City of London Corporation

Carbon Options Guidance

Planning Advice Note - December 2025 - Rev 02

CITY OF LONDON

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Executive summary

The built environment and its role in tackling climate change

Human activities which result in the release of greenhouse gases, including carbon dioxide (CO_2), are estimated to have caused 1.3-1.4°C of global heating above pre-industrial levels. Each of the last three decades have been hotter than the previous one and the last 10 years (2015-2024) were the warmest 10 years on record. As a result, there has already been ocean warming, sea level rise, increased likelihoods of extreme weather events and melting of sea ice, glaciers 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). Across the 753 terrestrial and freshwater species studied, the UK has experienced an average 19% decrease since 1970. The distributions of 54% of flowering plant species and 59% of bryophytes (mosses and liverworts) have decreased across Great Britain (State of Nature Report, 2023)

Global emissions need to decrease by 43% by the end of this decade and reach Net Zero by 2050 (the total amount of greenhouse gases released into the atmosphere being equal to the amount removed) to stay under the preferable 1.5°C global warming target set as part of the Paris Agreement (2015). This is the current recommended threshold to avoid unprecedented heatwaves, terrifying storms, flooding and widespread water shortages (Intergovernmental Panel on Climate Change IPCC, 2022). In the UK by 2070, UK winters are projected to be between 0.6 and 3.8°C warmer and between 3 to 39% wetter depending on the region, compared to our climate in 1990. UK summers are projected to be between 1.3 and 5.1°C warmer, depending on the region (Climate change explained, DESNZ 2025).

The built environment contributes 25% of UK greenhouse gas emissions (CO_2e) that it has direct control over. If emissions influenced by the built environment are included (surface transport vehicle emissions) the built environment contributes around 42% of the UK's total greenhouse gas emissions, $MtCO_2e$. (Net Nero Whole Life Carbon Roadmap, 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.

City of London Corporation Climate Action Strategy

The City of London is a 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 (City Corporation) has adopted a radical Climate Action Strategy (CAS) in 2020 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 its own operations by 2027.**
- **Achieve net zero carbon emissions across its 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 Corporation has set out a fully funded action plan for 2020-2027 which includes annual targets against a decarbonisation pathway. Further information on the CAS including a link to our annual reporting dashboard can be found on the Climate Action Strategy page of the City Corporation website.

Scope of this guidance

The Carbon Options Guidance provides a clear and consistent approach to carbon optioneering for development sites. The optioneering methodology is a first step of carbon evaluation, designed to enable a consistent, early-stage approach to assessing realistic development options.

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

This is considered to be one of the first steps in the City Corporation's pursuit to achieve outstanding, best in class buildings that contribute to an attractive and vibrant City environment.

This approach is recommended to aid the review and decision-making process through the submission of more in-depth information that demonstrates how applicants have come to a development decision. This process can be relevant to various application types, that have a significant proportion of new build elements.

The assessment will contribute to the justification for the application proposal and help with achieving a successful outcome.

This document sets out the recommended approach to carbon optioneering and is accompanied by a 'Carbon Options Tool' (Excel template). This tool contains the minimum reporting requirements expected for all schemes and should be submitted to the City Corporation (in Excel format), accompanying a summary Carbon Options Study which should explain and clearly present the outcome of the optioneering to any interested parties scrutinising application proposals (third-party reviewer, public, councillors). The Carbon Options Tool enables applicants to provide the required information at pre-application stage.

Once completed, it is advised that applicants complete the full Whole Life-Cycle Carbon (WLC) Assessment for the planning application scheme, in line with the London Plan Guidance (LPG) 'Whole Life-Cycle Carbon Assessments (GLA, March 2022)' or, where updated, in line with the guidance in force at the time of application.

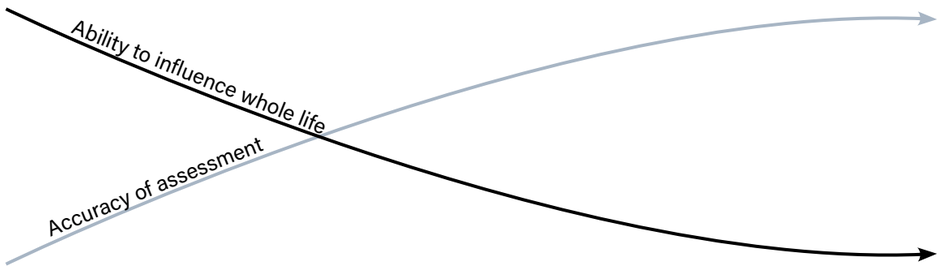

Figure 1: Carbon influence vs Assessment Accuracy from RICS WLC assessments - 2nd edition

Update from the previous version of the Carbon Options Guidance

Planning applications under consideration in 2021 and 2022 reported carbon option studies and WLC Assessments in various and inconsistent ways. The range of different approaches posed significant risks in assessing, evaluating and comparing proposals, making it difficult for City Corporation planning officers to report key results and conclusions to members and stakeholders for decision making.

The first version of the Carbon Options Guidance (COG) was published in March 2023, with the purpose of providing a consistent framework for early-stage carbon optioneering and to advise on:

- The merits of a WLC emission options study as part of the pre-application process to ensure that development proposals maximise retention of the existing building structures and fabrics, thus minimising demolition waste and reducing carbon emissions from the earliest project stages.
- The scope and methodology of comparative WLC emission options for development proposals at the earliest project stage.
- Ensuring like for like comparison, enabling consistency of reporting of carbon emissions and the evaluation of pre-application schemes as a substantive basis for the planning application scheme.
- How to inform decision-making through a thorough assessment of redevelopment options and by encouraging a retrofit first approach, to ensure carbon emissions are considered from an early stage with the aim of reducing overall impacts in the City of London.
- Third Party review to ensure consistency and provide technical reviews for the City Corporation and give assurance to committee members.

In the past two years, since first publication, optioneering has been carried out as part of many planning applications in the City, informing decisions around the anticipated carbon impacts, the extent of demolition and retention of the existing building stock, and consideration of other aspects of environmental, social and economic sustainability of development options.

The vast majority of the major applications approved by the City Corporation during 2024 (15 out of 16) have undertaken an appraisal of different development options in collaboration with and during early conversations with planning and sustainability officers during the pre-application process. This helped identify opportunities for retaining existing buildings and/or parts of the existing buildings. In fact, 14 out of 16 approved applications have retained substantial parts of their structure with significant carbon savings compared to alternative new build scenarios.

The current revision of the COG has been prepared by Hilson Moran in collaboration with the City Corporation sustainability officers, with contributions and constructive feedback gathered from private developers and industry experts with relevant planning experience in the Square Mile, including carbon assessors, sustainability consultants, structural engineers and planning consultants.

This revision of the Carbon Options Guidance:

- Defines more clearly which planning applications are expected to include a Carbon Options Study - in line with the requirements provided in Chapter 3.
- Provides further clarifications on the scope, methodology and reporting requirements for the Carbon Options Study submitted by the applicants during the pre-application process (Chapters 2 and 6). There is an expectation that applicants use developed knowledge obtained since the original COG was issued in 2023, from detailed WLC calculations / benchmarking performance to improved early-stage estimations, and prevent underestimation of carbon impacts.
- Provides additional guidance for third-party reviewers to enable greater consistency in the review process and ensure that all applications are subject to the same level of scrutiny (Chapter 7).
- Clarifies the City Corporation's expectations with regard to embodied carbon benchmarks and 'wider environmental sustainability benefits' (Chapter 8), in line with the Planning for Sustainability Supplementary Planning Document (SPD), adopted February 2025. Additionally, the relation between a carbon options study developed in compliance with this guidance and pre-redevelopment audits, as defined in the current London Plan Guidance (LPG) 'Circular Economy Statements' (GLA, March 2022) is set out in Chapter 8.

1. Carbon in regulations and planning policy

This chapter outlines how carbon emission quantifications and reductions are required to be reported for planning applications in the Square Mile.

Since the first issue of the COG (March 2023) there have been a number of changes to overarching policy in the UK as well as to local planning policies / requirements on carbon reductions. Currently, however, there is no specific national policy in relation to carbon optioneering or embodied carbon reduction.

The EU have recently announced a timeline and plans mandating embodied carbon reporting from 2028 under the Energy Performance of Buildings Directive (EPBD). In December 2025 the Commission shall adopt a delegated act setting out a Union framework for the national calculation of life-cycle Global Warming Potential (GWP). Member states will be required to publish a road map and introduce limits. From 2028 all buildings above 1,000 m^2 will be required to disclose their life-cycle GWP. From 2030 this will encompass all new buildings.

In the UK, the National Planning Policy Framework (NPPF - 2024 December update) explicitly addresses climate change in section 161 onwards. The NPPF includes a requirement for the planning system to 'support the transition to net zero by 2050'. Paragraph 163 of the NPPF states: 'the need to mitigate and adapt to climate change should also be considered in preparing and assessing planning applications, taking into account the full range of potential climate change impacts.' This involves taking full account of operational and embodied carbon impacts.

The National Model Design Code (Ministry of Housing, Communities and Local Government, 2021) sets out clear design parameters to help local authorities and communities decide what good quality design looks like in their area. Part 2, R.2.i Embodied Energy states a preference for reuse/ refurbishment of buildings over new build development as part of the high-level guidance to reduce embodied carbon.

Development proposals are generally required by the GLA and City Corporation to report both:

- Embodied carbon emissions, i.e. carbon emissions resulting from materials, construction and the maintenance of a building's life-cycle, and
- Operational carbon emissions, from energy consumption throughout the life-cycle of the building.

However, the scope of reporting in applications is determined by several factors relating to 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:

Building regulations

At a National Level, in England, Approved Documents Part L Conservation of fuel and power, Volume 1: Dwellings and Part L Conservation of fuel and power, Volume 2: Buildings other than dwellings 2021 editions incorporating 2023 amendments, set out energy efficiency requirements. These regulate 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. The Part L 2021 update tightens target requirements and introduces a minimum Primary Energy metric to place more emphasis on reducing energy demand and on site 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. Whilst Part Z has been widely supported by industry, at the bill's second reading the Government declined to support it. However, the UK Government have committed to undertake consultations on embodied carbon in 2023 and 2024 (Environmental Audit committee - Building to net zero: costing carbon in construction: Government Response to the Committee's First Report, third special report of session 2022-2023, September 2022). Some initial consultations and surveys were undertaken, however, there has been no update on outcomes or any updated reports issued since the COG was first issued.

In 2023, the UK Government set out a project to evaluate the 'Measurement and Reduction of Embodied Carbon in New Buildings'. A report prepared by AECOM for The Ministry of Housing, Communities and Local Government (MHCLG) was published in July 2025, 'The practical, technical and economic impacts of measuring and reducing embodied carbon in new buildings'. The report presents the findings of the research and provides recommendations to Government. This is available from the MHCLG website.

Greater London Authority (GLA) policy

The Mayor of London's London Plan 2021 requires proposals referable to the GLA to be net zero carbon.

The London Plan Policy SI 2 sets out requirements for major developments to minimise carbon emissions. Part F of Policy SI 2 requires referable development proposals to calculate WLC emissions through a nationally recognised WLC Assessment and demonstrate actions taken to reduce life- cycle carbon emissions.

LPG 'Whole Life-Cycle Carbon Assessments Guidance' (GLA, March 2022) sets out the reporting requirements and the scope of the WLC Assessment. The GLA methodology uses RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment, 1st edition (November 2017) and sets out some requirements that go beyond the 2017 RICS scope in Box 1 of the GLA guidance.

WLC Assessment reporting is required at pre-application, application and post- completion stages of schemes that are referable to the GLA, but it is also encouraged for all major developments. All studies account for a 60-year life-cycle period, as standard. Provisions for a different assessment period can be established if accompanying explanations are provided.

The guidance document is recognised as industry-leading. It contains a detailed methodology and list of information to be included for materials across a number of Life-Cycle Assessment (LCA) modules (Table 1) as well as including requirements for reporting emissions for demolition of existing assets on site and from refrigerants.

The London Plan 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 life-cycle. 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.

LPG 'Energy Assessment Guidance' (GLA, June 2022) 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 and energy performance metrics in terms of Energy Use Intensity (EUI) for regulated emissions. It introduces a new 'be seen' stage to calculate

whole building EUI (including unregulated emission), to monitor and report its energy performance post-construction. This will help to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target.

LPG 'Be Seen Energy Monitoring Guidance' (GLA, 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). It requires analysis for regulated and unregulated energy loads using a process such as TM54 which is aligned with the LPG for WLC Assessments module B6 approach, but does not account for decarbonisation of the grid.

A London Plan update is expected in 2027, and the review of WLC Assessment and Circular Economy Statement guidance is underway.

Other planning policies

Across the UK there are other policies that have detailed or high-level requirements for a retrofit first and /or a whole life-cycle carbon approach to developments.

Manchester is setting out the evidence basis for a retrofit first policy, and a number of other cities have climate plans to reduce carbon and prioritise retrofit, such as Bristol, and Leeds. A number of boroughs in London have set out similar approaches such as the London Borough of Camden, London Borough of Lambeth, London Borough of Hackney, London Borough of Southwark and the City of Westminster in their emerging plans and their associated guidance documents. All have different requirements and levels of details, with similar principles of supporting retrofit.

City of London Corporation policy

The City Corporation's Local Plan (2015) aligned with the London Plan 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 (WLC Assessment) in this policy document. However, Policy CS 15 requires all redevelopment proposals to demonstrate the highest feasible and viable sustainability standards in the design, construction, operation and "end of life" phases of development. It does further state that development should 'avoid demolition through the reuse of existing building or their main structures'.

Emerging City Plan 2040

The emerging City Plan 2040, once adopted, will replace the Local Plan 2015. The City Plan 2040 sets out the strategic priorities, spatial strategy and policies to provide a framework for future development in the Square Mile.

Key sustainability policies are set out in Chapter 9: Design. Policies S8 and DE1 require development proposals to take a 'retrofit first' approach, prioritising the retention and retrofit of existing buildings, as informed by an appraisal of development options. The retrofit and retention of existing buildings and structures (where feasible) is a key focus to reduce embodied carbon emissions and demolition waste. The Carbon Options Guidance provides the methodology for the implementation of the Retrofit First policy.

Policies S8 and DE1 require all developments to minimise WLC emissions and major applications must submit a WLC Assessment in line with GLA Guidance. The policies cover overarching principles circular economy principles and design approaches, improved environmental performance, and the delivery of exemplary low carbon development.

Climate Resilience is covered in Strategic Policy S15, which sets out the need for buildings and the public realm to be designed to be adaptable to future climate conditions and resilient to more frequent extreme weather events. Circular economy/waste planning is specifically covered in the Strategic Policy S16: Circular Economy and Waste.

Planning for Sustainability SPD

The Planning for Sustainability SPD (February, 2025) provides guidance on how applicants should approach environmental sustainability through the planning application process. It sets out detailed guidance on how to fulfil policies of the Local Plan 2015, as well as emerging policies such as the City Plan 2040. Specifically, it:

- Sets out the key approaches the City Corporation is targeting on different sustainability themes.
- Identifies a list of key actions.
- Provides guidance on what, how and when relevant sustainability aspects should be considered during the planning application process.

Figure 2: The proposed amendment of the Building Regulations, Part Z, to regulate embodied carbon on a national scale.

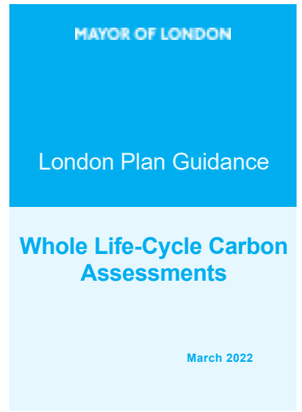

Figure 3: London Plan Guidance on 'Whole Life-cycle Carbon Assessments' March 2022

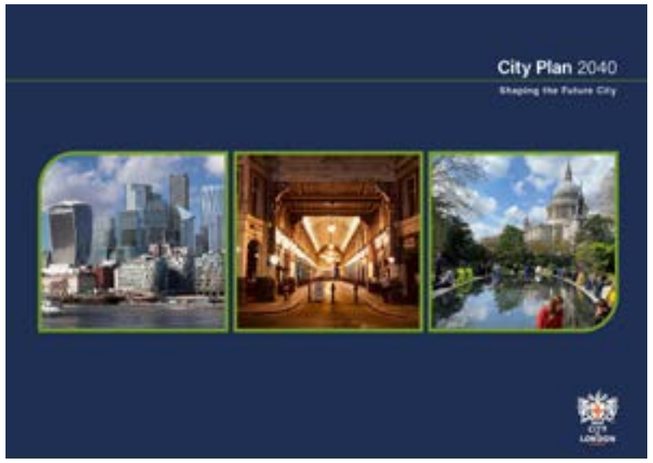

Figure 4: Emerging City Plan 2040

- Provides a collation of relevant recommended standards, certifications and guidelines.

The SPD is divided into five thematic chapters that focus on the environmental sustainability of the City's built environment:

- Chapter 3, **Retrofit and reuse,** requires developments to adopt a retrofit first approach that is informed by carbon optioneering in accordance with this Carbon Options Guidance. The chapter provides a definition of retrofit, sets out the retrofit first approach, and provides advice on retrofit in historic buildings.
- Chapter 4, **Greenhouse gas emissions and energy use,** sets out guidance for how applicants should address whole life-cycle carbon and operational energy use. A key action highlights that developments should prioritise retrofit over redevelopment solutions. Carbon optioneering is a key process to reduce whole life-cycle carbon.
- Chapter 5, **Circular economy,** sets out guidance for how applicants should address circular economy in construction and operational circular economy. It recommends that the strategic assessment of retention and development scenarios in a pre-redevelopment audit is aligned with carbon optioneering.
- Chapter 6, **Climate resilience,** addresses six climate related risks and contains guidance to ensure climate resilience principles are embedded within the design process of each development in the City. The six key risks are: Flooding, Water stress, Overheating, Pests and diseases, Trade food and infrastructure, and Biodiversity losses.
- Chapter 7, **Urban greening and biodiversity,** provides guidance on how to protect, conserve and enhance biodiversity, habitats and green infrastructure in the City, and how to adhere to policy targets for Urban Greening Factor (UGF) and Biodiversity Net Gain (BNG).

Chapter 8 outlines key considerations, required application documents and recommended supplementary material to support planning applications at all RIBA stages.

Related reporting requirements

There are other carbon-related planning reports that should be taken into consideration. They include Greenhouse Gas impact assessments, the Circular Economy Statement, operational energy and operational water assessments. Where relevant, these should be referenced in WLC Assessment reporting, in particular to highlight discrepancies and overlaps in design considerations and decisions. An overview of the related reporting requirements is provided in Appendix 1.

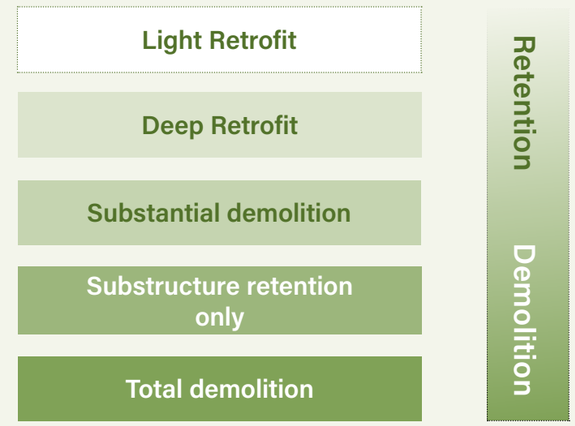

Figure 5: Scale from retrofit to new build (Planning for Sustainability SPD)

Figure 6: Planning for Sustainability SPD

2. Whole life-cycle carbon assessments for pre-application optioneering and planning applications

This chapter compares the typical life-cycle boundaries and elemental scope for pre-application carbon optioneering (following this Carbon Options Guidance) and detailed WLC Assessments. There is currently a variety of methodologies for conducting WLC Assessments and the scope of life-cycle modules, building elements, and information that should be included within them differs, as shown below in Table 1 and Table 2.

Modules A1-A3 include the product manufacture, modules A4-A5 cover transport to site and the installation processes. Combined these are known as upfront embodied carbon A1-A5 (i.e. at practical completion of the building). Modules B1-B5 cover operational and fugitive emissions relating to use, maintenance, repair, replacement and refurbishment, modules C1-C4 cover 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 life-cycle, i.e. the benefits of reusing or recycling in the net flows of materials exiting the system boundary.

In a WLC Assessment, operational energy use, module B6 and operational water use, module B7, are also included. Module B8 accounts for user activities that are not covered in B6-B7, such as emissions from vehicles using a road on site or the impact of commuting to an office building during the building's in-use stage. Module B8 is a recent addition of the 2nd edition of the Royal Institution of Chartered Surveyors (RICS) Professional Standard (PS) for 'Whole Life Carbon Assessment in the built environment'. However, it is not currently included in GLA WLC Assessment reporting

Table 1 compares the typical WLC Assessment scoping boundaries for pre-application carbon optioneering studies (following this guidance) and detailed WLC Assessments conducted for different types of development in the City.

Table 2 includes a comparison of building element scoping across industry bodies such as the UK Green Building Council (UKGBC), Greater London Authority (GLA), Low Energy Transformation Initiative (LETI), RIBA, RICS, and the UK Net Zero Carbon Buildings Standard (UK NZCBS) in terms of European Standard EN 15978:2011 Sustainability of construction works.

Table 1: Comparison of life-cycle stages. Whole life-cycle carbon Scope of whole life-cycle carbon reporting in the City of London.

Lifecycle stages (based on EN 15978)	PRE-APPLICATION STAGE	APPLICATION STAGE		
	Whole Life-Cycle Carbon Optioneering	WLC Assessment for GLA referable developments in the City	WLC Assessment for major developments in the City	WLC Assessment for minor developments in the City Strongly encouraged (depending on the scope of works)
Impact of the existing building's demolition				
Demolition impact of existing building structures	✓ Reported separately	✓ Reported separately	✓ Reported separately	✓ Reported separately
Product and Construction Process (Practical Completion) Stage				
A1-A3 Construction product supply, transport and manufacturing	✓ Aggregated	✓	✓	✓
A4-A5 Transport to site and construction impacts		✓	✓	✓
Use Stage				
B1-B5 In Use Embodied Carbon	✓	✓	✓	✓
B6 Operational energy use # **Regulated**	✓ For 60 years	✓ 30 years for energy assessments 60 years for WLC Assessments	✓ 30 years for energy assessments 60 years for WLC Assessments	✓ 30 years for energy assessments 60 years for WLC Assessments
B6 Operational energy use # **Unregulated**	Unregulated	✓ 60 years for WLC Assessments	✓ 60 years for WLC Assessments	✓ 60 years for WLC Assessments
B7 Operational water use		✓	✓	✓
B8 User activities				
End of Life-Cycle Stage				
C1-C4 Deconstruction, demolition, transport, waste processing and disposal	✓	✓	✓	✓
Beyond the Project Life-Cycle				
D Stages beyond the life-cycle, including reuse, recovery, recycling		✓	✓	✓

Operational energy assessment i.e.TM54 or NABERS whole building or base build with tenancy prediction where possible, to enable a more accurate estimation of in use energy performance

It is worth noting that the referenced documents may change and that the industry landscape is continually evolving and improving at pace. The methodology for optioneering set out in Chapter 6 will be updated, as necessary, should there be any significant changes to existing or new methodologies and policies relating to carbon reporting and early-stage WLC optioneering.

Notes on using calculation methodologies

Given the early stage of assessment, carbon optioneering as set out in this guidance, does not follow the RICS PS WLC Assessment guidance (any version) but uses its own scope (as shown in Tables 1 and 2), methodology and reporting requirements (as outlined in further detail in Chapter 6).

The WLC Assessment methodology provided in the RICS PS WLC Assessment 2nd edition, effective from 1 July 2024, is currently the most comprehensive of all the industry methods set out in Table 2.

The current version of the GLA WLC Assessment guidance (March 2022), including the embodied carbon benchmarks and the GLA WLC template, is based on the 1st edition of the RICS PS 'Whole life carbon assessment for the built environment' methodology. For consistency and comparison purposes, all planning stage WLC assessments submitted to the City Corporation should follow the RICS PS 1st Edition methodology until the GLA updates its WLC Assessment guidance, which is anticipated to be in line with the new RICS WLC Professional Standard 2nd edition.

Applicants can provide additional WLC Assessments in accordance with RICS 2nd edition methodology. This additional layer of detail would be welcomed.

Table 2: Whole life-cycle carbon comparison of scopes vs building part element/group

Building part / Element group	Pre-Application Carbon Optioneering (in line with this guidance)	Detailed Whole Life Carbon Assessments					Net Zero Carbon UK Standards	
		GLA WLC Guidance (March 2022)	RIBA 2030 Climate Challenge Version 2	LETI Embodied Carbon Primer	RICS PS WLC Assessment 1st edition	RICS PS WLC Assessment 2nd edition	UK NZCBS (Pilot version Rev 1)	UKGBC Net Zero Carbon Framework
Demolition prior to construction	✓ Reported separately	✓ Reported separately			Optional and reported separately	✓ Accounted for under A5.1	✓ Accounted for under A5.1 (excluded from upfront limits)	Optional and reported separately
Facilitating works	Qualitative description of the anticipated temporary works	✓ Benchmarks do not include these building elements			Optional	✓	✓	Optional
Substructure	✓	✓	✓	✓	✓	✓	✓	✓
Superstructure (Frame, upper floors, roof, stairs, ramps)	✓	✓	✓	✓	✓	✓	✓	✓
Superstructure (External walls, windows, doors)	✓	✓	✓	✓	✓	✓	✓	✓
Superstructure (Internal walls, partitions, doors)	✓	✓	✓	✓	Optional	✓	✓	Optional
Finishes	✓	✓	✓	✓	Optional	✓	✓	Optional
Fittings, furnishings and equipment (FF&E)	✓	✓	✓	✓	Optional	✓	✓	Optional
Building services/ MEP (including refrigerant)	✓	✓	✓	✓	Optional	✓	✓	Optional
Prefabricated Buildings and Building Units	✓	✓	✓	✓	Optional	✓	✓	Optional
Work to Existing Building	✓	✓	✓		Optional	✓		Optional
External Works	✓	✓			Optional	✓		Optional

3. Introduction to carbon optioneering

The development of this methodology is driven by the growing realisation that the construction of new buildings using the most common and current construction techniques and materials result in high carbon emissions over the building's life-cycle. Carbon optioneering is a first step of carbon evaluation and is designed to enable a consistent, early-stage approach to assessing carbon impacts for a variation of retention and development scenarios for a specific site, in order to find the best balance in whole life-cycle carbon emission terms prior to adding other considerations (as set out in Chapter 4) into the planning process.

Optimising opportunities for a specific site whilst incentivising the retrofit of existing buildings and thus minimising demolition waste and reducing carbon emissions, are key actions in the City Corporation's pursuit to achieve outstanding, best-in-class buildings that contribute to an attractive and vibrant City environment.

The assessment and benchmarking of embodied carbon up to practical completion (Modules A1-3 and A4-A5) can be used as an effective way to evaluate and then mitigate emissions from construction and materials. Reducing upfront embodied emissions is particularly important to achieve the aspirational target limits set for global temperature rise. Whole life-cycle carbon impacts are an important part of the process and should be considered in decision making for developments.

It is also acknowledged that the majority of the Square Mile's existing building stock has relatively high operational emissions, primarily due to inferior energy efficiency standards and technologies at the time of original construction and/or latest refurbishment, compared to current requirements and design criteria (insulation, air tightness, solar control glass, building services etc.). As such, significant fabric and MEP improvements and switching to renewable energy sources are crucial measures expected for all proposed schemes.

When is carbon optioneering required?

Carbon optioneering is required for all major schemes. Minor developments should carry out carbon optioneering if they do not propose to retain at least 50% (by area) of an existing building(s)' floor slabs. This would include both upper and suspended floors in the basement, but exclude the lowest floor slab.

All schemes subjected to the above requirements should undertake independent third-party review as a quality assurance mechanism for their carbon optioneering results. The third-party review process will be managed, guided and supported by City Corporation officers, while being funded by the applicant.

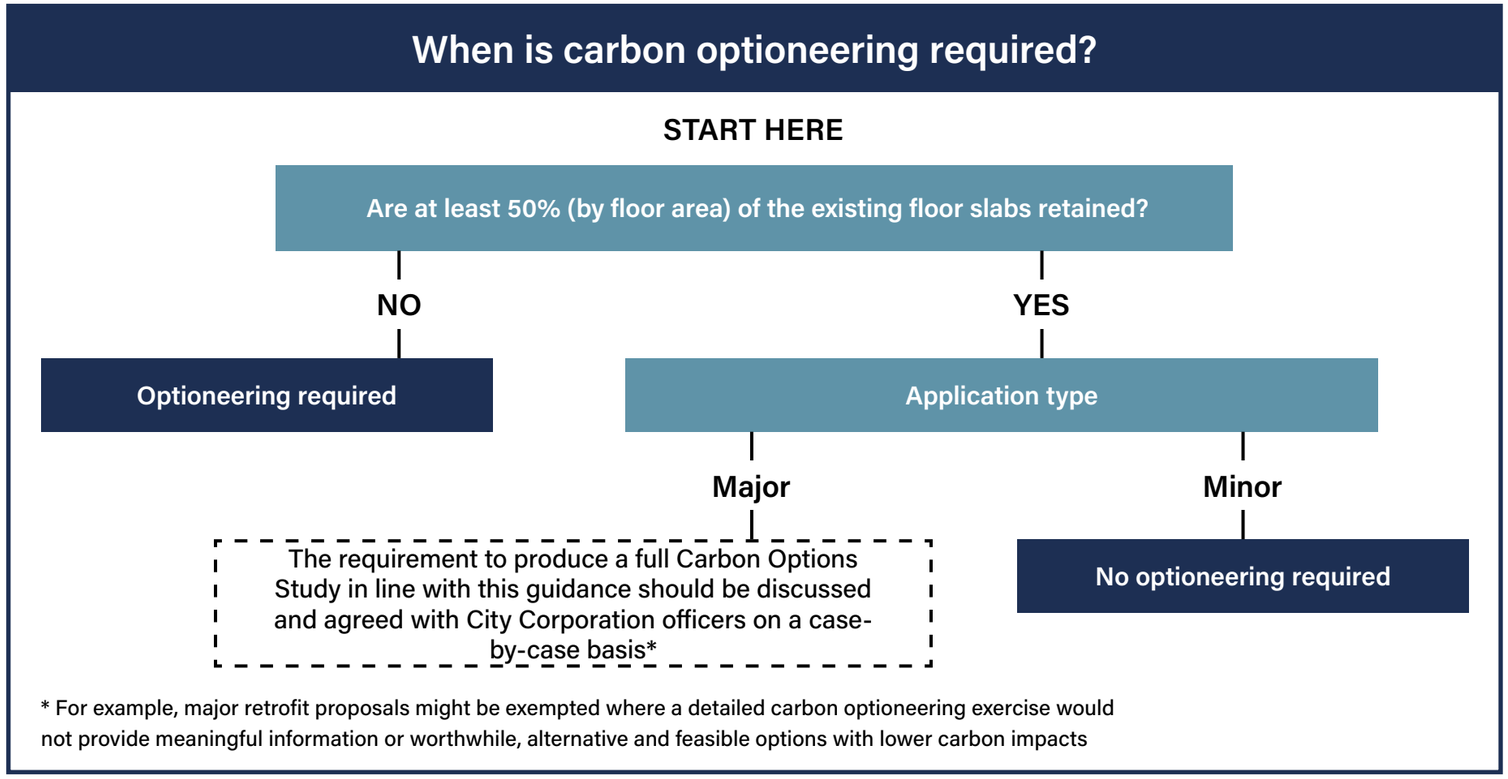

Figure 7: Decision tree for optioneering requirement

While minor schemes that do retain at least 50% (by area) of the existing floor slabs are not required to undertake full carbon optioneering, applicants are encouraged to explore alternative design approaches and construction methods that minimise the carbon intensity of the development.

The consideration of options and the need for a full Carbon Options Study in line with this guidance should be discussed and agreed with the City Corporation officers on a case-by-case basis. There may be major applications for retrofit proposals where a detailed carbon optioneering exercise would not provide meaningful information or worthwhile alternative feasible options with lower carbon impacts.

Applicants might be exempted from the requirement of producing a detailed assessment of different development options when the proposal presented by the applicant team early in the pre-application process clearly demonstrates the lowest level of intervention needed to optimise the energy efficiency, the quality and the quantity of the proposed development, that meets, as a minimum, conditions 1 and 2 from the list below:

1. The existing foundations and other substructural elements of the building are fully retained in use, supporting the proposed building, and without any strengthening works.
2. The proposal involves a major retention of the existing floor slabs (80% or higher, by area), without significant strengthening works for any new extension.
3. The existing façade relating to the retained superstructure is retained with minimal remedial works that entail the sole replacement of materials showing evident signs of deterioration and/or approaching the end of their reference service life (e.g. residual life less than 5 years).

4. Optioneering considerations

The following characteristics can significantly affect the WLC impacts and the evaluation of different development options, and should be considered as part of the optioneering exercise:

Quality of existing building: The condition of materials and structures in an existing building will be a critical determinant of the extent of elements that can be retained when seeking to improve an existing asset and bring it up to current performance and functional market standards.

For example, a structure that was poorly constructed or maintained may require too many (life-cycle) interventions to maintain structural integrity for retention to be feasible. Often, existing assets require extensions to validate the Capital Expenditure (CAPEX) of a major intervention. Extension potential will be dictated by structure and substructure design of the existing building.

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. Recent industry experience shows that particular care should be taken when considering 1950s/60s concrete structures, due to the construction techniques, curing of the concrete, and the grading of the concrete/steel used at the time. However, each project should check the condition of the existing building materials quality as far as practically possible, to enable informed decisions to be made. Poorly maintained windows can be restored to improve air permeability, but conductivity, light transmittance and solar control are more difficult to achieve without additional material or complete replacement.

Façade interfaces: As well as assessing existing quality, decisions around façade retention need to take into consideration any new interfaces with the internal environment, for example, for on-floor ventilation systems and mixed-mode ventilation. These are increasingly being adopted by commercial buildings to improve energy efficiency, spatial adaptability (as part of a health and wellbeing design strategy) and to free up roof area for amenity uses. There is a relationship between operational energy performance and embodied carbon of the facade, which should be optmised to minimise whole life carbon (embodied + operational) impacts over the asset lifecyle.

Health and wellbeing: Design considerations and interventions 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. However, achieving an optimum ventilation strategy while retaining an existing facade can be challenging. Increased fresh air rates are also leading to increases in operational carbon emissions.

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 new building services solutions. For example, low floor-to-ceiling heights may not lend themselves to certain uses, and optimised clear heights, achieved by transferring heating, cooling and ventilation plant to an underfloor system, is often limited by existing lift lobby and stair landing levels. Whilst acknowledging the inherent challenges of adapting existing structures unable to deliver clear floor-to-ceiling heights in line with the current market expectations for best-in-class office spaces, applicant teams should explore any opportunity for maximise retention. Opportunities include change of use and/or use of certain areas of a building with lower heights for meeting rooms, server rooms, or other functions not significantly compromised by lower floor-to-ceiling heights. When existing floor levels cannot be maintained, the City Corporation supports greater creativity and encourage project teams to explore pioneering strategies for reuse on-site of the existing slabs (e.g. jacking up or down portions of existing slab, cut existing slabs and reuse in soft-spots, etc.) whilst being mindful of the impacts of temporary works.

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; and uses that have higher loading requirements and need vibration control, for example in science labs (life sciences) and gymnasiums; and increased structural materials due to 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: 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 why 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 is consumed.

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 (subject to authority approval). 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 a mix of vegetable oils and animal/fish fats.

Building complexity: Design complexity and the number of elemental sub-components typically increases carbon intensity. Therefore, simplification of structure, façades, systems, etc. has carbon benefits and is encouraged. In retrofit and refurbishment schemes, temporary works can play a crucial role in securing safety and stability of the existing walls, floors, and other building elements during demolition, alteration, and reconstruction phases, allowing for safe access to work areas, and protecting surrounding areas from damage, all while maintaining structural integrity throughout the project. An accurate assessment of the carbon impacts of temporary works at the early design stages of the project is often unviable, however design teams should provide a description of the anticipated temporary works required for each option and acknowledge their potential impact on carbon.

Procurement: The options and availability of low carbon building products on the market are currently limited. 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. It can also be challenging to anticipate procurement of lower carbon materials and effects on programme at an early stage. The material specifications and the procurement routes should generally remain realistic and consistent (as appropriate) between options in the Carbon Options Study.

Carbon assumptions: Due to market fluctuations and limitations, it is recommended that, at pre-application and application stages, material and component specifications for the Carbon Options Study and the detailed WLC Assessment for planning are both based on reliable market-average databases and sector-level carbon data. Relevant carbon benchmarks from verifiable tools or software, such as One Click LCA and Cerclos (eTool) can be used in absence of detailed design information for certain building layers / systems. The carbon factors and the adopted carbon benchmarks should generally remain consistent (as appropriate) between options in the Carbon Options Study.

Manufacturer-specific Environmental Product Declaration (EPD) certificates should not be used in early design stages (unless the manufacturer is known) in order to mitigate procurement risks and uncertainty arising from differentiation in performance of similar products/materials produced by different manufacturers. The approach to data selection should be reviewed in the later design stages; sector-level data will be replaced by product-specific data only once there is a reasonable certainty on targeted manufacturers and/or specific products to be procured.

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 the City is shifting demand for net zero carbon, fossil fuel free, health and wellbeing conscious and smarter workspace. As market demands change, many asset holders are racing to update their lettable spaces at the end of the next lease term, by retrofitting, extending and improving the quality of their assets. 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 that it is trying to attract, and the cost of the intervention needs to be justified by a likely return on investment.

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 (the increasing density of people in urban areas) 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 is very well served by sustainable transport infrastructure and planning policies are in place to limit pressures on utility infrastructure and the existing community (the people who live, work and use the City).

Densification, e.g. extensions and taller buildings, 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 addressing climate change. Resilience and sustainability should be central priorities for increasing existing building heights.

5. Other policy opportunities

This chapter addresses circumstances where other environmental 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.

Circular Economy

The Mayor of London has introduced a requirement for referable developments to develop a circular economy strategy and produce a statement as part of the planning application. The approach is defined in the 'Circular Economy Statement Guidance' (adopted 25 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 upfront carbon emissions. For example, design for future adaptability and flexibility might require additional use of resources and materials, such as for buildings with larger structural grid spans offering flexible use of space are generally less performing from a material efficiency perspective. On occasion, it has been found that recovering/repurposing a material for reuse 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 life-cycle 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.

Low and zero carbon technologies

Planning policy, building regulations and BREEAM assessments have for years required the inclusion of low carbon and zero carbon technology in the energy hierarchy of proposed developments.

One example, and often the most viable option in the City of London, is to install air source heat pumps (ASHPs) and 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 and other renewable energy sources. An array in London can achieve carbon break-even within a decade, but as the electrical grid decarbonises, there is an argument that the array will displace less carbon and could never balance out the embodied carbon emitted. For this reason, it is recommended that circularity principles are applied to the specification of PVs (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 that PV can bring other benefits like localised power and diversification of energy sources; current WLC Assessments 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.). PV will be a crucial piece of the UK energy and decarbonisation strategy.

District Energy Networks

Another local policy requirement is connecting to existing District Energy Networks (DEN), preparing for a future connection to a planned DEN, or contributing to the development of DEN in the Square Mile in various other ways. This is emphasised by both the London Plan's and emerging City Plan's heat infrastructure priorities. 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 currently have much lower carbon emissions than existing heat networks. This is because the energy centres that serve the DENs still largely run on gas systems. In assessing operational carbon emissions (B6) for early design-stage carbon optioneering studies, applicants should consider the same energy source and apply the same carbon factors for all options.

Public realm and urban greening

The City includes a network of gardens, small open spaces and squares that are maintained by the City 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 (BNG), for which the City Corporation has adapted the London Plan's Urban Greening Factor (UGF) calculation which is required for proposed developments to demonstrate higher value green infrastructure. Due to the high density of the City, urban greening measures are often located at roof levels or on terraces and balconies. Some of these measures can have a reverse effect on upfront embodied carbon, especially if they increase the structural load of the building (e.g., blue roofs are generally heavier than standard flat roofs due to the additional components required for water retention and controlled drainage, and the installation of trees in the upper floor terraces or on the building's roof could significantly impact the structural load). Retrofit proposals aiming to reuse the structural capacity of the existing building without structural strengthening works might face additional challenges in achieving UGF and BNG requirements.

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, this can be difficult to achieve on existing structures mostly due to loading limits and plant requirements, 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.

Climate resilience

Adapting to climate change is crucial in the City as a densely built environment which is especially prone to local flooding and urban heat island effects. Integrating measures to minimise the risk of local flooding and overheating of buildings as well as the public realm are key to making the City a resilient area as the effects of climate change become more pronounced. Space constraints and loading limits of existing buildings can make it challenging to incorporate measures such as green roofs and walls, sustainable urban drainage measures such as blue roofs, rainwater harvesting and attenuation tanks, adapted façade systems and sustainable heating, ventilation and air conditioning (HVAC) systems. Opportunities and constraints must be clearly communicated to identify the balance between climate change mitigation and adaptation.

6. Carbon optioneering methodology

The GLA's Whole Life-Cycle Carbon Assessments Guidance, Circular Economy Statement Guidance and the City Corporation's Planning for Sustainability SPD require a full exploration of development options before considering substantial demolition. This Carbon Options Guidance recommends a methodology to do so, and it recommends how this should be demonstrated in the planning application. A Carbon Options Tool has been created for reporting purposes, which should be completed by the applicant and submitted to the City Corporation in Excel format.

Due to the significant impact on carbon emissions and climate change by major building interventions and new construction, proposed developments need to demonstrate reduction and mitigation of carbon emissions using a consistent carbon optioneering approach.

Carbon optioneering is required for all major development proposals and those minor proposals where at least 50% (by area) of the existing building(s)' floor slabs is not retained and reused. There may be major development proposals that are classed at retrofits where there is no feasible other option with lower carbon impacts from new construction, as outlined in Chapter 3. Where this has been discussed and agreed with planning officers, application proposals may be considered exempt from carbon optioneering.

Options will be developed by the applicants in early discussions with planning officers in the pre-application process, and their details will vary on a case-by-case basis. The number of options will be limited and agreed based on presenting clearly discernible, feasible design approaches to the proposal in order to inform the optimum design for the application scheme, both in carbon terms and in considering other environmental opportunities such as urban greening, biodiversity, climate resilience measures and circular economy. Agreement on the options to be assessed is not commensurate with planning officers accepting the applicant's preferred option or the 'direction of travel' of the development proposal.

Options should provide an indication of the potential for a given site. They should be based on the same assumptions including which energy strategy is thought to be the most advantageous in carbon reduction terms, in order to be able to compare the options - unless there are reasons for not doing so, which should be stated. Opportunities, constraints and wider considerations should be transparently reported for each option. The options assessment report should include a narrative and explanation around the options initially considered but subsequently excluded from the detailed optioneering exercise.

Optioneering requirements

Carbon optioneering should be carried out as part of discussing the pre-redevelopment audit at pre-application stage with planning officers and include the following:

1. A thorough assessment of the existing building on site, including:
    - Year of original construction and summary of subsequent refurbishment/remedial interventions.
    - Existing building Gross Internal Area (GIA), Net Internal Area (NIA), number of storeys (below and above ground) and overall building height.
    - Building use and occupation status.
    - Description of existing structure, existing façade, and existing building servicing.
    - Slab-to-slab heights (the vertical distance between the top of one floor slab and the bottom of the slab above it).
    - Sustainability credentials, energy performance and sustainability certifications held by the existing building.
    - Type, quality, conditions and residual service life of the existing building's structure, façade, lift and MEP installations.
    - Description of existing issues and constraints – This includes any critical issues affecting any safety requirements, the quality of the space, building's accessibility, and sustainability performance.
    - Minimum upgrades required to resolve the identified critical issues, prolonging the building's lifespan and making the asset usable for an additional period of time (applicants might consider this to be the time that covers the typically shorter lifespan of elements like building services or glass curtain walling, e.g. 15-20 years).
2. Well-considered options that are realistic and feasible development proposals for a specific site from both a short-term and a long-term perspectives - For a short-term upgrade or retrofit options, the carbon impacts of additional interventions occurring after the foreseeable future (e.g. when the short-term ends) and up to 60 years should be considered and included in the Carbon Options Study.
3. Demonstrating different levels of interventions to the existing buildings on site in the design process.
    - The first option of the appraisal (baseline scenario) should reflect the lightest level of interventions to mitigate the critical issues affecting the existing site, prolonging the building's lifespan and making the asset usable/lettable for the foreseeable future, minimising demolition and upfront carbon impacts by delaying more whole scale replacement and associated carbon impacts as much as possible. This can include limited areas of demolition (e.g. plant area) or new build (e.g. infill of part of a floor slab).
    - Options for extension should generally include a variant which demonstrates the maximum extension (floor area) achievable, or that is under consideration by the applicant, whilst minimising works to existing or introducing new foundations or superstructure.
4. Providing options information in Dashboard 1 (Table A) of the City Corporation's reporting template 'Carbon Options Tool', including:
    - Summary of scope of works.
    - Existing GIA being demolished / retained.
    - Proposed Gross Internal Area (GIA)
    - Proposed Net Internal Area (NIA)
    - List of existing materials and building elements being demolished.
    - Overall building height and number of floors above ground.
    - Slab-to-slab heights and achievable floor to ceiling heights.
    - Estimates of existing material retained % by mass for substructure and superstructure (frame, upper floors, roof structure, stairs and ramps, internal and external load-bearing walls) and by area for façade (external walls, windows and external doors).
    - Embodied carbon to practical completion (modules A1-A5).
    - Life-cycle embodied carbon (modules A1-A5, B1-B5, C1-C4).
    - The carbon impact of pre-construction demolition needs to be accounted for and reported separately. For full demolition, applicants should use 50 $kgCO_2e/m^2$ of demolished area as per current GLA WLC Assessment guidance.
    - Whole building energy consumption (kWh/m^2GIA/year and kWh/m^2NIA/year) and operational carbon emissions from energy consumption (module B6). The assumptions behind the figures provided, i.e. UKGBC target or similar, should be stated.
    - EPC rating.
    - Fuel source for operational energy (gas, electricity, other to be defined).
    - Carbon factors used for operational energy.
    - Whole life-cycle carbon including both embodied carbon and operational emissions (A1-A5, B1-B6, C1-C4).

- Opportunities, main benefits and constraints of each development option, specifically in relation to carbon emissions and other sustainability policy areas.
- Any assumptions and justifications for the above in the estimations.

5. Carbon calculations for structure - The embodied carbon of the structure should be calculated for each option using structural engineer estimations. These should be based on standard material specifications for UK projects and default carbon factors as per IStructE guidance 'How to calculate embodied carbon', consistently applied across all options. The results should include 15% contingency, given the early stage of the project and the inherent uncertainty.

6. Other elements or layers of the building can either be based on a detailed calculation, should the design information be available, or on an estimation based on appropriate, and reasonably conservative, carbon benchmarks. The methodology chosen should be identified and explained in the carbon optioneering report. Consistent methodology and assumptions should be adopted across the various development options. If based on detailed calculations, assumptions should align with standard material specifications where possible.

7. Refrigerant impacts (In module B): Refrigerant fugitive emissions from building services can have large impacts in terms of WLC emissions. There are complexities in predicting these emissions at the earliest stages as designs are often not established to the level where they can be accurately estimated. However, optioneering should take into account the refrigerant impacts, this is especially important if different systems are proposed in the options assessed i.e. a Chiller, a VRF/ VRV system, an ASHP etc.

   These impacts should be calculated consistently using reasonable data and stated assumptions. The refrigerant type should be clearly stated along with the GWP. Where systems are the same type for all options it is reasonable to assume the refrigerant impact would be similar across options.

   Estimations of impact should be reported in Table B in the cumulative impacts tab of the tool.

8. Operational energy (B6) – Applicants are required to report the estimated Energy Use Intensity (EUI) for the whole building (kWh/m^2GIA/year and kWh/m^2NIA/year) for each option.

   - The energy use can be estimated through use of industry benchmarks and energy targets (e.g., UKGBC energy targets for office buildings, NABERS DFP whole building estimations, or Better Building Partnership (BBP) benchmarks, for example the Real Estate Environmental Benchmark (REEB) are deemed to be the most realistic for whole building estimations based on actual data. Detailed energy modelling such as predictive energy assessment is not required for the purpose of the Carbon Options Study. However, given the early stage of the project, the applicant team should adopt appropriate, and reasonably conservative, energy consumption rates that can realistically be delivered by each option.
   - Consistent methodology, assumptions and carbon factors should be adopted across the various development options. Where different options involve significant fabric improvements and/or new energy-efficient HVAC systems, it reasonable to assume the same (or at least a similar) energy performance.
   - Applicants should not account for the long-term decarbonisation of the electricity grid in their carbon optioneering studies. This is to make sure there is better impact flow into the detailed WLC and to represent a worst case solution at this stage.
   - For electricity sourced from the national grid, the Part L 2021 carbon factor (0.136 $kgCO_2e/kWh$) should be used.
   - Where gas is supplied, the 0.210 $kgCO_2/kWh$ Part L figure should be used. Where gas is used, it will need to be converted to an electric equivalent in kWh. To convert gas consumption (kWh) to electrical equivalent (kWhe), multiply kWh gas by 0.75. Refer to latest guidance from NABERS/BRE/BBP/UKGBC as appropriate.
   - District Energy: Where a district energy network is used, the carbon factor should be stated based on information from the network provider and must be referenced in the reporting.
   - Where a mix of different energy sources are used in the same option, carbon estimations depending on consumption by fuel type should be calculated.

9. Ensuring like-for-like reporting, without bias to favour one option against the others. For example, the opportunity for energy and carbon improvements (such as the adoption of high-efficient heating/cooling/ventilation systems or the specification of low-carbon construction materials) should be equivalent across all options, except where constraints can be demonstrated, and the equivalent level of aspiration to reduce elemental embodied carbon should be applied equally across all options.

10. Presenting the development options on the basis of consistent, assumed and proposed data including:

    - An equivalent approach to the level of assumptions and certainty applied to embodied carbon estimates.
    - Reporting in line with the equivalent scope for the WLC Assessment (life-cycle stage and building element scopes).
    - Embodied carbon impact of further interventions with justifications provided i.e. what has been assumed. For example, estimated impact of plant replacement every 15 years of operation over the life-cycle, using life-cycle modules B1-B5, C1-C4.

11. Exclude Module B7 'Water Consumption' at this stage, as it does not vary significantly between options, and it has a minor impact on the carbon footprint of the development. Any variances, in particular where an opportunity or constraint occurs for one option and not another, should be shown.

12. Existing multi-building sites - Dashboard 1 (Table A) of the City Corporation's reporting template 'Carbon Options Tool' should be completed with the cumulative information of the whole development, however the applicants should provide additional granularity and include specific information for each building within the accompanying optioneering report. Information to report for each existing building includes all information listed in point 1 and point 4 of this chapter.

    It should also be noted that the WLC Assessment emissions fluctuate and are likely to be different in later design and construction stages. Generally, this is due to the availability of more detailed design information, material quantities and accurate carbon data from the supply chain. 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.

Chapter 7, Third-party review, is also a useful reference point to ensure applicants provide all the necessary information in the Carbon Options Study.

7. Third-party review

Third-party review is required to ensure that options have been designed, calculated and evaluated realistically, consistently and to prove transparency.

The requirement for third-party review introduces rigour and scrutiny into the process and ensures that the carbon optioneering forms a robust basis for the development of the application scheme.

The review process will be arranged by the planning officers to prevent any dependency issues and shall be funded by the applicant (see Figure 6 below). A tender process will be started at the earliest opportunity by planning officers, inviting external organisations able to meet the requirements and the qualifications described in this chapter to submit their proposal for third-party verification.

The appointment of the third-party reviewer will be managed by planning officers and funded by the applicant. The tender process will be started at the earliest opportunity by planning officers to ensure that the appointment of the third-party reviewer is confirmed before the options are agreed.

Third-party review process

The applicant team should complete a preliminary optioneering assessment for the existing site and present the outcome of this exercise to planning officers during the first pre-application sustainability workshop, and third-party reviewer once appointed. This preliminary scoping exercise should include:

- A detailed assessment of the conditions of the existing building on site, including existing opportunities and constraints (e.g., any potential critical issues affecting safety requirements, building accessibility, sustainability performance, compliance with buildings regulation and current planning policies, the quality of the space and lettability) and potential upgrades to resolve the described issues and to prolong the building's lifespan, guaranteeing usability and lettability of the asset for a period of time to make full use of the lifespan of the upgrade.
- An overview of the optioneering criteria, including any key drivers factored in the decision-making process.
- A list of well-considered, realistic and feasible development options for the specific site, as well as any options assessed and discounted as part of the scoping assessment – opportunities and constraints of each option should be presented and discussed with the planning officers.

A carbon assessment for each option is not required at this stage, this will be completed afterwards and only for the options collaboratively agreed between the applicant, planning officers and third-party reviewer.

Upon completion of the third-party review of the Carbon Options Study, the third-party reviewer and the applicant shall submit the latest documents to the City Corporation officers, who will review the results and the main findings from the review process and will inform the applicant of any arising actions required to complete a successful carbon optioneering process.

To ensure consistency of review, it is preferred that the same third-party reviewer would be instructed to complete a third-party review of the detailed planning stage WLC Assessment in the subsequent stage of the application process.

Where the proposal submitted for planning is substantially different from any of the options assessed during the pre-application stage (see Chapter 8 for the definition of 'substantially different'), the applicants should produce an addendum to the Carbon Options Study previously submitted. This might be subjected to additional verification from the third-party reviewer.

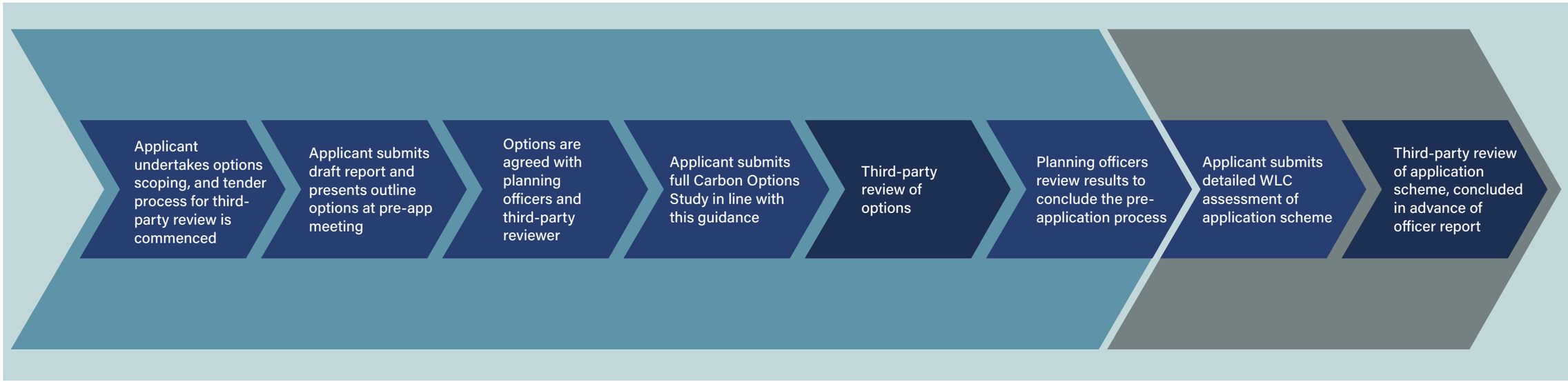

Figure 8: Optioneering and third-party review process. Informal discussions between applicant and planning officers are encouraged in all stages of the optioneering process.

Third-party reviewer qualifications

Third-party reviewers appointed by the City Corporation must:

- Be independent from the applicant's team. A statement will be needed to avoid conflicts at tender stage, providing a declaration of their independence.
- Have suitable experience of a minimum of 3 years in carrying out and reviewing whole life-cycle carbon assessments and energy strategies / operational energy assessments (whole building).
- Have recent working experience in the construction industry, preferably on projects in the City, on building assets with similar scale and use.
- Submit CVs of the team of reviewers and relevant experience.

Third-party review output

The output should be in the form of a summary report that clearly summarises the main findings from the review process.

A Third-party review framework has been developed and can be provided by planning officers. All third-party reviewers should use this framework to ensure consistency as well as guaranteeing that all applications are subject to the same level of scrutiny. The Third-party review framework and governance guidance can be downloaded from the City Corporation webpage *'Sustainable development planning requirements'*.

The findings should be categorised based on their potential impact on the carbon comparison, adopting the following status codes:

- *Status A – Compliant and/or satisfactory evidence.*
- *Status B – Minor discrepancies, observations and recommendations provided by the third-party reviewer with minor impact on the carbon comparison of the different development options. The applicants should review all Status B findings, provide the necessary clarifications and update the Carbon Options Study accordingly. However, as they are expected to be of low significance, it is acceptable to conclude the third-party verification with a small number of unresolved Status B findings, should this be deemed a reasonable approach agreed with the third-party review and City Corporation officers.*
- *Status C - Discrepancies and/or inconsistent assumptions detected by the third-party reviewer, for example, that could potentially alter the carbon comparison of the different development options.*

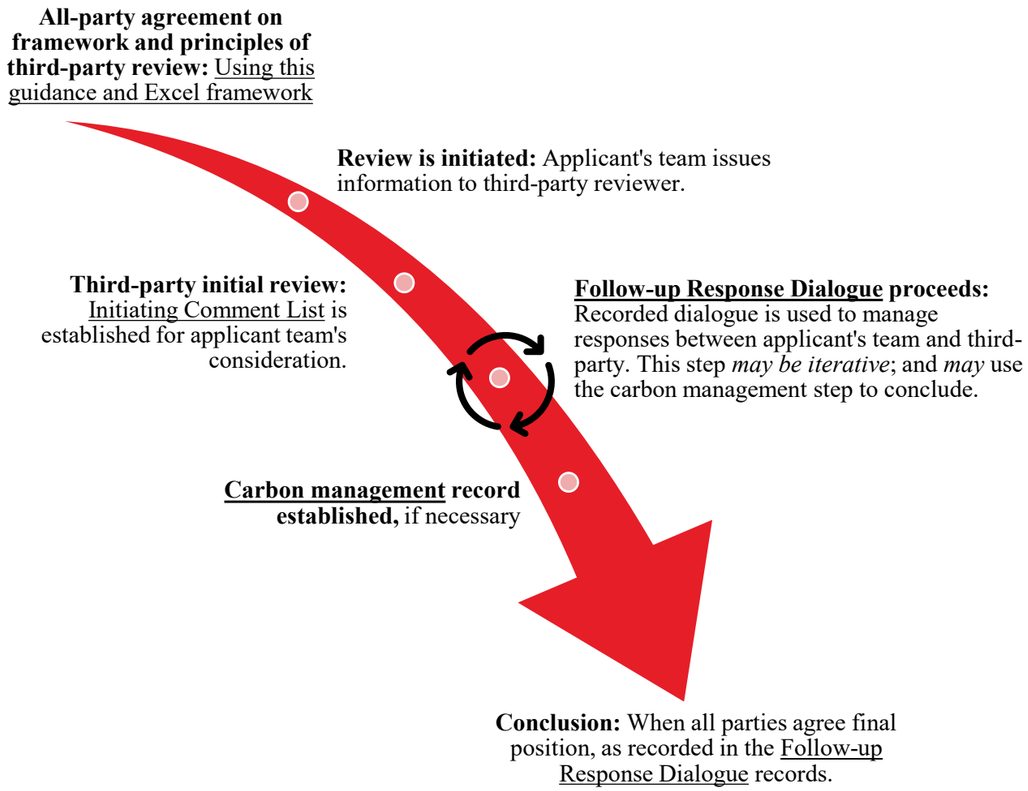

Figure 9: Third-party review process (Third-party review governance guidance, Arup 2025)

All findings classified with a status 'C' should be reviewed and addressed by the applicant team ahead of the conclusion of the carbon optioneering process. The applicant team may, at their own risk, conclude the optioneering process with certain unresolved Status C findings; in such instances, the applicant is expected to substantiate their decision with robust justifications, providing valid reasons for not addressing the feedback from the reviewer.

Assessment guidance for Reviewers

The review process should start with a briefing session between the applicant team and the third-party reviewer. This is an opportunity for the applicants to brief the appointed reviewer on the wider context of the project, the site-specific opportunities and challenges, as well as providing an overview of the optioneering process and the resultant carbon assessment.

The overarching goal of the third-party review process is to ensure like-for-like reporting, without bias to favour (or penalise) one development option against the others. The review is not intended to be a criticism of the Carbon Options Study prepared by the applicant; instead, the process should help ensure consistency in assumptions and elevate the information provided by the applicant to the planning officers for consideration of carbon impacts, as well as improving industry and applicant knowledge.

In reviewing the Carbon Options Study, the third-party reviewer should cover the following items:

1. Information on the existing site – This should include a thorough assessment of the existing building on site, covering as a minimum the information listed in Chapter 6.

   Are the existing building conditions reflected in the choice and nature of options presented?

2. The review should ensure that options are sensible and pragmatic. Does the choice of options reflect realistic and workable proposals for the maintenance, retrofit and development of the site and cover clearly discernible scenarios? Is the scope of the works fully set out for each option?

3. Has a baseline scenario been set in accordance with the recommendations provided in Chapter 6? This should reflect the lightest level of interventions to mitigate the critical issues affecting the existing site, prolonging the building's lifespan and making the asset usable/lettable for the foreseeable future, minimising demolition and upfront carbon impacts.

4. Where the Carbon Options Study includes options for extending the building floor area, has an option which demonstrates the maximum extension (floor area) achievable whilst minimising strengthening works to the existing structure been considered?

5. Are the structural impacts calculated for each option robust, consistent and do they include a breakdown into relevant elements? As per the methodology recommended in Chapter 6, the embodied carbon of the structure should be calculated for each option using structural engineer estimations.

6. Are other key design elements aligned between options, and if not, are differences declared and explained? Other elements or layers of the building can either be based on a detailed calculation, should the design information be available, or be based on an appropriate estimation and reasonably conservative benchmark. Are the adopted methodology and assumptions consistent across the various development options? Are the chosen methodologies and benchmarks clearly presented in the carbon optioneering report?

7. Are any differences in operational emissions (life-cycle stage B6) reasonable between options? Has the energy consumption for the whole building been considered in the appraisal? Are the Energy Use Intensities (kWh/m^{2}NIA/year or kWh/m^{2}GIA/year) assumed by the project team for the various options reasonably conservative and realistically achievable? Or are they unrealistically low? And, if so, what is the justification? Is there a consistent approach across options? Are the energy sources and the related carbon factors ($kgCO_2e$/kWh) aligned across the options?

8. How has refrigerant impact been considered? Are the estimations and assumptions reasonable?

9. Where applicable, is the carbon impact resulting from a change of use clearly presented (e.g. changing from offices to hotel, requiring works to risers, cores, building services etc.)?

10. Have demolition impacts been calculated in accordance with the recommendations provided in Chapter 6 (50 $kgCO_2e/m^2$ of demolished floor area), as per current GLA WLC guidance? Are demolition impacts separately reported?

11. Are the options fully evaluated, including circular economy approaches, climate resilience measures and wider considerations, such as commerciality and risks? Are the constraints and the opportunities for each option clearly presented without bias and avoiding use of inconsistent assumptions that can favour or penalise one or some of the options presented?

12. Does the evaluation of the options focus on carbon impacts, sustainability, and quality issues separately? Does it include an overall summary that is clear and comprehensible?

13. Is all the required and relevant data in the methodology presented clearly and correctly in Dashboard 1 of the Carbon Options Tool? Are all options based on the same level of detail and supported by the same level of design information?

14. For multi-buildings sites, have specific EUIs, carbon impacts and retention rates for each building been separately provided within the summary report, as well as the overall figures within Dashboard 1 of the Carbon Options Tool?

The reviewers are responsible for reviewing the information provided to them by the applicant's team. It is the responsibility of the applicant to ensure the information provided to the reviewers is accurate, updated and as clear as possible. Reviewers may need to request some additional contextual information from the applicant to complete the review process.

8. The consideration of options in the planning application process

Planning applications submitted to the City Corporation are expected to provide a narrative of how the optioneering process has informed the design of the application scheme in terms of retaining building elements and materials and reducing carbon emissions. The Carbon Options Study should include an analysis of the opportunities and constraints of each option along with high level estimates of the associated WLC impact compared against the vision and deliverables of a site. This assessment is designed as a tool for the discussion and negotiation of a proposal in the early pre-application stage between applicants and planning officers to help optimise the design of the application scheme.

The methodology set out in this guidance will be updated as necessary to reflect the latest scientific advances, technologies, policies and regulations.

Carbon Options Study and pre-redevelopment audit

A Carbon Options Study developed in compliance with this guidance and a pre-redevelopment audit, as defined in the London Plan Guidance for Circular Economy Statements (current version, March 2022), serve the same purpose: they are both tools to explore options for retaining existing structures, materials and the fabric of existing buildings into the new development; and the potential to refurbish buildings before considering substantial demolition.

These two assessment tools are based on similar optioneering considerations:

- Both assessments require a deep understanding of the existing building, including its age, condition, and anticipated lifespan (e.g. facade, structure, MEP systems, etc.).
- Both assessments should be undertaken as early as possible and completed during pre-application stage to inform the design of the application scheme.
- An independent review of the pre-redevelopment audit is strongly encouraged (as per Clause 4.6.3 of GLA CES Guidance), just as a Carbon Options Study developed in compliance with this guidance should undergo independent third-party review as a quality assurance mechanism for their optioneering results.

- The decision-making process followed in both assessments should include considerations covering a wider range of environmental, social and economic sustainability of developments, in addition to an evaluation of the carbon impact of different development scenarios (which is the overarching goal of a Carbon Options Study completed in line with this guidance).

In consideration of the similarities between the two optioneering assessments, applicants might consider combining the Carbon Options Study and the pre-redevelopment audit into one comprehensive report, provided that this exhaustively meets the reporting requirement listed in this guidance, in addition to the submission of the City Corporation Carbon Options Tool in Excel format.

Application stage WLC Assessment

When required by development plan policy, all major developments must submit a WLC Assessment that complies with GLA WLC Assessment Guidance. The Planning for Sustainability SPD encourages minor developments with significant demolition to submit a WLC Assessment for the benefits of data monitoring and sharing of insights.

The WLC Assessment report should transparently disclose the main assumptions that inform the assessment, as well as any exclusions and/or deviations from the requirements stated in the current GLA WLC Assessment Guidance (March 2022). The WLC results of the application scheme may vary from the WLC results reported in the Carbon Options Study, as (1) the application stage WLC Assessment is based on more, and perhaps different, design detail compared with the options, and (2) the final application scheme may include measures explored in various options.

Where the proposal submitted for planning permission is 'substantially different' from any of the options assessed and presented to the City Corporation officers in the pre-application stage, in particular consisting of works with significantly higher carbon impacts, the applicants should produce an addendum to the Carbon Options Study previously submitted to justify deviations. The addendum might be subjected to additional verification from the third-party reviewer, would this be requested by planning officers.

The planning scheme can be considered 'substantially different' when any of following conditions apply:

- The new build GIA is more than 20% higher than the new build GIA stated in the carbon optioneering for the assessed options.
- The existing GIA being demolished is more than 20% higher that the value stated in the Carbon Options Study.
- The retention rates of the substructure, superstructure and/or façade are 20% lower than the retention rates provided in the pre-application stage for the preferred option.
- The upfront embodied carbon (A1-A5) of the proposed structure, either in absolute terms (tCO_2e) or as intensity ($kgCO_2e/m^2GIA$), is more than 20% higher than the performance stated in the Carbon Options Study.
- The planning scheme would not deliver the main benefits described in the Carbon Options Study.

The addendum to the Carbon Options Study should include:

- Justification for deviations from preferred option previously submitted and relevant design evidence (e.g. additional on-site surveys that demonstrate the need for additional structural demolition and/or façade alteration/replacement).
- Identification of any sustainability areas where the planning scheme would fall short on performance and/or would not achieve the targets presented in the pre-application stage.

Embodied carbon benchmarks

The Planning for Sustainability SPD (pages 22-23) sets out that proposals should achieve the GLA 'WLC benchmark' ('standard' benchmark) as a minimum for upfront carbon emissions (life-cycle modules A1 – A5). Proposals should target the GLA 'aspirational WLC benchmark' for all embodied carbon emissions (life-cycle modules A – C). The Carbon Options Study should provide early indications as to which options may result in high upfront carbon impacts.

Where the standard benchmark is not achieved (or aspirational from 2030), high embodied carbon impacts of development proposals should be mitigated by providing 'wider environmental sustainability benefits'. These should provide substantial benefits beyond policy requirements onsite or beyond the site boundary to contribute to the sustainability of the Square Mile, as required by the Development Plan and detailed in the 'Beyond the building' section of the City Corporation's Planning for Sustainability' SPD, February 2025.

Third-party verification

The WLC Assessments submitted at application stage should be independently reviewed to ensure consistency, accuracy and quality assurance in reporting. The review will be arranged by planning officers and funded by the applicants. To ensure consistency of review, it is preferred that the same third-party reviewer would be instructed to complete a third-party review of the detailed planning stage WLC Assessment in the subsequent stage of the application process. The third-party review should be undertaken using the Third-party review framework.

Conditioned WLC Assessment submissions

Planning stage WLC Assessments include assumptions in advance of subsequent design and procurement stages of the proposed development. Estimated carbon emissions may change due to design development, market availability, available carbon data etc. This may result in an embodied carbon gap between planning stage and practical completion. To manage this process more constructively in the planning process, and mitigate risks in collaboration with applicants, major applications will be conditioned to submit RIBA Stage 4 (Technical Design) and RIBA Stage 6 (Post-Construction) WLC Assessments. The City Corporation will monitor post-completion results that are required to be submitted by condition.

The updated WLC Assessments should include details and information that explain changes to the reported carbon emissions. The as-built submission (RIBA Stage 6) should be based on as-built bills of material quantities provided by the appointed contractor and approved by the project Quantity Surveyor. The as-built WLC Assessment should comply with the data validation criteria provided in section 2.7 of the current GLA's WLC Assessment guidance (Materials and products) including the 'Acceptable sources of carbon data for materials and products' section.

Appendix 1 Related reporting requirements

Non-policy related reporting for net zero carbon

Over the past five 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 Low Energy Transformation Initiative (LETI) targets and scope.
- The UKGBC Net Zero Carbon Definition Framework and energy performance benchmarks for office buildings.
- The forthcoming Net Zero Carbon Buildings Standard. Note: this initiative is currently in the pilot stage (Pilot version rev2 – April 2025). Version 1 is due in Q1 2026.

Low Energy Transformation Initiative (LETI)

LETI has published several design guidance documents that set out a trajectory of embodied carbon and operational energy targets required to address the climate emergency. The WLC Assessment scope associated with their targets is limited to stages A1-A5 to practical completion.

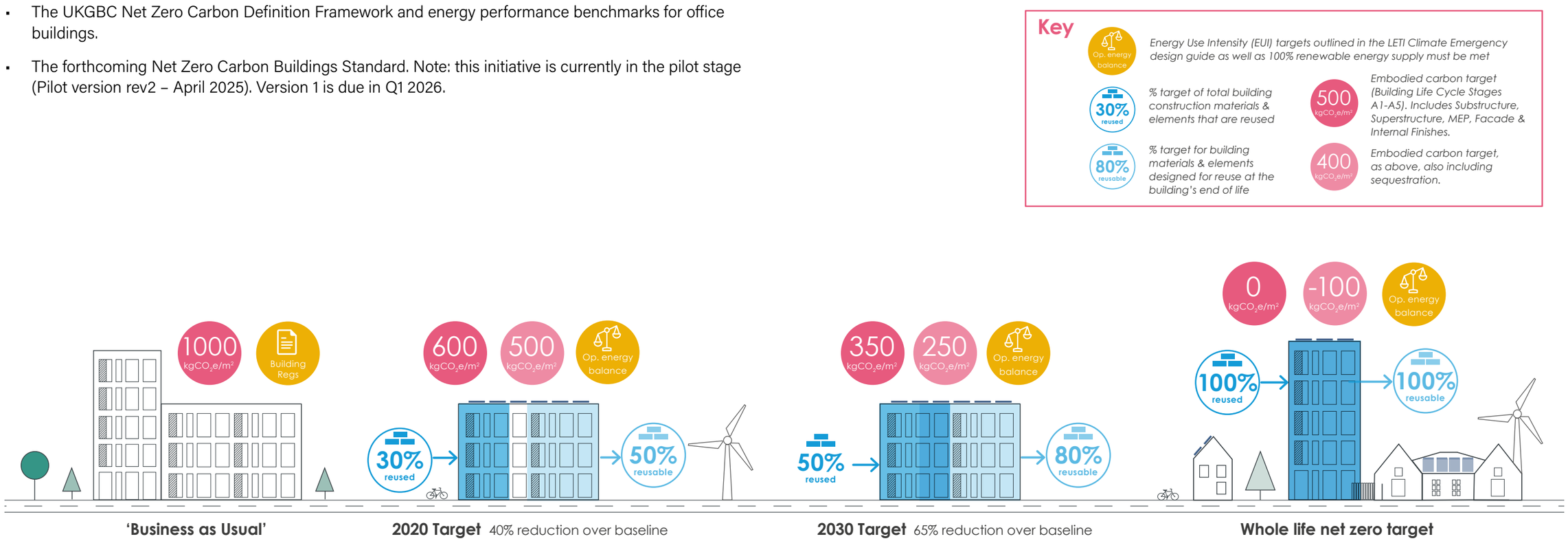

Figure 10: Example of LETI Carbon best practice targets for Commercial offices from LETI Embodied Carbon Primer (Jan 2020), Figure 7.1.

UKGBC Net Zero Carbon Buildings Framework Definition and UK Net Zero Carbon Building Standard

The UKGBC sets 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.

The framework requires third-party review of WLC Assessments and operational energy assessments, including a minimum carbon reporting template and information that 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.

Since the above by the UKGBC took place, leading industry organisations such as BBP, BRE, the Carbon Trust, CIBSE, IStructE, LETI, RIBA, RICS, and UKGBC have joined forces to champion a UK Net Zero Carbon Building Standard (UK NZCBS). The first pilot version of the UK NZCBS has been released in September 2024. Following the publication of the first pilot draft, the UK NZCBS is currently trialling the pilot version of the Standard on real projects. The pilot testing scheme aims to gather feedback on the process of implementing the Standard across a range of sectors and project stages. The pilot testing phase should be completed by Q4 2025 with the publication of the first edition of the UK NZCBS in early 2026, ready for adoption across the wider industry. The UK NZCBS pilot includes energy limits, decreasing year on year, for different types of buildings including offices. The limits differ from the UKGBC energy performance targets shown in Table 3.

Table 3: Energy performance targets for buildings targeting net zero carbon for operational energy, Net zero carbon: energy performance targets for offices UKGBC, January 2020.

Scope	Metric	Interim Targets 2020-2025	Interim Targets 2025-2030	Interim Targets 2030-2035	Paris Proof Target 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

Comparison of Net Zero Carbon definitions

Table 4: Comparison on UKGBC net zero carbon and London Plan net zero carbon definitions

Topic	London Plan GLA Reporting Requirements	UKGBC Net Zero Carbon	UK NZCBS Pilot Version – Revision 1
Whole Life-Cycle carbon	All life-cycle modules A-D (B6, B7, and D not included in GLA benchmarks).	Minimum reporting Stages A1-A5, B4 for superstructure ext. walls and windows/external doors, B6 operation energy. Full Assessment Modules A-C	Upfront embodied carbon (A1-A5) limits for projects starting on site in 2025-2050, with performance limits decreasing over time. Currently no limits for lifecycle embodied carbon (A-C, excl. B6-B7), only reporting requirements. Lifecyle limits might be included in future versions of the Standard.
Regulated operational carbon emissions from energy use	Part L2 regulated carbon assessment used to determine net zero carbon target TM54 required for 'be seen' (non-residential)	Includes all energy use within declarant's control	Whole building operational energy assessed and reported, including both regulated and unregulated energy use. Minor exclusions: Electric vehicle charging, heavy process loads managed by regulation, energy used by external works and within car parks. Energy use intensity limits (kWh/m²GIA/year) for different building typologies, decreasing over time.
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 5,000m² TM54 requires for 'be seen' (non-residential)		
Renewable energy generation	Priority for on-site renewables, but offsite renewables are acceptable alternative to carbon offset (conditional)	Onsite and off-site renewables	On-site renewable electricity generation targets (kWh/m² building footprint / year) for different building types and location Upfront embodied carbon limits for PV panels per peak power output ($kgCO_2e$/kWp)
Carbon offsetting	Offset residual carbon relative to 100% regulated carbon savings only, determined by Part L2 target. Carbon offset is recommended as £95/tonnes CO_2 paid in advance and for a 30-year life-cycle	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 Transition Fund for further decarbonisation	Optional

Other carbon-related planning reports

There are other carbon-related planning reports that should also be taken into consideration. They include greenhouse gas impact assessments, the Circular Economy Statement, operational energy and operational water assessments. Where relevant, these should be referenced in WLC Assessment reporting, in particular to highlight discrepancies and overlaps in design considerations and decisions.

Greenhouse gas 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 Sustainability and Environmental Professionals (ISEP) 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 life-cycle scope, aligning with parts of the GLA WLC Assessment method referred to above. The approach covers similar themes but may not be as detailed as a full WLC Assessment due to the timing of the assessment.

The differences in the approach include:

1. The scope of emitters is broader, including for example emissions from operational transport and leaking F-gases (refrigerants). Note, the GLA requires separate calculation of refrigerant emissions (including fugitive emissions) in the reporting WLC Assessment template.
2. The proposal is compared to a current baseline.
3. Exclusions, metrics, data quality, degree of uncertainty and mitigation measures need to be defined.
4. GHG assessments can be carried out a lot earlier than a detailed application WLC Assessment (to GLA standards), for example for an Outline Planning Application, and therefore the results tend to be based on industry averages and sector-level carbon benchmarks for different type of buildings and/or building layers, rather than specific design information of the proposed scheme.

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

Table 5: GHG Management Hierarchy, 2020 (Source: ISEP, Assessing Greenhouse Gas Emissions and Evaluating their Significance' (2nd edition.)

IEMA Greenhouse Gas Management Hierarchy (updated 2020)
Eliminate ▪ Influence business decisions/use to prevent GHG emissions across life-cycle ▪ Potential exists when organisations change, expand, rationalise or move business ▪ Transition to new business model, alternative operation or new product/service
Reduce ▪ Real and relative (per unit) reductions in carbon and energy ▪ Efficiency in operations, processes, fleet and energy management ▪ Optimise approaches (e.g. technology) and digital enablers
Substitute ▪ Adopt renewables/low-carbon technologies (on site, transport etc.) ▪ Reduce carbon (GHG) intensity of energy use and of energy purchased ▪ Purchase inputs and services with lower embodied/embedded emissions
Compensate ▪ Compensate 'unavoidable' residual emissions (removals, offsets etc.) ▪ Investigate land management, value chain, asset sharing, carbon credits ▪ Support climate action and developing markets (beyond carbon neutral)

GLA pre-application optioneering

The London Plan Guidance 'Whole Life-Cycle 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 life-cycle stage) to aid planning applicants in designing buildings that have low operational carbon and low embodied carbon.

The GLA WLC Assessment template needs to be completed at four stages, namely at, pre-application, planning submission (outline and detailed) and post construction (prior to occupation).

The GLA encourages WLC Assessments on major applications that are not referable to the Mayor. The City Corporation is supportive of this approach and requires that they are provided as part of the planning application in line with the GLA requirements. In addition to the above, City Corporation planning officers request, by condition, a more detailed update of the WLC Assessment following the detailed design phase (RIBA Stage 4) prior to construction when more design and procurement information is available to the project team. This is to ensure that the City Corporation is aware of and understands opportunities and constraints through changes of and improvements to developments.

The GLA WLC Assessment guidance includes a hierarchy of WLC reduction principles (see Appendix 2 for full list) which should inform the design of the development from the earliest stages and throughout the WLC Assessment process. Principle 1 is 'Reuse and retrofit of existing buildings.'

At pre-application stage the following must be demonstrated:

- Examples of how the design of the development addresses each WLC principle or reasons why a principle cannot be met.
- 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 (currently 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.

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 requires the reporting of refrigerant Global Warming Potential emissions in $kgCO_2e/m^2GIA$. This is important to include in the WLC Assessment. The GLA requires reporting of refrigerant impact in the WLC Assessment template spreadsheet. Measures can be installed to prevent and manage refrigerant leakage to the atmosphere. The requirement for leak detection and containment of refrigerants as part of the commissioning process could be secured through a condition.

Table 6: Extract from the GLA WLC Assessment template (March 2022) showing where and how the retention of existing building and structures is reported

Retention of existing buildings and structures	
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.]

Circular Economy Statement

The Mayor of London's London Plan 2021 requires proposals referable to the Mayor to calculate a development's impacts and solutionsto 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 WLC Assessment.

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 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 to 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/space plan/interior/ interior space, stuff and contents.

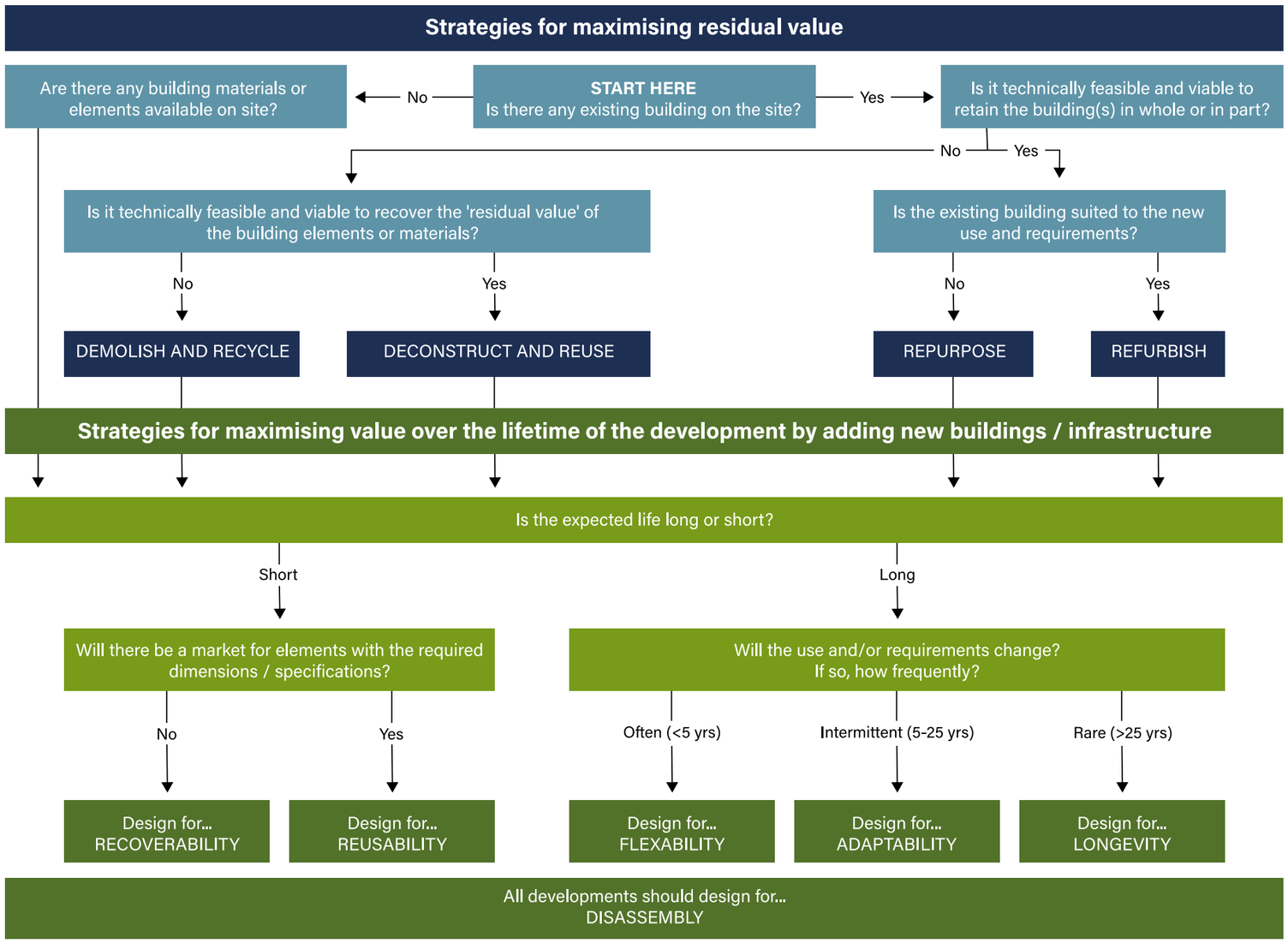

Figure 11: Decision tree for design approaches to existing structures/buildings -GLA Circular Economy Guidance March 2022

Carbon Emissions from Operational Energy and Water

The WLC Assessment includes life-cycle stages B6 (Operational Energy) and (B7 Operational Water). GLA planning policy currently requires separate energy and water consumption reporting. This section clarifies the requirements and overlaps between reporting requirements. GLA benchmarks for life-cycle embodied carbon 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 life-cycle.

BREEAM New Construction's 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 Design for Performance (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, post-completion 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'. NABERS UK DfP is encouraged for office buildings greater than 5,000 m^2.

CIBSE, TM54 and NABERS UK give a far more accurate and complete estimate of operational carbon emissions than Building Regulations Part L as they allow for detailed prediction of regulated and unregulated energy using more detail and realistic parameters to evaluate energy performance, rather than a uniform set of standardised regulated energy parameters. Part L modelling is used to ensure that buildings meet the minimum energy efficiency standards set by building regulations, while TM54 operational energy modelling is used to identify areas where energy consumption can be reduced and to inform decisions on building design and operation

Both the TM54 and NABERS UK (currently for commercial offices only, other schemes are being developed) approaches align with the reporting requirements of Stage B6 'Operational Energy Use' under the GLA's WLC Assessment Guidance (March 2022) and the GLA's 'Be seen' guidance.

The GLA also requires in use monitoring and Energy Use Intensity (EUI) reporting of actual energy use for the first 3 years of a building's operation.

Operational water use

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

1. Part of the WLC Assessment (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 Corporation'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.

Figure 12: CIBSE TM54 'Evaluating operational energy use at the design stage' (2022)

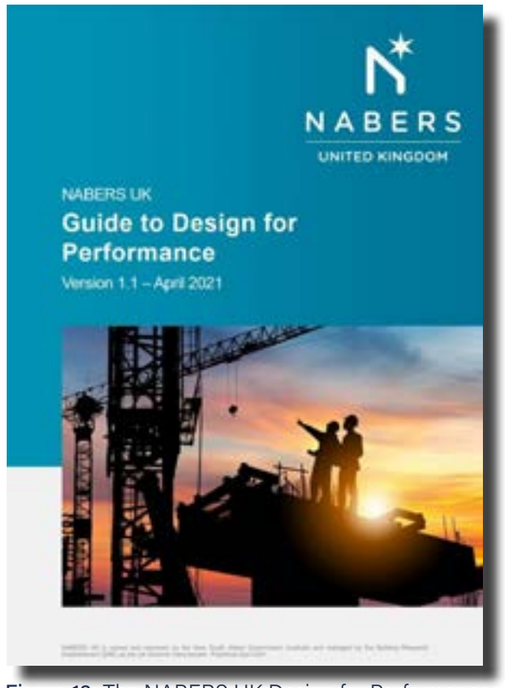

Figure 13: The NABERS UK Design for Performance guidance manual

Appendix 2 GLA WLC Assessment pre-application WLC reduction principles

Table 7: GLA WLC Reduction Principles

No.	WLC reduction principles	Key benefits
1	**Reuse and retrofit of existing buildings**	Retaining existing built structures for reuse and retrofit, in part or as a whole, should be prioritised before considering substantial demolition, as this is typically the lowest-carbon option. Significant retention and reuse of structures also reduces construction costs and can contribute to a smoother planning process.
2	**Use re-purposed or recycled materials**	Using repurposed or recycled or materials, as opposed to newly sourced materials, typically reduces the carbon emissions from constructing a new building and reduces waste. This process would start by reviewing the materials already on site for their potential for inclusion into the proposed scheme. Many of the currently available standard products already include a degree of recycled content.
3	**Material selection**	Appropriate low-carbon 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. It is important to note that the overall lifetime carbon emissions of a product can be as much down to its durability as to what it is made of. For example, bricks may have high carbon emissions in terms of their manufacture, but they have an exceptionally long and durable life expectancy. The selection of reused or recycled materials and products, plus products made from renewable sources, will also help reduce the carbon emissions of a project.
4	**Minimise operational energy use**	A 'fabric first' approach should be prioritised to minimise the heating and cooling requirement of a building and the associated systems. Naturally ventilated buildings avoid the initial carbon and financial costs of a ventilation system installation, and the repeat carbon and financial costs of its regular replacement.
5	**Minimise the carbon emissions associated with operational water use**	Carbon emissions from water use are largely due to the materials and systems used for its storage and distribution, the energy required to transfer it around the building, and the energy required to treat any wastewater. The choice of materials used and the durability of the systems, which help avoid leakage and resulting damage to building fabric, are therefore key aspects of reducing the carbon emissions of water use. On-site water collection, recycling and treatment, and storage can have additional positive environmental impacts as well as reducing in-use costs.
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. A simple example is using lime rather than cement mortar - the former being removable at the end of a building's life, the latter not. This enables the building's components (e.g. bricks) to have a future economic value as they can be reused for their original purpose rather than becoming waste or recycled at a lower level (e.g. hardcore in foundations). Designing building systems (e.g. cladding or structure) for disassembly and dismantling has similar and even broader benefits. Ease of disassembly facilitates easy access for maintenance and replacement leading to reduced maintenance carbon emissions and reduced material waste during the in use and end-of-life phases. This leads to the potential for material and product reuse which also reduces waste and contributes to the circular economy principle.
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. A complex building shape with a large external surface area in relation to the floor area requires a larger envelope than a more compact building. This measure of efficiency can be referred to as the 'wall to floor ratio', or the 'heat loss form factor'. This requires a greater use of materials to create the envelope, and a potentially greater heating and/or cooling load to manage the internal environment.

No.	WLC reduction principles	Key benefits
8	**Regenerative design**	Removing carbon from the atmosphere through materials and systems absorbing it makes a direct contribution to carbon reduction. Examples include unfinished concrete, some carpet products and maximising the amount of vegetation.
9	**Designing for durability and flexibility**	Durability means that repair and replacement is reduced which in turn helps reduce lifetime 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. Buildings designed with this principle in mind will be less likely to be demolished at their end-of life as they lend themselves to future refurbishment. Examples include buildings being designed with 'soft spots' in floors to allow for future modification and design, as well as non-structural internal partitions to allow layout change.
10	**Optimisation of the relationship between operational and embodied carbon**	Optimising the relationship between operational and embodied emissions contributes directly to resource efficiency and overall cost reduction. For example, the use of insulation has a clear carbon benefit whereas its fabrication will generate carbon emissions. This means that it is important to look not only at the U-value of insulation, but also the carbon emissions from the manufacture and installation of different product options. Avoiding fully glazed façades will reduce cooling demand and limits the need for high-carbon materials (glass units, metal frame, shading device etc.) at both the construction and in-use stages through wholesale replacements.
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 therefore supply chain lengths; and has associated local social and economic benefits, e.g. employment opportunities. It also has benefits for occupiers as replacement materials are easier to source. Transport type is also highly relevant. A product transported by ship will have significantly lower carbon emissions per mile than one sent by HGV. A close understanding of the supply chain and its transport processes is therefore essential when selecting materials and products.
13	**Minimising waste**	Waste represents unnecessary and avoidable carbon emissions. Buildings should be designed to minimise fabrication and construction waste, and to ease repair and replacement with minimum waste, which helps reduce initial and in-use costs. This can be achieved through the use of standard sizes of components and specification and by using modern methods of construction (MMC). Where waste is unavoidable, the designers should establish the suppliers' processes for disposal or preferably reuse or recycling of waste.
14	**Efficient construction**	Efficient construction methods (e.g. modular systems, precision manufacturing and MMC) can contribute to better build quality, reduce construction-phase waste and reduce the need for repairs in the post completion and defects period (snagging). These methods can also enable future disassembly and reuse with associated future carbon savings.
15	**Lightweight construction**	Lightweight construction uses less material, which reduces the emissions of the building as there is less material to source, fabricate and deliver to site. Foundations can then also be reduced with parallel savings. Lightweight construction can also be easier to design for future disassembly and reuse. The benefits of lighter construction should be seen in the context of other principles such as durability.
16	**Circular economy**	The circular economy principle focuses on a more efficient use of materials which in turn leads to financial efficiency. Optimising recycled content, reuse and retrofit of existing buildings; and designing new buildings for easy disassembly, reuse and retrofit, and recycling as equivalent components for future reuse are essential. The use of composite materials and products can make future recycling difficult. Where such products are proposed, the supplier should be asked for a method statement for future disposal and recycling.

Glossary

The below included a series of definition for terms used in the document. A number of these terms are aligned with industry standards including the document *Improving Consistency in Whole Life Carbon Reporting Assessment and report – Carbon definitions for the Built Environment Buildings and Infrastructure, January 2023.* (https://www.leti.uk/carbondefinitions). *'This document was put together initially by a working group within the Whole Life Carbon Network (WLCN, a group of some 90 built environment professionals) and includes detailed discussions between WLCN, LETI, CIBSE, RIBA, RICS, IStructE, ICE, and UKGBC. The 'Definitions' are structured around CEN TC 350 life-cycle modules, (e.g. BS EN 15978:2011 for buildings, BS EN 17472: 2022, PAS 2080:2016 for Infrastructure, BS EN 15643 2021.)'*

Absolute Zero Carbon: Eliminating all carbon emissions without the use of offsets.

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 Life-cycle (Beyond–LC): Carbon emissions arising from any benefits or burdens of materials and components beyond the life-cycle (Module D).

Biogenic Carbon: 'Biogenic Carbon' refers to the carbon removals associated with carbon sequestration into biomass as well as any emissions associated with this sequestered carbon. Biogenic carbon must be reported separately if reporting only upfront carbon but should be included in the total if reporting embodied carbon or whole life carbon.

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 of methane has a CO_2 equivalent of 23.

Carbon Sequestration: 'Carbon sequestration' is the process by which carbon dioxide is removed from the atmosphere and stored within a material – e.g. stored as 'biogenic carbon' in 'biomass' by plants/trees through photosynthesis and other processes.

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.

Densification: Is a term used by planners, designers, developers and theorists to describe the increasing density of people living in/using urban areas. There are a number of metrics attributing to densification, one is total building floor area divided by the area of land the buildings are built on.

Embodied Carbon or Life-Cycle Embodied Carbon: Embodied carbon emissions of an asset are the total GHG emissions and removals associated with materials and construction processes throughout the whole life-cycle of an asset (Modules A0-A5, B1-B5, C1-C4, with A0 assumed to be zero for buildings). (A0 is generally assumed to be zero for buildings, however for infrastructure projects A0 can include ground investigations and activities associated with designing the asset)

Energy use intensity (EUI): An indicator of the energy efficiency of a building's design and/or operations. It is the total amount of energy used in a building in a year divided by its floor area (kwh/m^2/yr). It can be expressed in terms of GIA or NLA, and this should be clearly stated when reporting.

Environmental Aspect: An aspect of construction works, part of works, processes or services related to their life-cycle 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 Product 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 life-cycle. 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.

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

Greenhouse Gases (GHGs): 'Greenhouse Gases' are constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds: For these 'carbon definitions', we are only addressing the GHGs with Global Warming Potential assigned by the Intergovernmental Panel on Climate Change (IPCC), e.g. carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's), and sulphur hexafluoride (SF6).

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

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.

IMPACT (Integrated Material Profile and Costing Tool): A specification and database for software developers to incorporate into their tools to enable consistent Life-Cycle Assessment (LCA) and Life-Cycle 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.

Life-cycle: consecutive and interlinked stages in the life of the object under consideration.

Life-Cycle 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 life-cycle (from cradle to grave) of the product, process or activity encompassing extracting and processing of raw materials, manufacturing, transportation and distribution, use and reuse, maintenances, recycling and final disposal.

Minimum Energy Efficiency Standards (MEES): The Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015 established the new Minimum Energy Efficiency Standards in the residential and commercial private rented sector in 2016.

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 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 operating.

Net Zero Carbon: A 'net zero (whole life) carbon asset is one where the total sum of all assets related to GHG emissions, both operational and embodied, over an asset's life-cycle (Modules A0-A5, B1- B8, C1-C4) are minimised, which meets local carbon, energy and water targets or limits, and with residual 'offsets', equals zero.

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 regulations, and would include unregulated energy.

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

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

Recycling: Recycling is the process of converting waste materials into new materials and objects. A recovery operation by which waste materials are reprocessed 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. However, upgrades to, or installation of new, equipment or materials with the primary intention of improving efficiency or reducing environmental impact (e.g. heat pumps or triple glazing) would be defined as retrofitting.

Regulated Energy Consumption: The 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: This is defined as the upgrading of a building in relation to the installation of new building systems or building fabric to improve efficiency, reduce environmental impacts and/or adapt for climate change. A range of interventions may be deployed, from 'light retrofit' to 'deep retrofit'. The City Corporation considers that a retrofit should retain and reuse at least 50% of the existing building(s)' superstructure (by mass), and it could or could not include a vertical or horizontal or infill extension.

TM 54: A CIBSE technical memorandum that covers all types of building energy modelling with the aim of more accurately estimating a building's energy consumption in the design process and allowing more meaningful comparison with actual in-use consumption once operational.

UK NZCBS: UK Net Zero Carbon Standard aims to robustly verify that buildings are Net Zero Carbon Aligned, in accordance with the UK's climate targets.The Standard was created through unprecedented collaboration within the UK built environment industry, and is backed by building data and science-led modelling.

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 plug-in equipment such as white goods, laboratory equipment, external lighting and audio visual equipment.

Upfront Carbon Embodied Carbon at Practical Completion: 'Upfront carbon' emissions are the GHG emissions associated with materials and construction processes up to practical completion (Modules A0-A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion. A1-A3 covering materials product, A4 transport of materials and A5 construction and installation processes.

Whole life-cycle Carbon (WLC) or Whole Life Carbon over Life-Cycle: Whole life carbon emissions are the total sum of all asset related GHG emissions and removals, both operational and embodied over the life-cycle of an asset including its disposal (Modules: A0-A5; B1-B7; B8 optional; C1-C4, all including biogenic carbon, with A0* assumed to be zero for buildings). Overall whole life carbon asset performance includes separately reporting the potential benefits or loads from future energy or material recovery, reuse, and recycling and from exported utilities (Modules D1, D2). * A0 is generally assumed to be zero for buildings, however for infrastructure projects A0 can include ground investigations and activities associated with designing the asset.

Demolition of existing structures or buildings must be separately identified and included within Module A5.

Application types:

FULLEIA: any application requiring EIA in support

FULMAJ: – Any application over 1,000m² - major applications may include schemes for redevelopment, substantial refurbishments and extensions. 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 including minor applications for development

Organisations referenced in this Carbon Options Guidance:

BBP: The Better Buildings Partnership is a collaboration of leading property owners who are working together to improve the sustainability of commercial buildings. It aims to enable market transformation through sustainability leadership and collaboration, improve professional understanding through knowledge sharing and to develop common approaches with our members, stimulating the property industry to deliver buildings that perform better.

BRE: The Building Research Establishment is a centre of building science in the United Kingdom, owned by charitable organisation the BRE Trust. It is a former UK Government national laboratory that was privatised in 1997. BRE contributes to a thriving and sustainable world by developing science-led solutions to built environment challenges, making buildings better for people and for the environment. It provides services, standards and qualifications that are used around the world to improve the built environment. BRE is a profit-for-purpose organisation. Any profits from BRE's work go to the BRE Trust, which invests in research projects for the public benefit, or are invested in upgrading the research facilities at the BRE Science Park.

Carbon Trust: The Carbon Trust was founded by the UK Government in 2001, with the unique purpose of driving decarbonisation for businesses, governments and financial institutions. They don't have shareholders and reinvest any financial surplus to further grow their impacts. Their mission is to accelerate the move to a decarbonised future. They partner with leading businesses, governments, and financial institutions to accelerate routes to Net Zero.

CIBSE: The Chartered Institution of Building Services Engineers is the professional body that exists to advance and promote the art, science and practice of building services engineering, to invest in education and research, and to support the community of built environment professionals in their pursuit of excellence.

ISEP: Institute of Sustainability and Environmental Practitioners (formerly known as the IEMA) is the global membership body that sets the standard for anyone wanting to sustainable change that delivers for the environment society or the economy. ISEP's purpose is to empower their members to become global change makers of the can transform the world today for a sustainable future.

IStructE: The Institution of Structural Engineers is a professional body that leads and supports the development of structural engineering worldwide, in order to secure a safe and resilient built environment for all.

LETI: The Low Energy Transformation Initiative is a voluntary network of over 1,000 built environment professionals, working together to put the UK and the planet on the path to a zero-carbon future. Their vision is to understand and clarify what this means in the built environment and develop the actions needed to meet the UK climate change targets. Volunteers are made up of developers, engineers, housing associations, architects, planners, academics, sustainability professionals, contractors and facilities managers, with support and input provided by local authorities and other organisations

NABERS (UK): The National Australian Built Environment Rating System UK is a simple, reliable system for rating the energy efficiency of office buildings across England, Wales, Scotland and Northern Ireland. NABERS UK measures and rates the actual energy use of offices, helping building owners to accurately track and communicate the energy performance of their buildings. It also helps identify areas for savings and improvements, and provides a rating system of 1-6 stars (1 being poor to 6 being market leading). NABERS UK is an adaptation of the highly successful rating programme NABERS that operates in Australia. Launched in Australia in 1999, NABERS is widely considered to be a world leading environmental performance rating tool for commercial buildings. NABERS UK is administered by BRE, who are responsible for the day-to-day operations of the scheme. The strategic operations of NABERS UK are overseen by a steering committee comprising BRE, the Better Buildings Partnership and NABERS.

RIBA: The Royal Institute of British Architects is a global professional membership body driving excellence in architecture. They serve their members and society in order to deliver better buildings and places, stronger communities and a sustainable environment. Being inclusive, ethical, environmentally aware and collaborative underpins all that they do.

RICS: The Royal Institution of Chartered Surveyors is a global professional body for those working in the built environment, construction, land, property and real estate. The RICS was founded in London in 1868. RICS promotes and enforces the highest professional qualifications and standards in the development and management of land, real estate, construction and infrastructure. The work of RICS professionals is hugely varied.

UKGBC: The UK Green Building Council is a charity organisation with over 700 members and was formed in 2007. It aims to add clarity, collaborate and improve the way that the built environment in the UK is planned, designed, constructed, maintained and operated. UKGBC is part of the World Green Building Council.

Revision 02 of this Carbon Options Guidance was written by Andrew Moore and Samuele Rando (Hilson Moran) in collaboration with the City of London Corporation Planning Officers