CITY OF LONDON

Hilson Moran

Planning Advice Note

Whole Lifecycle Carbon Optioneering

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Author	M Schembri
Checker	V Ugarow
Approver	A Moore

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Contents

Executive Summary

The City of London Corporation (CoL) has committed to Net Zero Carbon (NZC) for both embodied and operational carbon emissions by 2040. The Climate Action Strategy sets up a fully-funded action plan to deliver and achieve annual targets against a decarbonisation pathway.

Hilson Moran was appointed to develop a Planning Advice Note on Whole Lifecycle Carbon emission options. The purpose of this study is to advise on:

- The merits of a Whole Lifecycle Carbon (WLC) emission options appraisal as part of the pre-application process to ensure that development proposals maximise the reduction of carbon emissions;
- The scope and methodology of comparative Whole Lifecycle carbon emission options for development proposals;
- To ensure a like for like comparison and consistency of projects submitted for planning.

The majority of planning applications, 76%, fall under the City's definition of Major development. The remaining applications are varied full implications covering change of use and extensions. This means that major development will be responsible for a large proportion of new emissions in the City of London.

As a result The City of London Corporation expects that all major development undertake a Whole Lifecycle Carbon Assessment (WLCA). Full applications should aim to follow this guidance wherever possible. This is also support by GLA WLC guidance for major applications to undertake Whole Lifecycle Carbon Assessments (WLCA).

Recent planning applications have reported development optioneering and (WLCA in different ways. The diversity of approaches between pre-application material and planning application is making it very difficult for CoL to establish the level of consistency and what to look out for in results/data being proposed alongside the Climate Action Strategy targets.

This Planning Advice Note establishes the variety of ways by which carbon is estimated in the current planning process, and how they can vary between them. A methodology is proposed that requires options for different degrees of major interventions in the commercial built environment to be considered and presented.

The methodology establishes the minimum data required at the pre-planning and planning stages, and the level of transparency to be disclosed to CoL. The proposal aligns with the GLA's new guidance on Whole Lifecycle Carbon Assessment reporting (March 2022).

A dashboard has been created to equip CoL with easy, visual and quantified information that is clear and benchmarkable, enabling an informed discussion between them and the Applicant party.

Future updates of the methodology may be required as the market matures, and industry standards and assessment tools become more robust and reliable.

The Climate Emergency

'Human activities which result in the release of greenhouse gases, including carbon dioxide ($C0_2$), are estimated to have caused 1°C of global heating above pre-industrial levels. As a result, there have already been sea level rises, increased likelihoods of extreme weather events and melting of sea ice and permafrost. This has direct and devastating impacts on society, including land loss; increased severity and occurrence of wildfires; drought; and difficulties producing food.

Alongside this, there have been unprecedented declines in global biodiversity, with the average abundance of native species in most major land-based habitats falling by at least 20%, mostly since 1900. The quality of habitats which support this biodiversity has also declined, with a 30% reduction in global terrestrial habitat integrity caused by habitat loss, fragmentation and deterioration.' (CIEEM, 2019)

Global emission need to decrease by 43% by the end of this decade to stay under the 1.5 degree C, the current recommended threshold to avoid unprecedented heatwaves, terrifying storms, and widespread water shortages. (IPCC 2022)

The built environment contributes 25% of UK greenhouse gas emissions (CO_2e) that it has direct control over. If influenced emissions, surface transport (vehicle emissions) are included it contributes around 42% of the UK's total greenhouse gas emissions, CO_2e. (UKGBC ,2021)

The property and construction industry has a moral duty to act and reduce the environmental impacts of this sector as well as mitigate the effects of Climate Change.

Climate Action Strategy 2020-2027

The City of London is major global commerce centre with huge influence and opportunity to lead the Net Zero Carbon and Climate Change mitigation and adaptation agenda.

The City of London Corporation has adopted a radical Climate Action Strategy which breaks new ground and sets out how the organisation will achieve net zero, build climate resilience and champion sustainable growth, both in the UK and globally, over the next two decades. By adopting the strategy, the City Corporation has committed to:

- ***Achieve net zero carbon emissions from their own operations by 2027***
- ***Achieve net zero carbon emissions across their investments and supply chain by 2040***
- ***Support the achievement of net zero for the Square Mile by 2040***
- ***Invest £68m over the next six years to support these goals of which £15m is dedicated to preparing the Square Mile for extreme weather events***

The City of London Corporation (CoL) has set out a fully funded action plan for 2020 -2027 and set annual targets. Data on progress will be shared via a programme dashboard, expected to go live for the public mid-2022. At the end of each year CoL will publish a report of progress against targets for that year. Stakeholders will be invited to participate in a survey to help us understand how well they are reaching and engaging with them.

Climate Action Strategy 2020-2027

Headlines

THROUGH THIS STRATEGY THE CITY CORPORATION COMMITS TO ACHIEVING:

- Net zero by 2027 in the City Corporation's operations
- Net zero by 2040 across the City Corporation's full value chain
- Net zero by 2040 in the Square Mile
- Climate resilience in our buildings, public spaces and infrastructure

ACROSS THE SQUARE MILE WE WILL:

- Work with all stakeholder groups to accelerate the transition to net zero
- Support SMEs to reach net zero
- Invest in making the Square Mile more resilient to extreme weather and flooding

AT THE CITY CORPORATION WE WILL DO THIS THROUGH MAJOR INVESTMENT IN:

- Improving energy efficiency at our investment and corporate properties
- Aligning our investment portfolio with the Paris Agreement
- Enhancing carbon removal in our open spaces
- Protecting our shared natural resources
- Driving net zero through our supply chain
- Integrating climate considerations into all our decisions

Vision, aims & goals

Our Vision

The City of London is **Responsible, Sustainable** and **Competitive**

Our aims

To **support** the **achievement** of **net zero**

To **build climate resilience**

To champion **sustainable growth**

Our goals

For the City of London Corporation

City of London Corporation **scope 1 and 2 emissions are net zero by 2027** and **scope 3 emissions are net zero by 2040.**

The City of London Corporation and its assets **are resilient to climate change.**

The City of London Corporation supports UK and overseas organisations to **become climate responsible.**

For the Square Mile's fabric and function

The Square Mile's scope 1, 2 and 3 emissions (BASIC+ definition) **are net zero by 2040.**

The Square Mile's buildings, public spaces and infrastructure **are resilient to climate change.**

For society

People in the Square Mile and beyond **benefit from a clean, green and safe environment** and **job creation.**

Actions

Actions to support the achievement of net zero

THE CITY OF LONDON CORPORATION

Transform the energy efficiency of our operational buildings through the adoption of best available technologies

Maximise the use of renewable energy sources across our operational buildings

Introduce new land management practices across our open spaces aiming to maximise their ability to remove carbon, and optimise their biodiversity and resilience value

Align our financial investment portfolio with the goals of the Paris Agreement on climate change

Embed circular economy principles into our capital projects and reduce carbon intensity by using life cycle carbon and cost assessment techniques and design specifications

Accelerate the move to net zero carbon and energy efficient tenanted buildings, working closely with tenants to achieve shared goals

Strengthen our requirements and supplier engagement to drive performance and innovation in delivering sustainable products and solutions

Upskill our workforce on net zero

THE SQUARE MILE

Work with other organisations to develop a Climate Action Fund to invest in effective zero carbon technologies and accelerate decarbonisation

Develop a Square Mile renewable energy strategy

Use our planning role to influence others to embed carbon analysis and circular economy principles in capital projects

Advocate the importance of green spaces and urban greening as natural carbon sinks, and their contribution to biodiversity and overall wellbeing

Support organisations in the Square Mile to build circular, low-carbon and resilient supply chains

Provide tailored support to SMEs on their decarbonisation journeys

Increase engagement and communications about sustainability with residents, businesses, visitors and other stakeholders

Actions to build climate resilience

THE CITY OF LONDON CORPORATION

Build on our existing work to develop an early warning system, and clear resilience strategies for pests and diseases across our ports and markets, driving down the climate related food security risks

Embed resilience measures into our upgrade plans for our owned and operated buildings

Upskill our workforce on climate resilience

Embed a climate resilience lens into all our decision-making

THE SQUARE MILE

Make the Square Mile public realm more climate change ready through adding in more green spaces, urban greening, flood resistant road surfaces, adaptable planting regimes and heat resistant materials

Reduce the risk of flooding through developing sustainable rain and surface water management policies, resulting in a connected system of water recycling, sustainable urban draining and rainwater management measures

Strengthen our planning guidance on climate resilience measures for new developments

Work with our partners to create a more climate resilient and diversified energy network across the Square Mile

Develop a strong, data-led approach to deepen our understanding of climate related risks and mitigations across the Square Mile

Ensure that we continue to protect the residents, critical assets, infrastructure and heritage of the Square Mile

Actions to champion sustainable growth

THE CITY OF LONDON CORPORATION

Mobilise capital into sustainable finance

Secure the UK's place as a leader for investment in sustainable finance products

Help faster development and adoption of sustainable finance products and services

Share best practice on standards, tools, platforms and expertise to facilitate green and sustainable investment and growth

Encourage global movement towards disclosure and production of credible transition plans as the norm

Foster an ambition to achieve net zero emissions by 2050 or sooner for UK-based financial and professional services firms

Join other investors working through development and implementation of net zero transition action plans

Support financial institutions committing to net zero in the 2040s at the latest, covering all emissions, including scope 3 and where data allows reliable measurement

Support charities and SMEs to consider, prepare for and lead the response to climate change

Promote responsible procurement and investment practices.

Enhance the UK/London's capacity to finance sustainable investment opportunities globally, including emerging markets

Work with the financial services sector and UK Government to promote and scale sustainable finance products and services that countries and corporates need to help them transition to net zero

Influence and support the delivery of technical solutions to increase comparability of data and ease of reporting

Share learning and best practice about the challenges and opportunities of our net zero journey

Address existing inequalities and ensure no one is left behind

Prepare people for skills needed in a net zero economy

Facilitate collaborative action on air pollution in London

Reduce pollution and increase the resilience of the Square Mile

Reduce air pollution through implementing our ambitious air quality and transport strategies

Embrace circular economy principles across our strategies and work

Work with our creative and educational sector partners to deliver sustainable initiatives

Enhance greening and biodiversity across our public realm and open spaces

1. Carbon in Planning Policy

This section outlines the ways by which carbon emissions quantification and reduction are required to be reported for planning applications in the City of London in the recent past.

In short, planning applications are required to report both:

- **Embodied carbon emissions, i.e. carbon emissions resulting from materials, construction and the maintenance of a building lifecycle, and**
- **Operational carbon emissions, from energy consumption throughout the lifecycle of the building.**

However, the scope of reporting in applications is determined by several factors relating the type of application, the size of the building and the scope of the intervention proposed.

There are a number of policy and guidance documents that determine reporting requirements:

1. **Building Regulations**: At a national level, *'Approved Document L2A: Conservation of fuel and power in new buildings other than dwellings'* ('Part L2A') regulates some elements of design and specification of buildings that affect energy consumption, including insulation, solar control, the efficiency of building services and renewable energy generation. Part L sets minimum requirements and targets for carbon emissions and defines the carbon intensity of fuel and power. An update being implemented from June 2022, which tightens target requirements and introduces a minimum Primary Energy metric to place more emphasis on reducing energy demand with less reliance on renewable energy generation. 'Unregulated emissions' refer to the elements of energy use that sit outside Part L and includes carbon emissions from plug-in equipment and cooking.

   Embodied carbon emissions are not regulated at a national level. A bill was proposed in Parliament in February 2022 to change this based on a proposed *Part Z*, developed by industry experts.

2. **City of London policy:** City of London's Local Plan (2015) aligns with the London Plan (see point 3) at the time of its adoption. The London Plan has subsequently been updated (2021). The adopted Local Plan focusses on reducing operational 'regulated' carbon emissions resulting from energy used in operation, low and zero carbon technologies for on-site and local energy generation (including existing and planned District Energy Networks), local and national carbon offsetting mechanisms. Carbon offsets are required for a 30-year period of operation but there is no specific mention of unregulated carbon and embodied carbon (WLCA) in this policy document. However policy CS 15 does state that development should 'avoid demolition through reuse of existing building or their main structures...'

   The Local Plan is being reviewed and a replacement Plan, City Plan 2040, is in preparation. This draft Plan refers to the London Plan's carbon emissions requirements towards achieving whole lifecycle net zero carbon emissions. Further updating of the draft Plan will be undertaken during 2022 to ensure that it aligns with the London Plan, recent Mayoral guidance and best practice in the City development market and puts policies in place to deliver the City Corporation's Climate Action Strategy targets.

Figure 1: The proposed amendment of the Building Regulations, Part Z, to regulate embodied carbon, was launched in March 2022.

Figure 2: The draft City Plan 2036 is currently being revised to align with policy and market changes

1. Carbon in Planning Policy

3. **Greater London Authority (GLA) policy:** The Mayor of London's *London Plan 2021* requires proposals referable to the mayor to be net zero carbon.

The policy requires calculation of whole lifecycle carbon emissions through a nationally recognised whole lifecycle carbon assessment, and to demonstrate actions taken to reduce lifecycle carbon emissions.

Reporting requirements and the scope of the assessment are defined in the London Plan Guidance '*Whole Lifecycle Carbon Assessments (WLCA)*' (adopted 25th March 2022). WLCA reporting is required at pre-application, application and as built stages of schemes that are referable to the Mayor, but is also encouraged for all major developments. All studies account for a 60-year lifecycle.

The Guidance document is recognised as industry-leading. It has a detailed list of information to be included for materials across a number of Lifecycle Assessment (LCA) modules (table 1) as well as including estimations for demolition emissions and emissions from refrigerants.

The Mayor of London's London Plan 2021 also sets out a clear energy hierarchy for net zero *operational* carbon emissions. It defines the process required for reducing these emissions, clarifying local priorities for heating and cooling strategies, setting minimum target savings and local carbon offsetting mechanisms. The carbon savings targets are based on regulated operational carbon and a 30-year lifecycle. Reporting unregulated carbon is encouraged through the design process and building infrastructure provision. Other policy requirements are in place for on-site energy generation and energy storage.

The Mayor of London's draft '*Energy Assessment Guidance (April 2020)*' clearly outlines reporting requirements for planning applications to demonstrate that the proposed climate change mitigation measures comply with London Plan energy policies, including the energy hierarchy.

The '*Be Seen Energy Monitoring Guidance*', (September 2021) explains the process that needs to be followed and reporting requirements to demonstrate compliance with the London Plan policy addressing the monitoring, verifying and reporting of energy performance after a building's practical completion ('Be Seen' level of the Energy Hierarchy).

Figure 3: The new London Plan Guidance 'Whole Lifecycle Carbon Assessments' March 2022, sets out a framework of priorities and carbon information required

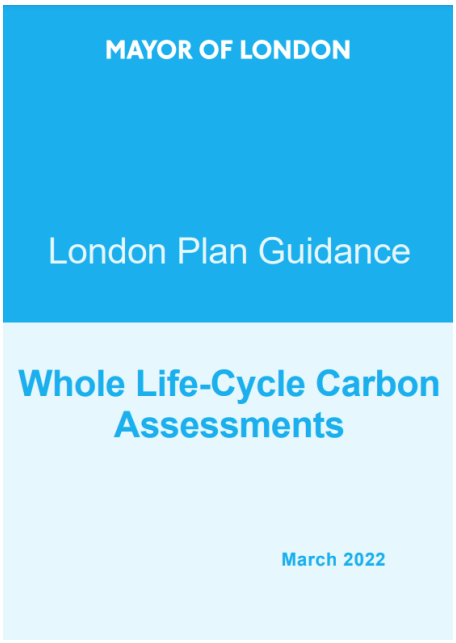


Figure 4: Regulated target operational carbon emissions are reduced further by local planning policy minimum requirements

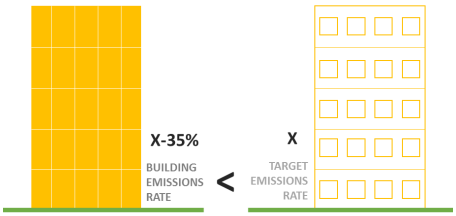
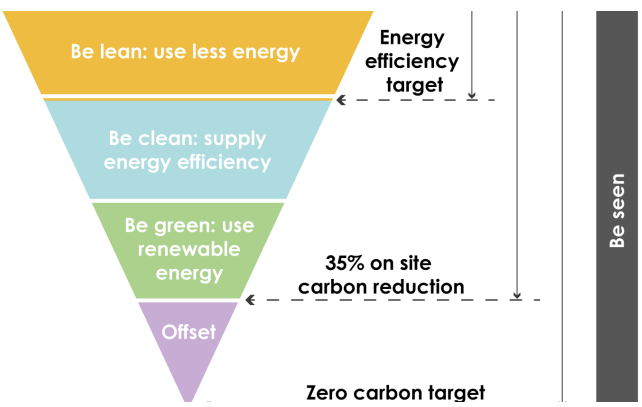


Figure 5: The Energy Hierarchy defines policy priorities and interim targets to Net Zero Carbon in operation



The following table outlines the typical *current* carbon reporting *scopes* driven by national and local policy requirements in the City of London.

As stated earlier ('City of London policy'), the current planning policy for major developments in City of London do not require a WLCA. However, it does require the achievement of a minimum BREEAM 'Excellent' certification rating, with a provision to ideally achieve 'Outstanding'. BREEAM does include criteria relating to Lifecycle Assessment, Environmental Product Declarations and Circular Economy. These aspects of design and procurement are therefore typically addressed in proposals targeting a minimum 'Excellent' rating.

The BREEAM scope for Lifecycle Assessment extends between Stages A and C, but the scope of *building elements* to be included is optional and limited compared to the GLA approach (see table 4, Page 18). BREEAM does not currently require an as built review of embodied carbon performance.

The total lifecycle carbon of major, non-referable planning applications with reduced scopes, e.g. limited to addressing BREEAM requirements for *fewer building elements*, are *not comparable* to GLA benchmarks. Note that Modules B6, B7 and D (EN 15978: 2011 Sustainability of construction works. Assessment of environmental performance of building) are excluded from the GLA WLCA benchmarks.

	Scope (Stages based on EN 15978)	Sub-groups	National – Building Regulations	GLA referable developments in CoL	Major developments in CoL*	Minor developments in CoL
	Product and Construction Process (Practical Completion) Stage					
Whole life cycle carbon	**A1-A3 Construction product supply, transport and manufacturing**			✓	✓	
	A4-A5 Transport to site and Construction			✓	✓	
	Use Stage					
	B1-B5 Operational emissions relating to maintenance, repair, replacement and refurbishment			✓	✓	
	B6 Operational energy use	Regulated	✓ 1 year	✓ 30 years for carbon offsetting 60 years for reporting	✓ 30 years for carbon offsetting 60 years for reporting	Depends on scope of works
		Unregulated		✓	✓	
	B7 Operational Water Use			✓	✓	
	End of Life Cycle Stage					
	C1-C4 End of life stage including deconstruction, demolition, transport, waste processing and disposal			✓	✓	
	Beyond the Project Lifecycle					
	D Stages beyond the life cycle, including re-use, recovery, recycling			✓		

Table 1: Scope of whole lifecycle carbon reporting in the City of London. Major developments' scope of works are currently dictated by BREEAM requirements

2. Related reporting requirements

There are a few other carbon-related planning reports that should be taken into consideration. They include Greenhouse Gas impact assessments, the Circular Economy Statement, operational energy and water assessments. Where relevant, these should be referenced or summarised in WLCA reporting, in particular to highlight discrepancies and overlaps in design considerations and decisions.

GHG reporting in Environmental Impact Assessments

A greenhouse gas (GHG) is a gas that absorbs and emits radiant energy within the thermal infrared range, essentially, they trap heat causing the greenhouse effect. Very large developments, such as infrastructure projects and high-rise buildings, usually require a GHG chapter within the Environmental Impact Assessment scoping for a planning application.

In February 2022 the Institute of Environmental Management and Assessments (IEMA) published an update to their guide 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' (2nd ed.) to align with government and industry agendas. The methodology for writing this environmental impact assessment chapter includes a full lifecycle scope, aligning with parts of the GLA WLCA method above. The approach covers similar themes but may not be as detailed as a full WLCA due to the timing of the assessment.

The differences in the approach include:

a. A range of gases is broader than carbon (Carbon Dioxide CO_2) and includes methane (CH_4), nitrous oxide (N_2O), and ozone (O_3);

b. The scope of emitters is broader, including for example emissions from operational transport and leaking F-gases (refrigerants). Note, GLA requires separate calculation of refrigerant emissions in the reporting WLCA template;

c. The proposal is compared to a current baseline;

d. Exclusions, metrics, data quality, degree of uncertainty and mitigation measures need to be clearly defined; and

e. They could be carried out a lot earlier than a detailed application WLCA (to GLA standards), for example for an Outline Planning Application, and therefore the data tends to be based on industry averages / benchmarks.

The process and content of a GHG assessment is structured by the IEMA guidance and should not preclude the need for a WLCA. In many cases, the information in relation to carbon in a GHG assessment may differ from that of a WLCA due to timing and the accuracy of information available at the time of assessment.

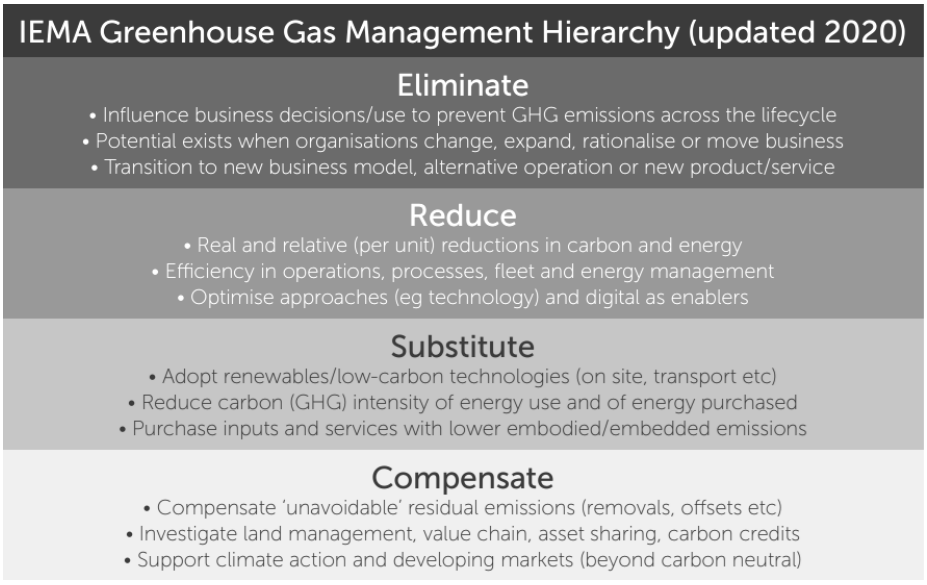


Table 1: GHG Management Hierarchy, 2020 (Source: EIMA, Assessing Greenhouse Gas Emissions and Evaluating their Significance' (2nd ed.)

GLA Pre-application optioneering

The London Plan Guidance 'Whole Lifecycle Carbon Assessments' (March 2022) explains how to calculate WLC emissions and the information to be submitted to comply with the policy, including the scope required. It also includes information on design principles and WLC benchmarks (by lifecycle stage) to aid planning applicants in designing buildings that have low operational carbon and low embodied carbon.

A WLC assessment template needs to be completed in four parts, namely, at pre-application, planning submission (outline and details) and post construction (prior to occupation).

The GLA encourages WLC assessments on major applications that are not referable to the Mayor. The City of London is supportive of this approach. In addition to the above, CoL will condition a more detailed update of the WLCA following the detailed design phase (RIBA Stage 4) when more design and procurement information is available to the Applicant team.

The GLA's pre-application section includes a hierarchy of WLC reduction principles (see Appendix 3 for full list). Principle 1 relates to *options* for 'significant retention and reuse of structures' as shown in table 2 below, requiring examples to demonstrate that:

- Options for retaining existing buildings and structures have been fully explored before proposing substantial demolition, including incorporating the fabric of existing buildings into the new development (aligned with London Plan Guidance for Circular Economy Statements , March 2022);
- Carbon emissions associated with pre-construction demolition are reported separately;
- An estimate of the percentage of the new build development which will be made up of existing façades, structures and other key components is reported
- An optional requirement to report on the effects of future grid decarbonisation on the development's *embodied* carbon emissions.
- The WLC principles are informing the proposed development of the site.

If substantial demolition is proposed, applicants will need to demonstrate that the benefits of demolition would clearly outweigh the benefits of retaining the existing building or parts of the structure.

Further considerations and options in relation to the retention of building elements and material are required by the Circular Economy principles (see following page).

Note, the GLA (and optionally BREEAM) requires the reporting of refrigerant Global Warming Potential emissions in $kgCO_2e/m^2GIA$. This is often excluded from WLCA. Measures can be installed to prevent and manage refrigerant leakage to atmosphere. We recommend that CoL condition a requirement for leak detection and containment to form part of the commissioning process.

WLC reduction principle: 1. Reuse and retrofit of existing buildings

Key benefit: Significant retention and reuse of structures is carbon efficient and reduces construction costs

Provide examples of how reduction principle has been used, or give reasons why is cannot be used.

Confirmation that options for retaining existing buildings and structures have been fully explored before considering substantial demolition	[Outline the options that have been considered - plus an explanation of opportunities and limitations, and why demolition outweighs the benefits of retaining existing buildings/structures where applicable]
Carbon emissions associated with pre-construction demolition ($kgCO_2e$)	[If estimates are not possible, please apply standard assumption of $50kgCO_2e/m^2$ of the existing building/s]
Estimate of the percentage of the new build development which will be made up of existing elements	[e.g. X% existing facades; Y% existing foundations; Z% superstructures etc.]

Table 2: Retention of existing building and structures from the GLA WLCA assessment template, March 2022

2. Related reporting requirements

Circular Economy Statement

The Mayor of London's *London Plan 2021* requires proposals referable to the Mayor to calculate a development's impacts and solutions to meet circular economy principles. It sets out the aim of retaining material at their highest value for as long as possible, to increase reuse and recycling, leaving minimal residual waste.

The reporting requirements and scope of the assessment are described in a London Plan Guidance 'Circular Economy Statements' (adopted 25th March 2022), which structures a reporting framework and principles to be considered by all referable applications. This needs to be considered alongside the WLCA.

The guidance includes requirements for a decision pathway to be outlined and for *pre-redevelopment and* pre-demolition audits, which need to be communicated at the earliest stages possible. The aim is for projects to incorporate these into a their brief at procurement stage.

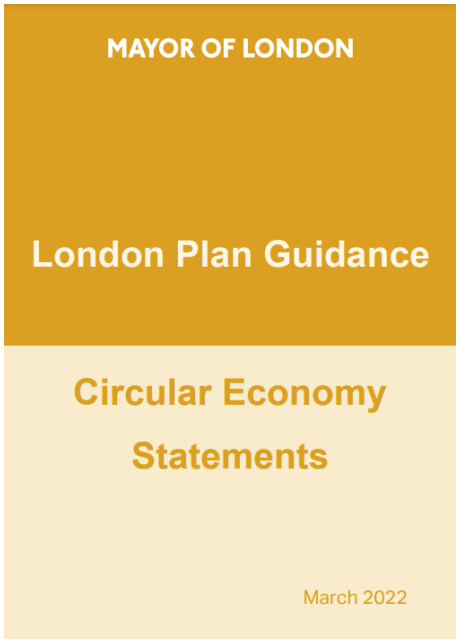
The guidance sets out six principles which are seen as critical to the design process:

1. **Building in layers**, ensuring that different parts of the building are accessible and can be maintained and replaced where necessary
2. **Designing out waste**, ensuring that waste reduction is planned in from project inception to completion, including consideration of standardised components, modular build, and reuse of secondary products and materials
3. **Designing for longevity**
4. **Designing for adaptability or flexibility**
5. **Designing for disassembly**
6. **Using systems, elements or materials that can be reused and recycled**.

The principles apply the waste hierarchy to reduce or avoid waste wherever possible and to try and ensure that materials are applied and used at their highest value.

The concept for building in layers, attributes design life to different aspects of the building in terms of skin, shell, structure/frame, building services, space plane interior, stuff and contents.

Figure 6: The new London Plan Guidance 'Circular Economy Statements' sets out the principles to be adopted to demonstrate the adoption of circularity in design and construction



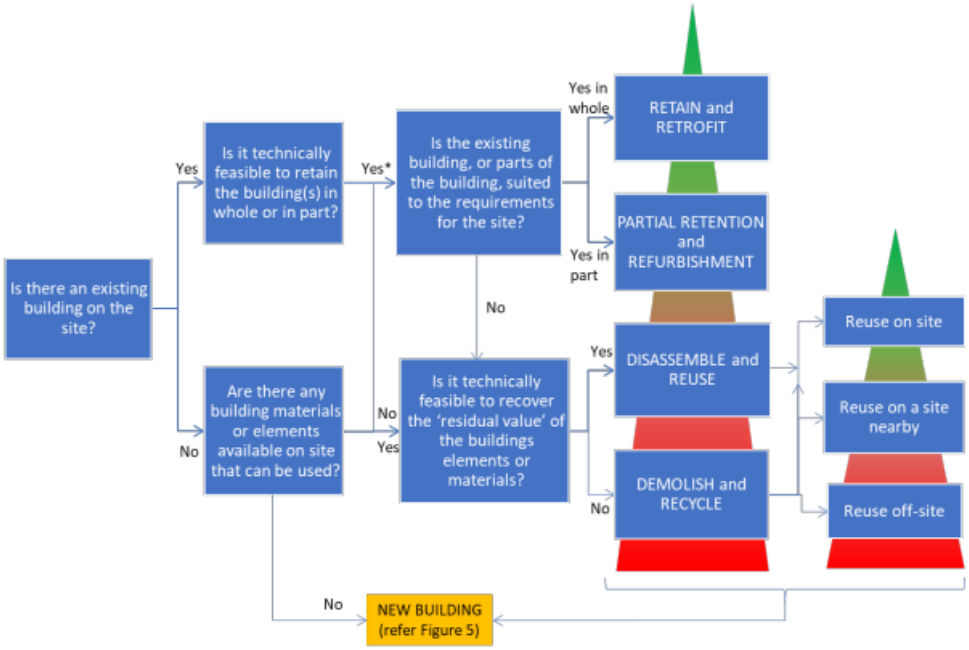


Figure 7: Decision tree for design approaches to existing structures/buildings -GLA Circular Economy Guidance March 2022

The WLCA includes B6 Operational Energy and B7 Operational Water. CoL planning policy currently requires energy and water consumption reporting elsewhere. This section clarifies the requirements and overlaps between reporting requirements. GLA benchmarks exclude stages B6 and B7.

Operational Energy modelling

NABERS UK 'Design for Performance' (DfP) and CIBSE TM54 'Evaluating operational energy use at the design stage' (2022) are increasingly being used by applicants to more accurately estimate and reduce operational energy during design, and to inform metering, commissioning and management requirements to maintain low energy consumption throughout a building's lifecycle.

BREEAM New Construction's (optional) operational energy modelling requirements are similar. NABERS UK is the most onerous approach of the three because of independent design reviews required during design, post completion and post occupancy seasonal monitoring, and tuning, metering infrastructure criteria to facilitate annual rating and annual energy rating updates. Note that the UK Government is proposing to introduce a new obligatory energy rating disclosure, that aligns with NABERS UK, starting with all offices greater than 1,000m^2, from 2022/23, indicatively. In addition, CIBSE TM54 has recently aligned with NABERS UK DfP, and BREEAM is set to do the same at the next update (estimated 2023) .

The GLA requires referable schemes to evaluate operational energy as part of the 'be seen' stage of the Energy Hierarchy. The associated guidance sets out parameters for evaluating performance at the planning, as built and in use stages of a development.

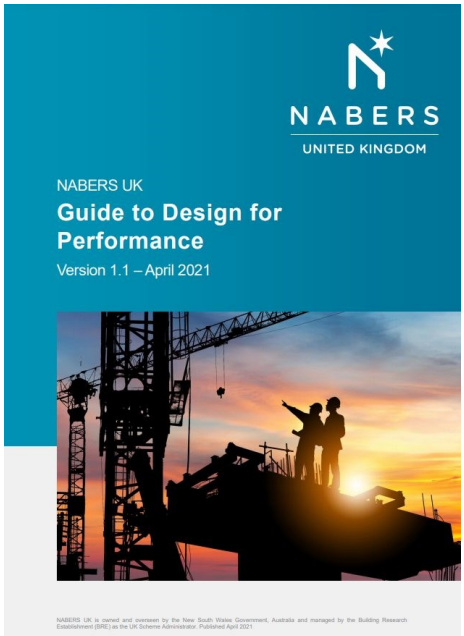
The planning stage requires an estimation of the regulated and unregulated energy. The recommendation is for the use of analysis guided by CIBSE TM54 'Evaluating operational energy use at the design stage', and NABERS UK DfP is encouraged for office buildings greater than 5,000m^2.

CIBSE TM54 and NABERS UK give a far more accurate and complete estimate of operational carbon emissions than Building Regulations Part L. This approach also aligns with the reporting requirements of Stage B6 ' Operational Energy Use' under the GLA's WLCA Guidance (March 2022).

The GLA also requires in use monitoring of actual energy use for the first 3 years of a buildings operation.

Figure 8: The new revised CIBSE Technical Manual for evaluating operational use at the design stage provides and framework for more accurate prediction of regulated and unregulated energy consumption

Figure 9: The NABERS UK Design for Performance guidance manual



Operational water use

Operational water consumption in commercial planning applications is currently reported in 2 ways:

1. Part of the WLCA (module B7), in line with the RICS method, which requires all *carbon emissions* related to water supply and wastewater treatment to be reported, using BSRIA benchmarks initially, then estimated values once known. Carbon conversion factors for water use and treatment as published by the local water supplier should be used.
2. Part of the BREEAM Assessment, which aims to reduce and benchmark the *consumption of potable water* for sanitary use (credit Wat 01) in new and refurbished buildings through the use of water efficient components and water recycling systems. City of London's current policy refers to requiring all BREEAM water credits to be achieved.

The latter consumption evaluation is therefore limited to potable water only, while the former looks at all water consumption and treatment and associated carbon emissions. BREEAM does review non potable water but in a qualitative way (credit Wat 04).

The UK Government is proposing to introduce a new obligatory water rating disclosure (in a similar way to energy, above) and to regulate all water consumption for different land uses. Currently only potable water in residential uses is regulated.

3. Whole Lifecycle Carbon Assessments

There are currently a variety of different approaches and scopes relating to Whole Life Carbon and what should be included within the review. Tables 3 and 4 include a comparison between industry drivers such as the UK Green Building Council (UKGBC), GLA, London Energy Transformation Initiative (LETI) and BREEAM scopes in terms of *EN 15978:2011 Sustainability of construction works*. Assessment of environmental performance of buildings is broken down into modules / stages and building element groups to be included.

Modules A1-A3 include the product manufacture, modules A4-A5 cover transport to site and installation processes. Combined these is known as **embodied carbon at Practical Completion (PC)**. Modules B1-B5 covers operational emissions relating to use maintenance repair, replacement and refurbishment, C1-C4 covers demolition, transport to a disposal facility, waste process and disposal. Module D covers emissions beyond the system boundary, accounting for consideration of what happens to material at the end of the building lifecycle. In

	Scope (Modules based on EN 15978)	UKGBC Full Assessment	UKGBC Minimum Reporting	GLA WLC Guide	RIBA 2030 CC Ver.2	LETI EC Primer	BREEAM NC 2018 and RFO 2014
	Product and Construction Process (Practical Completion) Stage						
Whole life cycle carbon	**A1-A3 Raw material extraction & supply, transport to manufacturing plant and manufacturing**	✓	✓	✓	✓	✓	✓
	A4-A5 Transport to project site and Construction &installation processes	✓	✓	✓	✓	✓	✓
	Use Stage						
	B1-B5 Operational emissions relating to use, maintenance, repair, replacement and refurbishment	YES	B4 only 2.5 External Wall 2.6 Windows & Doors	✓	✓		✓
	B6 Operational energy use	Optional if included operational energy (1.2)	Optional if included operational energy (1.2)	✓ (SAP / TM54)	In terms of kWh/m²/yr only		✓ (not RFO)
	B7 Operational water Use	✓		✓			✓
	End of Life Stage						
	C1-C4 End of life stage including deconstruction/demolition, transport, waste processing and disposal	✓		✓	✓		✓
	Beyond the Project Lifecycle						
	D Benefits and loads beyond the system boundary, including re-use, recovery, recycling potential	Optional / Future development		✓			

Table 3: *Comparison of lifecycle stages*

a WLCA, operational energy use, B6 and operational water use, B7, are also included.

All the different industry drivers listed above vary in scope as shown below. It is worth noting the source documents may change and the landscape is evolving and continually improving at pace. The GLA methodology is currently the most comprehensive of all the industry methods.

For the GLA method, a minimum of 95 per cent of the capital cost allocated to each building element category should be included for at each stage of the WLCA. This should be approved by the project Quantity Surveyor. In addition, for building services the GLA guide includes a list from which the applicant is required to indicate in-scope items.

Building part / Element group	UKGBC Full Assessment	UKGBC Minimum Reporting	GLA WLC Guide	RIBA 2030 CC Ver.2	LETI EC Primer	BREEAM NC 2018 and RFO 2014***
Demolition prior to construction			YES Reported separately. Benchmarks do not include these building elements.			
Facilitating works	✓					
Substructure	✓	✓	✓	✓	✓	NC credit option RFO if in scope
Superstructure (Frame, upper floors, roof, stairs, ramps)	✓	✓	✓	✓	✓	NC mandatory RFO if in scope (excludes ramps)
Superstructure (External walls, windows, doors)	✓	✓	✓	✓	✓	NC mandatory RFO if in scope
Superstructure (Internal walls, partitions, doors)	✓		✓	✓	✓	NC mandatory education only RFO if in scope
Finishes	✓		✓	✓	✓	RFO if in scope
Fittings, furnishings & equipment (FF&E)	✓		✓	✓		RFO if in scope to CN7 limited furniture / shop fitting
Building services/ MEP	✓		✓	✓	✓	NC credit option RFO if in scope
Prefabricated Buildings and Building Units	✓		✓	✓	✓	
Work to Existing Building	✓		✓	✓		
External Works	✓		✓			NC credit option RFO if in scope: hard landscaping and boundary protection only

Table 4: Comparison of scopes vs building part element /group (full version including notes in Appendix 2)

4. Carbon optioneering

It has become clear to the industry that the construction of new buildings using current construction techniques and materials result in high carbon emissions over the buildings lifecycle. For this reason the assessment and benchmarking of embodied carbon to Practical Completion (Modules A1-3 & A4-A5) can be used as an effective way to evaluate and then mitigating emissions from materials as an initial starting point.

It is also acknowledged that the majority of the existing building stock has high operational emissions, primarily due to inferior energy efficiency standards and older technology at the time of their construction, compared to current ones (insulation, air tightness, solar control glass, etc.).

Another major contributor to existing operational emissions is the common use of natural gas combustion equipment for space heating and hot water. In recent years, the carbon intensity of natural gas has remained relatively stable and was once the lower carbon fuel of choice. However, investments in renewable power generation have seen the carbon emissions of electricity decrease rapidly to almost half that of gas and it is continuing to decrease rapidly over time.

Therefore, a feasible carbon balance needs to be explored in any intervention of the built environment. This planning advice note recommends a hierarchy of decision making that prioritises carbon and the City's Climate Action Strategy, ensuring that all primary and secondary considerations form part of the design process so informed decisions can be made. Considerations and constraints frequently encountered in the decision process are considered in this section.

The graph below demonstrates, in general terms, the relationship between carbon emitted at Practical Completion of a building intervention and operational carbon saved. The decarbonisation of the electrical grid and minor maintenance and replacement interventions during the lifecycle are also included.

The data in figure 11 is indicative and improved embodied and operational carbon figures, and combinations, are possible. For example, a minor refurbishment can achieve better operational savings and breakeven earlier than the examples shown below. This may also depend on the specific project undertaking review.

Due to the number of variables and considerations, it would be beneficial to standardise some of the assumptions used to estimate carbon breakeven for consistency between developments at pre-applications and planning submissions.

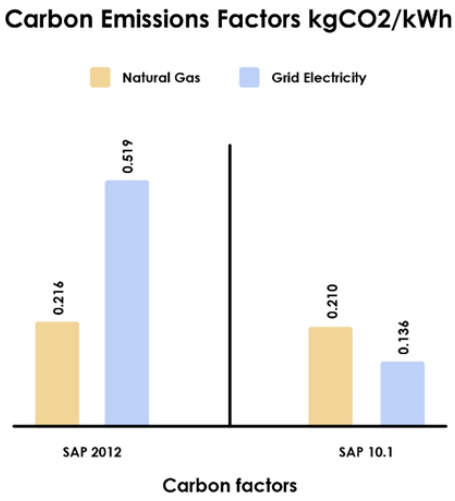


Figure 10: Investments in renewable energy have are resulting in rapid decarbonisation of grid electricity compared to natural gas

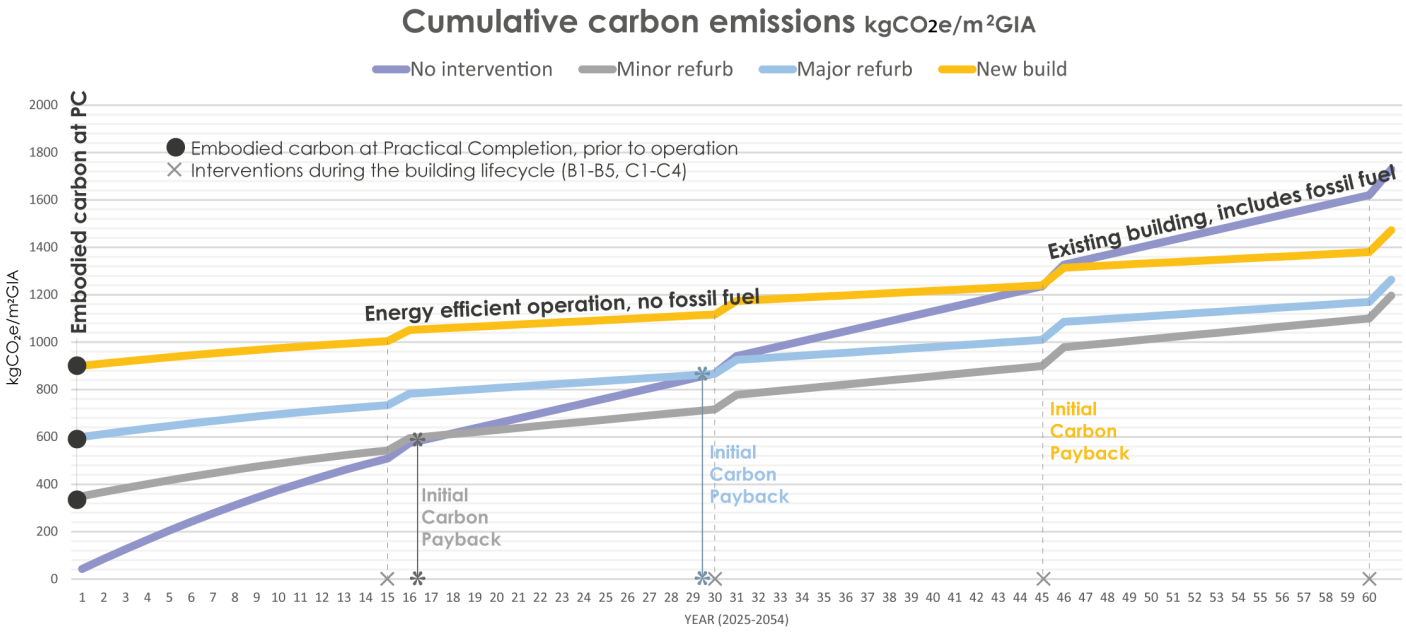


Figure 11. Examples of initial embodied carbon payback during building operational lifecycle for different options, indicative only

5. Optioneering considerations

Quality of existing building: **The quality of material in an existing building will be a critical determinant of the extent of elements that can be retained in an intervention aimed at improving an asset and bringing it up to current performance and functional market standards.**

For example a structure that was poorly constructed or maintained may require too many lifecycle interventions to maintain structural integrity for retention to be feasible. Very often, existing assets need to be extended to validate the CAPEX of an intervention, therefore a structure and sub-structure need to do more then what they were initially designed to do.

Adding piles and foundations to an existing building could mean a level of complexity that increases cost and programme to a degree that the proposition becomes unviable. It is likely that the quality and design of structures and sub-structures in the City is generally of a high quality, with few exceptions such as post war (1950s-1970s) concrete. In some cases, intrusive structural investigations are not immediately possible due to access and leasing constraints, or as-built information is not available to inform a design team about the structural capacity and quality of a building.

Poorly maintained windows can be restored to improve air permeability, but conductivity, light transmittance and solar control are difficult to achieve without additional material or complete replacement.

Façade interfaces: As well as quality, **decisions around façade retention need to take into consideration new interfaces with the internal environment**, for example, for on-floor ventilation systems and mixed-mode ventilation opportunities. The two examples are increasingly being adopted by commercial buildings to improve energy efficiency, spatial adaptability (as part of a health and wellbeing design strategy) and free up roof area for amenity uses.

Health and wellbeing: Design considerations around health and wellbeing have become more prevalent in workspace over the past few years, and increasingly so in a post-pandemic era. More consideration is being given to quantities of fresh air to dilute indoor pollutants, for example through the application of enhanced on-floor ventilation systems. **Aligning a ventilation strategy to existing façade retention can be challenging. Increased fresh air rates are also leading to increases in operational carbon.**

Other design considerations for healthier internal environments include **internal levels of daylight and thermal comfort, which may shift a decision to replacing existing glass in a refurbishment**; and the **presence of toxic materials**, such as asbestos, which could result in the removal of existing building elements.

Floor to ceiling heights: **Existing floor to ceiling heights could constrain the functional adaptation of an existing structure and building services solutions**. For example, low floor to ceiling heights may not lend themselves well to laboratory uses and optimised clear heights by transferring heating, cooling and ventilation plant to an underfloor system is often limited by existing lift lobby levels.

Land use and building type: It is important to note that **different land uses and building types have an effect on the structural requirements of a building due to loading expectations and flexibility requirements.** A few examples include uses that require wider clear spans, such as retail, which could make the structural solution and carbon impact more intense; higher loading requirements and

vibration control for uses such as science labs and gymnasiums; and lateral loading on tall buildings.

The way a building is operated and managed also has a direct effect on operational carbon emissions from energy consumption, for example longer hours of operation by food and beverage establishments.

Power infrastructure: For the reason described in point 1 above, substituting gas-fired heating systems with energy efficient electric alternatives is a very effective way of reducing operational carbon emissions. However, in some cases, **securing enough power to serve a development's decarbonisation initiatives can be challenging due to utilities infrastructure constraints**. This is another reason for which reducing energy demand should be prioritised. A mitigating action could be that a building's systems and controls are set to prioritise electricity and thermal storage before gas.

Buildings that apply electric heating may still have other *intermittent* uses of fossil fuel, such as life safety generators and façade maintenance equipment. These **systems require on-site storage of fuel**, which is frequently diesel. Alternatives that can be explored for generators are secondary utility high voltage supply fed from a primary network substation that is independent from that of the primary supply, or uninterruptible power supply equipment incorporating an appropriately sized battery installation. An alternative fuel that is considered due to low environmental impact relative to diesel is Hydrotreated Vegetable Oil, a synthetic diesel, manufactured from waste products comprising of a mix of vegetable oils and animal/fish fats.

Building complexity: **Design complexity and the number of elemental sub-components increases carbon intensity**. Therefore, simplification of structure, facades, systems, etc. has carbon benefits and is encouraged.

Procurement: **The options and availability of low carbon building products are relatively limited on the market at this point in time.** In some cases, lower carbon options are available from longer distances, increasing the emissions associated with transport (Stage A4), although these can be comparatively minor compared to the product manufacture. However, this is changing rapidly as manufacturing processes are adapting and supply chains recognise the high value of low carbon in sections of the market, for real estate in London in particular.

Invariably, a limited quantity of higher value products is less attractive during a time of economic inflation. Applicants of major developments could be asked to state what measures they have in place to increase the probability of lowering embodied and operational carbon in procurement processes.

Assumptions: In addition to fewer options of low carbon products, information **about the quantity of carbon in products is also limited.** A requirement for EPD certificates, or similar third party verified information, should be a requirement in procurement. For products with no certified embodied carbon data, assumptions and metrics should be clear and reliable market-average databases should be used, derived from a verifiable tool or software, such as One Click LCA and eTool.

In addition **supply chains can be constrained by very long lead time**, impacting construction programmes and leading to product changes with potentially higher carbon impact.

Due to market fluctuations and limitations, it is recommended that, at application stage, the WLCA is based on market averages of a committed specification, based on a Quantity Surveyor's bill of quantities. Product-specific Environmental Product Declaration (EPD) certificates should not be used in early design stages (unless the manufacturer is definitely known, sector level data e.g. EPDs that use data covering several manufacturers could be used) because they may be giving a false impression of future procurement opportunities. This is an area the industry needs to improve upon over the next few years.

Commerciality: **A critical factor in decision making around the level of intervention in a building is the commerciality of the asset**. In commercial buildings, the net lettable area and lease value are imperative metrics. The market in City of London is shifting demand for Net Zero Caron, fossil fuel free, health and wellbeing conscious and smarter workspace. As market demands change, a number of asset holders are racing to update their lettable spaces at the end of the next lease term. This is to ensure that buildings don't become stranded assets, and equity and operating value are maintained.

The standard for what is required in a building update needs to be competitive in the market it is trying to attract, and the cost of the intervention needs to be justified by a likely return on investment. In most cases this balance can only be achieved by improving quality and quantity. Quality can be improved by refurbishments, but necessary replacement and increasing floor area are carbon intensive.

Densification: As London tries to move towards a polycentric city to release infrastructural pressures and improve quality of life, its existing 'mega-centres' remain very relevant. Urban densification is accepted as a necessary part of limiting land take while serving population growth. Densification tends to occur in fast growing population centres with a combination of demographic change, economic pressure and large transport infrastructure projects. The City of London is very well served by transport infrastructure and planning policies are in place to limit pressures on utility infrastructure and the existing community.

Densification, e.g. extensions and taller building, tend to increase the carbon intensity of structural elements relative to benchmarks derived from mid-height buildings.

Striking the right balance between the environmental (and social) costs and benefits of increasing NIA on brownfield sites is a critical factor that policy makers have to deal with, in particular in a Climate Emergency. Resilience and sustainability should be central priorities for increasing existing building heights.

6. Other policy opportunities

This section addresses circumstances where other planning policy requirements may result in lower or higher carbon emissions. All factors need careful consideration on a project by project basis, and policy requirements need to be fine-tuned depending on priorities discussed at pre-application stage.

A. **Circular Economy**: The Mayor of London has introduced a requirement for referable proposed developments to develop a circular economy strategy and produce a Statement as part of an application. The approach is defined in 'Circular Economy Statement Guidance' (adopted 25th March 2022). The principles encourage building reuse, recovery of material for reuse and recycling, material efficiency, waste management and infrastructure to support material reuse (such as storage and collection systems).

The circular approach often aligns with the principles of low carbon interventions. For example, it encourages refurbishment and efficient use of materials and requires consideration of the end-of-life stage by a proposed new building (building as a material banks/ materials passport approach). This area is still evolving and can significantly reduce carbon.

There are, however, some circumstances where actions that align with circular principles can increase carbon emissions. For example, on occasion, it has been found that recovering / repurposing a material for re-use on site frequently requires the material to be reformulated into a new high value use (or upcycled), a process that requires transport to and from the site and energy to repurpose the materials. Recovering material can also lengthen construction programmes prolonging stage A5 of the lifecycle and local environmental impact.

Therefore, it is important to compare the carbon emissions of the product stages of recycled elements to their newly made equivalents with the lowest carbon opportunity established.

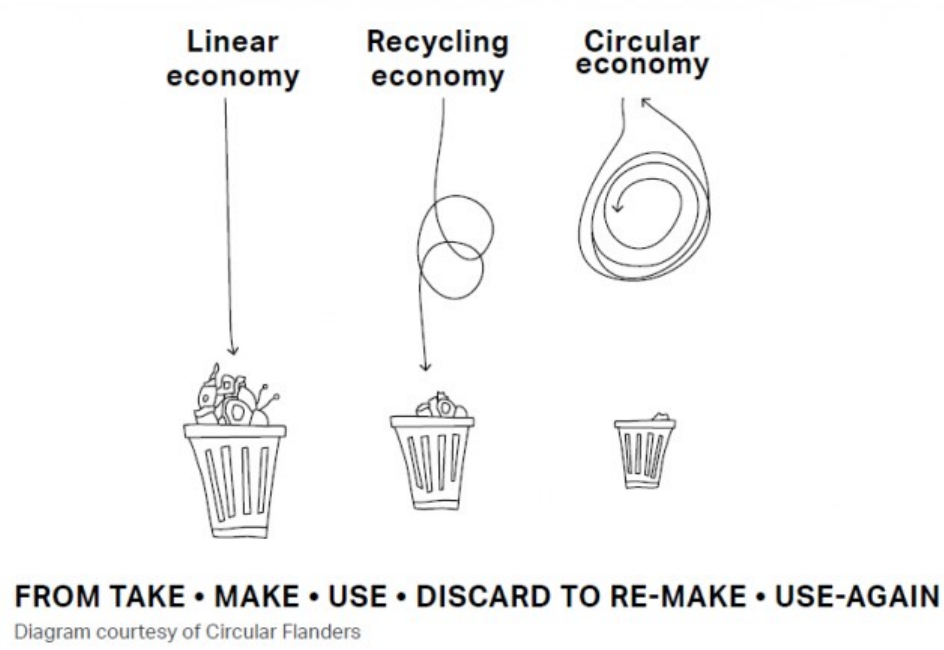


Figure 12: Circular Economy compared to Linear Economy (Source: Circular Flanders)

B. **Renewables**: Planning policy, building regulations and the BREEAM assessments have for years required the inclusion of low carbon and zero carbon technology in the energy hierarchy of proposed developments. The most viable option in the City is frequently a maximum area of roof-mounted photovoltaics (PV). Policy prioritises operational energy and carbon reduction in advance of renewable energy generation, but no consideration is given to reducing the embodied carbon of PV. An array in London can achieve carbon breakeven within a decade, but as the electrical grid decarbonises, there is an argument the array will displace less carbon and could never recover the embodied carbon emitted. For this reason, it is recommended that circularity principles are applied to their specification (e.g. reusable mounting and take-back schemes) and energy storage is incorporated to increase the proportion of renewable energy uptake at time of use.

It is important to note PV can bring other benefits like localised power, and we tend not to factor in the impact or wider power networks embodied carbon (i.e. the impact of the power plant construction upgrades, cabling etc.)

Another local policy requirement is connecting to existing District Energy Networks (DEN) or preparing for a future connection to a planned DEN. This is emphasised by both the London Plan's and draft City Plan's heat infrastructure priorities. The City of London includes the extensive Citigen network, which is planned to extend south in the near future and eastwards at a later date. However, due to the drive to remove fossil fuel combustion from buildings, for reasons relating to both carbon reduction and air quality targets, electrically heated buildings tend to have much lower carbon emissions then existing heat networks. This is because the Energy Centres that serve the DENs still run on gas systems, and while they are intended to decarbonise over time, there is very little information about their programme. In addition, the carbon intensity of planned networks is unknown at this stage. Therefore, the policy can be interpreted to contradict the Climate Action Plan and can impact lifecycle aspirations, such as high NABERS UK energy ratings.

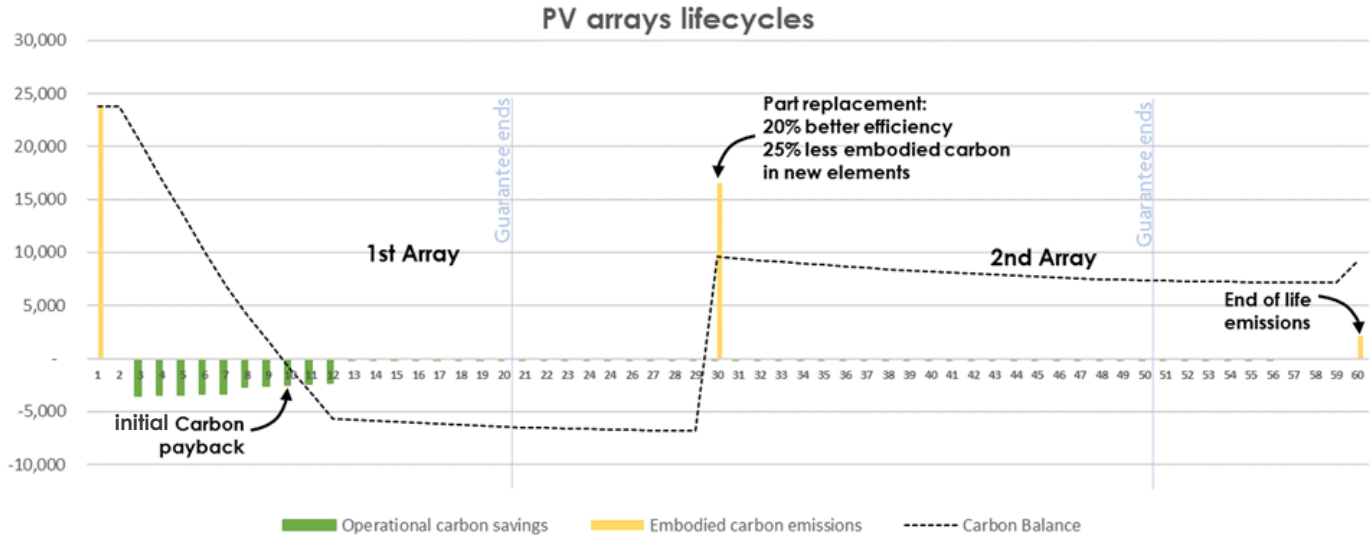


Figure 13: Lifecycle carbon of a roof-mounted array in the City of London, to be installed in 2025 (Source: Hilson Moran)

6. Other policy opportunities

Public realm and urban greening: The City of London includes a network of gardens, small open spaces and squares that are maintained by the Corporation. Nevertheless, the area of green and open space per capita is relatively small, and the discrepancy will increase as the population and densification rises.

Planning policy encourages urban greening and biodiversity net gain, for which the City has adapted the London Plan's Urban Greening Factor (UGF) calculation which is required for proposed developments to demonstrate higher value green infrastructure. However, urban greening does not often translate into open space, because private roof gardens and green walls are often used to satisfy the UGF target.

In order to increase the amount of open and green space in the City, brownfield and lower quality space may need to be upgraded. This may result in decisions to demolish lower quality infrastructure. In addition, the UGF can be difficult to achieve on existing structures due to loading limits, plant requirements etc, however all solutions to overcome this should be explored and communicated.

In addition, major developments are required to carry out ecological surveys of the site, and propose ecological protection, enhancement and maintenance measures.

7. Planning application trends

An evaluation of recent planning applications and types has been undertaken based on the City of London Development Schedule *'Development Schedules March 2021 _Updated Jan'* Issued to Hilson Moran by CoL

This undertaken establish trends and to provide the evidence base to support this guidance document.

The majority of applications, 76% (of which 40% where GLA referable), fall under the City's definition of Major development (>1,000m^2) and/or require an Environment Impact Assessment. This demonstrates that the greatest proportion of projects are likely to have the largest Carbon impact and therefore should be required to mitigate it.

Project type	Year(s)	Number of applica-tions	FULMAJ	FULEIA	FULL	GLA referable
Office	2014-March 2021	37	15	11	11	**4**
Office	March 2021-2022	9	4	5		**8**
Total		46	19	16	11	**12**
Percentage		100%	76%		24%	**41%**
Hotel / Student accommodation	2012-2021	9	5	0	4	**2**
Percentage		100%	56%		44%	**22%**
Other (law court, police + commercial)	2021	1		1		**1**
Percentage			100%			**100%**

Table 5: *Number and types of commercial development applications in City of London*

7. Planning application trends

The remaining applications are varied full implications covering change of use and extensions (24%). These are broken down as follows:

Project type	Full	Change of Use - Partial Building	Extension only	New Buildings with Change	Refurbishment with Change of Use	Refurbishment without Change of Use
Office	11	1	4	2	2	2
Percentage by type	100	9	36	18	18	18

Table 6: *Number of full planning applications, excluding major application, by type*

The following is a breakdown of office applications by size. The majority have an area above 10,000m^2 (76%). This also confirms the trend for larger scale applications with potentially bigger impacts.

Project type	Total	1,000-5,000 sqm	5,001-10,000 sqm	10,001-15,000 sqm	15,000 sqm +
Office	46	9	2	5	30
Percentage	100	20	4	11	65

Table 7: *Size of office development applications in the City of London*

Three planning applications that were submitted in the past 5 years were analysed and compared to provide a better understanding of typical WLCA approaches adopted, carbon scopes covered, local constraints and opportunities. Key observations are included in table 11.

More recent applications that are referable have followed the GLA approach for WLCA. The non-referable, major application project has also reported the WLC carbon estimations. It has loosely used the GLA approach, but has applied estimates in the assessment. This also highlights the need for consistent policy so comparable determinations and reviews verses benchmarks can be made.

Two of the applications reviewed building options, however both used very different assumptions and methods. It is clear that a transparent and consistent approach to optioneering is required.

Where a building is undergoing a minor refurbishment (or refit), it is unlikely to require a planning application and therefore would not be required to report on carbon emissions. However, developers should be aware of buildings services and tenant fit-out carbon impacts wherever possible.

*TM54 not provided, source of operational energy use unclear

** Project is using early NABERS DfP model for operational energy use rather than the CIBSE TM54 approach

*** Multiple buildings indicated but only 1 WLCA sheet submitted for main development

				Circular Economy	Whole Lifecycle Carbon Assessment			Operational Energy	
Project	Size (GIA m²)	Land use class/es	Referable/ major	Options	Lifecycle scope	Building elements scope	Value kgCO₂e/ m²GIA	Scope	Value kgCO₂e /m²GIA
14-21 Holborn Viaduct	35,948	Class E	FULMaj Referable	Demolish and rebuild Mitigate impacts	GLA (draft guidance) A1-A5, B1-B5, C1-C4, D	GLA (draft guidance) WLC spreadsheet submitted	670 (Stage 2)	Estimated	925** (stage 2)
115 – 123 Houndsditch	66,867	Class E (Sui Generis)	FULMaj Not Referable	Demolish and rebuild Mitigate impacts	GLA (draft guidance) A1-A5, B1-B5, C1-C4,	State followed GLA (draft guidance)	768 (+25% factor used) (Excludes module D)	Estimated	844* (Stage 2)
120 Fleet Street**	61,135	Class E	FULEIA Referable	Demolish and rebuild Mitigate impacts	GLA (draft guidance) A1-A5, B1-B5, C1-C4, D	GLA (draft guidance) WLC spreadsheet submitted	753	Estimated	1,321

Table 8: WLC sample from recent projects submitted for planning to the City of London

Conclusion

On the basis of the above it is reasonable and recommended to follow the GLA approach for a WLCA to provide a consistent approach across the CoL.

Advantages:

- Leads to consistent and more transparent results;
- Will create a uniform and well-understood approach across the industry;
- Will build consistency around the metrics used over time;
- Can be compared to GLA benchmarks for benchmarking;
- Future-proofs policy updates across London;
- Greater awareness of impacts could lead to better design decisions and to greater carbon savings in the City of London.

Disadvantages:

- Will require additional time / detail from the design team for evaluation and assessment.

The review of data above concludes that there is a need for emissions to be accounted for and for options to be considered in the City of London for **all major applications**. Full major applications are to consider development options and carbon impacts, applying the methodology presented later in this document.

Within this is a requirement to review building options accounting for carbon in a more consistent way, to ensure the correct choices are made. There will always be some carbon emissions. However, there is a duty to try and limit them wherever possible and for Officers to be able to make informed decisions in line with the City's Climate Action Strategy.

8 Methodology

Due to the significant impact on carbon emissions Climate Change by major interventions and new construction, proposed developments need to demonstrate reduction and mitigating of carbon emissions using a consistent approach. Option reviews and their considerations should be transparent with opportunities and constraints clearly identified.

CoL requires all major developments to consider and assess both operational and embodied carbon emissions over a whole lifecycle. Non-major developments should align with the GLA guidance and pre-application reporting requirements wherever possible.

It is envisaged that this methodology will be updated from time to time to industry learning and changes.

Pre-Applications

Pre-application discussions with the City of London should include the following:

1. Major and referable developments should demonstrate that a minor or major refurbishment have been considered in the procurement and design process.
2. Options should be well-considered, realistic and feasible.
3. Applicants are to complete options information in table A in the WLCA dashboard (section 9), including:
    - Gross internal area (GIA)
    - Increase in net internal area (NIA)
    - Embodied carbon to Practical Completion (Modules A1-A5)
    - Lifecycle embodied carbon (A1-A5, B1-B5, C1-C4)
    - Percentage of material retained (By volume, relative to existing building).
    - Operational carbon from energy consumption (Module B6)
    - Regulated operational carbon savings relative to current Part L Target Emissions Rate
    - EPC rating
    - Fuel source for operational energy (gas, electricity, other to be defined)
    - Whole Lifecycle Carbon (A1-A5, B1-B6, C1-C4) in $kgCO_2e/m^2GIA$ and tCO_2e
    - Opportunities and constraints, specifically in relation to carbon emissions and other policy areas.
3. Where substantial refurbishment or demolition is not being considered, an options appraisal is not required, but a WLCA is required.
4. The comparison of options should include like-for-like reporting, without bias to favour one option against the others. For example, the opportunity for energy and carbon improvement should be equivalent across all options, except where constraints can be clearly demonstrated. For example, the equivalent level of aspiration to reduce elemental embodied carbon should be applied equally across all options.
5. A WLC options plot / comparison graph should be produced to compare the options relative to the existing building. Consistent data should be used to produce the graph, including:

- Actual annual energy consumption of the existing building (whole building annual energy meter reading)
- An equal rate of electrical grid decarbonisation over time applied to *operational* energy (derived from the latest BEIS *Energy and Emissions Projection* (EEP)).
- An equivalent approach to the level of assumptions and certainty applied to embodied carbon estimates.
- Equivalent scope for the WLCA (lifecycle stage and building element scopes)
- Embodied carbon impact of further interventions to be included, say every 15 years of operation over the lifecycle, using lifecycle modules B1-B5, C1-C4.

Module B7 'Water Consumption' can be excluded at this stage because it does not vary significantly between options. Any variances, in particular where an opportunity or constraint occurs for one option and not another, should be clearly presented.

Non-major developments should align with the GLA guidance and pre-application reporting requirements wherever possible.

It should also be noted that the WLCA emissions fluctuate and are likely to be different in later design and construction stages. Generally this is due to more detail being known in developed design and cost plans. Emissions at Practical Completion may also change due to procurement variations and the market. As more data becomes available it will inform future projects to refine early estimations.

Preferred option

At application stage, all major and referable developments should clarify the following:

1. The preferred option, based on the optioneering exercise presented at the pre-application stage and reasons to support the decision.
2. Calculate the WLCA in alignment with GLA guidance at the time of the assessment, and complete the GLA reporting spreadsheet i.e. including all modules and building elements.
3. Clarify the scope of the WLCA (lifecycle stage and building element scopes), by completion of Tables B (section 9).
4. Clarify all assumptions, exclusions and level of certainty of the data used in the assessments.
5. Plot lifecycle stages A1-A5, B-C (excluding B6 and B7) against the GLA WLCA benchmarks (see Figure B):
    - By stage for the proposed land use
    - By building element for Stage A1-A5 (embodied carbon to Practical Completion)

5. Report the total $kgCO_{2e}/m^2$ GIA.

The WLCA should be based on the cost plan in line with GLA guidance. The GLA WLCA reporting template should be completed and submitted to CoL.

Non-major developments should align with the GLA guidance and planning application reporting requirements wherever possible.

City of London will condition an update of the WLCA pre-commencement on site and at Practical Completion based on as-built information.

9. Dashboard

Minor Major GLA Referable

Dashboard 1: Pre-application options appraisal

Completion of Dashboard 1 is required to improve reporting consistency, transparency and standardisation across application. Applicants are to complete it for pre-application discussions about proposed major and referable development proposals. Non-major applications are encouraged to complete as much of the information as feasible. Applicants who are only considering retrofit, refurbishment and/or + extension, only need to provide the WLCA preferred option (compared to GLA benchmarks).

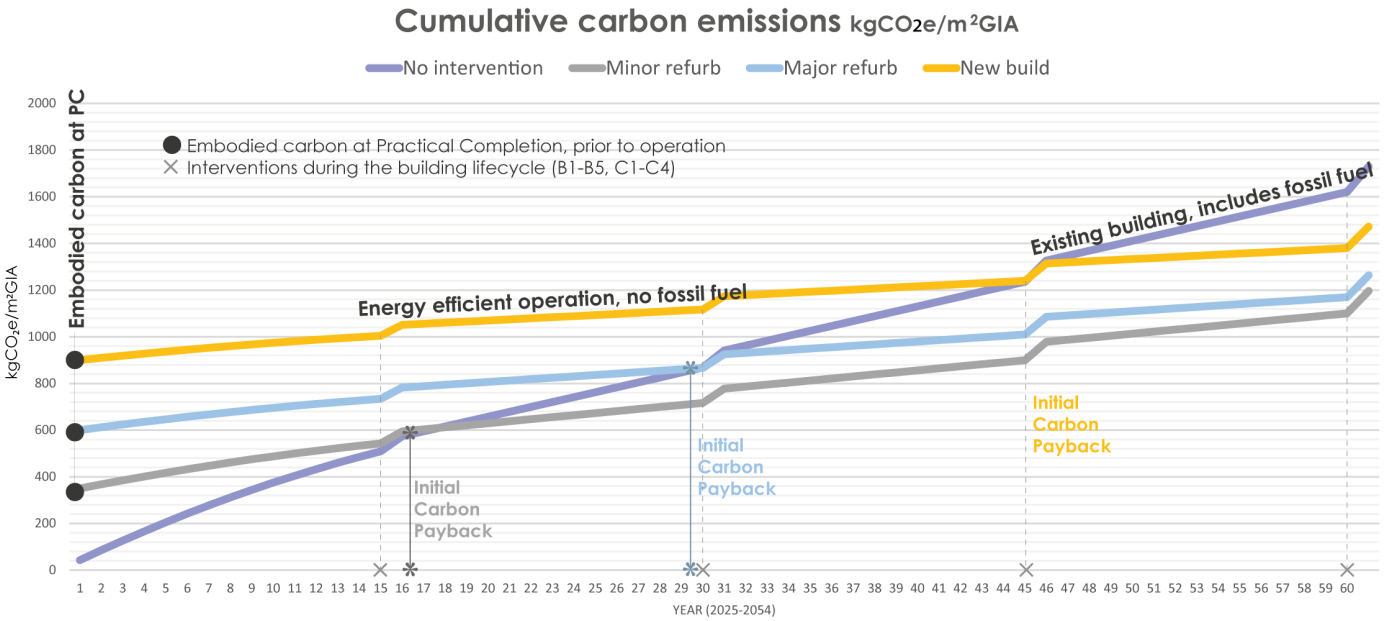


FIGURE A: Example of completed template optioneering graph over a 60yr life cycle, including whole lifecycle carbon (embodied and operational) (Source: Hilson Moran)

For the Cumulative Carbon Emissions graph above use:

- Actual annual energy consumption of the existing building (whole building annual energy meter reading)
- An equal rate of electrical grid decarbonisation over time applied to *operational* energy (derived from the latest BEIS *Energy and Emissions Projection* (EEP)).
- An equivalent approach to the level of assumptions and certainty applied to embodied carbon estimates.
- Equivalent scope for the WLCA (lifecycle stage and building element scopes)
- Embodied carbon impact of further interventions to be included, say every 15 years of operation over the lifecycle, using lifecycle modules B1-B5, C1-C4.

Dashboard 1 continued

Applicable	Minor refurbishment	Major refurbishment	Major refurbishment with extension	New build, reclaim and recycle
☐ ☐	Image	Image	Image	Image
Gross Internal area (GIA)	_____ m^2	_____ m^2	_____ m^2	_____ m^2
Increase in NIA	_____ m^2	_____ m^2	_____ m^2	_____ m^2
Embodied Carbon (A1-A5)	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA
% material retained rel. to existing	_____ %	_____ %	_____ %	_____ %
Embodied Carbon (A1-A5, B1-B5, C1-C4)	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA
Operational Energy (B6)	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA
Regulated carbon savings	_____ %	_____ %	_____ %	_____ %
EPC rating	___	___	___	___
Fuel source	☐ Gas ☐ Electricity ☐Other	☐ Gas ☐ Electricity ☐Other	☐ Gas ☐ Electricity ☐Other	☐ Gas ☐ Electricity ☐Other
Total WLCA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA	_____ $kgCO_2e/m^2$ GIA
Total WLCA	_____ tCO_2e	_____ tCO_2e	_____ tCO_2e	_____ tCO_2e
Opportunities	• A • B • C	• A • B • C	• A • B • C	• A • B • C
Constraints	• A • B • C	• A • B • C	• A • B • C	• A • B • C
Notes and assumptions	•	•	•	•

TABLE A: Optioneering outcomes to be presented to City of London at the Pre-Application stage. Where substantial refurbishment or demolition is not being considered, an options appraisal is not required, but a WLCA is required

Dashboard 2: Application WLCA Preferred option

Lifecycle stage scope

	Scope (Modules based on EN 15978)	Proposed development
	Product and construction process stage	
Whole life cycle carbon	**A1-A3**	✓
	A4-A5	✓
	Use stage	
	B1-B5	✓
	B6	✓ SAP ☐ TM54 ☐ NABERS UK ☐
	B7	✓
	End of life stage	
	C1-C4	✓
	Beyond project lifecycle	
	D	✓

Building elements scope

Building part / Element group	Proposed development
Demolition prior to construction	✓
Facilitating works	
Substructure	✓
Superstructure (Frame, upper floors, roof, stairs, ramps)	✓
Superstructure (External walls, windows, doors)	✓
Superstructure (Internal walls, partitions, doors)	✓
Finishes	✓
Fittings, furnishings & equipment (FF&E)	✓
Building services/ MEP	✓
Prefabricated Buildings and Building Units	✓
Work to Existing Building	✓
External Works	✓

TABLES B: Example of completed scoping template table

	Comments
Justification	• ... • ... • ...
Exclusions	• ... • ... • ...
Assumptions	• ... • ... • ...
Certainty	• ... • ... • ...

TABLES C: Information in relation to the preferred option providing justification for preference, and clarity on assumptions, exclusions and level of certainty of the data used in the assessment

Completion of Dashboard 2 is required to provide reporting consistency, improved transparency and standardisation across application. Applicants are to complete it and include it in the Executive Summary of the WLCA report that forms part of the Planning Application. The GLA WLCA reporting template should also be used for submitting the final results.

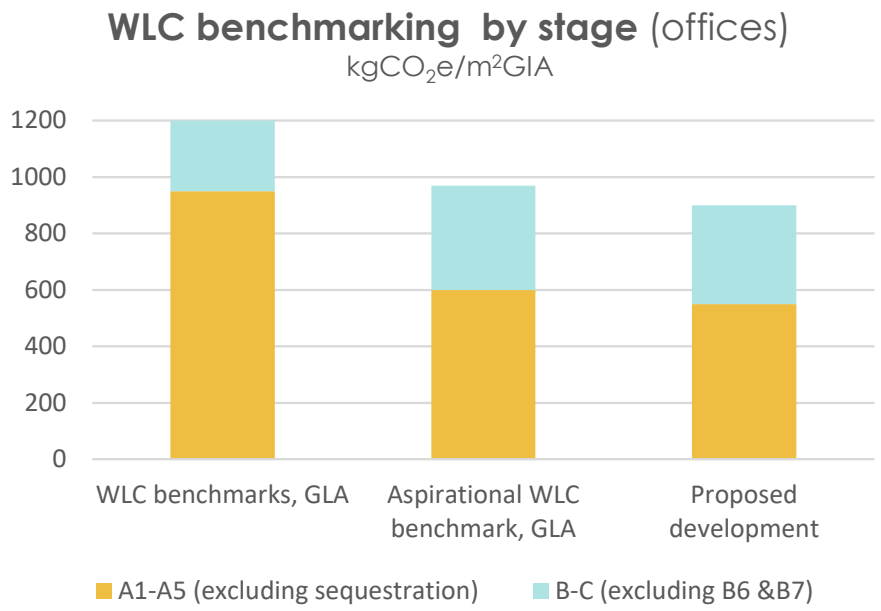
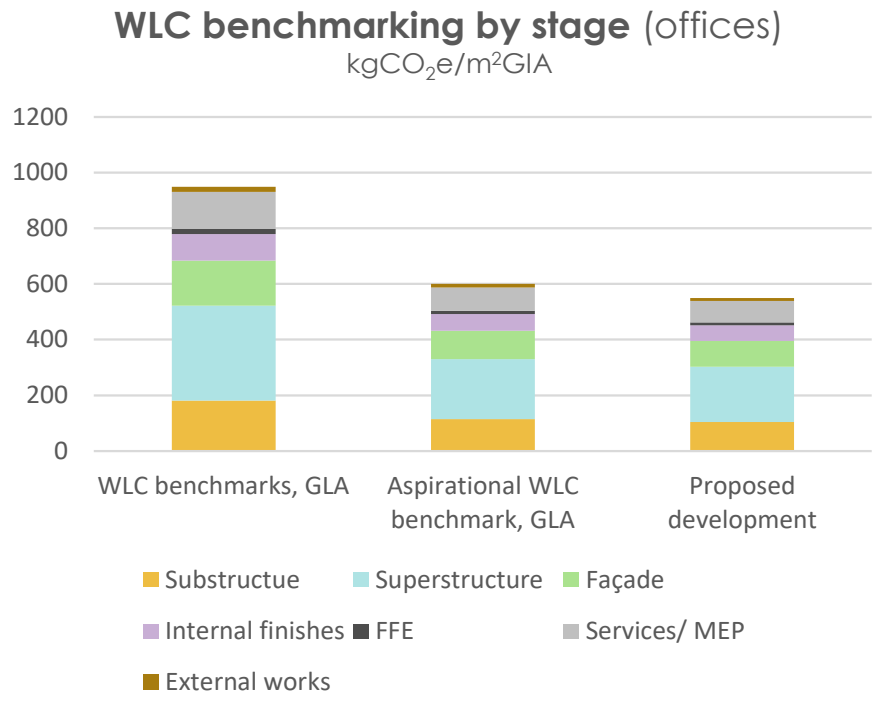


FIGURE B: Example of completed template table comparing the WLCA (Modules A1-A5, B1-B5, C1-C4) to published GLA standard and aspirational benchmarks

Applicant to identify reasons where benchmarks are exceeded for lifecycle stages and building elements, using evidence of explored improvements where possible.

Additional opportunities for improvements should also be identified in the application report.



FIGURES C: Example of completed template table comparing the Embodied Carbon (Modules A1-A5) to published GLA standard and aspirational benchmarks for elemental carbon emissions

Whole Lifecycle Carbon ___kgCO$_2$/ m^2 GIA

(modules A1-A5, B1-B7, C1-C4, D)

APPENDICES

APPENDIX 1 Related reporting requirements

Non-policy related reporting for Net Zero Carbon

Over the past three years, the UK property industry has done more to advance the environmental agenda than ever before. Developers, consultants and professional bodies have come together to declare a Climate and Biodiversity Emergency and have taken concrete action. Together we have developed much needed clarity and guidance on how to truly achieve Zero Carbon by 2030.

Property lenders, investors, asset managers and occupiers are all driving this shift by demanding a very high standard of environmental, social and governance policy as a prerequisite to any transaction. This trend is increasing rapidly across all workplace environments, both for new and existing assets.

A number of businesses have declared that they have become Net Zero Carbon in operation across portfolio assets and activity within their control. These declarations in the London market tend to align with the World Green Building Council or UK Green Building Council Definition Framework and consists of accounting for and reducing carbon emissions, investing in renewable energy, offsetting residual carbon through accepted credit frameworks and publicly disclosing their pathway.

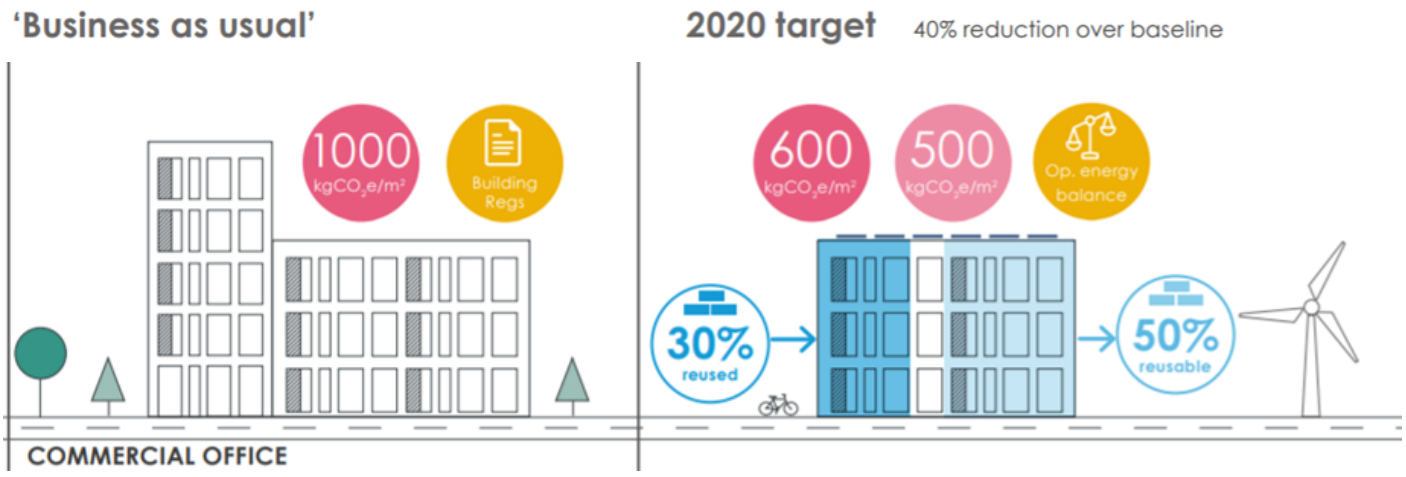
Other approaches adopted by applicants that vary in scope to planning policy requirements include:

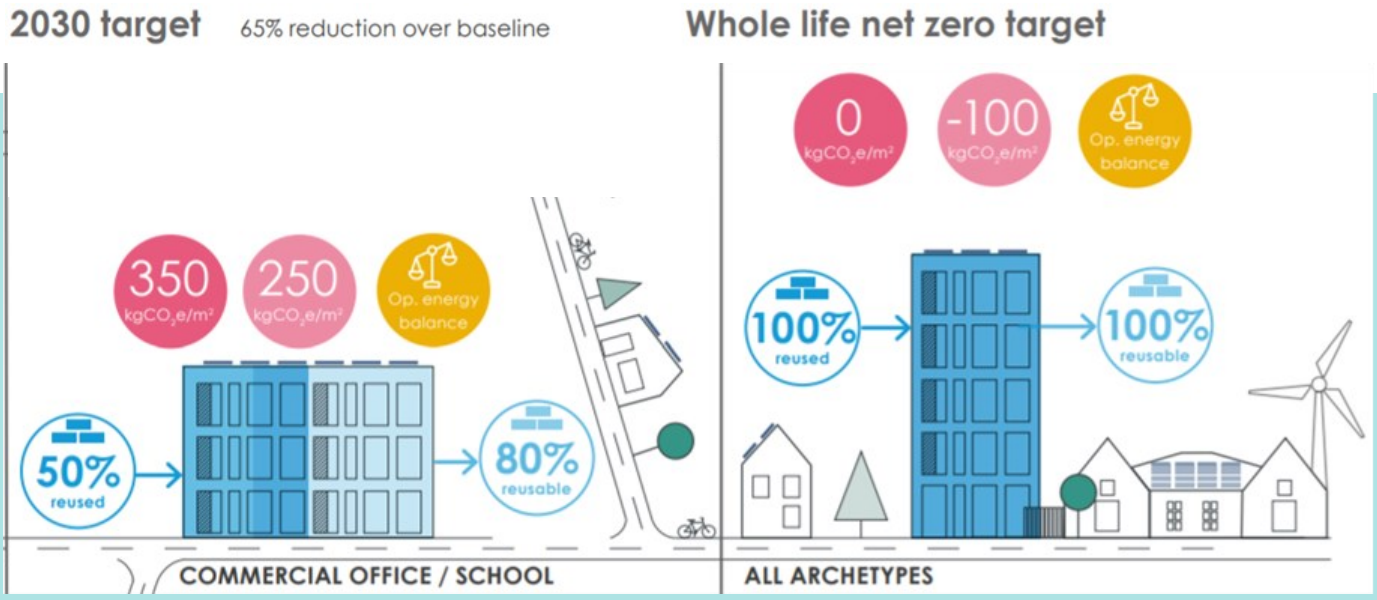
- The London Energy Transformation Initiative (LETI) targets and scope
- The UKGBC Net Zero Carbon Definition framework and benchmarks

Related reporting requirements

London Energy Transformation Initiative (LETI)

LETI has recently published a number of design guidance documents that set out a trajectory of embodied carbon and operational energy targets required to address the Climate Emergency. The WLCA scope associated with their targets is limited to stages A1-A5 to Practical Completion.





Related reporting requirements

UKGBC Net Zero Carbon Buildings, Framework Definition

The UKGBC set out guidance in consultation with the industry to define Net Zero Carbon. At time of writing this planning guidance, a building can claim to be Net Zero Carbon in construction or in operation or in both. UKGBC has published benchmarks for operational energy with a trajectory to Net Zero Carbon, but none for embodied carbon at this time.

		Interim Targets			Paris Proof Target
Scope	**Metric**	**2020 - 2025**	**2025 - 2030**	**2030 - 2035**	**2035 - 2050**
Whole building energy	kWhe/m² (NLA) / year	160	115	90	70
	kWhe/m² (GIA) / year	130	90	70	55
	DEC rating	D90	C65	B50	B40
Base building energy	kWhe/m² (NLA) / year	90	70	55	35
	kWhe/m² (GIA) / year	70	55	45	30
	NABERS UK star rating	4.5	5	5.5	6
Tenant energy	kWhe/m² (NLA) / year	70	45	35	35

NLA = net lettable area GIA = gross internal area

The framework requires third party verification of Whole Lifecycle Assessments and operational energy assessment, includes a minimum carbon reporting template and information needs to be publicly disclosed. Notably, key differences between the UKGBC Net Zero Carbon definition and the London Plan definition are shown in the following table.

Comparing Net Zero Carbon definitions

	UKGBC Net Zero Carbon	London Plan Net Zero Carbon
Whole Life Cycle carbon	Minimum reporting Stages A1-A5, B4 for superstructure ext. walls & windows / ext doors, B6 operational energy. Full Assessment Modules A-C.	Modules A-D (B6, B7 and D not included in benchmarks).
Regulated operational carbon emissions from energy use	Includes all energy use within declarant's control	Part L2A regulated carbon assessment used to determine Net Zero Carbon target TM54 required for 'be seen' (non-residential)
Unregulated operational carbon emissions from energy use		Unregulated energy to be estimated and infrastructure in place to monitor, verify and report all annual energy consumption. NABERS UK Design for Performance (see below) encouraged for commercial office buildings 5,000m^2 TM54 required for 'be seen' (non-residential)
Renewable energy generation	On-site and off-site renewables	Priority for on-site renewables, but offsite renewables are acceptable alternative to carbon offsets (conditional)
Carbon offsetting	Offset **all** residual carbon using an approved international or domestic carbon offset standard, applying standard market rates. UKGBC recommend also using higher rate from HMT Green Book at the time of offset to create a Transition Fund for further decarbonisation	Offset residual carbon relative to 100% **regulated** carbon savings **only**, determined by Part L2A target. Carbon offset is recommended as £95/ tonnes CO_2, paid in advance of and for a 30-year life cycle

APPENDIX 2 Detailed building element scope

Table 4 compares the UKGBC, GLA, LETI and BREEAM scopes for building elements in more detail than the table provided earlier in the main body of this guidance report.

** Building-related items are building-integrated technical systems and furniture, fittings and fixtures built into the fabric or included in the shell and core specification. Building-related MEP and FFE typically include the items classified under Shell and Core and Category A fit-outs.*

*** Non-building-related items are loose furniture, fittings and other technical equipment like desks, chairs, computers, refrigerators, etc. Such items are usually part of Category B fit-out. Therefore, for Shell and Core construction this is not part of the assessment scope.*

****BREEAM NC = BREEAM New Construction 2018; BREEAM RFO = BREEAM Refurbishment and Fit-out 2014*

Building part / Element group	Building Element	UKGBC Full Assessment	UKGBC Minimum Reporting	GLA WLC Guide	RIBA 2030 CC Ver.2	LETI EC Primer	BREEAM NC 2018 and RFO 2014***
Demolition prior to construction	0.1 Toxic /Hazardous /Contaminated Material Treatment			YES Reported separately. Benchmarks do not include these building			
	0.2 Major Demolition Works						
Facilitating works	0.3, 0.4, 0.5 Temporary/ Specialist ground/Enabling Works	✓					
	0.4 Specialist groundworks	✓					
Substructure	1 Substructure	✓	✓	✓	✓	✓	NC credit option, RFO if in scope
Superstructure	2.1 Frame 2.2 Upper Floors 2.3 Roof 2.4 Stairs and Ramps	✓	✓	✓	✓	✓	NC mandatory, RFO if in scope (excludes ramps)
Superstructure	2.5 External Walls 2.6 Windows and External Doors	✓	✓	✓	✓	✓	NC mandatory, RFO if in scope
Superstructure	2.7 Internal Walls and Partitions 2.8 Internal Doors	✓		✓	✓	✓	NC mandatory education only, RFO if in scope
Finishes	3.1 Wall finishes 3.2 Floor finishes 3.3 Ceiling finishes	✓		✓	✓	✓	RFO if in scope
Fittings, furnishings & equipment (FF&E)	4.1 Fittings, Furnishings & Equipment incl. Building-related* and non-building related**	✓		✓	✓		RFO if in scope to CN7 limited furniture / shop fitting
Building services/ MEP	5.1–5.14 Services incl. Building-related* and non-building related**	✓		✓	✓	✓	NC credit option, RFO if in scope
Prefabricated Buildings and Building Units	6.1 Prefabricated Buildings and Building Units	✓		✓	✓	✓	
Work to Existing Building	7.1 Minor Demolition and Alteration Works	✓		✓	✓		
External Works	8.1 Site preparation works 8.2 Roads, paths, paving & surfacing 8.3 Soft landscaping, planting and irrigation systems 8.4 Fencing, railings and walls 8.5 External fixtures 8.6 External drainage 8.7 External services 8.8 Minor building works and ancillary buildings	✓		✓			NC credit option RFO if in scope: hard landscaping and boundary protection only

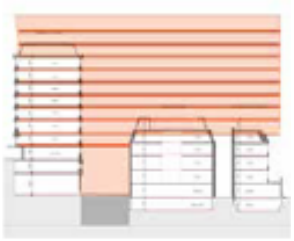
Table 4: Comparison of scopes vs building part element /group (in detail)

APPENDIX 3 GLA WLCA Pre-App proforma

WLC reduction principles		Key benefits
1	Reuse and retrofit of existing buildings	Significant retention and reuse of structures is carbon efficient and reduces construction costs.
2	Use repurposed or recycled materials	Reduces waste and carbon emissions.
3	Material selection	Appropriate material choices are key to carbon reduction. Ensuring that materials are selected with consideration of the planned life expectancy of the building reduces waste, the need for replacements and the in-use costs.
4	Minimise operational energy use	A 'fabric first' approach should be prioritised to minimise energy demand and reduce carbon and in-use costs.
5	Minimise the carbon emissions associated with operational water use	Choice of materials and durability of systems, which help to avoid leakage and subsequent building damage, contribute to reducing the carbon emissions of water use.
6	Disassembly and reuse	Designing for future disassembly ensures that products do not become future waste and that they maintain their environmental and economic value.
7	Building shape and form	Compact efficient shapes help minimise both operational and embodied carbon emissions from repair and replacement for a given floor area. This leads to a more efficient building overall resulting in lower construction and in use costs.
8	Regenerative design	Removing carbon emissions from the atmosphere through materials and systems absorbing it makes a direct contribution to carbon reduction.
9	Designing for durability and flexibility	Durability means that repair and replacement is reduced which in turn helps reduce life-time building costs. A building designed for flexibility can respond with minimum environmental impact to future changing requirements and a changing climate, thus avoiding obsolescence which also underwrites future building value.
10	Optimisation of the relationship between operational and embodied carbon	Optimising the relationship between operational and embodied carbon contributes directly to resource efficiency and overall cost reduction.
11	Building life expectancy	Defining building life expectancy gives guidance to project teams as to the most efficient choices for materials and products. This aids overall resource efficiency, including cost efficiency and helps future proof asset value.
12	Local sourcing	Sourcing local materials reduces transport distances and supply chain lengths and has associated local social and economic benefits.
13	Minimising waste	Waste represents unnecessary and avoidable carbon emissions. Buildings should be designed to minimise construction waste, and to ease repair and replacement with minimum waste, which helps reduce initial and in-use costs.
14	Efficient construction	Efficient construction methods (e.g. modular systems, precision manufacturing and modern methods of construction) can contribute to better build quality, reduce construction phase waste and reduce the need for repairs in the post completion and the defects period (snagging).
15	Lightweight construction	Lightweight construction uses less material which reduces the carbon emissions of the building as there is less material to source, fabricate and deliver to site.
16	Circular economy	The circular economy principle focusses on a more efficient use of materials which in turn leads to carbon and financial efficiencies.

Table 6: Principles from the GLA's new WLCA template for the pre-application stage

Appendix 4: Indicative example of completed Table A

Applicable	Minor refurbishment	Major refurbishment	Substantial refurbishment and extension	New build, Reclaim and recycle
		N/A		
Gross Internal area (GIA)	17,309 m^2	m^2	29,860 m^2	35,948 m^2
Increase in NIA	0 m^2	m^2	12,551 m^2	18,639m^2
Embodied Carbon (A1-A5)	68 $kgCO_2e/m^2$ GIA	$kgCO_2e/m^2$ GIA	571 $kgCO_2e/m^2$ GIA	670 $kgCO_2e/m^2$ GIA
Embodied Carbon (A1-A5, B1-B5, C1-C4)	176 $kgCO_2e/m^2$ GIA	$kgCO_2e/m^2$ GIA	734 $kgCO_2e/m^2$ GIA	874 $kgCO_2e/m^2$ GIA
% material retained rel. to existing	88%	-	20%	3 %
Operational Energy (B6)	1, 813 $kgCO_2e/m^2$ GIA	$kgCO_2e/m^2$ GIA	1,078 $kgCO_2e/m^2$ GIA	925 $kgCO_2e/m^2$ GIA
Regulated carbon savings	_____ %	_____ %	30%	42%
EPC rating	D		B	A
Fuel source	☒ Gas ☐ Electricity ☐Other	☐Gas ☐ Electricity ☐Other	☐ Gas ☒ Electricity ☐Other	☐ Gas ☒Electricity ☐Other
Total WLCA carbon	68,102 tCO_2e	tCO_2e	54,137 tCO_2e	64,757 tCO_2e

Applicable	Minor refurbishment	Major refurbishment	Substantial refurbishment and extension	New build, Reclaim and recycle
Opportunities	• Retention of existing 3 buildings • Extends building life • Embodied carbon lowest for immediate future	N/A	• Retains most of substructure and some structural elements with new build extension	• Better operational energy opportunities • Wider social benefits • More opportunities for roof space / greening (UGF) • Greater adaptability • Some foundations retained • Some stonework to be repurposed
Constraints	• Retention and intervention relies on gas due to roof space. • Poor floor area does not maximise space, risk of poorer EPC performance • Services upgrades restricted due to existing space constraints. Assumes like for like plant changes if upgrades	N/A	• Structurally challenging. Existing structure would need considerable new structure to support building which add to the complexity of the construction • Substantial temporary works required. • Quality of existing steel unknown. • Services challenging • Restricted Floor to floor heights and level changes add to complexity • Not maximising land use. • Less roof space for planting • Did not meet tenant space requirements.	• Embodied carbon is highest but there is a trade of for other wider benefits.
Notes	• Assumes no fabric interventions. • Pro rata carbon data estimates based on new build for building element categories, internal works 2.7 - 8. • Does not include future façade intervention which is likely to be required. Making embodied carbon worse over life—cycle	N/A	• Structure recalculation: for 1 Substructure, 2.1 Superstructure - frame, 2.2 Superstructure - upper floors. • 2.3 - 8 estimated pro rata	• Increase in GIA vs existing building(s) GIA • Based on new build cost plan so good data set for GLA reporting.

GLOSSARY

Glossary

Approved Document Part L conservation of fuel and power: Part L is a building regulation that covers both new and changes to existing dwellings and non dwellings**.** Part L sets minimum requirements and targets for energy performance and carbon emissions. It also defines the carbon intensity of fuel and power.

Beyond Lifecycle (Beyond – LC): Carbon emissions arising from any benefits or burdens of materials and components beyond the lifecycle (Module D).

BREEAM – Building Research Establishment Environmental Assessment Method: A leading and well established scheme for the evaluation, rating and certification of the sustainability of buildings developed by the BRE. It is the main sustainability certification standard in the UK but also is used internationally. The main schemes apply to new buildings and both non domestic refurbishment and fit-outs and domestic refurbishments.

Carbon dioxide equivalent (CO_2e): A metric expressing the impact of all greenhouse gases on a carbon dioxide basis. A measure used to compare the emissions from various greenhouse gases based upon their global warming potential in a common unit over a 100 year period. E.g. 1 kg of methane is converted into the amount of CO_2 needed to cause the same effect, in this case 23 kg. Therefore 1 Kg methane has a CO_2 equivalent of 23.

Climate Change: Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. However since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas.

Embodied carbon at Practical Completion (EC-PC): Carbon emissions arising from the product stages (A1-A3) and construction process stages (A4-A5).

Embodied Carbon over Lifecycle (EC-LC): Carbon emissions arising from the product stages (A1-A3), construction process stages (A4-A5), use stages (B1-B5) and end-of-life stages (C1-C4).

Environmental aspect: An aspect of construction works, part of works, processes or services related to their lifecycle that can cause change to the environment.

Environmental impact: A change to the environment, whether adverse or beneficial, wholly or partially, resulting from environmental aspects.

Environmental Performance Declaration (EPD): A transparent, objective report that communicates what a product or material is made of and how it impacts the environment across its entire lifecycle. An EPD is usually valid for five years, and is generated according to a number of relevant standards.

Global Warming: Is the long-term heating of Earth's climate system observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere.

Global Warming Potential (GWP): The standard metric used to calculate CO_2-equivalent emissions of different greenhouse gases in carbon budgets and the Kyoto Protocol. GWP measures the total radiative forcing over a given period (usually 100 years) after a pulse emission, relative to that from the same mass of CO_2.

Gross Internal Area (GIA): The area of a *building* measured to the internal face of the perimeter walls at each floor level. In the UK this is determined according to Royal Institute of Chartered Surveyors (RICS) property measurement standards.

Greenhouse Effect: A process that occurs when gases in Earth's atmosphere trap the Sun's heat. This process makes Earth much warmer than it would be without an atmosphere

Grid decarbonisation: The gradual reduction of the carbon intensity of electricity production.

Greenhouse Gas (GHG): A gas that absorbs and emits radiant energy within the thermal infrared range, causing the greenhouse effect causes global warming. The primary greenhouse gases in the Earth's atmosphere are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), ozone (O_3), chlorofluorocarbons (CFCs) and water vapour (H_2O).

IMPACT (Integrated Material Profile and Costing Tool): A specification and database for software developers to incorporate into their tools to enable consistent Lifecycle Assessment (LCA) and Lifecycle Costing (LCC). IMPACT compliant tools work by allowing the user to attribute environmental and cost information to drawn or scheduled items in the BIM. Put simply, IMPACT takes quantity information from the BIM and multiplies this by environmental impact and/or cost 'rates' to produce an overall impact and cost for the whole (or a selected part) of the design.

Lifecycle: consecutive and interlinked stages on the life of the object under consideration.

Lifecycle Assessment (LCA): is a process to evaluate the environmental burdens associated with a product, process or activity:

- By identifying and quantifying energy and materials used and wastes released to the environment;

- To access the impact of those energy and materials used and releases to the environment; and
- To identify and evaluate opportunities to affect environmental improvements.

The assessment includes the entire lifecycle (from cradle to grave) of the product, process or activity encompassing extracting and processing of raw materials, manufacturing, transportation and distribution; use and re-use; maintenances; recycling and final disposal.

NABERS UK 'Design for Performance' (DfP): A building rating scheme (currently for offices only) designed to help projects deliver against their design intent and overcome the well-evidenced performance gap between design and operation. It requires a developer or owner to design commission a new office to a defined rating. It is a more detailed way of undertaking an energy model with the aim of enabling better design decisions to help reduce carbon emissions once the building is operations.

NABERS Energy: NABERS Energy measures the efficiency of an office building and rates its performance (0-6 Stars). The energy rating works by comparing the energy consumption of a building against a set of benchmarks that have been developed using actual data. It is based on in use data

Operational energy (modelling): A detailed energy model that attempts to reflect real world energy consumption of a building during the design and construction stages of a development. This would include more detail than a standard model used for building regs, and would include unregulated energy

Operational energy (use): The total energy consumption of the building during its use and operation of the building based on measured building data.

Operational water use: Water consumption of the building as needed for the technically and functionally defined operation of the building.

Recycling: Recycling is the process of converting waste materials into new materials and objects. A recovery operation by which waste materials are reprocesses into products, materials or substances either for the original purpose or other purposes.

Refurbishment: Modification and improvements to an existing building in order to bring it up to an acceptable condition. The refurbishment of something is the act or process of cleaning it, decorating it, and providing it with new equipment or facilities.

Regulated Energy consumption: Is building energy consumption resulting from the specification of controlled, fixed building services and fittings, including space heating and cooling, hot water, ventilation, fans, pumps and lighting.

Retrofit: The act of providing something with a feature not fitted in the original construction or a replacement of a component. Often this refers to building systems upgrades, however if can refer to improving fabric and or glazing. This work generally improve amenities for the building's occupants and improves the overall building performance.

Unregulated energy: Energy consumption that is not 'controlled', it does not fall under Part L of the Building regulations. This would include consumption from elements such as IT equipment, lifts and other plugin equipment such as white goods, laboratory equipment, external lighting and audio visual equipment.

Whole life Carbon (WLC) or Whole Life Carbon over Lifecycle: The carbon emissions resulting from the materials, construction and the operation/use of a building over its entire life, including its demolition and disposal. A WLC assessment provides a picture of a building's carbon impact on the environment. It comprises of modules A1-A5, B1-B7, C1-C4 and D.

Application types:

FULL EIA: any application requiring EIA in support

FULMAJ: – Any application over 1,000m2 - Major applications may include schemes for redevelopment, substantial refurbishments, extensions or changes of use. Residential development of 10 or more dwellings or on a site of 0.5 hectares or more, and all other development of 1,000 square metres gross or more floorspace, or on a site of 1 hectare or more.

FULL: All other full applications