh KWh/unit KWh/year KWh/year/unit			m3 m3/year		kgCO2e kgCO2e/unit										
Sub-asset 3 [name]								KWh KWh/unit KWh/year KWh/year/unit			m3 m3/year		kgCO2e kgCO2e/unit										
Aggregated and normalised totals (optional)								KWh/ unit			m3		kgCO2e/ 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

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Deliverables

Key documentation can be based on a proforma to report key metrics and RICs template for more detailed calculation results, the same system as the upfront carbon limits.

Pre-commencement conditioning

See comments on previous page.

Third party verification

See comments on previous page.

Pre-app	Description	• Presentation of building retention (where relevant) and low carbon strategies employed so far. Structural and façade optioneering against upfront and life cycle carbon, justifying choices proposed.
	Format	• Short slide show covering points listed.
	Governance	• Pre-application could be mandatory where over 50% of an existing building by GIA. • Officers can request further detail behind calculations, further WLC options to justify demolitions and further pre-app.
Planning submission	Description	• Whole Life Carbon calculation results carried out in line with current RICS WLCA PS 2nd Ed.
	Format	• Completion of pro-forma including relevant figures and project information.
	Governance	• Officers can request consultation and resolution with the applicant/ design team if results vary significantly from the benchmarks. If third party verification is brought forwards to support implementation, it will be actioned at this point. • Officer discretion about overall priorities, potential recognition of over-performance in other areas if WLC is higher.
Discharge of pre-commencement condition	Description	• Confirmation that low carbon solutions that low carbon solutions committed to as part of the planning application are to be followed through construction.
	Format	• Statement of confirmation with re-submission of planning information showing all amendments.
	Governance	• Officer discretion regarding action if discrepancies are found • Third party verification if considered required by officer.
Post-completion reporting	Description	• Confirmation that the as built matches the planning permission.
	Format	• Resubmission of data using as built information. • Data entry to BECD.
	Governance	• Third party verification if considered required by officer. • Data collected to improve ability to set limits in the future, particularly for sectors with fewer datasets.

10.0

Appendices

Contents of appendix

10.1

Definitions, glossary and abbreviations

This section provides more detailed definitions of the embodied carbon boundaries; limits, targets and benchmarks; a glossary; and abbreviations.

Upfront and life cycle embodied carbon explained

Upfront carbon (modules A1-A5)

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 easily influenced by policy and addressed by client and design teams during the planning process.

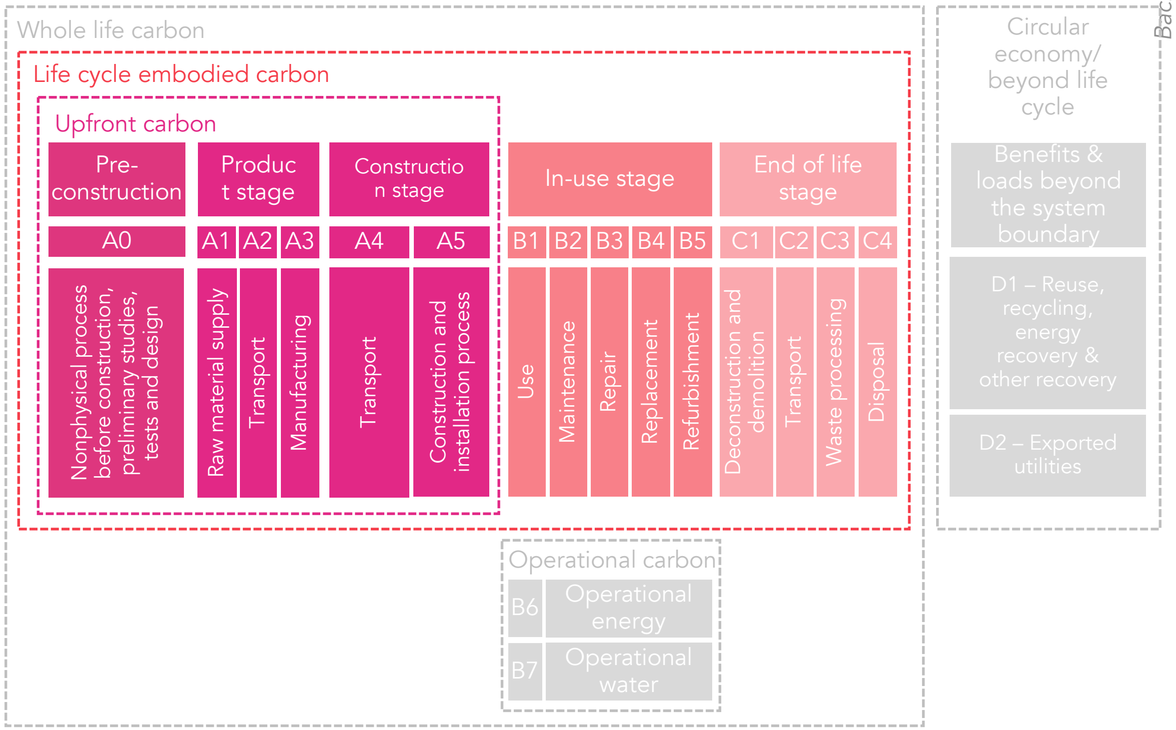
Industry targets such as LETI are framed around upfront carbon (modules A1-A5) and some recently adopted planning conditions also focus on these modules).

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.

Life cycle embodied carbon (modules A1-A5, B1-B5 and C1-C4)

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 quantitate. 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."

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Operational carbon explained

Operational carbon refers to the emissions associated with energy and water use of a building during its operation.

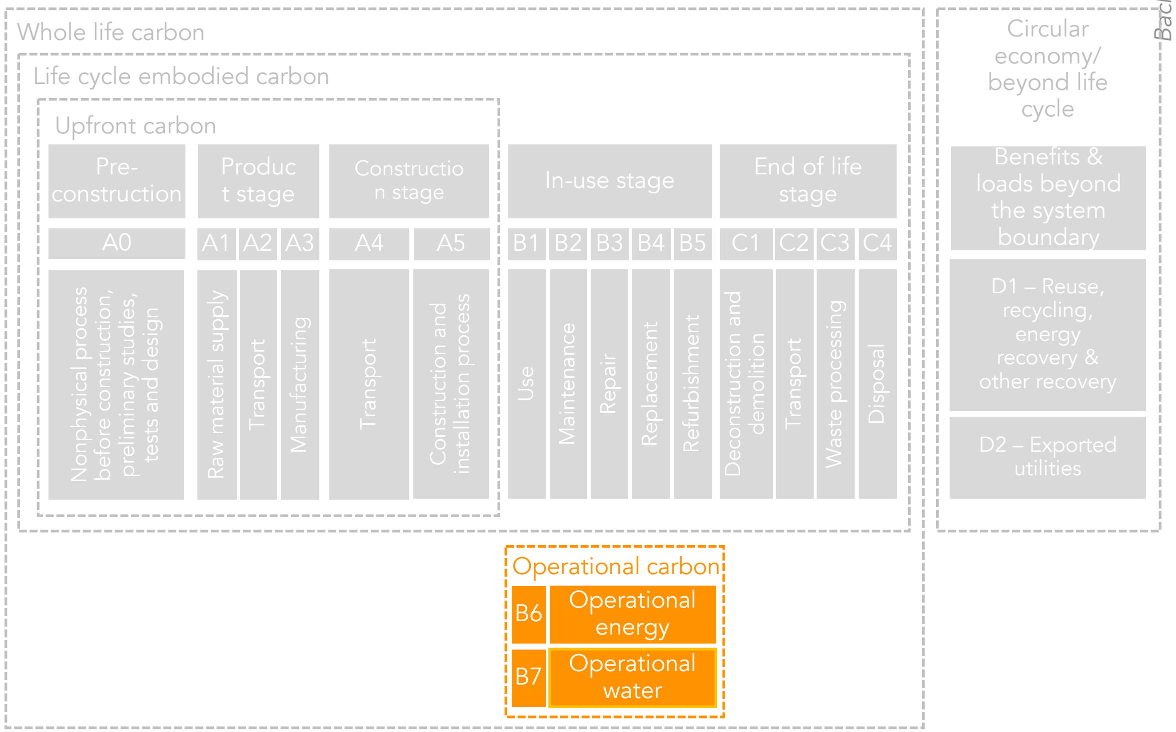
Operational carbon can and should be reduced through planning policy.

Balancing operational and embodied carbon

Decisions taken during the design of a building to improve operational carbon can have an impact on the resulting embodied carbon. Rather than considering operational carbon and embodied carbon separately a balance needs to be struck across all environmental considerations. Therefore, the focus should be to be on reducing operational carbon in support of ultra-low energy buildings alongside life cycle embodied carbon, as opposed to trading one off of another.

Some considerations for reducing upfront carbon, when ensuring the building achieves a net zero operational carbon include:

- An efficient building form almost always emits less upfront carbon than a complex building form. It is also more likely to have lower operational carbon and reduce construction costs.
- Features such as: shading devices to reduce overheating; dual aspect dwellings for cross ventilation and daylight; green and blue roofs for sustainable urban drainage and biodiversity; or renewables should not be traded with embodied carbon. Instead their impact should be recognised.
- Even though windows typically have a lower upfront carbon than external walls, their total area should not exceed the recommended glazing-to-walls-ratio (north 10-15%, south 20-30%, east and west 10-20% for residential buildings), in order to keep a balance between upfront carbon, the operational energy target, overheating and levels of daylight.
- When choosing different types of façade/external wall build-ups based on the lower upfront carbon, energy performance parameters (u-values/airtightness) should always seek to achieve an ultra-low energy building.



Building assessment modules with a focus on operational 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:

> **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.
> - water (module B7) refers to GHG emissions arising from water supply and wastewater treatment for an asset in use, over its life cycle "

Whole Life Carbon explained

Whole life carbon is the sum of life cycle embodied carbon and operational carbon.

Bringing together operational and embodied carbon

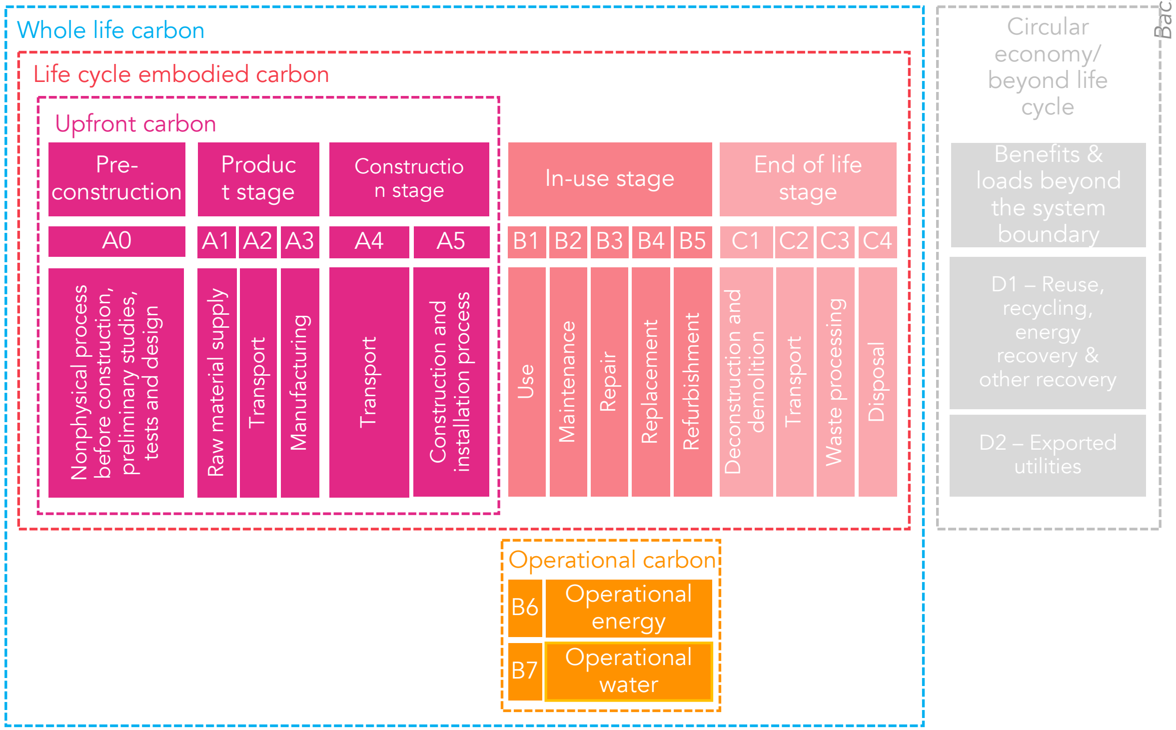
As an industry we are still learning about the interrelationships between operational energy and embodied carbon and the uncertainties when bringing the two together in a Whole Life Carbon Assessment. In 2023, LETI shared a useful opinion piece on this topic.

The RICS Whole Life Carbon Assessment for the Built Environment translates international guidance (BS EN15978) into the UK context. The second edition was released in 2023 and came into effect in June 2024. This industry standard methodology combines operational and embodied carbon to create whole life carbon figures following industry best practice.

While there are benefits to calculating and reporting whole life carbon figures, if used without interrogation of the embodied and operational components separately they can mask poor design decisions and performance. Allowing embodied carbon to be traded with operational carbon.

The Greater London Authority (GLA) London Plan Policy SI 2 requires the full submission of Whole Life Carbon emissions. This currently applies to large scale, referable applications.

The campaign to introduce Part Z in to the Building Regulations also proposes the mandatory measurement and reporting of Whole Life Carbon emissions.



Building assessment modules with a focus on whole life 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:

> Whole life carbon
>
> "Whole life carbon emissions are the sum total of all asset-related GHG emissions and removals, both operational and embodied, over the life cycle of an asset, including its disposal (modules A0–A5, B1–B7, B8 optional, C1–C4, all including biogenic carbon, with A0 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)."

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Circular economy explained

A circular economy seeks to ensure materials can be re-used again and again and are ultimately diverted from landfill and incineration. This combats planetary resource depletion and excessive waste production.

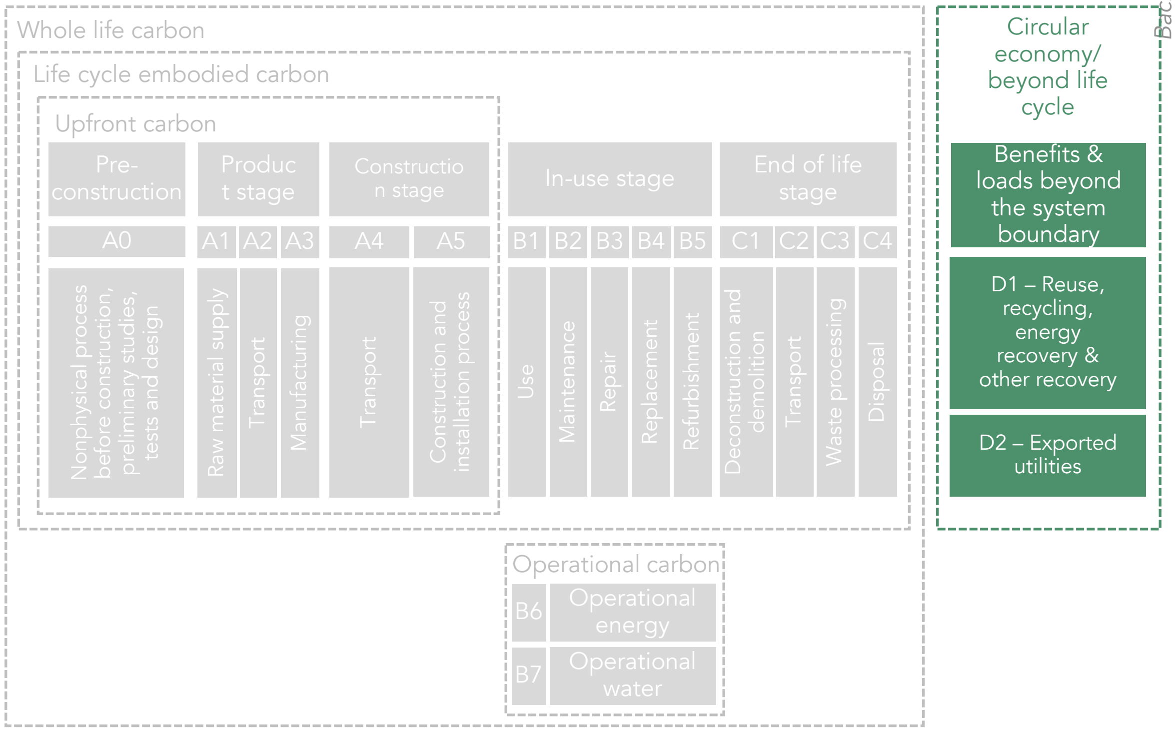
The cross over between circular economy and embodied carbon

The aims of the circular economy are to minimise resource depletion, increasing biodiversity through reducing material excavation and enabling improvements to ecological systems. The focus of embodied carbon is currently on the requirement to limit carbon emissions through material selection and use. In this context, upfront carbon is often viewed as more critical, because the emissions are more immediate. In 2021, LETI shared a useful opinion piece on this topic.

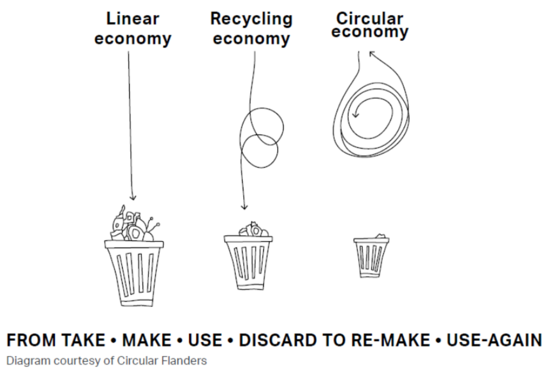
In some instances, applying circular economy principles could increase upfront carbon. For example designing in flexibility for a potential future use that may not come to fruition or designing for longevity and fewer replacement cycles versus designing for an expected shorter life cycle and allowing for deconstruction.

Conversely, circular economy principles can also be used to create embodied carbon reductions:

- The more building and material re-use on-site the lower the embodied carbon. This is because, less processing, transport and waste emissions are generated, even if new material is needed for repairs or fabric enhancements.
- Similarly, when re-using material from other sites there are generally fewer processing emissions than when using virgin material.
- When specifying materials with high recycled content it is important to check environmental product declaration (EPD) data as these can vary significantly, depending on the processing required to extract using material from existing and re-process.
- In principle, long life, loose fit and 'designing in layers' allows for future adaptation, replacement and maintenance; with less disruption and damage to surrounding material. It is also more likely that materials or elements can be salvaged for re-use elsewhere.



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



The difference between linear and circular economy (Source: Circular Flanders).

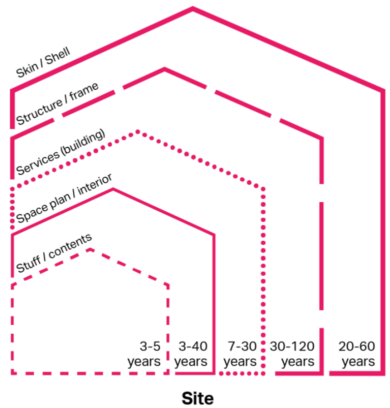


Illustration of building layers and their different lifespans – this will be specific to each development (Source: GLA).

Glossary of terms

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Biogenic 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

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). Therefore the limits proposed in this study will apply to these uses.

Deep retrofit – '*Development involving the re-use of as much of the existing building as possible, but may involve substantial demolition and replacement of parts of (but not all of) the façade, core, floor and slab, and which results in significant energy, performance, and climate adaptation upgrades, comparable to those a new building, dramatically reducing carbon emissions from the building and prolonging its usable lifespan.*' Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

Demolish and recycle - '*Traditional demolition, with elements and materials processed into new elements, materials and objects for use on the site or on another site.*' Source: CE Statement 2022.

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: CE Statement 2022.

Embodied/ life cycle 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

Inventory of carbon & energy (ICE) database – '*The Inventory of Carbon and Energy (also know 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

Major development – '*Development greater than or equal to: – 10 residential units; or – 0.5 hectares site area (residential) or 1 hectare (non-residential); or – gross floorspace of 1,000 sqm (GIA).*' Source: Westminster City Plan Draft 2024.

Major renovation – '*Defined in regulation 35 as the renovation of a building where more than 25% of the surface area of the building envelope undergoes renovation.*' Source: Approved Document Part L 2021.

Glossary of terms

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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

Partial retention and refurbishment – '*Significant quantities of carbon-heavy aspects of the building are retained in place, such as the floors and substructure, with replacement of some elements of the building, such as walls or roofing. More significant refurbishment can involve adding floors or extensions.*' Source: CE Statement 2022.

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

Process costs – Refers to the project consultancy fees needed to undertake a piece of work. Which are distinctly different to the physical capital costs that may be added to a project through the meeting of a metric of limit.

Responsible retrofit – '*Responsible retrofitting is an informed and integrated attitude to retrofit in a way that enables people to reduce the operational carbon of a building, improve energy efficiency, and/or improve a building's resilience to the impacts of climate change. Responsible retrofit will take into account the building's location, context, design, construction, materials and use, to ensure retrofit measures perform well and avoid adverse impacts to health, heritage and the natural environment.*' Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

Retain and retrofit - '*The vast majority of the building's fabric is retained, with the building refurbished for the same or new uses through restoring, refinishing and future-proofing. This also encompasses retrofitting, where new technology or features are added to existing buildings to make them more efficient and to reduce their environmental impacts.*' Source: Circular Economy (CE) Statement 2022.

Retrofit – '*Development involving the re-use of at least 50% of the existing building in-situ (by mass or volume), retaining as a minimum the foundations, core, and floor slabs, and which results in energy, performance, and climate adaptation upgrades, which will reduce carbon emissions from the building and prolong its usable lifespan.*' Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

RICS - the Royal Institution of Chartered Surveyors RICS Professional Standard (RICS WLCA PS 2nd ed 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

Substantial demolition – '*Development consisting of the demolition of 50% or more of existing above ground structures, by area or volume, but not constituting total demolition.*' Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

Total demolition – '*The removal, deconstruction or demolition of an existing building, which will entail the removal of all of its fit out, superstructure, cores, and basement slab(s), but which could involve the retention of parts or all of the façade.*' Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

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

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Abbreviations

B&NS: Bath and North East Somerset

BAMB: Buildings as Materials Banks

CAT A: Category A fit out

CAT B: Category B fit out

CCC: Climate Change Act

CE: Circular Economy

CES: Circular Economy Statement

CIBSE: Chartered Institution of Building Services Engineers

CLT: Cross Laminated Timber

CO_2e: 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

GFRC: Glass fibre reinforced concrete

GGBS: Ground Granulated Blast-furnace Slag

GHG: Greenhouse gas

GLA: Greater London Authority

IPCC: Intergovernmental Panel on Climate Change

IStructE: Institution of Structural Engineers

KPI: Key Performance Indicator

LCA: Life Cycle Assessment

LETI: Low Energy Transformation Initiative

LLDC: London Legacy Development Corporation

MEP: Mechanical, electrical and plumbing

NPPF: National Planning Policy Framework

PAN: Planning Advice Note

PBSA: Purpose-Built Student Accommodation

RC: reinforced concrete

RIBA: Royal Institute of British Architects

RICS: Royal Institute of Chartered Surveyors

RICS WLCA PS: RICS Whole Life Carbon Professional Statement

S&C: Shell and Core

SDS: Spatial Development Strategy

SHD: Space heating demand

SPD: Supplementary planning document

UKGBC: The UK Green Building Council

UKNZCBS: UK Net Zero Carbon Buildings Standard

WBLCA: Whole Building Life-Cycle Assessment

WLC: Whole life carbon

WOE: West of England

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10.2

Upfront and lifecycle carbon modelling assumptions and results

10.2.1

Upfront and lifecycle carbon modelling assumptions and results

Residential

General information | Flats ≥11 m

The purpose of this modelling analysis was to investigate the upfront carbon (modules A1-A5) of a high-rise residential building. The results have informed the proposed upfront carbon limits in this study. Capital cost modelling has been carried out to understand how cost and viability may affect policy. Lifecycle carbon has also been reported to give a wider understanding embodied carbon.

Residential typology modelled

This section of the report focuses on the residential typology, where a 13-storey block of flats (1 and 2 beds) has been identified and assessed for the upfront, life cycle carbon and cost modelling:

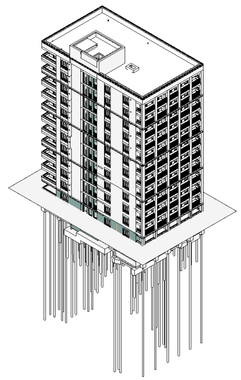
The building modelled is a real London-based project (RIBA stage 5) meeting best practice operational levels of performance taken from the consultancy team's portfolio. The table opposite summarises some general information of the building.

Carbon measurement standard

The methodology for measuring whole-life carbon emissions in the built environment has been evolving through the last couple of years. This evidence-base has adopted RICS whole life carbon assessment standard, 2nd edition, which is the industry's supported standard.

Operational energy performance

Decisions taken during the design of a building to improve operational energy can have an impact on the resulting upfront carbon. Rather than considering operational energy and upfront carbon separately a balance needs to be struck across all environmental considerations. In this case, the block of flats is capable of achieving best practice operational energy levels described on the table opposite.



	Block of flats
Number of storeys	13
Gross Internal Area (m^2)	5800
Ground to top floor height (m)	41.5*
Average floor to floor height (m)	3.15
Grid spacing (m)	3.5 – 1.8
Form factor	0.8
Glazing to wall ratio (%)	23
Second staircase	Yes
SHD level	Level 3 (15 kWh/m^2/yr (GIA))
EUI level	Level 3 (35 kWh/m^2/yr (GIA))

Table lists general information of the residential building typology modelled.

** The project is required to have non-combustible materials in the construction of all its external walls, balconies and spandrel panels. according to Approved document B (2019), due to its hight being above 18m.*

Lifecycle stages modelled | Block of flats

To determine which lifecycle stages and building elements were part of this embodied carbon modelling, the guidance from RICS Whole Life Carbon Assessment (WLCA) Professional Statement (PS) 2nd ed. 2023 was followed.

Upfront carbon

Upfront carbon (stages A1-A5) is the focus of this modelling exercise with a main aim to inform upfront carbon limits as part of the new London Plan energy and carbon policy. 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.

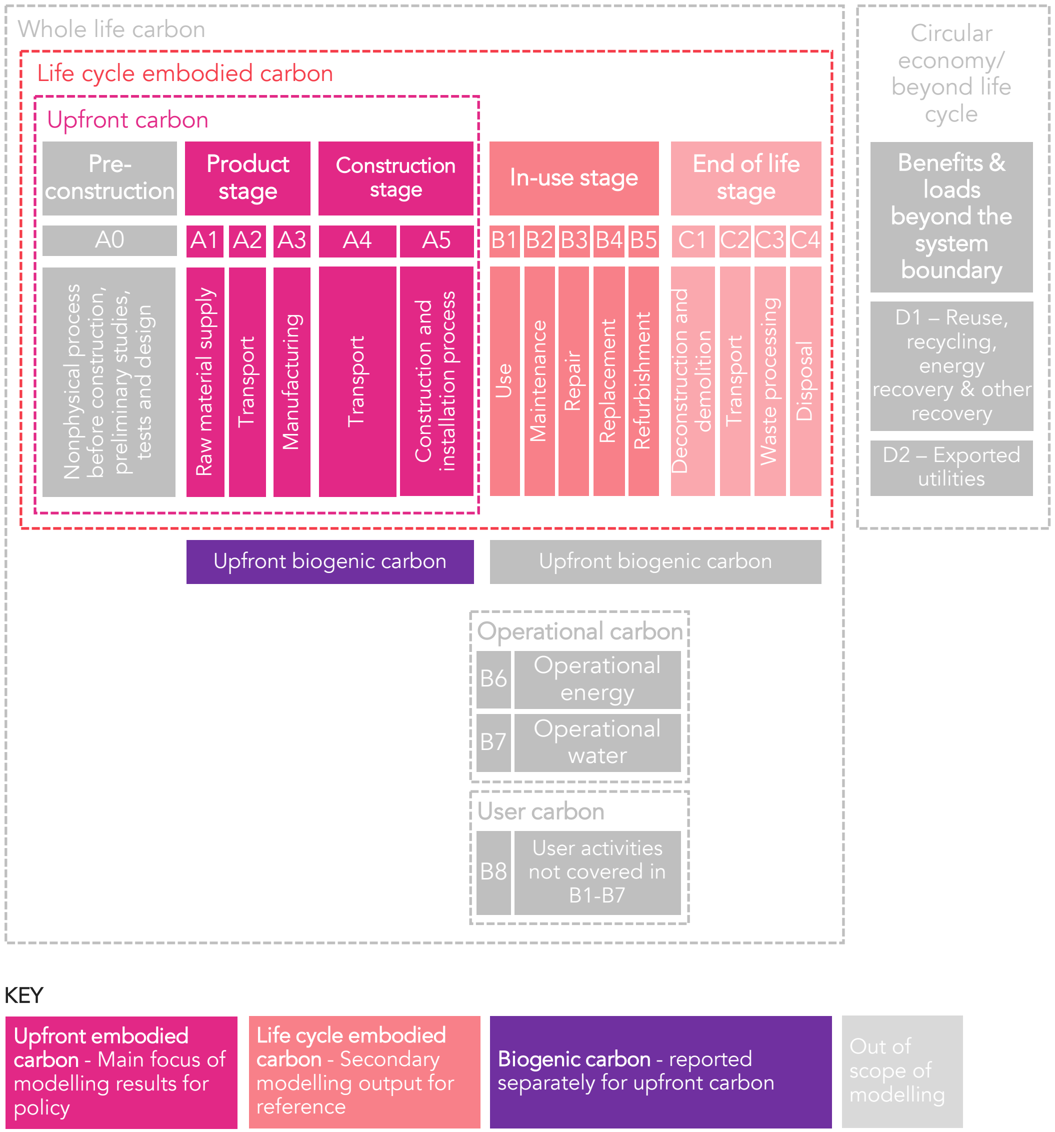
Following the UK NZCBS assessment methodology, *A0 Pre-construction module* is excluded from the calculation of the upfront carbon limit and according to RICS WLCA PS 2nd ed. 2023, when no site-specific data are available a 40 kgCO_2/m^2 should be assumed as a baseline for *A5.2 Construction Activities* carbon emissions.

Lifecycle embodied carbon

While the primary purpose of this modelling is to understand upfront carbon (A1-A5), lifecycle embodied carbon – in-use stages B1-B5 and end of life stages C1-C4 - has also been included and reported. This is due to the importance of understanding the full impact of materials and products on the whole life cycle of a building (for example, building services where replacement cycles are more frequent than the building fabric).

Biogenic carbon

Biogenic carbon is the sequestered carbon stored within biogenic construction materials incorporated into the building, such as timber. It has been included in the assessment and reported separately for stages A1-A5, in accordance with the RICS WLCA PS 2nd ed. 2023 guidance.



Life-cycle stages in and out 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.

Building elements modelled and carbon datapoints used I Block of flats

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

Modelled building elements

The modelling has covered the upfront and lifecycle carbon emissions from the sub-structure, super-structure and finishes. Since the building modelled is a London-based project taken from the consultancy team's portfolio, calculations were based on actual material quantities extracted from a BIM model developed for the actual live project. Therefore, the quantities used reflect real construction information rather than assumed generic values.

Assumed building elements

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% for residential. Services (MEP) emissions have also been assumed using internal project-based data with CIBSE TM65 methodology used (sanitaryware not included).

Out of scope

Following the UK NZCBS 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. For the purpose of this study, they are not included in the life cycle carbon results either.

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 (ICE), 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.

RICS WLCA PS 2nd ed. Category	Scope	Methodology
0.1 Treatment and demolition works Facilitating works	×	Not applicable
1 Sub-structure	✓	Modelled - BIM extracted quantities
2 Superstructure – structural elements	✓	Modelled - BIM extracted quantities
2 Superstructure – building envelope	✓	Modelled - BIM extracted quantities
2 Superstructure – internal elements	✓	Modelled - BIM extracted quantities
3 Finishes	✓	Modelled - BIM extracted quantities
4 Fittings, furnishings and equipment (FF&E)	✓	Assumed - GLA Benchmarks
5 Services (MEP)	✓	Assumed - CIBSE TM65 data
5.1 Renewables	×	Not included
6 Pre-fabricated buildings and units	×	Not included
7 Works to existing buildings	×	Not included
8 External works associated with the project	×	Not included

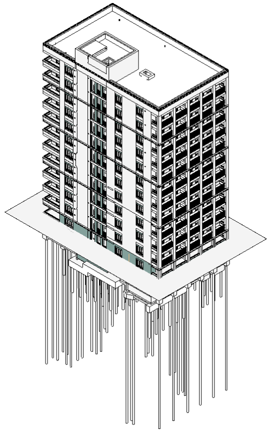
RICS WLCA PS 2nd ed. *building elements included and excluded from the calculation.*

Contingency factor

Following RICS WLCA 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	×	6%
Post completion	×	0%

Upfront carbon evidence-base | Modelled scenarios | Block of flats (1/2)



The baseline scenario (level 1) modelled for the block of flats represents typical construction practices for residential buildings ≥11 m in height in London, 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 scenario (level 1) are shown in detail on the table opposite.

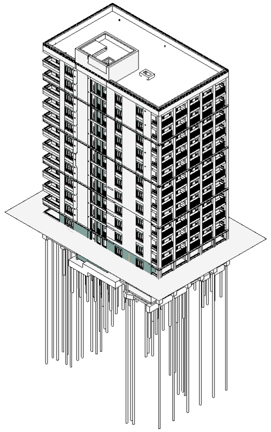
Balconies and associated fixtures were also included in the modelling.

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

	Level 1 (baseline)
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 (GFRC) 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 Level 1 baseline scenario specifications per building element.

Upfront carbon evidence-base | Modelled scenarios | Block of flats (2/2)



For the purpose of this study, two additional scenarios where tested to improve the upfront carbon of level 1 (baseline):

- 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 (GFRC) rainscreen cladding with brick façade.
- Level : an increase in the quantity of GGBS to 50-60%.

	Level 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 Level 2 scenario specification changes from level 1.

	Level 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 Level 3 scenario specification changes from level 2.

Upfront carbon evidence-base | Results | Block of flats

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The results opposite show the total upfront carbon of levels 1, 2 and 3 modelled scenarios for the block of flats. Total upfront biogenic carbon is also reported separately.

Level 2 – The upfront carbon is reduced by 12% from level 1 (baseline) to level 2 through two interventions: Adding a 20-25% of cement replacement in the substructure and structural elements, saving 39 $kgCO_2e/m^2$ and, replacing GFRC rainscreen cladding with brick facing, saving 36 $kgCO_2e/m^2$.

Level 3 – A further increase of cement replacement content to 50-60% in the substructure and structural elements could reduce upfront carbon by further 14%, saving an additional 79 $kgCO_2e/m^2$.

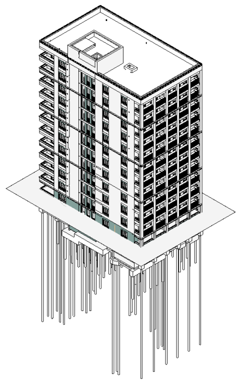
Combining both level 2 and 3 interventions from the baseline (level1 could reduce upfront carbon by **26%** in total, saving **177 $kgCO_2e/m^2$**.

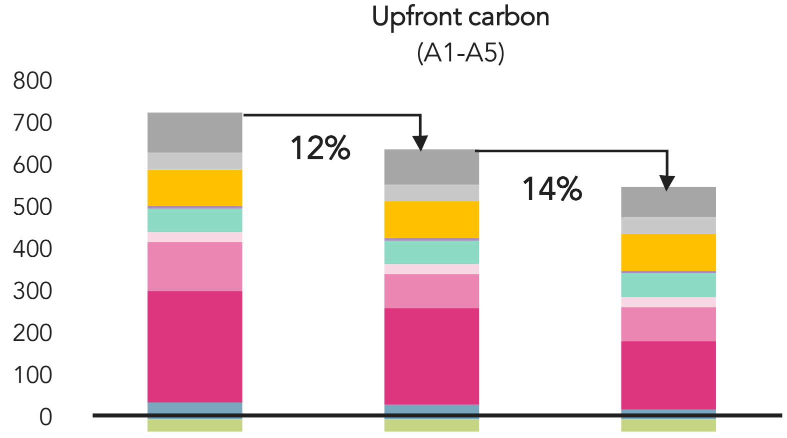
Possible further reductions

Given the constraints imposed by Approved Document B (fire) (mandatory inclusion of two staircases and the exclusion of natural materials) 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 $kgCO_2e/m^2$ (GIA) reduction) or switching to direct electric (~30 $kgCO_2e/m^2$ (GIA) reduction).
- Using lower-carbon bricks or alternative lower carbon façade systems.
- Removing false ceilings and wall service zones, however these are important for accommodating services and protecting the airtightness layer from damage.

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





$kgCO_2e/m^2$ (GIA)	Level 1 (baseline)	Level 2 (20-25% cement replacement and brick façade)	Level 3 (50-60% cement replacement and brick façade)
1 Substructure	39	34	22
2 Superstructure - Structural elements	264	230	163
2 Superstructure - Building envelope	116	80	80
2 Superstructure - Internal elements	25	25	25
3 Finishes	56	56	57
4 Fittings, furnishings and equipment (FF&E)	6	6	6
5 Services (MEP)	87	87	87
A5.2 Construction activities	40	40	40
15% Contingency factor	95	84	72
Biogenic carbon	-30	-30	-30
Total (excl. upfront biogenic carbon)	**729**	**641**	**552**

Table breakdown of upfront carbon emissions of levels 1,2 and 3 scenarios per RICS element category..

Lifecycle carbon | Results | Block of flats

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The results opposite show the total lifecycle carbon of levels 1, 2 and 3 scenarios for the block of flats, including the upfront biogenic carbon. Results do not include carbon emissions from refrigerant leakage and carbon savings from the biogenic carbon of modules B and C.

Under level 2, lifecycle carbon could be reduced by 6% through the addition of 20-25% cement replacement content and the replacement of GFRC rainscreen cladding with brick facing. Under level 3, it could be further reduced by 9% through the increase of cement replacement content to 50-60%.

RIBA 2030 Climate Challenge lifecycle carbon targets

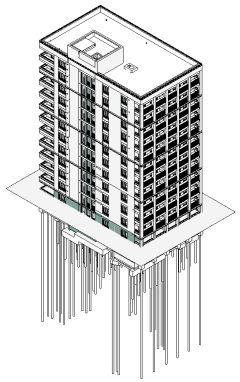
In 2021 RIBA 2030 Climate Challenge (version 2) introduced three performance targets for lifecycle carbon for new residential buildings. The targets were set after consultations with experts across the industry and are based on a growing database of projects submitted by signatories who have committed to participate the data collection for the initiative.

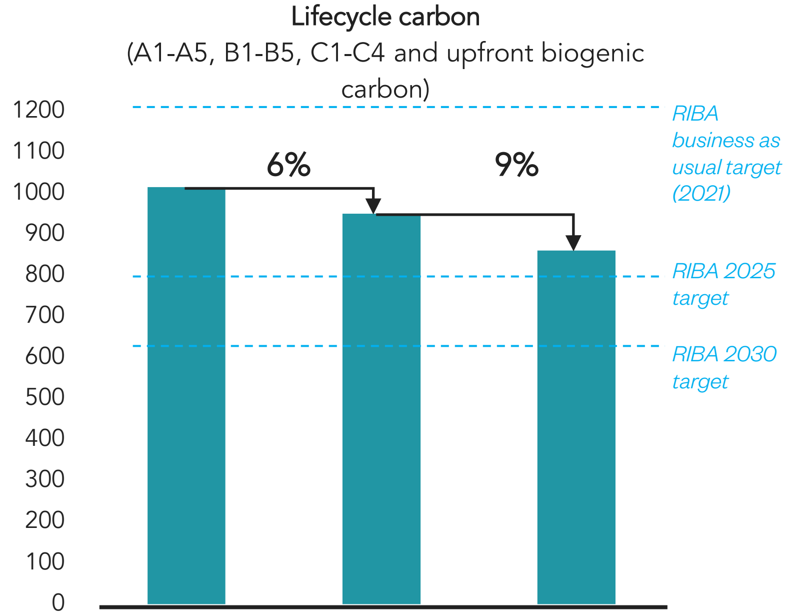
RIBA 2030 Climate Challenge target metrics for domestic / residential

RIBA Sustainable Outcome Metrics	Business as usual (new build, compliance approach)	2025 Targets	2030 Targets
Embodied Carbon $kgCO_2e/m^2$	1200 $kgCO_2e/m^2$	< 800 $kgCO_2e/m^2$	< 625 $kgCO_2e/m^2$

The RIBA targets above include the RICS modules A1-A5, B1-B5, C1-C4, biogenic carbon and the RICS categories substructure, superstructure, finishes, fixed FF&E, building services and associated refrigerant leakage.

The final results have been compared against RIBA 2030 lifecycle targets. However, refrigerant leakage and lifecycle biogenic carbon have not been included in the final results. By including these factors results would have either increase or decrease, depending on the extent of their influence. Based on the current results, all 3 scenarios meet RIBA business as usual 2021 target, but none of them meet the 2025 or 2030 target.





$kgCO_2e/m^2$ (GIA)	Level 1 (baseline)	Level 2 (20-25% cement replacement and brick façade)	Level 3 (50-60% cement replacement and brick façade)
Total (incl. biogenic carbon)	**1016**	**951**	**861**

Table shows total lifecycle carbon emissions of levels 1,2 and 3 scenarios, compared against the RIBA 2030 Climate Challenge targets for domestic/ residential developments.

10.2.2

Upfront and lifecycle carbon modelling assumptions and results

Non-residential

Upfront carbon evidence-base | Methodology

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In order to build the evidence base and investigate setting upfront embodied carbon limits for commercial buildings various sources of information have been collated:

- GLA data
- NZCBS data
- Westminster council evidence base September 2024 (WSP)
- Built case studies, where available

Further modelling was undertaken to fill gaps in the data received and fully investigate the upfront carbon (modules A1-A5) of multiple commercial building options (Shell and Core and Category A scopes). The results are to inform the proposed upfront carbon limits for the next version of the London Plan. Capital cost modelling has been carried out to understand how cost and viability may affect policy. Lifecycle carbon has also been reported to understand the more holistic impact of materials.

Carbon measurement standard

The modelling for this evidence-base has adopted RICS WLCA PS, 2nd edition (2023), which is the industry's supported standard.

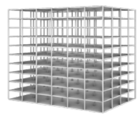
Typologies modelled

Buildings scenarios representing typical major and referable new build commercial scopes have been created for the upfront, life cycle carbon and cost modelling exercise. Various structural grids, materials and envelope options have been tested against each other and are described in detail in the following pages. While most scenarios did not incorporate a basement, this feature was explored in a variant of the baseline design to assess its impact on carbon and cost outcomes.

Operational performance

Decisions taken during the design of a building to improve operational energy can have an impact on the resulting upfront carbon. Rather than considering operational energy and upfront carbon separately a balance needs to be struck across all environmental considerations.

The outline specifications for levels 1, 2 and 3 upfront carbon have all been aligned with the performance parameters used to meet level 2 for the EUI and SHD policies. The table below represents the level 2 outline specification with more detail in the following pages.



	Referable	Major
Number of storeys	10	10
Gross Internal Area (m^2)	5400	13400
Average floor to floor height (m)	3.8	3.8
Grid spacing (m)	7.5 x 7.5	7.5 x 7.5
Form factor	0.9	0.7
Glazing to wall ratio (%)	45	45
SHD level	Level 2 (20 kWh/m^2/yr (GIA))	Level 2 (20 kWh/m^2/yr (GIA))
EUI level	Level 2 (90 kWh/m^2/yr (GIA))	Level 2 (90 kWh/m^2/yr (GIA))

Outline specification for the baseline scenarios

Upfront carbon evidence-base I An explanation of Shell and Core, Category A and B scopes

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The terms Shell and Core, Category A and Category B are not legal terms but are derived from letting agents to describe different scopes of commercial fit out.

The information opposite has led the scope for the modelling and limits and is derived from the information in Appendix P of the RICS WLCA PS 2nd ed. (2023).

Term	Description
Shell and Core	• Primary structure and thermal envelope • Centralised plant (including mechanical equipment, public health, life safety, electrical and waste disposal) supply and distribution to common/landlord areas like circulation/toilets in central core/car park/lift shafts
Category A	• Potential primary structural works, e.g. connecting floors • Could include secondary glazing if not included in shell and core offer • Likely to include internal walls, doors and raised access floors if agreed within the contract • Unlikely to include finishes • Systems required to support tenanted areas (including mechanical equipment, public health, sanitaryware, life safety, electrical and waste disposal)
Category B	• No works to structure or envelope • Tenant specific works to complete the space (aligned with organisational branding) • Tenant specific internal walls, doors and finishes • Systems required to support tenanted areas (e.g. specific lighting, IT, AV etc) • Full FF&E packages including tea points

Analysis of GLA upfront embodied carbon data from London Plan 2021

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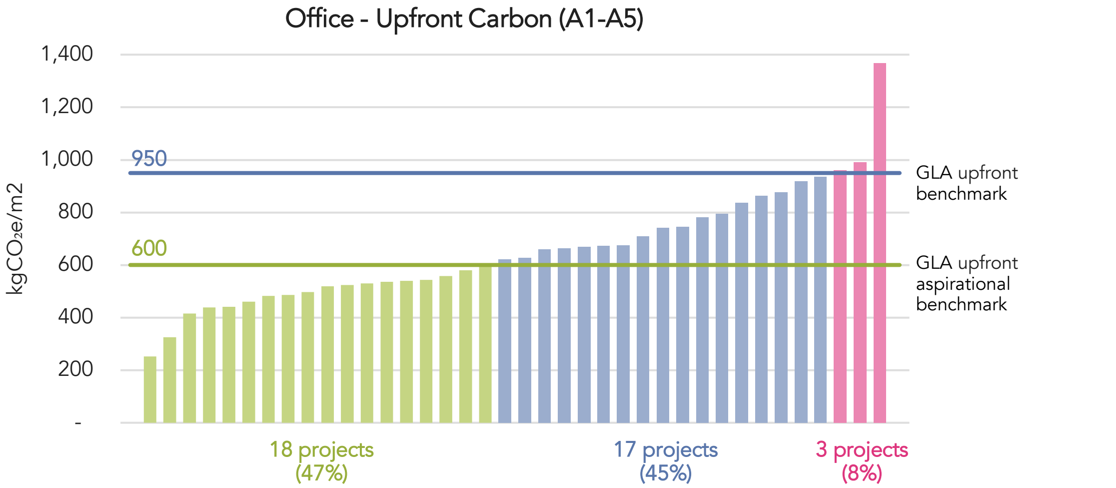
Data analysis

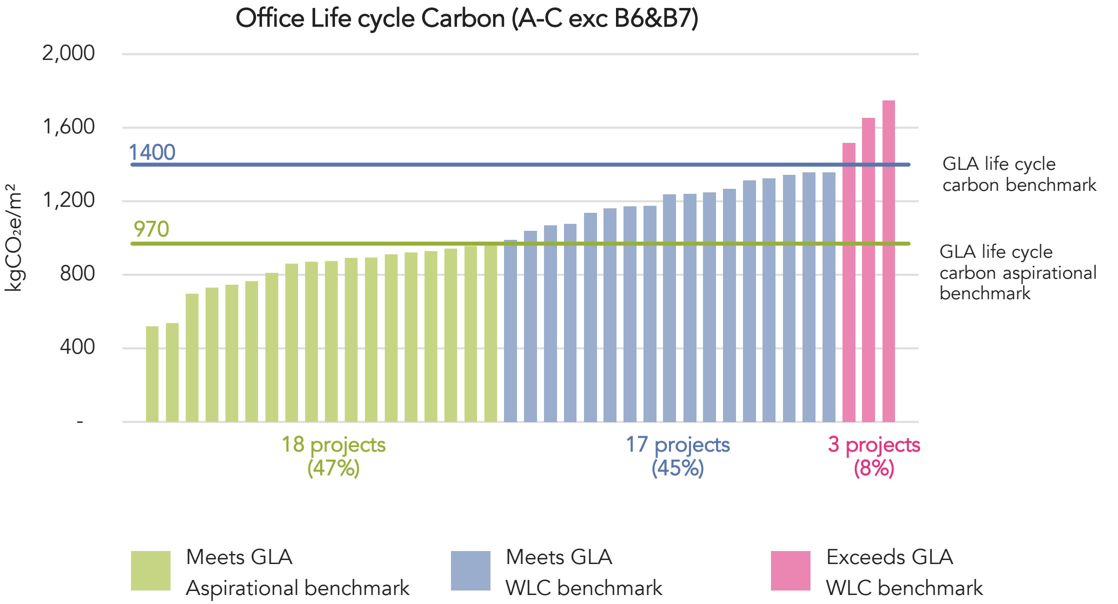
The team have received WLC data for GLA applications from Stage 2+ approved applications from year 2021 – 2023.

Planning applications in England: October to December 2023 - statistical release Overall report demonstrates that overall, 85,200 applications were received for planning. From this, 175 had embodied carbon data and 38 were commercial office schemes.

The bar chart shows the performance of office buildings compared against the GLA benchmarks. The GLA benchmarks included were based on Shell and Core assessment with CAT A.

For both upfront and life-cycle carbon, many projects (47%) are achieving the GLA Aspirational benchmark, with the majority (92%) under the WLC benchmark.





GLA planning application data representing applications from Stages 2-4 from years 2021–2023, including Outline, Detailed and Hybrid Planning Applications.

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Analysis of GLA upfront embodied carbon data from UK NZCBS Office limits

The bar charts on this page compare the current GLA dataset with the UK NZCBS Pilot Issue (October 2024) for upfront carbon (A1–A5) only.

The dataset does not specify the scope of assessment for each project (i.e. whether it involves refurbishment, shell and core, Cat A only, Cat B, etc.). As a result, the data has been compared against both the NZCBS limits for shell and core, refurb, and whole building office projects.

Shell & Core

The upper bar chart compares the GLA dataset against the NZCBS office shell and core limits. The results show that 84% of the projects exceed the 2025 limit.

Refurb

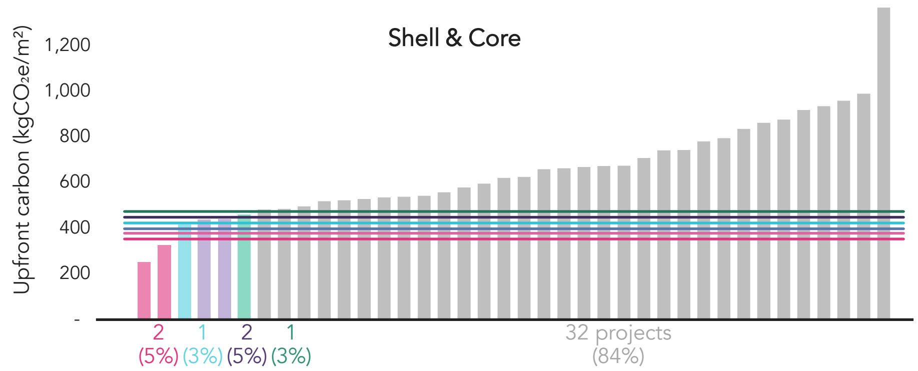
The middle bar chart compares the GLA dataset against the NZCBS office shell and core limits. The results show that 48% of the projects achieve or are under the 2025 limit.

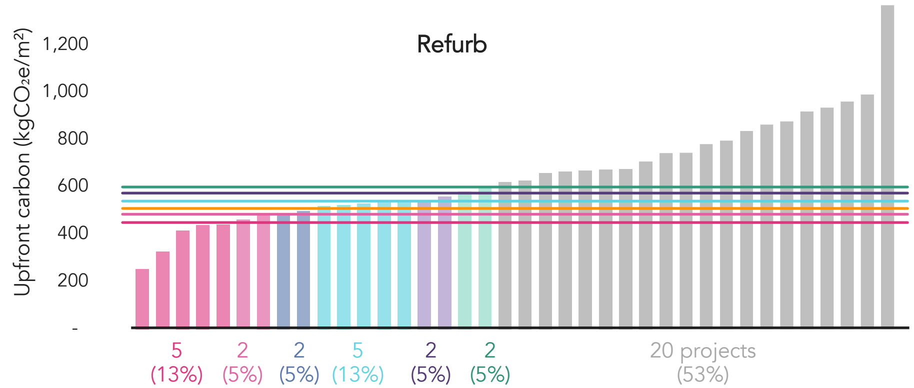
Whole Building

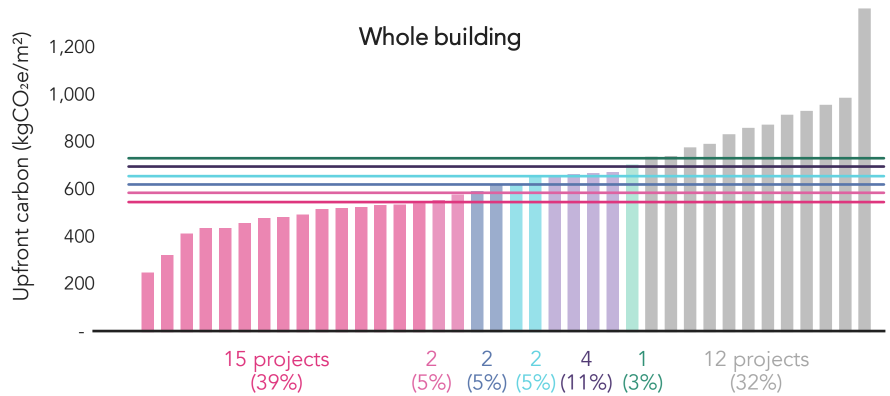
The lower bar chart compares the same dataset against the NZCBS office whole building limits. In this case, 39% of the projects achieve the 2030 Whole Building limit of 550 $kgCO_2e/m^2$.

Key

Meets NZCBS limits ($kgCO_2e/m^2$)	2030	2029	2028	2027	2026	2025	Exceeds/ above
Shell & Core	355	380	400	425	450	475	
Refurb	450	485	510	540	575	600	
Whole Building	550	590	625	660	700	735	







Commentary on the WSP Embodied Carbon Evidence Base

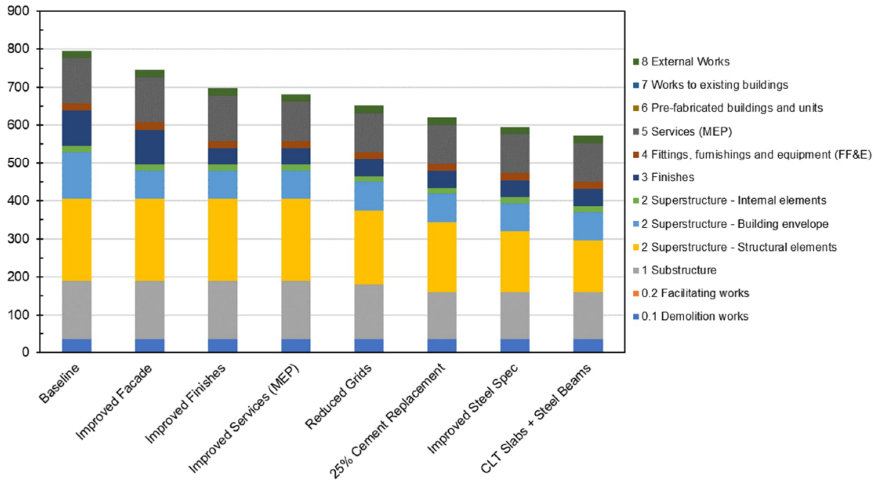
The WSP Embodied Carbon Evidence Base (Sept 2024), commissioned by Westminster City Council, assessed embodied carbon in non-residential buildings to support London Plan Policy SI 2.

2 Separate baseline office buildings were used in the study. These were defined by the following key parameters:

GIA	1,440 m2 (small office), 10,368 m2 (large office),
Foundation system	Piles (concrete)
Framing material	Steel structural frame with composite concrete-steel deck slabs
Façade surface area	882 (small office), 4,248 m2 (large office)
Façade form factor	0.61 (small office), 0.41 (large office)
Façade system	Stick-system curtain walling with Double Glazed Unit
Glazing ratio	68%
MEP systems	Heat pumps & chillers, with typical fan coil unit arrangement

The baseline A1–A5 intensities for the small and large office buildings (excl. basements) were **824 $kgCO_2e/m^2$** and **800 $kgCO_2e/m^2$**, respectively. The study then assessed the potential upfront carbon savings from the following design interventions relative to these baselines:

Intervention type	Small office	Large office
Improved facade	7%	5.8%
Improved finishes	4%	6%
Improved services (MEP)	2%	2.1%
Reduced Grids	1%	4%
Cement replacement	8%	4.4%
Improved steel spec	1%	3.7%
CLT Slabs + Steel Beams	2%	3.5%



WSP office building (small) scenarios and associated upfront carbon intensity savings

Limitations of the study:

- Each intervention assessed in isolation - not in combination
- One single grid size change in scenario testing; complex effects of changing spans on structural demand and material use underexplored
- One single alternative facade system assessed - no subcomponent variation.
- One single framing alternative, limited comparison to the baseline composite steel frame.
- Material carbon values derived from generic averages
- Focuses solely on A1–A5 stages, excludes full lifecycle stages (B-C)

Opportunities for further study:

- Test interactions between parameters more extensively - broader exploration across multiple grid sizes or layouts.
- Test multiple façade sub-options per system, with layer-by-layer material inputs using relevant specific EPD data, not averages.
- Test the carbon impacts of a broader range of structural systems

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Scenario testing for the new London Plan evidence base

This study aims to support the GLA in developing typology-specific embodied carbon targets for non-residential buildings through detailed, design-led optioneering. It aims to quantify how key design variables such as grid spacing, floorplate efficiency, structure, and façade - affect upfront carbon (A1–A5) to:

- Map variation across modelled design options
- Benchmark by key parameters (e.g. grid size, structure, façade build-up)
- Identify consistently low-carbon design pathways
- Provide an evidence base for phased, performance-based benchmarks to inform GLA policy
- Ground targets in London-specific data and construction context

Methodology: Through scenario testing across varied design options, over 50 unique combinations were modelled against a baseline office, exploring variations in the range of variables.

Design Parameter	Options Tested
Structural grid size (m)	6 × 6, 7.5 × 7.5, 9 × 9
Framing material	Reinforced concrete, CLT on steel frame, Steel frame with Composite deck
Façade system	GRC panel, Aluminium rainscreen, Brick with internal plasterboard

The following parameters were held constant throughout the study to provide a consistent baseline for comparing the impact of design changes:

Non-residential baseline	
Typology	Office
Scope	Shell & Core
Reference Study period (RSP)	60 years
No. floors above ground	10

A range of tools and data sources were used and cross-referenced to ensure robustness and validity of results. These include:

1. Whole Life Carbon emissions from each scenario modelled - VERT: Visionary Emissions Reduction Tool I WLCA
2. Façade build-up embodied carbon analysis & EPD Data - One Click LCA https://oneclicklca.com/
3. Structural quantities (excluding substructure) Heyne Tillett Steel
4. Inventory for Carbon and Energy (ICE) Database The ICE Database v03 – Circular Ecology

VERT One Click LCA HEYNE TILLETT STEEL Hawkins\Brown

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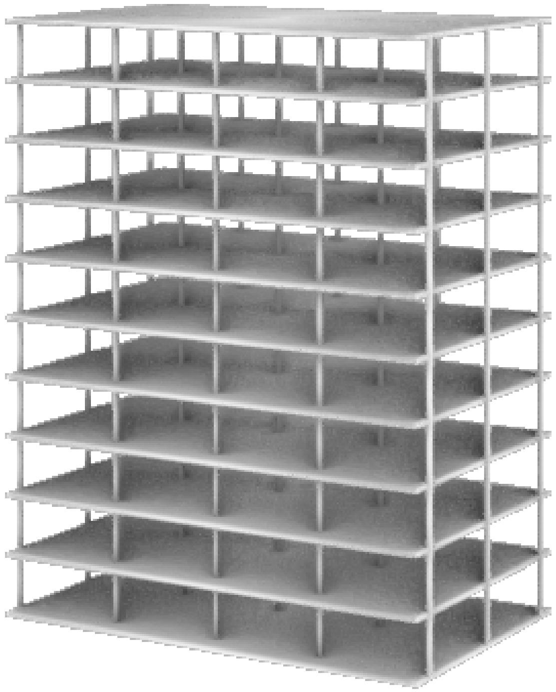
Referable development (GIA: 5,400 m²)

The baseline specification for the smaller office building used in this study is as below;

Preliminary building assumptions	Unit	Total
No. floors above ground	No.	10
No. of basement floors	No.	0
Floor to floor heights (average)	m	3.8
Gross internal area (GIA)	m^2	5400
Form factor	No.	0.68
Net to gross ratio	%	80
Plan area (typical floor)	m^2	540
Perimeter length (external wall)	m	96
Perimeter length (party wall)	m	0



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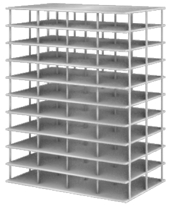
Referable development (GIA: 5,400 m²) - Level 1

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/m²K)	m²	1988
Roof area	Insulation & green roof (0.12 W/m²K) – some full planted areas	m²	648
Glazing area	Fixed Double glazed window aluminium frame, regular glass (1.55 W/m²K)	m²	2799
	Curtain walling Double glazed: aluminium frame, regular glass (1.55 W/m²K)	m²	182
Glazing ratio		%	60
External doors	Double glazed metal framed door (1.55 W/m²K)	m²	14
Form factor			1.2

Internal assemblies and finishes				
Internal non-loadbearing wall	Metal stud with plasterboard	m²	2417	3357
	Blockwork		604	
	Blockwork with plasterboard lining		336	
Internal doors	Solid timber	No.	68	85
	Glazed door		17	
Internal wall finish	Paint	m²	5564	6714
	Marble		260	
	GRC decorative cladding		420	
	Encaustic tile		470	
Floor substrate	Separating floor with acoustic batten	m²	1026	5131
	Non structural screed		257	
	Raised access floor		3848	
Floor finishes CAT A	Marble	m²	103	1,080
	Encaustic tile		977	
Ceiling finishes CAT A	Suspended plasterboard	m²	977	1,080
	Suspended SAS metal tile standard		103	

Building services	
Space heating system	ASHP with FCUs
Space cooling system	Chiller with FCUs
Ventilation type	Fully Mechanical ventilation
Refrigerant GWP	1000-2000 kgCO2e/kg (R140A; R134A)

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Referable development (GIA: 5,400 m^2) - Level 2

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

*An additional option with 2 basements has been tested for comparison

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	m^2	270
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)	m^2	182
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	m^2	2417	3357
	Blockwork		604	
	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	m^2	1026	5131
	Non structural screed		257	
	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 kgCO2e/kg (R32)

Scenario testing for the new London Plan evidence base | Non-residential baseline specification

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

External envelope			
Façade area (excl. party wall)	GRC with int. plasterboard (0.15 W/m2K)	m^2	2189
	Allowance for external shading		
Roof area	Insulation & green roof (0.12 W/m^2K) – with planters	m^2	270
	Insulation & Concrete pavers + pedestals	m^2	270
Glazing area	Double glazed: composite frame, regular glass (1.55 W/m^2K) – 50% openable 50% fixed	m^2	1277
	Curtain walling Double glazed: aluminium frame, regular glass (1.55 W/m^2K)	m^2	182
Glazing ratio		%	40
External doors	Double glazed metal framed door (1.55 W/m^2K)	m^2	14
Form factor			0.9

Internal assemblies and finishes				
Internal non-loadbearing wall	Timber stud with fermacell	m^2	2417	3357
	Blockwork		604	
	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	m^2	1026	5131
	Non structural screed		257	
	Reclaimed Raised access floor		3848	
Floor finishes CAT A	Cork tiles	m^2	103	1080
	Ceramic tile		488	
	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 kgCO2e/kg (R290, R1234-fy)

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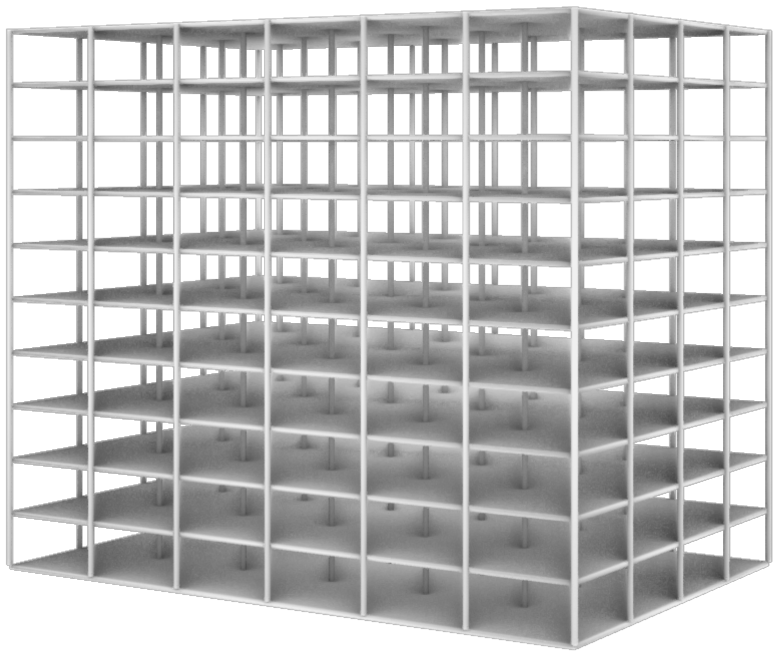
Major development (GIA: 13,500 m^2)

The baseline specification for the larger office building used in this study is as below;

Preliminary building assumptions	Unit	Total
No. floors above ground	No.	10
No. of basement floors	No.	0
Floor to floor heights (average)	m	3.8
Gross internal area (GIA)	m^2	13500
Form factor	No.	0.42
Net to gross ratio	%	80
Plan area (typical floor)	m^2	1350
Perimeter length (external wall)	m	150
Perimeter length (party wall)	m	0

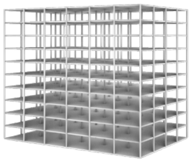


Scenario testing for the new London Plan evidence base | Non-residential baseline specification

Major development (GIA: 13,500 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/m²K)	m²	3577
Roof area	Insulation & green roof (0.12 W/m²K) – some full planted areas	m²	1215
Glazing area	Fixed Double glazed window aluminium frame, regular glass (1.55 W/m²K)	m²	5080
	Curtain walling Double glazed: aluminium frame, regular glass (1.55 W/m²K)	m²	285
Glazing ratio		%	60
External doors	Double glazed metal framed door (1.55 W/m²K)	m²	38
Form factor			0.9

Internal assemblies and finishes				
Internal non-loadbearing wall	Metal stud with plasterboard	m²	6043	8393
	Blockwork		1511	
	Blockwork with plasterboard lining		839	
Internal doors	Solid timber	No.	170	213
	Glazed door		43	
Internal wall finish	Paint	m²	13911	16786
	Marble		650	
	GRC decorative cladding		1050	
	Encaustic tile			
Floor substrate	Separating floor with acoustic batten	m²	2565	12825
	Non structural screed		641	
	Raised access floor		9619	
Floor finishes CAT A	Marble	m²	1159	2565
	Encaustic tile		1404	
Ceiling finishes CAT A	Suspended plasterboard	m²	1159	2565
	Suspended SAS metal tile standard		1404	

Building services	
Space heating system	ASHP with FCUs
Space cooling system	Chiller with FCUs
Ventilation type	Fully Mechanical ventilation
Refrigerant GWP	1000-2000 kgCO2e/kg (R140A; R134A)

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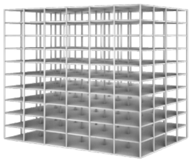
Major development (GIA: 13,500 m^2) - Level 2

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



*An additional option with 2 basements has been tested for comparison

External envelope			
Opaque facade area (excl. party wall)	Brick with int. plasterboard (0.15 W/m^2K)	m^2	3097
	Allowance for external shading		
Roof area	Insulation & green roof (0.12 W/m^2K)- with planters	m^2	675
	Insulation & Concrete pavers + pedestals	m^2	675
Glazing area	Double glazed: composite frame, regular glass (1.55 W/m^2K) – 25% openable 75% fixed	m^2	2280
	Curtain walling Double glazed: aluminium frame, regular glass (1.55 W/m^2K)	m^2	285
Glazing ratio		%	45
External doors	Double glazed metal framed door (1.55 W/m^2K)	m^2	38
Form factor			0.7

Internal assemblies and finishes				
Internal non-loadbearing wall	Metal stud with plasterboard	m^2	6043	8393
	Blockwork		1511	
	Blockwork with plasterboard lining		839	
Internal doors	Solid timber	No.	170	213
	Glazed door		43	
Internal wall finish	Paint	m^2	15611	16786
	Ceramic tile		1175	
Floor substrate	Separating floor with acoustic batten	m^2	2565	12825
	Non structural screed		641	
	Raised access floor		9619	
Floor finishes CAT A	Ceramic tile	m^2	1159	2565
	Vinyl		1159	
	Lino		245	
Ceiling finishes CAT A	Suspended plasterboard	m^2	1159	2565
	Suspended grid tile SAS horizon		245	
	Exposed painted soffit		1159	

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 kgCO2e/kg (R32)

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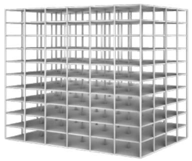
Major development (GIA: 13,500 m²) - Level 3

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



External envelope			
Façade area (excl. party wall)	GRC with int. plasterboard (0.15 W/m2K)	m²	3420
	Allowance for external shading		
Roof area	Insulation & green roof (0.12 W/m²K) – with planters	m²	675
	Insulation & Concrete pavers + pedestals	m²	675
Glazing area	Double glazed: composite frame, regular glass (1.55 W/m²K) – 50% openable 50% fixed	m²	1995
	Curtain walling Double glazed: aluminium frame, regular glass (1.55 W/m²K)	m²	285
Glazing ratio		%	40
External doors	Double glazed metal framed door (1.55 W/m²K)	m²	38
Form factor			0.9

Internal assemblies and finishes				
Internal non-loadbearing wall	Timber stud with fermacell	m²	6043	8393
	Blockwork		1511	
	Blockwork with plasterboard lining		839	
Internal doors	Solid timber	No.	170	213
	Glazed door		43	
Internal wall finish	Paint	m²	15611	16786
	Ceramic tile		1175	
Floor substrate	Separating floor with acoustic batten	m²	2565	12825
	Non structural screed		641	
	Reclaimed Raised access floor		9619	
Floor finishes CAT A	Cork tiles	m²	245	2565
	Ceramic tile		1159	
	Lino		793	
	Paint		366	
Ceiling finishes CAT A	Suspended plasterboard	m²	1159	2565
	Exposed painted soffit		1404	

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 kgCO2e/kg (R290, R1234-fy)

Scenario testing for the new London Plan evidence base | Structural calculation methodology

Process followed

To generate the structural element quantities, each option was designed individually using preliminary structural design equations. A suitable framing plan was found for each option's grid arrangement, and loading applied to size floor slabs, secondary beams and primary beams based on strength and deflection criteria for each material option. The total loading of the building was used to size the columns and foundations, reflecting the different self-weights of each material option. Building massing profile was used to determine the quantum of stability elements (all schemes used a similar magnitude of core walls to suit the architectural base requirements). Material quantities (volumes and masses) were provided for inclusion in the embodied carbon assessment, to ensure consistency in rates and assumptions.

Rationale for parameters tested

- **Grid spacing:** the typical spacing of columns has a significant impact on the volume of structural elements required to support a floor by providing an appropriate strength and stiffness. Structural stiffness (and therefore amount of material required) does not scale linearly with span length. Long spans have a disproportionate increase on material use in floors.
- **Material:** some materials and combinations, like composite concrete and metal deck floors on steel frames, are typically higher in embodied carbon than functionally equivalent alternatives. In addition, some materials are inefficiently used on small or large grids, making materiality a second parameter to test alongside grid spacing.
- **Basements**: excavating below ground requires casting thick (often piled) walls to retain the surrounding soil due to the sites constrained nature, adding significant volume of material per sq. metre of GIA added below ground.

Rationale for omissions

- **Transfer structures:** we did not model transfer structures (structures that step back and/or have columns that are not continuous to the ground) due to time constraints and the large variety of possible arrangements. The more indirect the load path, the more structural material is needed to support the same floor area: these "transfer" elements are inefficient and add embodied carbon. The addition of one transfer level to a building will increase the embodied carbon, but it is likely to be a small increase overall. However, the inclusion of many stepped back façade lines and vertical discontinuities will add more significantly to upfront carbon. Where step backs are considered within an architectural design, options that look to align these with the grid spacing provide opportunities for efficient design whilst providing architectural character.
- **Stringent deflection criteria for façade elements:** we did not account for extremely tight deflection criteria required by certain types of façade construction, because these are not universal to all facades, and when required can be considered by the facade support principles or increasing the structural stiffness with additional material.
- **Ground constraints:** the presence of underground assets and resulting constraints were not considered as these are too site-specific.

Key assumptions

- Piled foundations, with working capacities derived from typical buildings in London.
- Piled retaining walls, sized according to typical projects in London
- An unrestricted structural zone with minimal/no beam penetrations, resulting in efficient steel framing elements.

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Impacts of structural interventions on upfront carbon

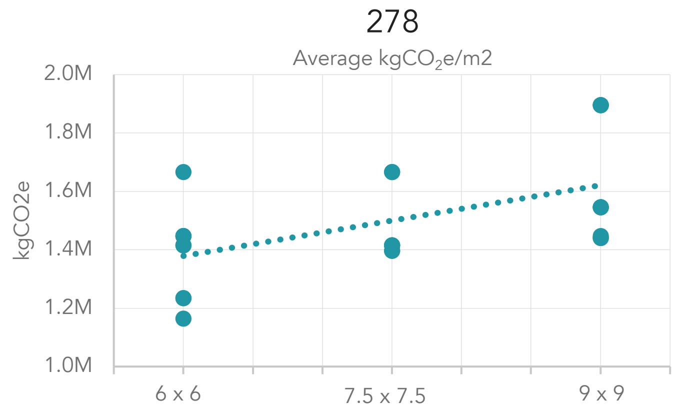
These observations remain valid but it should be noted the figures came from the first iteration of studies carried out for the evidence base.

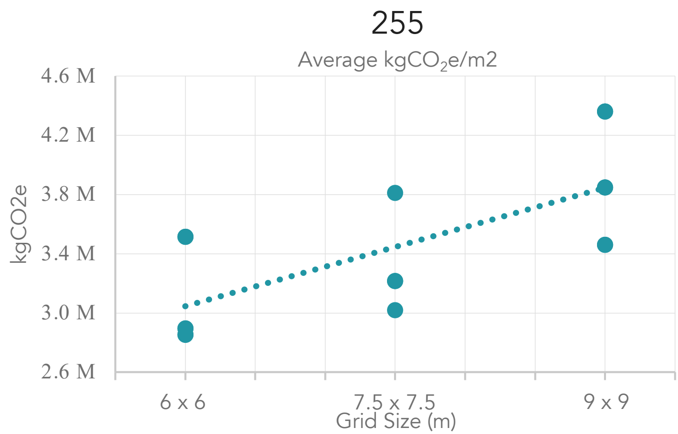
Span configuration

- Options with tighter grids consistently show lower upfront emissions. This is due to shorter spans enabling shallower structural depths and more efficient material distribution, reducing overall steel and concrete quantities.
- By contrast, wider grids (9 x 9 m) - while offering spatial and architectural benefits - demand significantly more material to meet structural performance and deflection requirements.
- The associated increase in embodied carbon is non-linear and reflects the complex interplay between span, load paths, member sizing, and structural form.

Material selection

- Composite steel deck systems had the highest upfront impacts, driven by high-carbon steel content, metal decking, and increased beam requirements to support wide spans.
- The CLT frame was shown to result in just 2.3% less in upfront carbon than concrete, however sequestration is excluded under the RICS methodology. The material's benefits are typically realised over the full lifecycle (A-C).





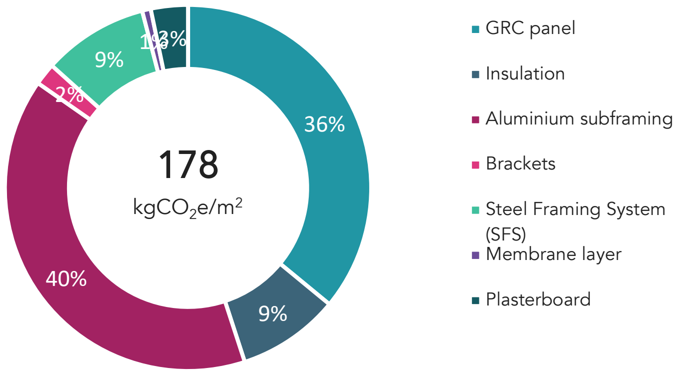
Upfront embodied carbon options between different structural solutions

Scenario testing for the new London Plan evidence base | Focused study on façade impacts

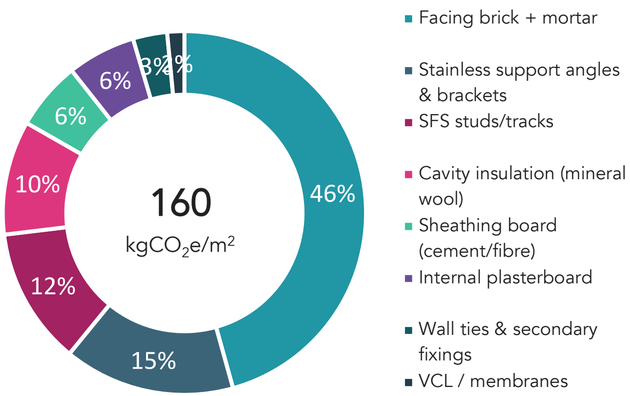
A layer-by-layer assessment of typical façade build-ups was undertaken to quantify the embodied carbon impact of the whole build up, including commonly under-estimated components such as sub-framing, brackets, and helping hand systems.

The adjacent chart illustrates the representative build-up options used for this study, as well as their relative contribution of each material layer. EPDs were selected for each layer from relevant product categories, enabling more accurate future modelling of use and end-of-life stages (B-C) using manufacturer data.

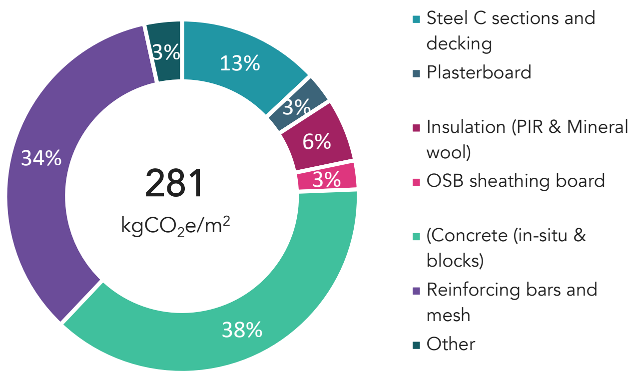
It should also be noted that additional structural implications from façade systems were not included as the are not uniform and depend on multiple factors.



Modelled GRC Rainscreen Façade build-up and upfront carbon intensity by façade surface area



Modelled Brick on SFS Façade build-up and upfront carbon intensity by façade surface area



Modelled Precast Concrete Façade build-up and upfront carbon intensity by façade surface area

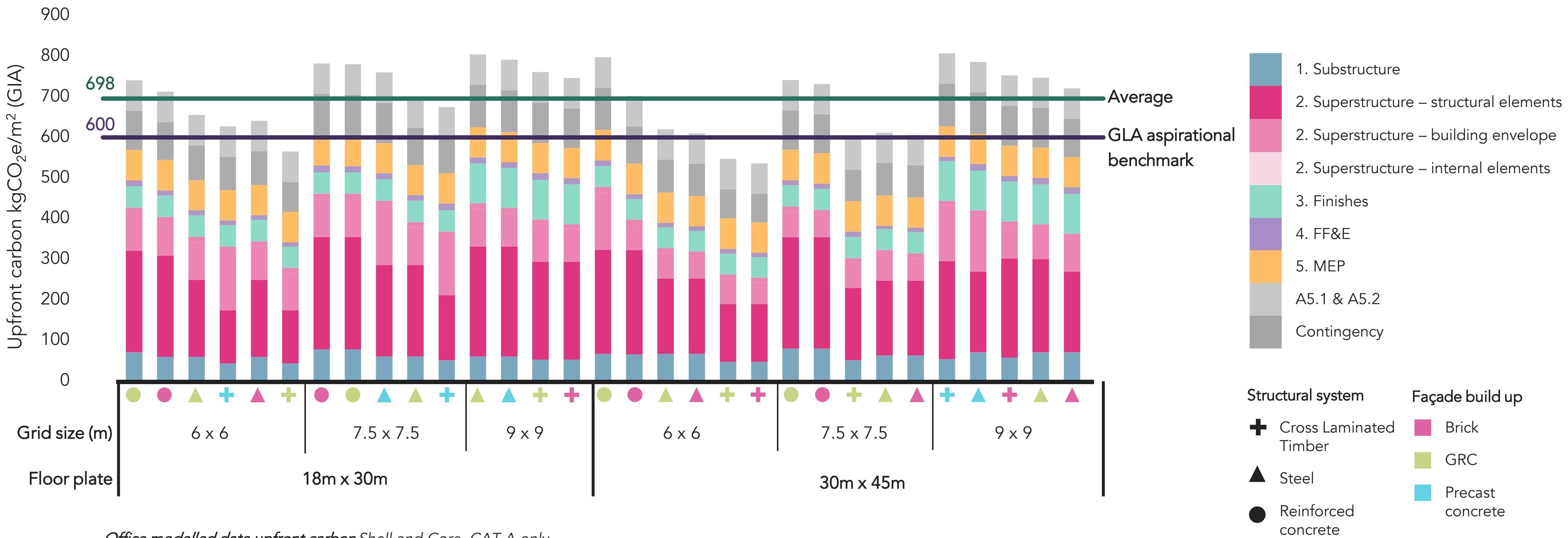
Scenario testing for the new London Plan evidence base

The chart below presents embodied carbon results from 31 commercial design scenarios, grouped by structural grid and two representative floorplate sizes, and benchmarked GLA Aspirational office benchmark (2025).

Scenarios tested a range of structural systems (e.g. concrete, steel-composite, and CLT hybrids), each having varying degrees of carbon intensity. The study reported average upfront carbon intensity of 698kgCO2e/m².

The WSP Evidence Base Study's higher average upfront carbon intensities of 975 kgCO_2e/m² (small office) and 738 kgCO_2e/m² (large office) are due to key differences in study scope:

- Structural systems in the WSP study were limited to steel frames; this study includes RC and CLT-based alternatives.
- Façade design in the WSP scenarios used curtain walling throughout, whereas this study tested a broader mix of envelope types.
- WSP scenarios included basement levels, which significantly increase embodied carbon; all models in the graph below were above-ground only.
- External works were included in the WSP analysis but are excluded from this study's scope (aligned with RICS WLCA 2nd Ed.)
- Grid spacing in WSP scenarios ranged from 12 - 9 m; this study focused on smaller spans (6–9 m), where slabs require less material.



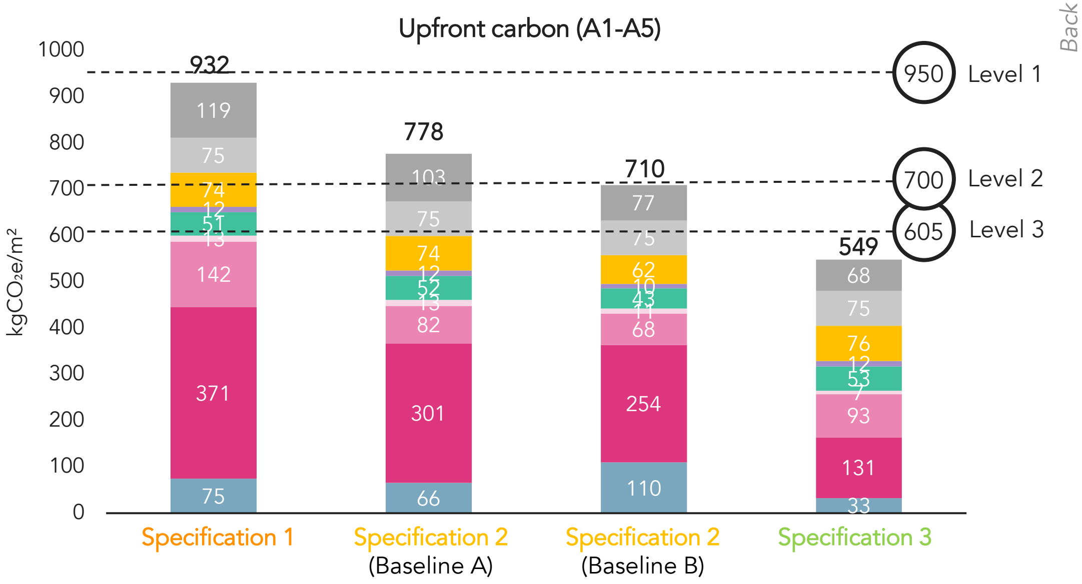
Office modelled data upfront carbon Shell and Core, CAT A only

Scenario testing for the new London Plan evidence base

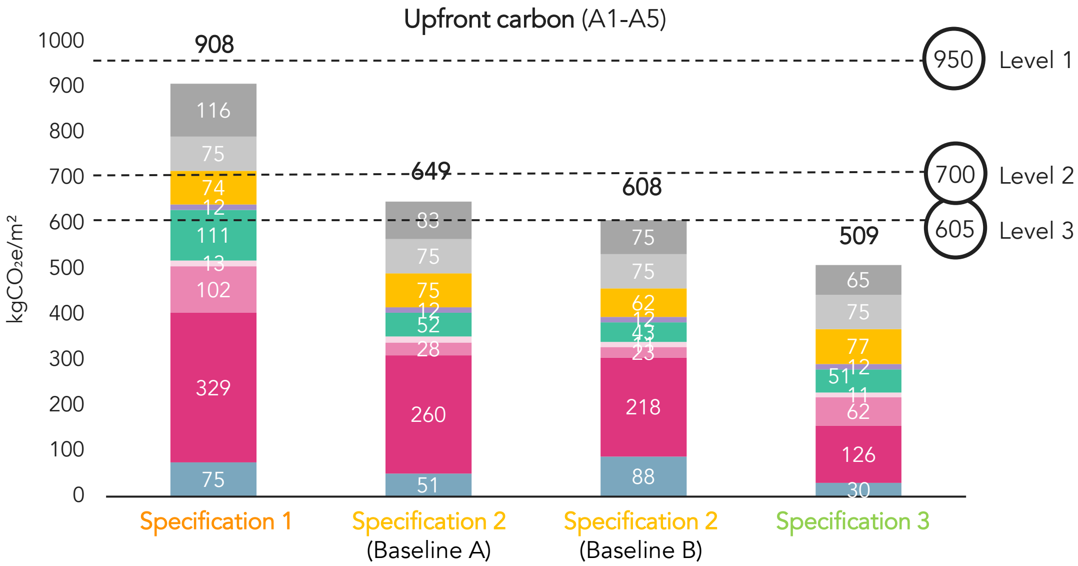
Finalising the performance levels

Following the modelling of multiple options, outline specifications and specific modelling were produced for the major and referable scenarios to align with performance levels 1, 2 and 3 as shown opposite with the elemental breakdowns colour-coded.

Each of these specifications has been proposed to align with performance level 2 for EUI and SHD as detailed in other chapters.



Referable commercial typology, alignment with outline specifications and proposed performance levels



Major commercial typology, alignment with outline specifications and proposed performance levels

1. Substructure
2. Superstructure – structural elements
2. Superstructure – building envelope
2. Superstructure – internal elements
3. Finishes
4. FF&E
5. MEP
A5.1 & A5.2
Contingency

Lifecycle carbon | Results | Commercial modelling

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The results opposite show the lifecycle carbon intensity (A-C exc B6/B7) of levels 1, 2 and 3 scenarios for referable the and major commercial modelling, including the upfront biogenic carbon.

For the referable development, lifecycle carbon could be reduced by 10% compared to level 1 due to a reduced quantum of material and systems needing replacement. Level 3 reduces life cycle carbon by a further 26% as there are greater options to re-use some of the elements at end of life (e.g. steel frame) and less material to dispose of.

In the case of a major development, the reduction between level 1 to level 2 is 29%. Level 3 shows a further 18% reduction. These reductions are for similar reasons.

RIBA 2030 Climate Challenge lifecycle carbon targets

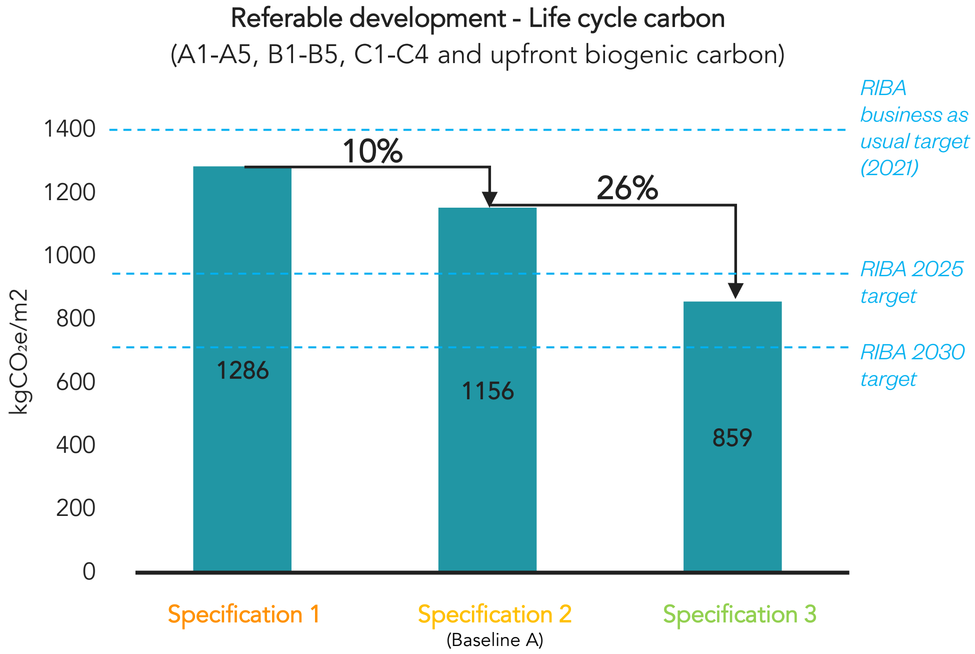
In 2021 RIBA 2030 Climate Challenge (version 2) introduced three performance targets for lifecycle carbon for new commercial buildings. The targets were set after alignment with the LETI bandings in 2021. They are due for review following the UK NZCBS release and collection of awards data, but the date for this is tbc.

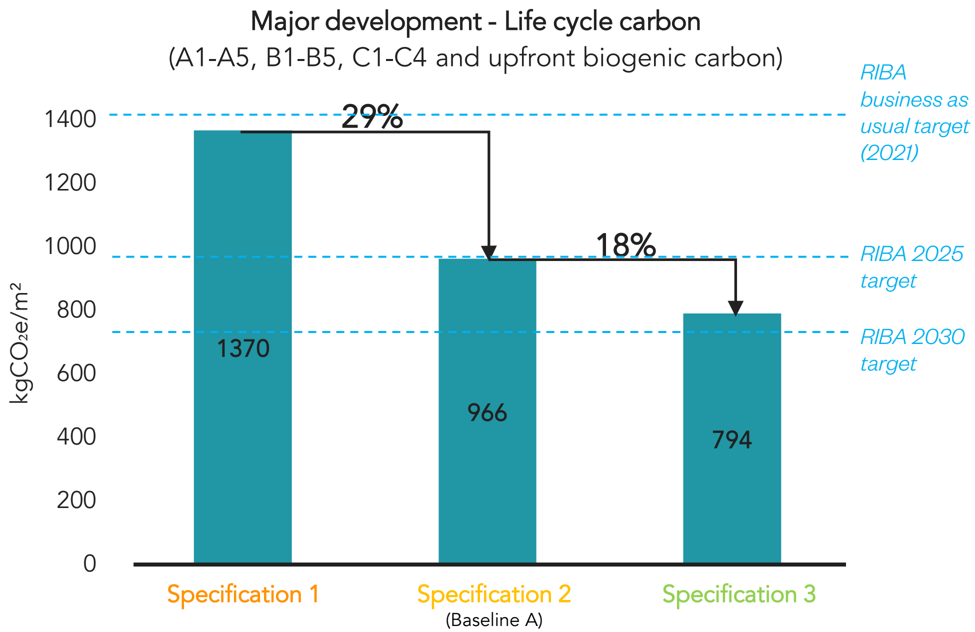
RIBA 2030 Climate Challenge target metrics for non-domestic (new build offices)

RIBA Sustainable Outcome Metrics	Business as usual (new build, compliance approach)	2025 Targets	2030 Targets
Embodied Carbon $kgCO_2e/m^2$	1400 $kgCO_2e/m^2$	< 970 $kgCO_2e/m^2$	< 750 $kgCO_2e/m^2$

The RIBA targets above include the RICS modules A1-A5, B1-B5, C1-C4, biogenic carbon and the RICS categories substructure, superstructure, finishes, fixed FF&E and building services, excluding external works.

The final results have been compared against RIBA 2030 lifecycle targets. Based on the current results, all 3 scenarios meet RIBA business as usual 2021 target. The referable development level 3, and major development levels 2 and 3 meet the RIBA 2025 target.





Total lifecycle carbon emissions of levels 1,2 and 3, compared against the RIBA 2030 Climate Challenge targets for commercial developments.

Scenario testing for the new London Plan evidence base | Elemental breakdowns of upfront carbon

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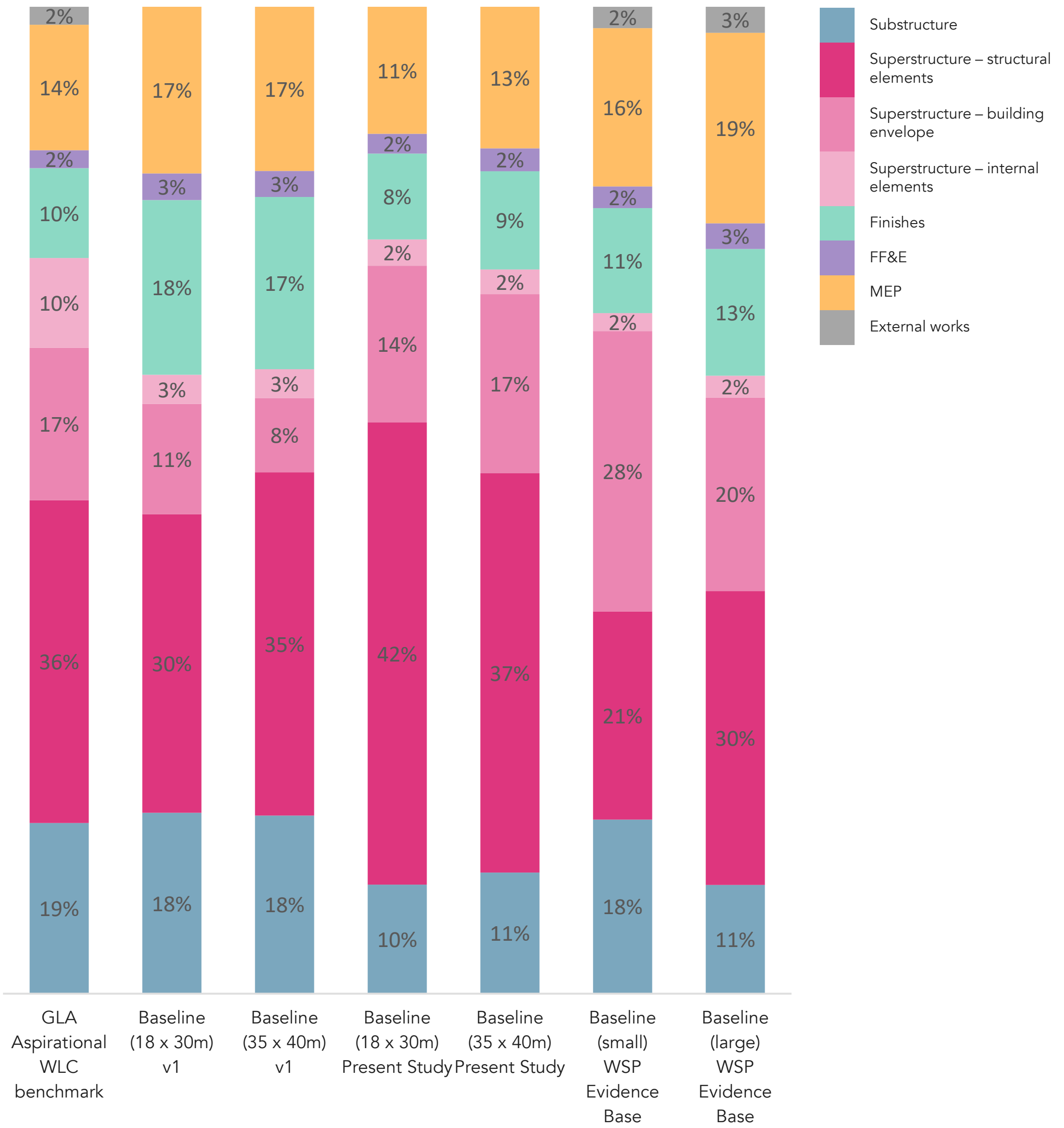
Results from Scenario modelling

The elemental breakdown of A1-A5 emissions across the small and large baseline buildings in this study shows clear differences in distribution compared to other relevant benchmarks.

- In earlier iterations, façade-related emissions were noticeably lower than the WSP baselines (8-11% vs 20-28%), driven by the use of less carbon-intensive systems and a simpler building form factor. The updated study expands the analysis to test both façade material type and façade form factor, adding greater sensitivity and variance to the results.
- The baseline building's reinforced concrete frame remains the largest single contributor, reflecting the influence of span length and material choice.
- The latest modelling also integrates more robust data on variations in substructure material demand across all structural systems. For the baseline building, the substructure's proportional contribution to upfront carbon decreased, reflecting the increased impact from superstructure elements.



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10.3

Costs

Construction Cost I Methodology

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Summary of approach

Analysis of the cost impact of meeting different upfront carbon levels reflects both changes in quantities and specifications between each level in line with the carbon modelling detailed in 10.2.1 and 10.2.2.

The costs of each specification is estimated using Currie & Brown's cost data from recent projects within London and is presented in Q2 2025 prices.

In some instances, the lower carbon solution is less expensive than the higher carbon alternative. This may be a result of a saving in material quantities following a design optimisation to reduce the quantity of concrete or steel in the building structure. In other instances, it may reflect the use of a specification that is both lower carbon and lower cost, for example in the selection of ceiling or floor finish options. While not included in the cost analysis it is noted that the change in finishes specification may have an impact on the design / feel of the completed building.

Costs were developed for each affected element to identify the variance in price between the specification and quantities for each performance level. Those elements that are not materially affected by the changes in specification or quantities were not costed in detail. Instead, these costs were incorporated within the 'balance of construction' cost estimated by reference to a typical whole building construction cost per m² for the building type in question.

Where a specification utilises the use of cement replacement within the concrete mix, the impacts of this option were assessed based on current market costs and availability of Ground Granulated Blast Furnace slag. For the options considered, the changes to the concrete mix would not materially impact the construction programme or associated costs, however it is recognised that for alternative design solutions, eg post tensioned slab systems, this may be a consideration.

10.4

Stakeholder engagement

This section will contain the summary write-ups from the industry, developer and local authority stakeholder events.

Stakeholder engagement summary | Overview

Between May and July 2025, four stakeholder engagements were held to support the development of this evidence-base. The workshops were also attended by representatives of the GLA London Plan team and the consultant's team. The workshops aimed to gather early feedback on the emerging ideas to support the new London Plan evidence-base.

	Workshop 1	Workshop 2	Workshop 3	Workshop 4	Individuals
Stakeholder group	Local authorities	Wider industry (built environment)	Property development companies	Local authorities	Conversations with key individuals
Date(s)	7th May 2025	23rd June 2025	25th June 2025	10th July 2025	3rd April, 8th April, 24th June, 1st August 2025
Location	Online meeting	Currie & Brown's offices	Currie & Brown's offices	Hybrid - London Councils/Online	Online
Duration	1 hr	2 hrs	2 hrs	2 hrs	30-60 minutes
Attendees	Katherine Frost & Nicola Tulley (Camden), Joe Penn (City of London), Vera Vajda (Enfield), Minerva Anderson (Essex County Council), Kat Scott (Hackney), Baker Paul (Hammersmith & Fulham), Suzanne Kimman (Haringey), Jill Warran (Havering), Duncan Mckane (Hounslow), Preeti Gulati & Jonathan Wade (Kensington and Chelsea), Katie Dowle & Luisa Brotas (Kingston), Jennifer Cairns & Thomas Davies (Lambeth), Tom Ardron & Laura Keay (Merton), James Scantlebury & Jane Custance (Newham), Joanna Hill (Richmond & Wandsworth), Lauren Wilkinson (Southwark), Patrick Whitter (Sutton), Jonathan Taylor & Charlotte Norris (Tower Hamlets), Carolyn Seymour (Waltham Forest), Hrabrina Nikolova, Aidan Nyman, Paolo Balice & Marika Gabbianelli (Westminster)	Aazraa Pankan, Margarita Chorafa & Steve Edge (Introba), Adam Lane & Lewis Knight (Bioregional), Bertie Dixon (Inside Outside), Chris Twinn (independent), Christian Dimbelby (White Arkitetker), David Kingston & Rahul Grover (Buro Happold), Duncan Cox (Thornton Tomasetti), Fabrizio Varriale (RICS/ UK NZCBS), Greg Jones (Hoare Lea), Joel Callow (Beyond Carbon), Kristen Haggart (Waugh Thistleton), Lizzie Oreily (KLH), Louisa Tredwell (Elliot Wood), Louise Wille & Tom Kordell (XCO_2), Mat Edis (SCS Partnership), Matthew Mapp (Sweco), Michelle Sanchez (RSHP), Olga Koumaditou (ARUP), Philip Exton (AECOM), Phoebe MacDonald (RIBA), Rodrigo Garcia Priego (Greengage), Susie Diamond (Inkling)	James Parker (Latimer/Clarion), Attzaz Rashid (Barratt), Harry Knibb (Oxford Properties), Robin Palmer (Peabody), Joe Jack Williams (By water properties), Victoria Herring (Grosvenor), Dan Rafferty (Stanhope)	**In person:** Eleanor Grace (Westminster), Nicola Tulley (Camden), Vera Vajda (Enfield), Ashwin Patel (London councils), Rachel Weaver (Hackney), James Scantlebury (Newham), Luisa Brotas (Kingston), Joe Penn (City of London), Tom Davis (Lambeth), Alice Leach (Barnet) **Online:** Adam Derham (Essex County Council), Amber Fahey (Be First), Paolo Balice, Hrabrina Nikolova-Laxness, Orlaigh McComish & Marika Gabbianelli (Westminster), Biplav Pageni (Haringey), Carlos Gonzalez- Martos (Lambeth), Carolyn Seymour (Waltham Forest), Chin Matos Lam (Camden), Ryan Clark (Greenwich), Alex Fish (Southwark), Rhoda Hayashi (Bexley), Huw Trevforrow (Havering), James Delamere (Waltham Forest), Jane Custance (Newham), Jennifer Cairns & Robert O'Sullivan (Lambeth), Jill Warren (Haringey), Joanna Hill (Richmond and Wandsworth), Kat Scott & Seonaid Carr (Hackney), Katie Dowle (Kingston upon Thames), Dominique Hill, Laura Keay & Tom Ardron (Merton), Lydia Brown (Islington), Partick Whitter (Sutton), Tessa Devreese (ReLondon), Vera Vajda (Enfield)	Philip Exton, Jon Hall, Atif Sibghat, AECOM (GLA data review team), Simon Sturgis (co-author of WKLCA Guidance 2021), Fabrizio Varriale (UK NZCBS, RICS) and BECD), Will Arnold (I Struct E and UK NZCBS TSG), Pat Herman/ Ale (BRE)

Stakeholder engagement summary | Overview

The workshops aimed to gather early feedback on the emerging ideas to support the new London Plan evidence-base. Seven key themes – shown on the table opposite – were presented, and participants shared their experiences, challenges and support for these topics. Some participants also followed up with additional evidence from research or projects in support of or to supplement the findings as part of this evidence base.

Operational energy was also discussed, and feedback is summarised in the *'Evidence for operational energy and carbon policies'* report. Feedback on embodied and whole life carbon is summarised on the following pages.

Key research topics	Points discussed
Space heating demand & Energy use intensity	**Performance levels** • Proposal of three levels of performance for SHD and EUI per building typology to support the introduction of policy targets/limits.
	Calculation method • Use of predictive energy modelling (PHPP/TM54) for greater accuracy as opposed to building regulations compliance tools (SAP/SBEM).
Cooling	**Identified gaps in current policy** • Skipping of passive measures for buildings which propose active cooling.
	Ensuring implementation of passive measures • Simplification of existing cooling hierarchy. • Compliance of residential schemes with 'passive design test'. • Meeting a cooling demand limit for non-residential typologies.
Low carbon heat	**Three key approaches** • Adoption of key zones. • Incorporation of low carbon heating options. • Conducting affordability analysis.
Renewable energy	**Performance levels** • Proposal of two levels of performance for on-site renewable energy generation per building typology to support the introduction of policy targets/limits.
	Energy balance • Adoption of energy balance as an offsetting metric.
Lean design	**Incentivising lean design and material efficiency for low embodied carbon outcomes through policy**
Upfront embodied carbon	**Performance levels** • Proposal of two levels of performance for upfront embodied carbon limits for residential developments and offices to support the introductions of policy targets/limits.
Whole life carbon	**Reflection on current policy** • Scope of reporting and submission points. • Policy administration and enforcement.

Table summarises the themes presented at the workshops

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10.4.1

Local authorities

Stakeholder engagement summary | Local authorities' workshop 07/05/2025

This workshop was an introductory engagement session with the local authorities to gather insights on their own experiences in producing evidence and implementing specific policies related to operational energy and embodied carbon within their local plans. In so doing, the research team aimed to leverage insights to anticipate difficulties and opportunities to avoid doubling existing evidence, understand where others have faced challenges when suggesting certain policies, and streamline processes for research and suggested policy mechanisms.

	Addressed questions
1	For those implementing SHD, EUI, specific renewable requirements, energy offsetting and embodied carbon limits. Where are you in the process?
2	Do you have useful evidence that we can use, especially evidence that is not in the public domain/ we might not be aware of?
3	Have you had any representations for or against any of your draft policies? Have they impacted your draft policies?
4	Have you encountered difficulties that you would like to share? Did you develop any helpful solutions?
5	How have you considered equality, diversity and inclusion (EDI) in plan making, and do you have ideas on how it could be integrated into London plan making. Do you know of any good examples, either within or outside of London? Are you working with any external partners on this, or know of any good work in this area?
6	Do you have any advice on evidence preparation?
7	Do you have any advice on viability?
8	Do you have any advice on streamlining?
9	Any other comments on the research questions and/or our approach?
10	Further questions for the GLA (and/or comments and assorted views/recommendations)

1. For those implementing SHD, EUI, specific renewable requirements, energy offsetting and embodied carbon limits. Where are you in the process?

Local authorities are at different stages in plan making. With most authorities in the process of implementing at least some of these metrics and limits. A few report not yet being in the process of implementing operational energy and embodied carbon metrics and limits while others report having fully implemented metrics and limits. Each local authority has developed their own evidence base or deferred to current GLA policy to support their emerging or adopted policy . However, many have chosen common metrics (SHD and EUI) and shown support for WLC. For more details see the existing approaches report produced as part of this research.

Stakeholder engagement summary | Local authorities' workshop 07/05/2025

2. Do you have useful evidence that we can use, especially evidence that is not in the public domain/ we might not be aware of?

A few useful documents and evidence packs have been suggested as summarised in the table below:

Local authority	Evidence / observations
Camden	Observation: WLC being used to justify demolition Basement extensions impact on EC: https://www.camden.gov.uk/documents/d/guest/embodied-carbon-impact-of-basement-extensions
City of London	Spreadsheet: major developments, EC (>2022).
Hammersmith & Fulham	Viability assessment for local carbon offset price
Merton	Workshop (by Arup & Uni of Sheffield) on EC and CE
Westminster	Have EC from planning submissions. Internal work on Science-based targets and benchmarking. Internal paper on carbon pricing https://committees.westminster.gov.uk/ieDecisionDetails.aspx?ID=2114 (and documents therein)
Richmond	Net Zero Carbon Study, 2023 https://www.richmond.gov.uk/media/rpjbt4xh/psed_05_richmond_cof_report_v11.pdf
Kensington & Chelsea	Etude study (Towards Net Zero Carbon, 2023)
Sutton	Suggest Southwest Local Energy Plan

3. Have you had any representations for or against any of your draft policies? Have they impacted your draft policies?

A few local authorities report having received representations. The majority of these questioned the viability of specific policies or limits.

An important identified gap in implementing some of the policies is the lack of information or references about specific uses or building typologies.

The main topics questioned by representations were:

- Missing considerations for specific building typologies (Camden – exempted lab-enabled buildings; City of London – tall buildings, hotels; Kensington & Chelsea – Care homes; Newham – exception made for a specific industrial use)
- High carbon offsetting costs (Kensington & Chelsea; Richmond – did not change policy; Westminster – dialled back)
- Consistent GLA and local authority policy alignment (City of London – case by case benefits where GLA WLC is not achieved)
- Local requirements are going beyond national regulations
- Resistance to mandatory heat network connections
- Viability of energy balance on site
- WLC RICS WLCA PS 2nd ed. seen as too challenging
- Achievability of NABERs 5* in retrofit (City of London – policy adapted to 4*)

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4. Have you encountered particular difficulties that you would like to share? Did you develop any helpful solutions?

Some of the concerns and difficulties were expressed by the participants:

- Concerns were raised about the rapidly changing policies and how best to future-proof them.
- Despite carbon offsetting mechanisms becoming more common, there is still a need for clarity, particularly when policies consider both embodied and operational carbon. For instance, if policy addresses both forms of emissions, can one offset the other?
- Some authorities, especially smaller ones, are concerned about the lack of in-house expertise, resources and/or tools that enable them to efficiently assess applications or develop more ambitious policy.
- Retrofit versus new build policies are being questioned due to the inherent limitations that these impose on the integration of more ambitious environmental improvements.
- Recent requirements mandating the need for producing a WLCA to evidence the request for demolition of dwellings was pushed back by applicants.
- There's a concern about the viability of managing overheating through passive measures alone in many circumstances and building types.
- Some are concerned by the incorporation of scarce resources (e.g., cement replacement/GGBS, recycled aluminium, etc.) to claim better project sustainability outcomes when this is known to make no difference in global terms.

5. How have you considered equality, diversity and inclusion EDI in plan making, and do you have ideas on how it could be integrated into London plan making. Do you know of any good examples, either within or outside of London? Are you working with any external partners on this, or know of any good work in this area?

The majority of participants report doing just enough to satisfy the Equality Act, by conducting Equalities Impact Needs Assessment or the Public Sector Equality Duty.

There is a general acknowledgement that the Equality Act duties and the Sustainability Appraisal framework have some overlapping purposes and objectives.

When viability testing has been conducted it has generally shown that new policies tend to have a bigger impact in deprived areas

Some of the local authorities claim having implemented further elements in favour of EDI in their policies, namely:

- Haringey – New Local Plan and all policies considered EDI. Safe, healthy, resilient buildings are key.
- Hackney – Fairness strongly considered in Climate Action Plan. Fair and just transition to net zero.
- Camden – Have an EDI statement in plan. Resist active cooling, direct electric heating, ASHP without thermal efficiency measures.

Stakeholder engagement summary | Local authorities' workshop 07/05/2025

6. Do you have any advice on evidence preparation?

The quality of evidence is seen as key to substantiate the policies, particularly when suggesting limits. It is thus essential to produce more quantitative data, instead of generic or qualitative outputs. Ideally, this should be backed up and tested with built projects.

Some participants recommend starting at a very ambitious level, with the assumption being that it will all be watered down during consultations.

The use and reference to RICS WLCA PS 2nd ed. in evidence gathering, with the assumption that that is the recommended methodology to follow, has been flagged as particularly challenging to many developers.

Recommendations for considering grid spacing in benchmark buildings (aligned with BCO standards) and the impact of basements on baselines for smaller buildings.

7. Do you have any advice on viability?

Policies tend to be particularly scrutinised when they exceed the current London Plan in terms of viability and cost (both direct and process costs). Both cost and value for money are perceived as essential (considering also the cost for inaction).

Planning inspectors generally want to understand the impacts of net zero policies when in combination with other policies. For instance, Kensington & Chelsea's Local Viability Plan (2022) has demonstrated that net zero for major development is still viable.

There's a lack of evidence showing if smaller developments are more challenging and economically unviable in commercial typology.

Allowing for credits in embodied carbon against energy offsets has been shown to improve viability for major schemes.

8. Do you have any advice on streamlining?

There was a general agreement that using proformas and simplifying submission and analysis of information is essential to improve efficiency and reduce repetitions. Ensuring that the data is collected in a usable form is fundamental, particularly to help inform future policy

9. Any other comments on the research questions and/or our approach?

Policies need to be considered holistically and work together (environmental, social, economic). For instance, concerns were raised in the relationship between raising overheating risk and other policies, such as daylighting.

A clear implementation guidance is essential to support both planning officers and developers. Ideally, a wider range of development scales, building types and uses should be covered by evidence and policies.

Developing robust post-occupancy performance monitoring and reporting mechanisms is important to ensure projects are meeting targets (or subject to fines for incompliance). This should go along with updated carbon offsetting costs.

10. Further questions for the GLA (and/or comments and assorted views/recommendations)

Further comments encompassed topics such as: making it harder to remove mature trees; doubling-down on unoccupied properties; considering requirements for external blinds; setting limits to cooling demand; developing guidance around compatibility of VRF systems with DHN; stricter façade design guides/limits (e.g., glazing ratios).

10.4.2

Wider industry

Stakeholder engagement summary | Industry workshop 23/06/2025

Lean design:

Participants agreed with the importance of proposing more specific lean design principles. However, there were no comments for or against specific ways of driving lean design.

Upfront carbon limits:

Performance levels approach:

- There was universal support for the principle of setting upfront carbon limits however, less consensus was reached on what they apply to - numbers, sectors, scope, etc.
- Ideas were advanced about aligning with limits set in the UK NZCBS, even if it is only to act as an aspirational target for which the project might get a 'bonus' or relaxation on some other aspect.

Implementation:

- Third party verification was seen as an essential aspect to get right if limits are introduced. This should be paid for by the applicant but managed by the authority, for independence and transparency.
- Mechanisms need to work to enforce this (acknowledging flexibility in some cases?). For instance, if a project is over the limit at planning, it can commit to a reduction pathway; then pre-commencement is conditional on achieving the limit, and financial penalties can be imposed if limit is ultimately not met at post-completion.

WLC assessment and reporting

Existing policy: Participants agreed that even if limits are set only for upfront carbon, there should be a need to calculate and report whole life carbon.

Streamline processes and reporting:

- Reporting requirements need to be consistent and properly enforced. RICS WLCA PS 2nd ed . seen as most robust when compared to similar efforts in other countries.
- General concern about lack of consistency in reporting scopes and level of detail considered in WLCA. Seen as unfairly distorting comparisons between projects.
- General support around the table for improving all projects, not only referrable through policy, potentially using a ratcheting system with more demanding requirements for larger projects.
- No significant ideas about streamlining processes other than through implementation and submission.
- Consistency of policies and reporting requirements between boroughs, particularly within the GLA would be a big win.
- Spreadsheet deliverable with long report accompanying it was seen as a potential issue, but they serve different purposes: planning authority needs the numbers, but most clients only look at the report.
- PACER mentioned a few times as a potential great move if all boroughs were to use the same platform.

10.4.3

Developers

Stakeholder engagement summary | Developers workshop 25/06/2025

Upfront Carbon limits

Performance levels approach:

- There was an agreement in principle to introducing limits.
- The majority of the participants were comfortable with the most onerous proposed level, pending clarity of what is included or excluded. For example, the workplace limit was seen as acceptable if CAT B fit-outs are excluded, with one participant offering to share supporting evidence.
- Participants suggested that limits for sub-typologies such as hotels and student accommodations should be considered in the future, although acknowledge the current lack of data.

Implementation: while there was no clear lines on project scale, there was no objection to apply the policy beyond referable projects.

Whole Life Carbon

Existing policy: There was no push back on continuing to report the whole life carbon scope.

Implementation: Similar to upfront carbon limits, there was no clear views on project scales, but extending the policy beyond referable schemes did not raise concerns.

Governance

- Participants were less definitive on governance mechanisms.
- There was no clear consensus on whether third-party verification should be required or how enforcement would work.

10.5

Existing evidence

Current guidance on embodied carbon and whole life carbon

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RICS - Whole Life Carbon Assessment for the Built Environment

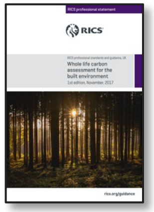
The Royal Institute of Chartered Surveyors (RICS) first published the '*Professional Statement: Whole Life Carbon (WLC) assessment for the built environment*' in 2017. It is the industry standard methodology for WLC assessments and provides supporting guidance in line with BS EN 15978 principles. The 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. RICS accounts for sequestered carbon in materials separately but does not account for biogenic carbon losses from the existing site (existing plants, habitats, etc.). A second edition of RICS Professional Statement was published in 2023 and is due to take effect in July 2024. Key changes include:

- the separate reporting of buildings within a site
- the introduction of new life-cycle stages, some of which are mandatory to report (e.g. A5.1, demolition)
- the alignment of carbon data with the cost plan of the projects
- the separate reporting of carbon offsets and biogenic carbon
- the rating of quality of data for carbon emissions.

Other useful guidance and targets

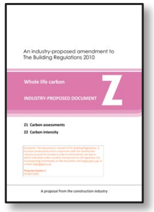
Additional useful embodied carbon guidance and information is available from the Royal Institute of British Architects (RIBA), Low Energy Transformation Initiative (LETI), Chartered Institution of Building Services Engineers (CIBSE), Building Research Establishment's BREEAM, the UK Green Building Council (UKGBC), the Institution of Structural Engineers (IStructE) , the Centre for Windows and Cladding Technology (CWCT) , the Concrete Centre, industry proposed Building regulations Part Z, Buildings as Material Banks (BAMB), and the UK Net Zero Carbon Building Standard (NZCBS) - currently under development.

Professional standard for assessment:



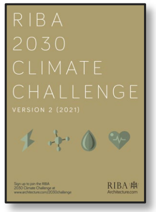
RICS 2017 (left) and 2023 (right) professional statements: Whole Life Carbon assessment for the built environment.

Part Z proposed amendment to building regulations



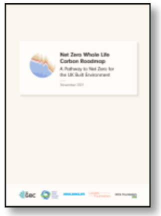
The Part Z proposal sought to provide a framework for regulating whole life carbon assessments and embodied carbon targets for all major development through the building regulations. It was aimed at giving regulators a high-level template for implementing reasonable standards sooner rather than later.

Industry guidance and targets:



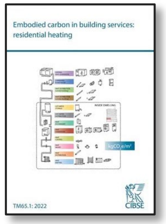
RIBA 2030 climate challenge

LETI embodied carbon primer



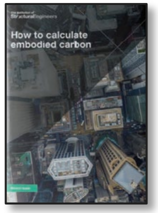
UKGBC – Net zero whole life carbon roadmap

UK Net Zero Carbon Building Standard

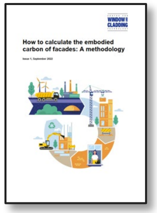


TM 65 – Embodied carbon in building services

Other useful guidance:



IStructE – How to calculate embodied carbon



CWCT– How to calculate embodied carbon of facades

The concrete centre– Sustainable concrete

BAMB – Material passports

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.

RIBA

RIBA developed voluntary performance targets for embodied 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.

Further work in the industry - NZCBS

The UK Net Zero Carbon Building Standard (NZCBS) is a science-based project aimed at developing a unified methodology for achieving net zero carbon buildings in the UK. The standard is in development and is in the process of reviewing upfront carbon targets. In a technical study (June 2023) focused on assessing the upfront carbon of new builds, performance levels of recent schemes were reviewed. The performance levels opposite give an indication of how projects compare for their predicted upfront carbon. The number of schemes submitted was significant across many building typologies. While this evidence base is useful, it also has some limitations in that the quality of the data submitted by design teams could not be verified. The pilot version of the standard set limits in autumn 2024.

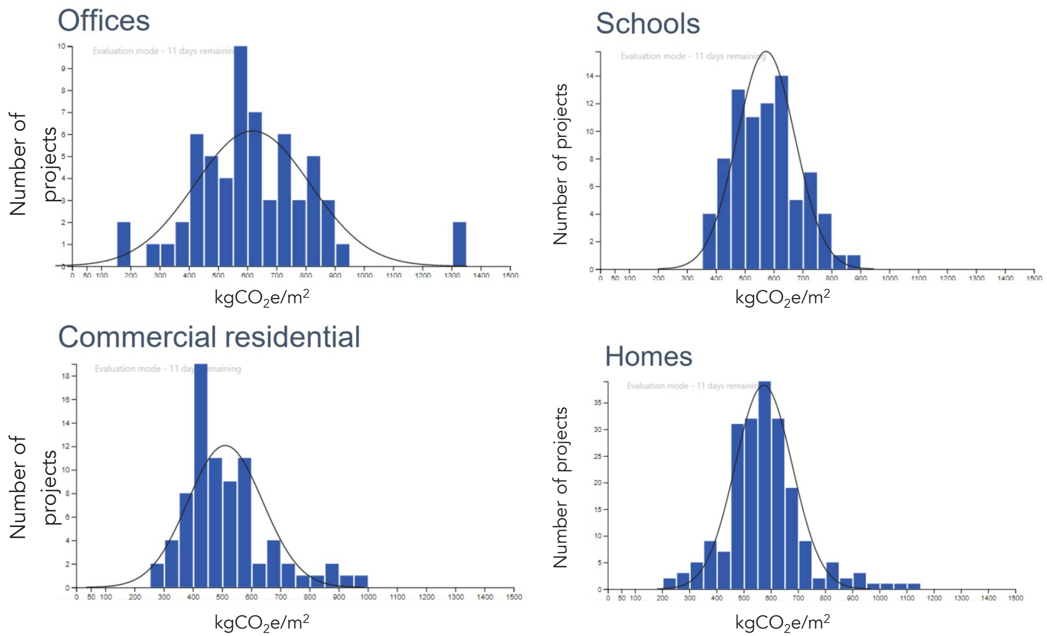
GLA

The GLA Whole-Life Carbon (WLC) assessment guidance (2022) includes life cycle carbon and upfront carbon benchmarks. It is important to note that these are benchmarks for comparison and not targets that must be met. These are less onerous than RIBA and LETI targets.

GLA upfront benchmarks →

Upfront carbon, $kgCO_2e/m^2$ (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

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



Upfront carbon case study analysis (Source: Net Zero Carbon NZCBS)

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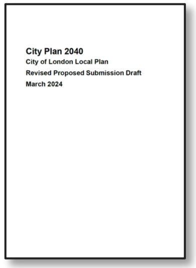
City of London Corporation | Retrofit and Whole life carbon policies summary


City Plan 2040
City of London Local Plan
Revised Proposed Submission Draft
March 2024

City of London 2024 - [Local Plan draft policy]

City of London 2023- [Carbon Options Guidance]

Key requirements

The City of London's City Plan 2040 is anticipated to be adopted in summer 2025. 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

'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.

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.

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.'

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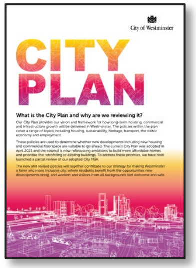
City of Westminster | Prioritising retrofitting over demolition policy summary



City of Westminster

City Plan draft policy

City Plan 2019-2040

Westminster produced a draft policy for prioritising retrofit over demolition in November 2023. In August 2025, the City of Westminster has published the partial review of the emerging city plan 2019-2040 document with main modifications. Through the modifications, upfront carbon limits and targets are suggested for new major developments and those involving substantial demolition..

City of Westminster – Draft policy v4 - Prioritising retrofitting over demolition

"All development involving substantial demolition of a building which has more than a single storey, and all major, with the exception of applications solely involving a material change of use, are required to:

Submit a Whole Life-Cycle Carbon assessment, which demonstrates how the development will aim to achieve:

- For major commercial schemes, including commercial-led mixed uses, an aspirational upfront embodied carbon equivalent of ≤550kg CO_2e/sqm, with a limit of ≤650kg CO_2e/sqm.
- For major residential schemes, including residential-led mixed-uses and hotels, over 18 metres in height, an aspirational upfront embodied carbon equivalent of ≤600kg CO_2e/sqm, with limit of ≤700kg CO_2e/sqm.
- For major residential schemes, including residential-led mixed uses and hotels below 18 metres in height, an aspirational upfront embodied carbon equivalent of ≤550kg CO_2e/sqm with a limit of ≤650kg CO_2e/sqm.
- All other major developments not covered by paragraphs a, b and c above must achieve the maximum reductions in upfront embodied carbon deliverable, and these should be fully justified, including reference to any recognised industry benchmarks where applicable.
- For non-major developments proposing substantial demolition, applicants must demonstrate how they will achieve the maximum reductions in upfront embodied carbon deliverable, and these should be justified, including reference to any recognised industry benchmarks where applicable.
- In exceptional circumstances, where there are justified site specific constraints or bespoke design requirements which make the requirements listed in paragraphs a, b and c above undeliverable, any shortfall against the upfront embodied carbon limits at practical completion will be offset through a financial contribution towards the council's carbon offset fund.
- 2. Developments that follow the Fast Track Route to affordable housing delivery must demonstrate the maximum embodied carbon reductions deliverable without affecting the viability of affordable housing delivery, rather than needing to adhere to the requirements set out in paragraphs b and c above.

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Camden and Tower Hamlets | Embodied carbon draft policies summary

Camden draft new local plan (Reg 18) 2024

Draft New Camden Local Plan Regulation 18 January 2024

The Council consulted on the draft new Local Plan (Reg 18) from 17 January to 13 March 2024. They are currently considering all the responses received and will publish an updated version of the Local Plan for further consultation in Spring 2025. The new draft policy requires all new developments to undertake a Whole Life Carbon assessment and to meet an upfront carbon limit. The limits suggested are divided per typology (residential and non-residential).

Camden - Policy CC4 - Minimising carbon emissions

'A. The Council will seek to ensure that all development minimises carbon emissions over the lifespan of the building(s). The Council will:

i. Require applicants for all new build development and all development proposing substantial demolition to:

- *a) submit a whole life carbon emissions assessment (including operational and embodied carbon), following the GLA Whole Life Cycle Carbon Assessment template, as part of the planning application; and*
- *b) demonstrate that they have done all they can to minimise carbon emissions over the lifespan of the building/s, targeting the GLA Whole Life Carbon aspirational benchmarks in modules B – C.*

ii. Require new build developments to meet embodied carbon limits of less than 500 kgCO_2/m^2 for residential, and less than 600 kgCO_2/m^2 for non-residential.

iii. Require applicants to demonstrate what action they have taken to reduce embodied carbon in the development, as part of the Energy or Sustainability Statement.'

Tower Hamlets draft new local plan (Reg 19) 2024

Tower Hamlets draft new local plan Regulation 19 summer 2024

Tower Hamlet's new draft policy requires all major developments to undertake a Whole Life Carbon assessment, following the 2021 London Plan and to meet an upfront carbon limits. The limits suggested are divided per typology (domestic and non-domestic).

Tower Hamlets - Policy CG4 Embodied carbon, retrofit and the circular economy

'1. Major developments must assess the whole lifecycle carbon emissions of a development by undertaking a Whole Life Carbon (WLC) assessment.

2. Major development proposals should achieve the following LETI 2020 best practice upfront embodied carbon emissions targets for building elements:

- *a) Domestic buildings should achieve upfront embodied carbon limits of 500kg CO_2/m^2 or less; and*
- *b) Non-domestic buildings should achieve upfront embodied carbon limits of 600kg CO_2/m^2 or less.'*

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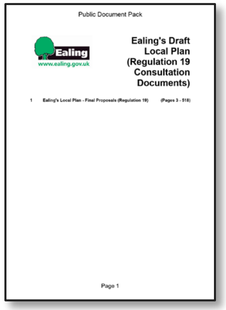
Ealing and Enfield | Embodied carbon and whole life carbon draft policies summary


Public Document Pack

Ealing

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Ealing's Draft Local Plan (Regulation 19 Consultation Documents)

Page 1

Ealing draft new local plan (Reg 19) 2024

Ealing's new local plan Regulation 19 28th February 2024

Ealing's new draft policy requires all major developments to undertake a Whole Life Carbon assessment, following the 2021 London Plan and to meet an upfront carbon limits. The limits suggested are divided per typology (residential, office, education and retail) and for applications before 2030 and after 2030.

Ealing - Policy ECP: Embodied Carbon – Ealing LPa – local policy

'Major developments should not exceed the embodied carbon limits set out in Table DMP4.

Table DMP4: Embodied Carbon Limits Buildings should not exceed the following embodied carbon limits (where technically feasible) by building type or nearest equivalent:

Building type	*Until 2030*	*After 2030*
Residential	*<500 $kgCO_2e/m^2$*	*<300 $kgCO_2e/m^2$*
Non-Domestic		
Office	*<600 $kgCO_2e/m^2$*	*<350 $kgCO_2e/m^2$*
Education	*<500 $kgCO_2e/m^2$*	*<300 $kgCO_2e/m^2$*
Retail	*<550 $kgCO_2e/m^2$*	*<300 $kgCO_2e/m^2$*

Policy WLC: Whole Life Cycle Carbon approach – Ealing LPa – local policy

A. *'Major developments should undertake a Whole Life Carbon assessment in accordance with the requirements set out in the London Plan (2021).*

Enfield's draft new local plan (Reg 19) 2024

Enfield's new local plan 2019-2041 Regulation 19 March 2024

Enfield's new draft policy requires all major developments to undertake a Whole Life Carbon assessment, following the 2021 London Plan and to meet an upfront carbon target. The targets suggested are divided per typology (domestic and non-domestic) and for applications before 2030 and after 2030.

Enfield - SE3: Whole-life carbon and Circular Economy

'' Major development proposals are required to calculate whole-life cycle carbon emissions through a nationally recognised whole life cycle carbon assessment tools, in line with London Plan Policy SI 2, or its subsequent update and associated guidance. Developments should demonstrate actions taken to reduce life-cycle carbon emissions with the aim of achieving the upfront carbon targets set out in Table 4.1, or higher future standards set by national or regional policy.

	Planning applications before 1st January 2030	*Planning applications after 1st January 2030*
Domestic	*<500 $kgCO_2e/m^2$*	*<300 $kgCO_2e/m^2$*
Non-Domestic	*<600 $kgCO_2e/m^2$*	*<350 $kgCO_2e/m^2$*

Table 4.1: Upfront carbon requirements, in accordance with the latest RICS Whole Life Carbon Assessment Methodology (Modules A1-5).''

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Newham | Embodied carbon Reg 19 draft policy summary

Newham draft new local plan (Reg 19) 2024

Newham's Draft Submission Local Plan (regulation 19) June 2024

Newham's new draft policy requires all major new developments to undertake a Whole Life Carbon assessment, following the 2021 London Plan and to meet an upfront carbon limit of less than 500 $kgCO_2/m^2$

Newham - CE3: Embodied Carbon and the circular economy

''1. Embodied Carbon should be considered as early as possible in the planning process, as upfront embodied carbon contributes the largest proportion of embodied carbon across a building's life cycle.

2. The planning of a building should apply circular economy principles and reduce embodied carbon by considering:

- a) *how a building is to be built; and*
- b) *how energy and waste can be minimised throughout the construction process; and*
- c) *how a building could be deconstructed in future; and*
- d) *how a building could facilitate future modification, adaption or retrofitting work.*

5. Major developments should undertake a Whole Life Carbon assessment in accordance with the requirements outlined in London Plan (2021) Policy SI 2.

6. Major developments are expected to meet embodied carbon limits of less than 500 $kgCO_2/m^2$.''

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 embodied 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 embodied 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 5,000m^2 of commercial floor space) are required to submit an Embodied Carbon Assessment that demonstrates a score of less than 900kgCO_2e/m^2 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 kgCO_2e/m^2*
- *Residential (5 storeys or greater) - <800 kgCO_2e/m^2*
- *Major non-residential schemes - <970 kgCO_2e/m^2*

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

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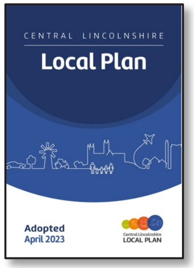


Central Lincolnshire updated Local Plan 2023

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 qualitive assessment. The policy does not only set immediate requirements but also future requirements from 2025.

Central Lincolnshire – S11 – Embodied Carbon

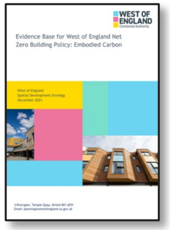
"All development should, where practical and viable, take opportunities to reduce the development's embodied carbon content, through the careful choice, use and sourcing of materials."

"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.



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

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 (RICS 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.

	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 $kgCO_2e/m^2$ 2020 target, and the most challenging scenario (Office_S6) complies with the LETI 350 $kgCO_2e/m^2$ 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 $kgCO_2e/m^2$ 2020 target and the most challenging scenario (ApartBlock_S6) complies with the LETI 300 $kgCO_2e/m^2$ 2030 target. On the other hand, the baseline semi-detached scenario (SemiDetached_S1) almost complies with LETI 500 $kgCO_2e/m^2$ 2020 target and the most challenging scenario (SemiDetached_S6) almost complies with the LETI 300 $kgCO_2e/m^2$ 2030 target.

Recommendations of the study

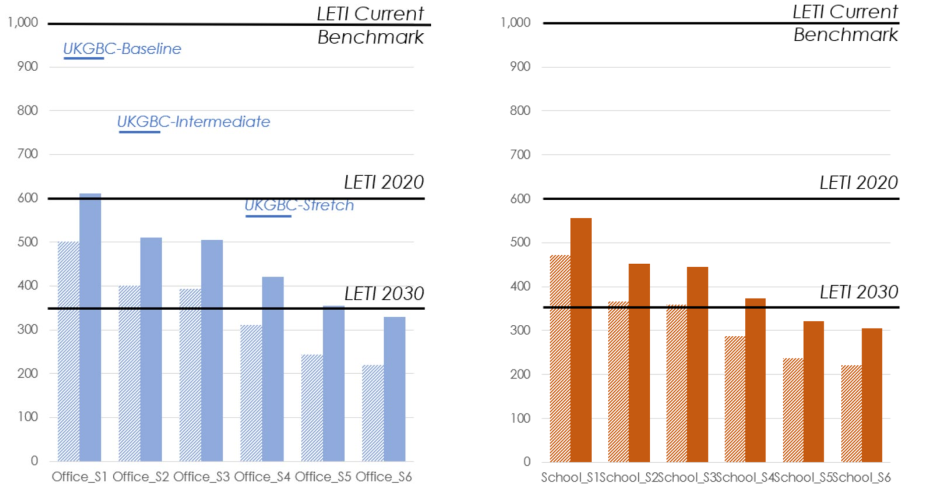
- Conduct and report whole life carbon assessment (including sequestration) and report upfront carbon (modules A1-A5) and circular economy (module D) separately.
- Set upfront (A1-A5) and lifecycle (A1-A5, B1-B5, C, including sequestration) embodied carbon targets.
- Careful investigation of an appropriate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

Important limitations raised

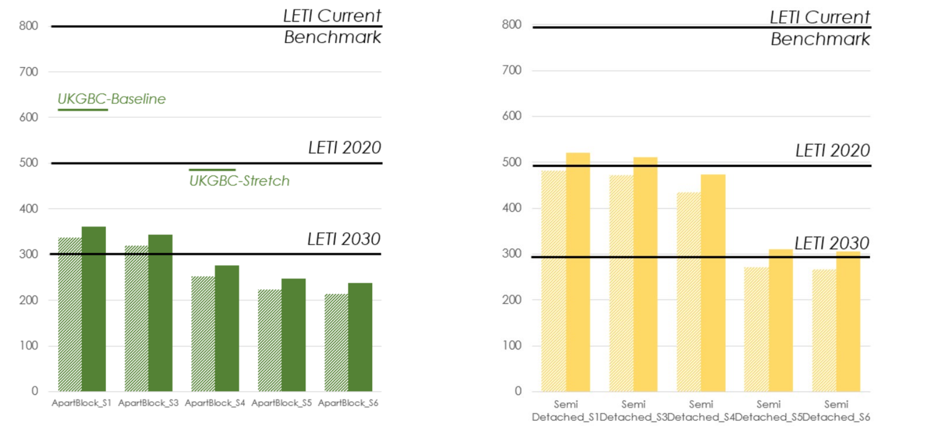
Some important limitations were noted:

- 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 WLCA PS 2nd ed. methodology was used. The cost impact of these measures was analysed as well.

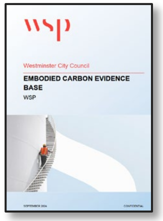
The modelling is based on a mixture of empirical data from previous WSP projects in London, along with material quantities developed from generated structural, MEP, façade and finishes design information per archetype. Internal elements were assumed based on WSP LCA data and fittings, furnishing and 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) ($kgCO_2e/m^2$ (GIA))	746	716	875	789
Baseline with basement (excl. demolition, facilitating and external works) ($kgCO_2e/m^2$ (GIA))	802	781	893	1115
A1-A5 with all measurements applied ($kgCO_2e/m^2$ (GIA))	633	618	720	884
A1-A5 (excl. demolition, facilitating and external works) ($kgCO_2e/m^2$ (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.

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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 Q3 2022 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 met the Essex recommended planning policy approach for Net Zero Carbon Development (in operation).

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

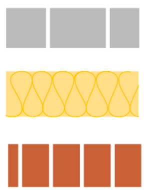
Essex Embodied Carbon Policy Study

Prepared by Levitt Bernstein, Etude, Introba, Hawkins/ Brown and Currie and Brown.

May 2024

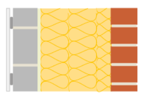
1 **Material Database**

A1-A5 and upfront biogenic carbon datapoints (KgCO_2 per kg) for each material/product.



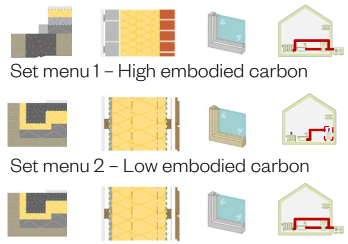
2 **Element library**

Materials combined to created and calculate the upfront carbon of building elements.



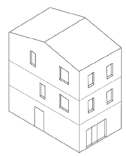
3 **Set menus per building typology**

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

Limits per typology.

3 **Reducing upfront carbon**

Summary of modelling process applied in Essex Embodied Carbon Policy Study

The Essex embodied carbon evidence base | Summary (2/2)

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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

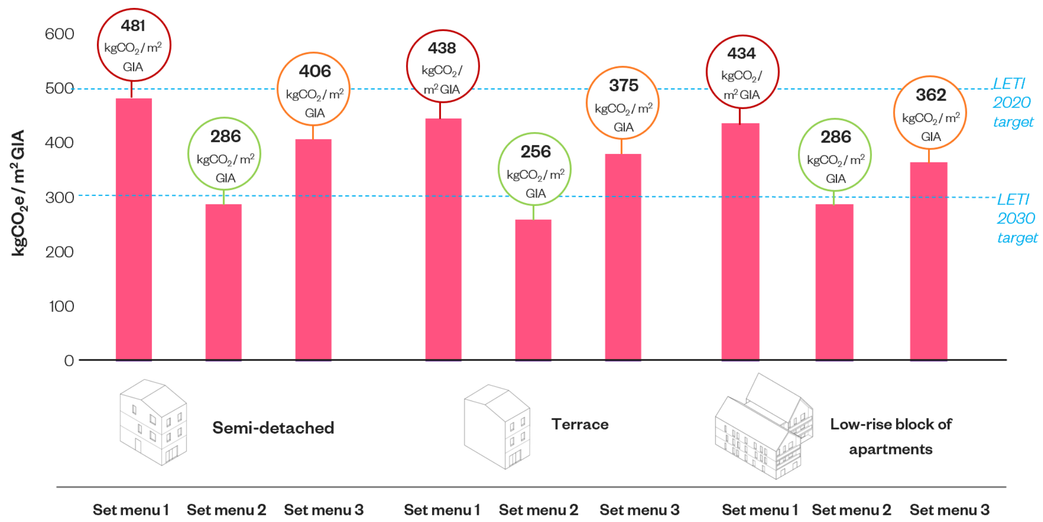
The high carbon (set menu 1) and cost and carbon optimised scenarios (set menu 3) both sit within the LETI 2020 target of 500kgCO_2e/m². Whilst the lowest carbon (set menu 2) sits within the LETI 2030 target of 300kgCO_2e/m². Lowest carbon (set menu 2) shows negligible variation in overall cost from 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 limit for policy - 500 kgCO_2/m² GIA

The report recommends setting the limit for low-rise housing (under 11m) at 500 kgCO_2/m² GIA. This would be a relatively loose limit 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 limit every 3-5 years to determine if it can be lowered or should be altered. A limit of around 400 kgCO_2/m² GIA would allow for a timber structure with brick face, while a limit of 300 kgCO_2/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

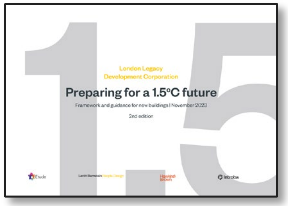
Table shows building elements forming set menu 1,2 and 3 for the houses.



Cost uplift from Part L 2021	+9.4%	+9.5%	+8.3%	+8.4%	+7.7%	+7.8%	+7.9%	+11.6%	+10%

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.*

Clearer guidance is required | Lessons learned from embodied carbon analysis for the LLDC



LLDC 'Preparing for a 1.5oC future'

An upfront carbon analysis was conducted on 86 residential projects across London, as part of the London Legacy Development Corporation's (LLDC) 'Preparing for a 1.5°C future' document. The purpose of this analysis was to determine if the existing LLDC upfront carbon target of <500 $kgCO_2e/m^2$ was applicable for all home types (low to high-rise). There was no conclusion on the above, as results extracted from GLA Whole Life Carbon assessments varied significantly from project to project. This raised questions about the consistency of reporting and quality of data used in GLA submissions.

Key issues identified

1. Quality of underlying data is often not clear and not consistent between projects
2. Reporting is not by building/building typology, making analysis of reporting challenging
3. Pre-planning embodied carbon reduction – lack of narrative/evidence behind the headline number
4. KPIs – the headline upfront carbon number is not enough
5. Post-planning embodied carbon reduction – there is no clear requirement

Upfront embodied carbon ($kgCO_2e/m^2$)

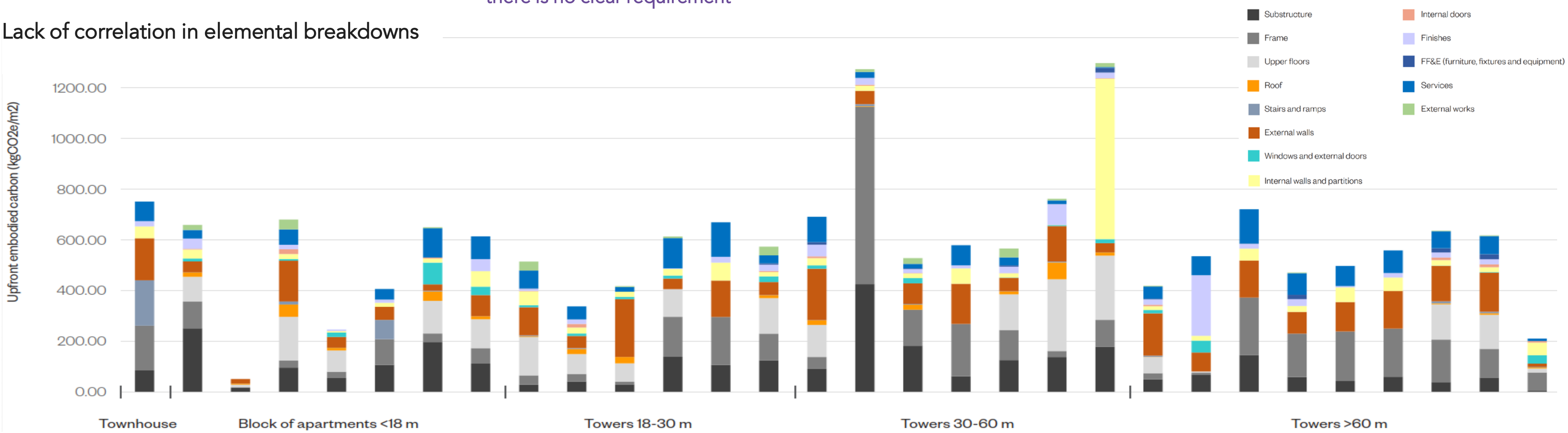
Building typology	<200	200-300	300-400	400-500	500-600	600-700	700-800	800-900	900-1000	1000-1100	Total
Townhouses							1				1
Block of apartments <18 m	1	1		2		4					8
Towers 18-30 m			1	1	1	2					5
Towers 30-60 m					4	1	1			1	7
Towers >60 m		1		3	2	2	1			1	10
Not specified			8	10	23	8	4	1	1		55

GLA data

KEY
- Meet the LLDC target/ GLA aspirational/ LETI benchmark: <500 $kgCO_2e/m^2$
- Meet the GLA benchmark: <850 $kgCO_2e/m^2$
- Above the GLA benchmark: >850 $kgCO_2e/m^2$

Distribution of the upfront carbon figures from the project data collected, categorised into five residential building typologies. It can be observed that when projects are split into typologies, there is very little correlation between building type and the number of projects that achieved the LLDC target of <500 $kgCO_2e/m^2$.

Lack of correlation in elemental breakdowns



When the upfront carbon of all the projects collected (excluding data from GLA) is broken down into building elements, there is a lack of correlation between the breakdowns and totals within each building typology. The variation across projects may occur for multiple reasons, examples include: varying structure and sub-structure types; the volume of reusable/recycled materials assumed; the amount of cement replacement assumed; any unusual features such as podium decks; level of detail of the building services analysis; and whether EPDs for materials were available. There are also some anomalies where the buildings have significantly higher or lower upfront emissions. These assessments may be more detailed or the building more carbon hungry. Data quality is particularly difficult to tell when comparing the buildings.

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Accreditations – existing approaches – BREEAM

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Introduction

BREEAM NC 6.1 and 2014 RFO both contain a MAT-01 credit that aims to require integration of LCA into design thinking and outcomes. The credits are highly scored, representing the BRE view that LCA is a highly valuable tool in the design process.

LCA v WLCA

The current approach of the GLA WLCA requirements and the RICS WLCA PS 2nd ed. is to capture and define carbon emissions from the built environment and therefore relevant databases and EPDs are used to define carbon factors used in the calculations.

The BREEAM MAT01 requires using a more restrict database that captures carbon factors and other environmental impacts. Further, the BRE have their own database called IMPACT that is used specifically to the comparison against the BREEAM LCA Benchmark (see below). So, the MAT-01 requirements rely on reporting and benchmarking projects using this database so a full LCA is undertaken.

New Construction version 6.1

Mat 01: Life Cycle Impacts, the assessment criteria provide a total of seven standard credits and three exemplary credits. The focus is only on LCA of superstructure, substructure, hard landscaping that are required to be completed at RIBA Stage 2. At Stage 4, the assessment is prepared focusing on superstructure only. This is to prepared by using an approved tool One Click LCA, eTool, IMPACT-compliant software, etc. The analysis is focused on the process and hence requires to demonstrate that the LCA results have informed material selection and design choices. For office, industrial and retail buildings the LCA results are to be compared against the BREEAM LCA benchmark. For this comparison, the IMPACT database needs to be used. For other building uses the focus in on options appraisal only. Exemplary level credits requires appraisal on core building services during Concept design, LCA and LCC alignment, and for third party verification for all building types.

Mat 02: Environmental Product Declarations (EPD), one credit available for specification of products with recognised EPDs.

Refurbishment and Fit Out 2014

Mat 01 focuses more on using pre-assessed ratings (via the BRE Green Guide) rather than a full Life Cycle Assessment model. Up to six no. of credits available and is broken down into 2 options. Option 1 requires project life cycle assessment using Mat 01 calculator and option 2 is focused on elemental assessment of environmental performance information, credits are assigned based on the points awarded for % of the element that is reused in-situ and the % of newly specified materials.

Non-alignment

Currently MAT-01 only requires a partial LCA analysis of a building, covering specific elements. This is not aligned with best practice WLCA. The use of IMPACT also mis-aligns data with the majority of WLCA assessments being carried out in London and the UK. If an assessor is appointed to carry out a RICS compliant WLCA, they will always carry out a separate BREEAM assessment for MAT-01, if required by the project, as the two calculations do not correlate.

MAT-01 revisions

The BRE are in the process of updating both the New Construction and RFO credit requirements. As a founder member of the UK NZCBS the BRE are considering how to best align their credit requirements to current industry best practice including the RICS WLCA PS 2nd ed. and the UK NZCBS criteria. This has not been released yet so , at present, this evidence base is not considering the BREEAM approach a robust alignment for the emerging London Plan.

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Embodied carbon in building regulations in France

Figure X - Réglementation environnementale (RE2020)

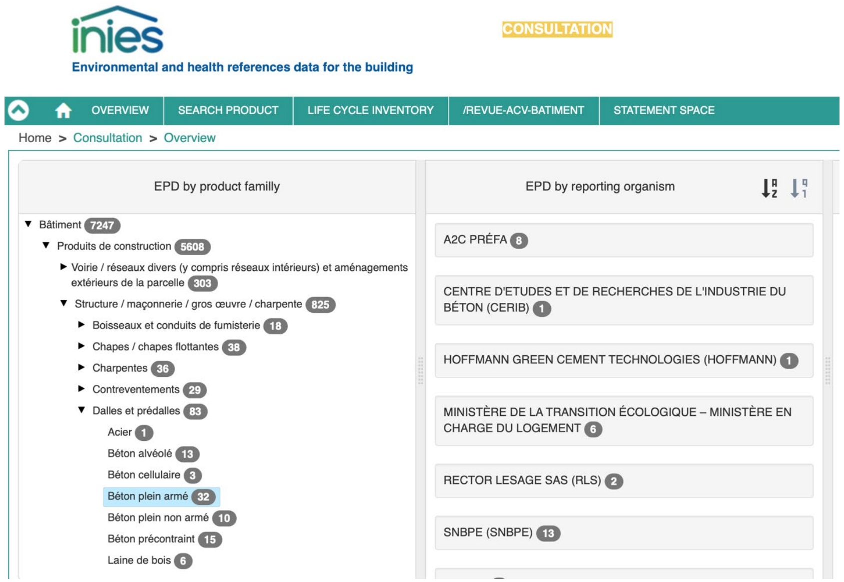
France's Réglementation environnementale (RE2020)

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.

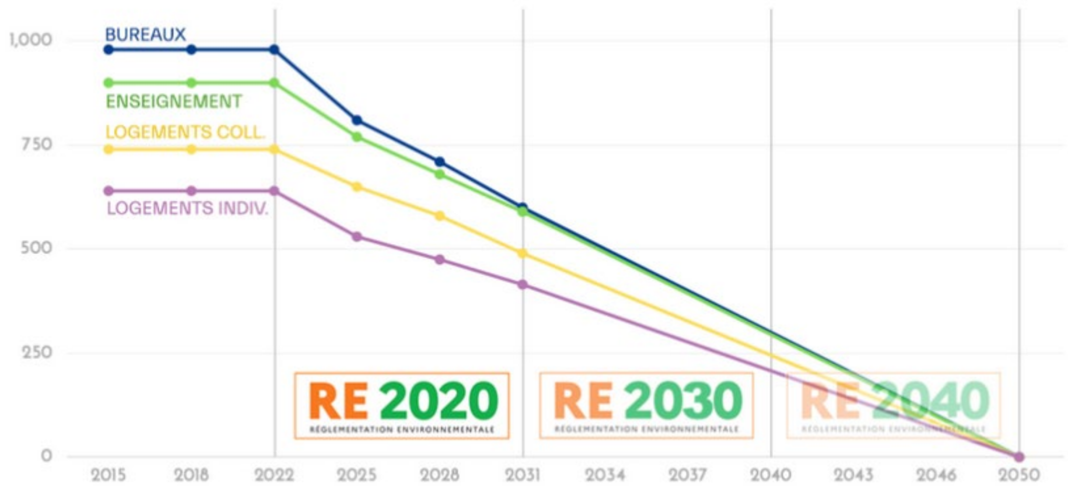
Threshold carbon emissions levels are set per typology and construction permit year. Specific levels of performance must be achieved that will be incrementally reduced (improved) with a new step every three years until 2031. These levels are being revised and reduced in line with France's low carbon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

A specific indicator ($IC_{construction}$ - 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

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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.

Figure X - 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 >1,000m^2 to comply with combined operational and embodied limit values (kgCO_2/m^2/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.

Figure X - 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.

Figure X - MilieuPrestatie Gebouwen (MPG)

Netherlands' "Milieuprestatie Gebouwen" (MPG)

MPG (2022) applies to all new residential buildings and office buildings larger than 100m^2. 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.

Figure X - 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 (WBLCA) at the time of building permit to compare the embodied carbon against a standardised baseline.
- Demonstrate via the WBLCA 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.

10.6

Additional information on Approved Document B

Part B Fire Safety – conflicts and opportunities in embodied carbon

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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, for new residential buildings:

- Between 11-18m in height (measured to highest 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). Balconies and spandrel panels should also be non-combustible over 11 m.
- With the highest occupied storey of ≥18m 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 e.g. outer London boroughs.

GLA funded projects

All new buildings/conversion, refurbishment or remodelling of existing buildings/acquisitions funded by the GLA should apply combustibility restrictions regardless of their height

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

<u>Number of storeys and height of top storey in building</u>

"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

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

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10.7

Equalities impact Appendix

Key questions to consider

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Key questions to consider

In the context of new planning policies that seek to significantly decrease the embodied carbon of new developments, the following questions are worth considering:

- Will buildings be more expensive to build, thereby increasing housing costs (for buyers and renters) and reducing the provision of social and affordable housing or accessible housing?
- Will these policies support cleaner construction sites and quicker build times to reduce the impact of development on noise pollution and air quality?
- Will new building materials and techniques require additional maintenance and lead to higher service charges?
- Will London have enough people with the right skills to build and maintain these buildings?
- Will populations that are currently under-represented in the construction sector be able to access new green jobs?
- Will access to skills be fair and address the cost barriers of re-skilling?
- Will there be a net loss of jobs in London with a move towards off-site manufacturing of building materials?
- Will these policies put additional pressure on industrial land and raise the value of this land?
- Will offsetting be a more common practice for certain types of developments with more viability concerns?

Stakeholder engagement summary

Jon Emmet | London Sustainable Development Commission

- Impacts are often indirect and disproportionately negative outcomes for some populations. These impacts can be personal and felt at an individual scale. For example, research conducted by the Young Foundation for the LSDC showed that some groups find it more challenging to invite tradespeople into their homes.
- It is important to note the potential to address energy inequalities. Increased energy efficiency reduces energy bills, which will address fuel poverty. Warmer homes are healthier as cold and damp homes impact elderly people and people with health conditions. There is however a risk that warmer, better insulated homes may, if poorly built, lock in damp and mould problems. This is particularly an issue for people living in the private rental sector who have less control over their home environment.
- There is a lack of disaggregated and intersectional data to help us have nuanced conversations. This is a particular issue when talking about disability and conflating groups with very different needs such as neurodiverse people or people that are visually impaired. We need to disaggregate this data if possible.
- Climate adaptation is maybe a bigger issue to consider than net zero. We need to consider the impacts of extreme weather, especially on the poorest and most marginalised. This will be an increasing source of disparities. Who will be able to afford air conditioning? How effective will passive cooling be for those who live in a flat without windows that can open? Exposure to heat will depend on the orientation and heigh of buildings and flats.
- The big trade-off to consider is if these policies make housing more expensive. This can make developments non-viable and raise house prices, keeping them out of reach of low-income groups. It is not always clear what the evidence is to back this claim up. Developers talk about risks and the potential costs, especially if meeting several new policies at once.

Nannette Youssef | Runnymede Trust

- The University of Manchester has done research about energy inequality through a racialised lens. They found that people of colour are more likely to be in bill arrears, less likely to shop around for different energy providers, more likely to encounter language barriers. These all mean people of colour are less likely to find value for money in the energy sector.
- There is scope to conduct more primary research and data collection about people's experiences of net zero policies and their homes – how do people interact with new technologies? How are they communicated?
- Social housing allocation a key process for racialised groups, who are less likely to own their homes, more likely to live in non-decent housing that does not meet energy efficiency standards. Lower income groups are less able to afford upgrades to their homes and may not have control as renters.
- In general, climate policies don't consider the needs of people of colour, who are often not included in the policy-making process to the extent that they should be.
- Environmental sector focuses on sticking plaster policies that don't tackle the structural underpinnings of the inequalities we see. We need a broader, more holistic approach. There is a lack of joined up thinking about how policy areas relate to one another. It is important to be visionary and to ask what needs to accompany technical policies for this to be fair and promote fairness. Lots of new-build housing is inaccessible to marginalised groups, through location, cost and design.

Stakeholder engagement summary

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Julie McLaren | The Young Foundation

- Research into net zero policies needs to be much more cross-cutting and holistic. Links between energy efficiency and health for example need to be communicated, researched and explored. Retrofitting social housing for example may be informed or led by a desire to improve health outcomes rather than through just a sustainability lens. Is there an opportunity to factor in green roofs or growing spaces into masterplans? Could this be required of developers to meet multiple policy objectives at once?
- There is no one size fits all for issues like retrofitting and refurbishment. A lot of people don't just experience one protected characteristic and there are intersections between them that shape how people may be treated. People want to be involved in the design of homes and developments to ensure their needs are met. Is there a risk of new policies locking people out of certain decisions they would like to make about their homes or reducing the flexibility or adaptability of those spaces?
- Affordability is the primary concern. Will these additional policy requirements come with additional costs? And even if the initial outlay is recouped over years in lower bills, do landlords and building owners have the right incentive as they typically don't see those savings? Likewise, if a home is a commodity to be resold, will homeowners not see the long-term benefits of their investments? These could be issues for more transient, less stable populations (or those displaced for any reason).
- Increased participation is one mitigation strategy for addressing any identified risks or negative impacts of policies. Hear from people about how the policies might impact them and how they would address those impacts.

Dan Daley | C40 Cities

- There is an issue of the costs of retrofitting being passed onto tenants and renters. This can be a barrier to retrofitting in places with rent controls as there is little incentive for landlords to shoulder retrofit costs if these cannot be recouped by higher rent. Likewise, these policies carry a risk of renovictions and adding green premiums for tenants.
- Off-site construction may deliver higher quality jobs but may represent a loss of employment within London.
- There may be cost savings overall. In Madrid, a public housing project of 52 homes delivered with timber cut construction time by 40%. These cost savings outmatch the higher upfront material costs (of usually about 4%).
- Reducing embodied carbon and material use has co-benefits including construction sites that are healthier and less disruptive to residents. Someone needs to quantify these benefits.
- C40 cities is pushing cities to think holistically about where climate and justice issues intersect to consider equitable policy outcomes. It is about writing policies that layers in what other departments are doing and what their priorities are to create holistic policies. Cities need to break down internal government silos and make links between policy priorities such as good work, climate policy and responsible procurement.

Betty Owoo | GLA Design Unit

- There is a knowledge and cost gap for these new net zero building technologies. Language is technical and people need real-life, costed examples of the types of outcomes and benefits they could see from retrofitting their homes. The benefits aren't always clear to people and they don't always make connections to other issues such as health and energy costs. There is a lot of misinformation about these topics.
- Some installations, such as loft insulation, may result in homes reducing their overall floor area. In older properties, there is a risk of sealing in damp issues. You may lose heritage features in some homes.

Stakeholder engagement summary

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Cara Holmes | Citizens Advice

- It is likely that people with Protected Characteristics will be missing out and inequalities will worsen. Access to flexible prices is how many of the benefits of net zero are accessed. It is the only way you can get cheaper energy. There are barriers to flexibility in the equipment and technologies people have in their homes. There are also problems around how people choose which tariffs will actually save them money. People don't understand how it works and how to navigate different offers. It is not always clear what the actual cost savings are for flexible energy use. A lot of people end up being penalised for not being flexible with their energy use or don't have smart appliances. People don't have the time to think about this and some people's energy use is inelastic. Flexibility is forced onto many people where this is not the appropriate solution.
- It is important to take, as much as possible, a building by building approach to retrofit. Not all solutions are appropriate for all places but there is a one size fits all approach and incentives to put in the cheapest measures. It is important to ensure we also have buildings that keep cool and to consider climate resilience and adaptation.
- There is a scenario where wealthy people get all of the benefits and when gas boilers are phased out, the people who can't afford a heat pump or solar panels are reliant on expensive plug-in electric space heaters. Net zero technologies work best when people have all the technologies working together such as on-site energy generation, batteries, electric vehicles and heat pumps. These represent a very significant upfront outlay. People need to be supported to invest in the right products to achieve a transition to net zero. There is a risk that this reduces people's ability to sell their homes if they can't invest in the right technology.
- Where heat networks do switch to greener energy sources, customers end up paying more for the upgrades and costs are passed on. The implications of moving into a property with a heat network are not always clear to new residents.
- Policies can mitigate these risks by having a focus on outcomes. Many schemes are about inputs and don't test or check the outcomes of these policies. Bake-in outcome and post-occupancy checks for new builds. EPC outcomes need to be measured not modelled. Quality assurance is key as some insulation, if not properly installed, can cause damp and mould. Policies need strong enforcement. Policies should be framed more holistically as being about health and safety in homes. This focus would encourage a different way of building.

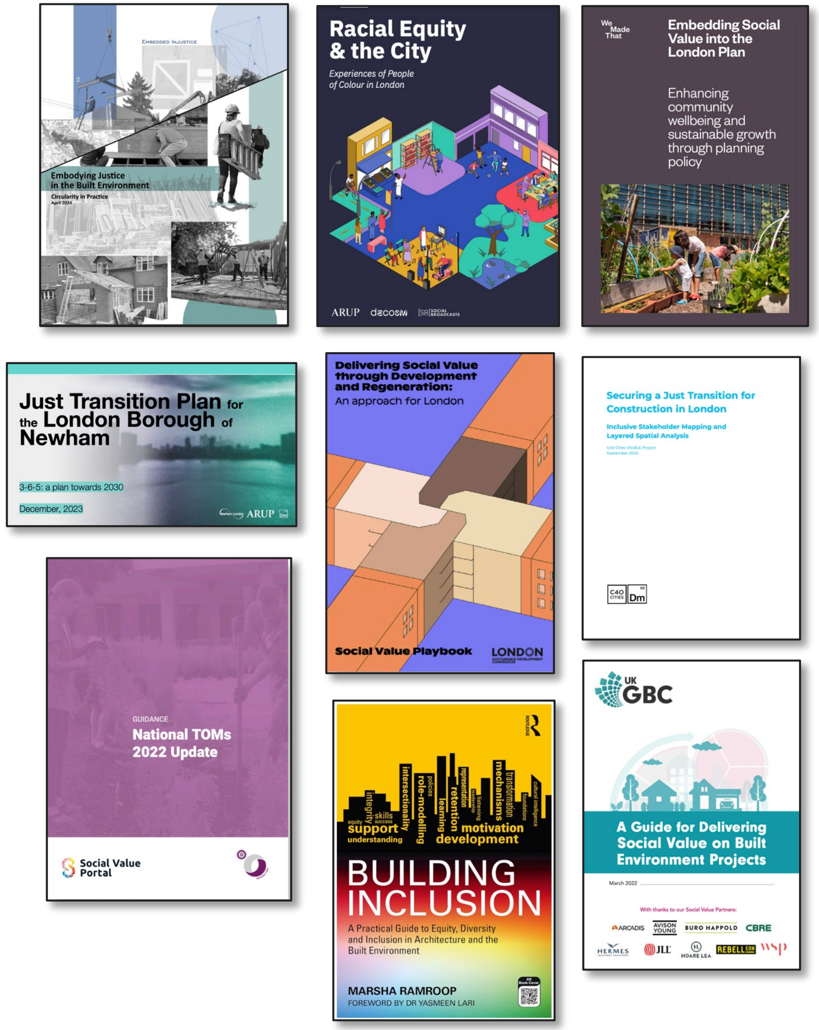
Review of document relevant to EDI

A review of relevant documents was carried out. An over-arching challenge was identified that the effects of climate change are not distributed evenly: climate change compounds poverty and structural disadvantage.

While the report ‘Securing a Just Transition for Construction in London’ has not been released publicly it serves as a useful background to some of the systemic challenges with achieving high performance and social value within the current built environment and planning system. For example, ‘Newham’s Just Transition Plan’ highlighted that lower-income and other disadvantaged groups contribute least to climate change; but are likely to be the most impacted by it. The ‘Racial Equity and the City’ corroborated this finding. Usefully, the Newham report identified interdisciplinary co-benefits in support of climate related policy.

The ‘Embodying Justice in the Built Environment’ guide is focussed on the Circular Economy but the wider framework for defining justice could be a useful reference point for wider issues related to the impacts and co-benefits of climate policy.

One mechanism to achieve greater equality and justice is through Social Value mechanisms and measurements. Nationally, the TOMS system allows the measurement of social value and includes the impact of carbon reductions. The ‘Embedding Social Value into the London Plan’ report highlights that Policy S1 2 (Minimising greenhouse gas emissions) and Policy SI 3 (Energy infrastructure are relevant to embedding social value into the London Plan.



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