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London Plan Guidance

Whole Life-Cycle Carbon Assessments

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London Plan Policy	Policy SI 2 Minimising greenhouse gas emissions Part F
Planning Application type and how the London Plan Guidance will be applied	All applications for referable development (outline, detailed and/or hybrid applications) are required to submit a Whole Life-Cycle Carbon (WLC) assessment. WLC assessments for non-referable major development are encouraged.
Who is this guidance for?	Planning authorities, developers, architects, energy consultants, engineers and applicants.

1 Introduction

1.1 What is this guidance?

1.1.1 This guidance explains how to prepare a Whole Life-Cycle Carbon (WLC) assessment in line with Policy SI 2 F of the London Plan 2021 using the WLC assessment template. Policy SI 2 F applies to planning applications which are referred to the Mayor. However, WLC assessments are also supported and encouraged on major applications that are not referable to the Mayor.

1.1.2 This guidance explains how to calculate WLC emissions and the information that needs to be submitted to comply with the policy. It also includes information on design principles and WLC benchmarks to aid planning applicants in designing buildings that have low operational carbon and low embodied carbon. For queries relating to this guidance, please email: ZeroCarbonPlanning@london.gov.uk.

1.2 What are WLC emissions?

1.2.1 WLC emissions are the total carbon emissions[1] resulting from the construction and the use of a building over its entire life, including its demolition and disposal. They capture a building's operational carbon emissions from both regulated[2] and unregulated[3] energy use, as well as its embodied carbon emissions - that is, emissions associated with raw material extraction, the manufacture and transport of building materials, and construction; and the emissions associated with maintenance, repair and replacement, as well as dismantling, demolition and eventual material disposal. A WLC assessment also includes an assessment of the potential savings from the reuse or recycling of components after the end of a building's useful life. It provides a true picture of a building's carbon impact on the environment.

1.2.2 The Mayor's net zero-carbon target for new development continues to apply to the operational emissions of a building. The WLC requirement is not subject to the Mayor's net zero-carbon target; but planning applicants are required to calculate operational and embodied emissions, and demonstrate how they can be reduced as part of the WLC assessment. Planning

[1] 'Carbon emissions' is used in this document as a shorthand term for greenhouse gases measured in carbon dioxide equivalent emissions, or CO_2e emissions.

[2] The carbon emissions arising from energy used by fixed building services, as defined in Approved Document Part L of the Building Regulations. These include fixed systems for lighting, heating, hot water, air conditioning and mechanical ventilation.

[3] The carbon emissions relating to cooking and all electrical appliances, and other small power.

applicants should continue to follow the GLA's Energy Assessment Guidance to assess and reduce operational emissions and insert the relevant information into the WLC assessment, as explained in this guidance.

1.2.3 Designing a development that follows a WLC approach will:

- ensure that a significant source of emissions from the built environment is accounted for, which is necessary in achieving a net zero-carbon city
- achieve resource efficiency and cost savings, by encouraging refurbishment, and the retention and reuse of existing materials and structures, instead of new construction
- identify the carbon savings from using recycled material and the benefits of designing for future reuse and recycling, to reduce waste and support the circular economy
- encourage a 'fabric first' approach to building design, to minimise mechanical plant and services in favour of natural ventilation
- ensure operational and embodied emissions are considered at the same time to find the best solutions for the development over its lifetime
- identify the impact of maintenance, repair and replacement over a building's life cycle which, by informing the building's design and specification, improves lifetime resource efficiency and reduces life-cycle costs, contributing to the future proofing of asset value
- encourage local sourcing of materials and short supply chains, with resulting carbon, social and economic benefits for the local economy
- encourage durable construction and flexible design, both of which contribute to greater longevity and reduced obsolescence of buildings and avoid carbon emissions associated with demolition and new construction.

2 Process and methodology

2.1 Before submitting a WLC assessment

2.1.1 Achieving the maximum WLC reductions for a proposed building begins early on in a development's design. Applicants should work closely with design teams at the earliest stages of project development to identify the priorities for the WLC assessment, and the opportunities and likely constraints in reducing WLC emissions. These should be built into the project brief, and should be aligned with the energy strategy for the site and with the Circular Economy Statement.

2.1.2 The WLC principles, which can be found in Table 2.1, should inform the design of the development from the earliest stages and throughout the WLC assessment process. The life-cycle modules which each principle relates to are also provided in the table. See section 2.5 for information on the life-cycle modules. It is good practice at this stage to commit to setting WLC targets for the site that the applicant will aim to achieve. The WLC benchmarks (see Appendix 2) are a useful starting point.

2.1.3 For further advice on what to consider prior to undertaking a WLC assessment, including roles and responsibilities within the project team, the Royal Institute of British Architects (RIBA) has produced a guide for architects;[4] and LETI (the London Energy Transformation Initiative) has produced an Embodied Carbon Primer[5] for anyone working in the construction industry.

Table 2.1 WLC principles

No.	Principle	Description	Relevant life-cycle modules
1	**Reuse and retrofit of existing built structures**	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.	A1-A5, B1-B6, C1-C4, D
2	**Use repurposed 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	A1-A5, B1-B5, C1-C4,D

[4] https://www.architecture.com/-/media/gathercontent/whole-life-carbon-assessment-for-architects/additional-documents/11241wholelifecarbonguidancev7pdf.pdf

[5] https://www.leti.london/ecp

No.	Principle	Description	Relevant life-cycle modules
		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.	A1-A5, B1-B5, C1-C4, D
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.	A1-A5, B1-B4, B6
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	A1-A5, B1-B7,

No.	Principle	Description	Relevant life-cycle modules
		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.	C1-C4, D
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.	A1-A5, B1-B5, C1-C4, D

No.	Principle	Description	Relevant life-cycle modules
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.	A1-A5, B1-B6
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.	A1, B1, D
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	A1-A5, B1-B5, C1-C4, D

No.	Principle	Description	Relevant life-cycle modules
		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.	A1-A5, B1-B6
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.	A1-A5, B1-B5, C1-C4, D
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	A1-A5, B3-B5

No.	Principle	Description	Relevant life-cycle modules
		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).[6] Where waste is unavoidable, the designers should establish the suppliers' processes for disposal or preferably reuse or recycling of waste.	A1-A5, B1-B7, C1-C4, D
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.	A1-A5, B1-B7, C1-C4, D
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	A1-A5, C1-C4, D

[6] MMC is defined as "a range of approaches which spans off-site, near site and on-site pre-manufacturing, process improvements and technology applications": https://www.london.gov.uk/sites/default/files/cast_-_mmc_-_december_2020.pdf

No.	Principle	Description	Relevant life-cycle modules
		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.	A1-A5, B1-B5, C1-C4, D

2.2 When to submit a WLC assessment

2.2.1 For planning applications that are referable to the Mayor, a WLC assessment should be submitted at the following stages:

- pre-application (where relevant)
- planning application submission (i.e. RIBA stage 2/3)
- Post-construction (i.e. prior to occupation of the development. Generally, it would be expected that the assessment would be received three months post-construction)

2.3 Reporting to the GLA

2.3.1 A WLC assessment template has been developed that includes all of the information applicants will need to submit at each stage; it is available on the

GLA's website.[7] This template should be completed and submitted as an Excel document to the GLA to ensure clarity and transparency. Section 3 explains what is included in the assessment template at each stage (that is, pre-application, planning application submission and post-construction stages), and gives further detail on submitting the template to the GLA.

2.3.2 The assessment should be aligned with the project brief, and with the latest available cost plan for the scheme.

Ensuring data quality

2.3.3 Applicants and developers should adopt third-party quality assurance mechanisms to ensure accuracy in their submissions. The mechanisms used should be reported at the planning application submission and post-construction stages using the template. Allocating the same person, team or organisation to oversee the WLC assessment process from design to post-construction, where possible, would provide consistency in reporting.

2.4 Methodology

2.4.1 WLC assessments should demonstrate the actions that have and will be taken to reduce WLC emissions. The assessment should cover the development's carbon emissions over its lifetime, accounting for:

- any carbon emissions associated with pre-construction demolition
- any carbon savings associated with the retention, reuse and recycling of existing structures and materials that are already on-site
- its operational carbon emissions (both regulated and unregulated)
- its embodied carbon emissions
- any future potential carbon savings post end-of-life, including savings from reuse and recycling of building structure and materials.

2.4.2 WLC assessments should be carried out using BS EN 15978: 2011 (Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method). This is the standard UK framework for appraising the environmental impacts of the built environment. It sets out the principles and calculation method for the whole-life assessment of the environmental impacts from built projects.

[7] https://www.london.gov.uk/what-we-do/planning/planning-applications-and-decisions/pre-planning-application-meeting-service-0

2.4.3 The RICS Professional Statement: Whole Life Carbon assessment for the built environment (the RICS PS)[8] is a useful guide to the practical implementation of the BS EN 15978 principles. It sets out technical details and calculation requirements.

2.4.4 In developing a WLC assessment, applicants should follow BS EN 15978. The RICS PS should be used as the methodology for assessment, except where noted in Box 1, which lists the key areas where compliance with Policy SI 2 takes a different approach to the RICS PS.

Box 1: Key requirements of this guidance that differ from the RICS PS methodology

1. Operational carbon emissions should be reported following the GLA's approach to carbon emission factors – see section 2.8.
2. Operational carbon emissions for non-residential uses should be reported using CIBSE TM54 - see paragraph 2.5.14.
3. All life-cycle modules (A-D) should be reported to comply with the WLC policy – see section 2.5 for further details.
4. Carbon emissions from pre-construction demolition should be reported– see section 3 for further details.
5. Reporting the key actions undertaken to reduce WLC emissions and the associated carbon savings, including those associated with the retention, reuse and recycling of existing structures and materials that are already on-site – see section 3 for further details.

2.4.5 This guidance and the assessment template have been developed with residential projects and non-residential projects such as offices, retail, hotels and educational institutions in mind. They may also be used to assess the WLC emissions of infrastructure projects, but we would recommend that such projects also refer to PAS 2080 – carbon management in infrastructure framework, in completing their assessment.

2.5 Life-cycle modules

2.5.1 BS EN 15978 and the RICS PS set out four stages in the life of a typical project, described as life-cycle modules:

- Module A1 – A5 (product sourcing and construction stage)
- Module B1 – B7 (use stage)

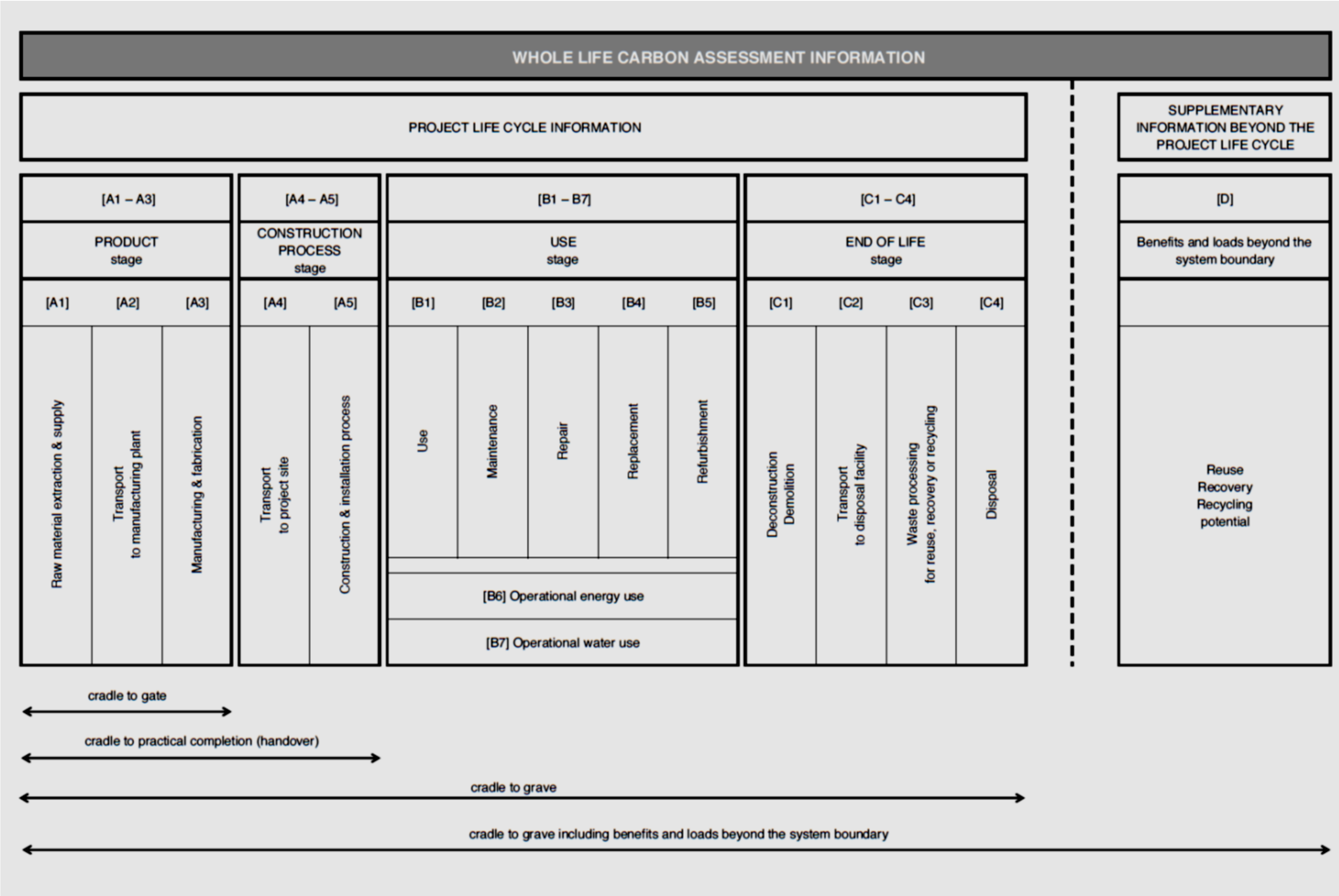
[8] https://www.rics.org/globalassets/rics-website/media/news/whole-life-carbon-assessment-for-the--built-environment-november-2017.pdf

- Module C1 – C4 (end-of-life stage)
- Module D (benefits and loads beyond the system boundary)

2.5.2 A WLC assessment needs to cover the entirety of modules A, B, C and D, rather than just the minimum requirements identified in the RICS PS. Figure 2.1 outlines what is captured under each module. Further detail is provided from 2.5.4 onwards.

2.5.3 Each module should be presented separately, as identified in the WLC assessment template. The reference study period (that is, the assumed building life expectancy) for the purposes of the assessment is 60 years. Where the design life of the project exceeds or is less than 60 years, the assessment should still be done to 60 years but with an accompanying explanation of the life cycle and end-of-life scenarios for the actual design life.

Figure 2.1 Life-cycle modules (BS EN 15978)



Module A (Product sourcing and construction stages)

2.5.4 The objective of this module is to report carbon emissions from the sourcing, transportation, fabrication and construction of all materials and products (A1-A5).

2.5.5 To ensure that the choices that are made will also help reduce future carbon emissions through subsequent life-cycle stages (B, C, D), a close understanding of the supply chain is needed. For example:

- whether virgin or recycled material sources are being used (A1)
- the energy sources and local energy grid associated with the manufacture of products (A1)
- the location of manufacturing plants in relation to the site, the transport methods and travel distances from material sources to fabrication plants (A2), and from fabrication to site (A4)
- the level of waste associated with the manufacture of the product (A1, A3)
- the on-site assembly of products into the finished scheme (A5).

2.5.6 The processes used in fabricating products (A3) are also important, as well as the methods used to construct the building, including contractor-related items such as temporary works, shuttering type and energy use (A5). MMC can have significant benefits in reducing waste (A1, A3, A5) and the extent of repair and maintenance required as part of the 'snagging' process (A5).

2.5.7 Whilst the focus of module A is on the materials and processes up to project completion, the selections made should also take account of the future life cycle of the building (modules B, C, D).

Module B (Use stage)

2.5.8 The objective of this module is to understand, at the design stages, how the building will perform post-construction; and how to ensure that in-use emissions (B1-B7) will be minimised. This includes the in-use emissions of some products, for example, some refrigerants[9] and paints (B1).

2.5.9 With the increasing uptake of mechanical, electrical and plumbing engineering (MEP) equipment using refrigerants, particularly heat pumps, applicants will be expected to report on the environmental impact from

[9] It is recommended that CIBSE TM65 is used to calculate emissions from refrigerants (including leakage) and that the following guidance is referred to: Refrigerants & Environmental Impacts: a Best Practice Guide https://www.integralgroup.com/news/refrigerants-environmental-impacts/

refrigerants over the building's lifespan. The WLC assessment will require the applicant to report the refrigerant type, its global warming potential (GWP), initial quantity/charge, assumed annual leakage rate, maintenance regime and end-of-life recovery rate. Further guidance on calculating the carbon emissions associated with module B1 is available in CIBSE TM65.[10] There are materials and products that are capable of being 'regenerative', in that they absorb carbon dioxide from the atmosphere (B1) over the life cycle of the building, and these should also be accounted for in the assessment.

2.5.10 Designing to minimise future emissions from maintenance (B2), repair (B3) and replacement (B4) across all building element categories over the future life cycle of the building will have long-term carbon (and financial) benefits. Reasonable maintenance scenarios should be developed based on facilities management information, maintenance strategy reports, façade access and maintenance strategy, life-cycle cost reports, Operation and Maintenance manuals and professional guidance, e.g. CIBSE Guide M, RICS New Rules of Measurement (NRM) 3.

2.5.11 Emissions from maintenance, repair and replacement should be estimated using manufacturers' recommendations and environmental product declarations (EPDs) where possible. Alternatively, warranty periods for the replacement of major systems such as windows, cladding, services and plant should be used unless scenarios are provided, supported by evidence, for periods longer than the provided warranties. Where warranty periods are unavailable, reasonable lifespan periods should be assumed supported by suitable evidence (e.g. Table 9 of the RICS PS). See item 3.5.3.4 of the RICS PS for details of replacement assumptions that should be made. Lifespan data for MEP equipment not included in Table 9 is available in CIBSE Guide M[11] or from the Building Cost Information Service.[12]

2.5.12 During the design stage, modules B2 and B3 will be more challenging to estimate. Applicants can estimate how much electricity may be used multiplied by the expected number of days of planned maintenance each year. Alternatively, for module B2 emissions, a total figure of 10 $kgCO_2e/m^2$ gross internal area (GIA) may be used to cover all building element categories, or 1 per cent of modules A1-A5, whichever is greater. For module B3 emissions, these may be estimated as 25 per cent of module B2, as per the RICS PS (item 3.5.3.3).

2.5.13 If there is an alteration or refurbishment (B5) planned from the outset of the project, then steps can be taken during the design stages to ensure that this will be facilitated with minimum or zero waste, or damage to existing fabric.

[10] https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q3Y00000IPZOhQAP

[11] https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q20000008I7oZAAS

[12] https://www.rics.org/uk/news-insight/latest-news/news-opinion/bcis-component-life-expectancy-update-for-2018/

Specific future alterations or improvements that are known and planned at the point of practical completion should be included.

2.5.14 Operational energy use (B6) should be minimised by considering the overall resource efficiency of the building. Applicants should report regulated and unregulated carbon emissions separately, and include all emissions as described in the RICS PS. In reporting regulated emissions, applicants should use the estimate of carbon emissions from operational energy use provided in the energy assessment and insert this figure directly into the WLC assessment. This should reflect the estimated figures calculated as part of the SAP and CIBSE TM54 analyses for domestic and non-domestic uses respectively. This differs to the approach in the RICS PS but is in line with section 3 of the 'Be Seen' – energy monitoring guidance. In reporting unregulated emissions, this should include carbon emissions from non-building-related systems, such as ICT equipment, and from the operation of building-integrated systems, such as lifts. Modules A1-A5 and module B6 should be considered together. Any energy use and emissions associated with the distribution of water within the building should be captured under operational energy use (B6).

2.5.15 Module B7 covers the carbon emissions related to water supply and wastewater treatment before it enters the building. Estimates of anticipated water consumption at early design stages may be made using Table 22 of the BSRIA Rules of Thumb – guidelines for the building services (fifth edition).[13] The estimated water consumption should be replaced by figures provided by the public health and/or MEP consultant and landscape architect as they become available. Carbon conversion factors for water use and treatment as published by the local water supplier should be used.

Module C (End-of-life stage)

2.5.16 This module captures the emissions from when the building has reached the end of its useful life, i.e. at the end of the 60-year reference study period. It covers deconstruction and demolition (C1), transport (C2), waste processing for reuse, recovery or recycling (C3) and disposal (C4), until the site is cleared, level and ready for further use.

2.5.17 Suitable project-specific scenarios should be used to establish the anticipated end of life scenarios for each building element and the associated carbon emissions (C1-C4). The potential end-of-life scenario for each building element should be reported in the module C column of the 'material quantity and end-of-life scenarios' table of the WLC assessment template. The carbon emissions associated with these activities should be reported in

13 https://www.bsria.com/uk/product/Ln3Q4B/rules_of_thumb_guidelines_for_building_services_5th_edition_bg_92011_a15d25e1/

the 'GWP for all life cycle modules' table of the WLC assessment template. Applicants should ensure that the end of life scenarios and GWP results reported in the WLC assessment match the end-of-life scenarios reported in the Circular Economy Statement. See the Circular Economy Statement Guidance for further information.

2.5.18 Designing to enable future disassembly and dismantling will reduce the likely carbon emissions of these activities and support potential carbon savings in the future (see module D). Proposed solutions and technologies should be based on those that are proven to be technically and economically viable, as per EN 15978.

Module D (Benefits and loads beyond the system boundary)

2.5.19 Deciding what will happen to a building after it has been dismantled or demolished many years in the future is clearly speculative. However, in order to transform London to a resource-efficient, zero-carbon economy, it is essential that these issues are given careful consideration at the design stage. The potential carbon savings associated with these activities should be calculated and included in module D of the WLC assessment, based on the end-of-life scenarios reported for module C and in the Circular Economy Statement. The objective is to facilitate future reuse, recovery and recycling at the highest possible level. Due to the speculative nature of these scenarios this module is reported separately.

2.5.20 To complete module D of the 'material quantity and end-of-life scenarios' table, applicants should repeat the estimates of the percentages of reusable and recyclable materials reported in the Bill of Materials template from the Circular Economy Statement. To complete module D of the 'GWP of all life-cycle modules' table applicants should use the results from the software tool they are using. If the tool does not include module D, refer to the guidance in paragraph 3.2.13.

2.5.21 The principle is that for a project that follows the 'end of life' of the applicant's project, the future carbon emissions from making a component (for example – an appropriately specified steel beam or an entire structural frame) will be avoided and the saving will be equivalent to providing a new component or system. As the potential future carbon savings are the result of a design decision made today, it is recorded in this module.

2.6 Building elements

2.6.1 The WLC assessment should, in line with the RICS PS, cover all building elements listed in Table 2.2 that are applicable to the project and are to be included in the finished area of the completed project, including temporary works.

2.6.2 The building elements are broken down according to the RICS NRM classification system level 2 sub-elements. The unit of area measurement to be used is GIA m^2. Floor areas should be measured in accordance with RICS Property Measurement standards.

Table 2.2 Building elements (RICS PS)

Building element group	Building element (NRM level 2)
Demolition	0.1 Toxic/hazardous/contaminated material treatment 0.2 Major demolition works
0 Facilitating works	0.3 and 0.5 Temporary/enabling works 0.4 Specialist groundworks
1 Substructure	1.1 Substructure
2 Superstructure	2.1 Frame 2.2 Upper floors incl. balconies 2.3 Roof 2.4 Stairs and ramps 2.5 External walls 2.6 Windows and external doors 2.7 Internal walls and partitions 2.8 Internal doors
3 Finishes	3.1 Wall finishes 3.2 Floor finishes 3.3 Ceiling finishes
4 Fittings, furnishings and equipment (FFE)	4.1 FFE including building-related* and non-building-related**
5 Building services/MEP	5.1–5.14 Services including building-related* and non-building-related**

Building element group	Building element (NRM level 2)
6 Prefabricated buildings and building units	6.1 Prefabricated buildings and building units
7 Work to existing building	7.1 Minor demolition and alteration works
8 External works	8.1 Site preparation works 8.2 Roads, paths, pavings and surfacings 8.3 Soft landscaping, planting and irrigation systems 8.4 Fencing, railings and walls 8.5 External fixtures 8.6 External drainage 8.7 External services 8.8 Minor building works and ancillary buildings

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

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

N.B. Scope comparison with BREEAM 2018: items 2.1 to 2.6 is mandatory for BREEAM Mat01 assessment and items 1 and 5 are optional.

2.6.3 The total quantities for the project should be used (including temporary works), as provided or approved by the project Quantity Surveyor, to inform the project cost appraisal at planning application submission stage of the WLC assessment. At the post-construction stage of the WLC assessment, the 'as built' information should be used, with quantities approved by the project Quantity Surveyor. A minimum of 95 per cent (EN 15804; 6.3.5) of the capital cost allocated to each building element category should be accounted for at each stage of the assessment and this should also be approved by the project Quantity Surveyor as part of the third-party review of each submission. Items excluded should each account for less than 1 per cent of the total capital cost of that building element category. It is good practice to include the carbon emissions from the excluded items. If the software tool used does not do this automatically, then applicants are encouraged to calculate and report this by multiplying the carbon emissions of each building element category by the following adjustment factor to account for the impacts of the items not quantified:

Coverage adjustment factor = (100 per cent / per cent of cost covered in the given category).

Building services/MEP

2.6.4 The following box lists the suggested building services/MEP elements that should be included in the assessment. This is not an exhaustive list but a guide for applicants to use.

Box 2: Building services/MEP elements to be included in the WLC assessment

1. Distribution ductwork and extract; including grilles and diffusers
2. Distribution pipework to and within risers
3. Air-handling unit and fans
4. Grey water harvesting tanks (if applicable)
5. Waste pipes and stacks
6. Hot water and cold water: supply and distribution pipework including insulation
7. Sprinkler system (sprinklers, pipes etc.)
8. Drenching system
9. Cabling, containment, trunking and cable trays
10. Materials of light fittings
11. Air conditioning units
12. Heat and cooling emitters (fan coil units, radiators etc)
13. Pumps (including heat pumps)
14. Valves
15. Dampers
16. Mechanical ventilation and heat recovery (MVHR) system
17. Lifts and escalators

2.7 Materials and products

Acceptable sources of carbon data for materials and products

2.7.1 The following are acceptable sources of carbon data for materials and products (or the latest available versions) in order of preference:

- verified Type III EPDs in accordance with BS EN 15804 2012+A1:2013 or A2:2019
- verified Type III EPDs in accordance with ISO 21930: 2017
- verified Type III EPDs in accordance with ISO 21930: 2007
- third-party (independently) verified, or peer-reviewed, carbon emissions to ISO 14067. EN 15804 or ISO 21930:2017 should be used as a CFP-PCR where relevant.
- verified Type III EPDs in accordance with ISO 14025
- peer-reviewed Life-cycle Carbon Assessment studies in accordance with ISO 14044
- independently verified or peer-reviewed carbon emissions to PAS 2050:2011. EN 15804 should be used as the product sector specific requirements where relevant.

2.7.2 Applicants should use data from the manufacturer of the actual materials and products being used, following the order of preference above. If the manufacturer has not provided data or it is too early in the design process for the manufacturer to be known, then sector level data (e.g. EPDs that use data covering several manufacturers) should be used. Further guidance on sourcing data for specific materials, products and life-cycle modules is provided here:

- **Structural elements:** Where EPDs are not available for structural elements, e.g. concrete, it is recommended that applicants use IStructE's guide, 'How to calculate embodied carbon',[14] to source default values.

- **MEP:** The embodied carbon emissions of MEP systems may be difficult to calculate in detail due to a lack of EPDs or other data sources. In these cases, it is recommended that applicants use the calculation methodology in CISBE TM65 Embodied carbon in building services which provides guidance for the calculation at each life-cycle stage at product level: A1-A4, B1, B3, C1-C4. The "mid-level calculation" method should be used but if there is not enough information available then the "basic calculation"

[14] https://www.istructe.org/IStructE/media/Public/Resources/istructe-how-to-calculate-embodied-carbon.pdf

method can be used instead. Applicants using the CIBSE TM65 methodology are also encouraged to report their results to CIBSE via their reporting form.[15] Applicants should use the default material carbon data in TM65 if product-specific carbon data is not available. For any materials that are not covered by TM65, applicants should use generic data sources which follow the EN15804 methodology e.g. the ICE Database v3.[16] If data following this methodology is not available then other generic data sources should be used e.g. older versions of the ICE Database v2. The final resort would be to use specific data from other manufacturers for similar products.

- **Module C3:** To calculate the carbon emissions for module C3 of materials and products i.e. their end-of-life, relevant EPDs such as a manufacturer or sector EPD should be used in the first instance. Applicants should ensure that the end of life scenario modelled aligns with the Circular Economy Statement and is relevant to the building and the typical fate of construction and demolition waste in London. If EPDs are not available other relevant sources which follow EN15804 should be used[17]. The data provided by the software tool being used may also be appropriate, but applicants should check the end-of-life scenario assumed to ensure it is appropriate.

- **FFE:** For projects where FFE is included in the scope of the planning application (e.g. lockers, benches, desks, etc.) applicants can refer to the Furniture Industry Research Association's data[18] if specific product information is not yet known.

- **Timber:** Sequestered carbon from the use of timber should be assessed in accordance with Clause 3.4.1 of the RICS PS. Sequestered carbon should be reported separately in the relevant part of the WLC assessment template.

2.8 Grid decarbonisation

2.8.1 The UK's electricity grid is decarbonising and this will have an impact on the WLC emissions of a development. It will be important for consistent decarbonisation assumptions to be built into the available software tools and industry's progress with this will be monitored. However, at present, the data

[15] The form is available here: https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q3Y00000IPZOhQAP

[16] https://ghgprotocol.org/Third-Party-Databases/Bath-ICE

[17] For example: https://woodforgood.com/lifecycle-database and https://www.steelconstruction.info/End_of_life_LCA_and_embodied_carbon_data_for_common_framing_materials#Whole_life_embodied_CO2e_emissions_data

[18] https://www.fira.co.uk/technical-information/sustainability/study-into-the-feasability-of-benchmarking-carbon-footprints-of-furniture-products

is not reliable to do so accurately for embodied carbon emissions. Applicants are therefore not required to account for the long-term decarbonisation of the electricity grid in their WLC assessments, in line with EN 15978.

2.8.2 Any applicants who wish to account for grid decarbonisation in their WLC assessment should discuss and agree their proposed approach with the GLA.

2.8.3 Applicants should ensure that in reporting module B6 results, the carbon emission factors used align with those used in the energy strategy for the development. See the GLA's Energy Assessment Guidance[19] for further information on the GLA's approach to carbon emission factors in energy strategies.

3 Content of a WLC assessment by stage

3.1 Pre-application stage

3.1.1 At pre-application stage, applicants are required to complete the pre-application tab of the WLC assessment template. This should be submitted to the GLA at pre-application along with all other pre-application documentation. Applicants who are not completing a pre-application are still encouraged to undertake the pre-application assessment to inform their planning application.

3.1.2 The pre-application assessment should include the information listed in Box 3.

Box 3 – Pre-application stage information requirements

1. A description of the proposed development.
2. Confirmation that options for retaining existing buildings and structures have been fully explored before considering substantial demolition, including incorporating the fabric of existing buildings into the new development.
3. The carbon emissions associated with pre-construction demolition.
4. An estimate of the percentage of the new build development which will be made up of existing façades, structures, buildings.
5. The WLC principles that are informing the development of the site.

[19] https://www.london.gov.uk/sites/default/files/gla_energy_assessment_guidance_april_2020.pdf

3.1.3 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. Retention should be seen as the starting point; this will usually be the most sustainable option as it can make an immediate contribution toward the Mayoral objective of London becoming a zero carbon city by 2030, as well as reflecting the need to both move towards a low-carbon circular economy (set out in Good Growth objective GG6 – Increasing efficiency and resilience) and to push development up the waste and energy hierarchies (see Policy SI 2 – minimising greenhouse gas emissions; and Policy SI 7 – reducing waste and supporting the circular economy).

3.1.4 To calculate the carbon emissions associated with pre-construction demolition, actual figures should be used where possible. If actual figures are not available, applicants can apply a standard assumption of $50kgCO_2e/m^2$ to the GIA of the existing areas being demolished that fall within the boundary line.

3.1.5 The WLC principles are listed in Table 2.1. Applicants should consider all of the principles and, subject to each development's unique characteristics, provide examples of how the design of the development is taking each principle into account. Reasons for not considering certain principles should also be provided in the template. Applicants are encouraged to keep returning to the WLC principles throughout each stage of the WLC assessment so that they continue to inform the design of the development as it evolves.

3.2 Planning application submission stage (outline and detailed)

3.2.1 At the planning submission stage (RIBA stage 2/3), applicants should complete the applicable tab of the WLC assessment template (depending on whether it is an outline or detailed application) and submit it as part of the planning application. This stage of the process requires a WLC assessment against each life-cycle module to be undertaken.

3.2.2 The WLC assessment template for both outline and detailed planning applications should include the information listed in Box 4.

Box 4 – Planning application submission stage information requirements

1. Project and assessment details e.g. brief description of the project, software tool used, type of EPDs used.
2. Confirmation that the assessment accounts for a minimum of 95 per cent of the capital cost allocated to each building element category (or an explanation of any omissions).

3. An explanation of the third-party mechanisms that have been adopted to quality assure the submission.
4. Estimated total WLC emissions (kgCO2e and kgCO2e/m^2 GIA) for each life-cycle module, which will form the baseline for the development, and will automatically populate based on the 'GWP of all life-cycle modules' table. The applicant will be required to report on how the total WLC emissions compare against the WLC benchmarks (see paragraph 3.2.4 for further information on the benchmarks).
5. Confirmation that options for retaining existing buildings and structures have been fully explored before considering substantial demolition, including incorporating the fabric of existing buildings into the new development. See paragraph 3.1.3 for further guidance.
6. The carbon emissions associated with pre-construction demolition.
7. The percentage of the new build development that will be made up of existing façades, structures, buildings.
8. Summary of key actions to achieve the WLC emissions reported and the emission reductions they are expected to achieve, including from the retention, reuse and recycling of existing structures and materials that are already on-site
9. Opportunities to reduce the development's WLC emissions further.
10. Completion of the 'material quantities and end-of-life scenarios' table covering all building element categories. This should be aligned with the Bill of Materials table produced as part of the Circular Economy Statement. If specific lifespan information is not available, the default values provided in Table 9 of the RICS PS are recommended; and for any MEP equipment not covered, CIBSE Guide M or the Building Cost Information Service component life expectancy are recommended.
11. Completion of the 'GWP of all life-cycle modules' table. Modules C3 and D of the GWP reporting table should also be informed by the Circular Economy Statement. Module B6 should be informed by the methodology outlined in the 'Be Seen' energy monitoring guidance.

3.2.3 Applicants should ensure the information they submit is as accurate as possible at the time of reporting. Any changes in design following the submission of the planning application stage submission should be accounted for in the post-construction assessment. Applicants are also encouraged to submit their WLC assessments to the Built Environment

Carbon Database[20] to help develop consistency in how carbon emissions are reported and measured across the built environment.

Using the WLC benchmarks

3.2.4 WLC benchmarks have been developed for the most typical typologies, and can be found in Appendix 2 together with an explanation of how they have been developed.

3.2.5 The estimated total WLC emissions form the baseline for the development. All developments, regardless of their scope, are expected to compare their WLC baseline against the most relevant benchmark. If the WLC emissions of a development falls outside the range of the benchmarks (whether they are higher or lower), applicants should explain why in the relevant text box of the template.

3.2.6 Mixed-use developments should compare their WLC baseline with the benchmark of the typology which makes up the greatest proportion of the development in GIA. If the uses are relatively equally split, then the highest WLC benchmark should be used for comparison.

3.2.7 It is good practice to set targets for WLC emissions reductions and to track progress against them throughout the project. Applicants can use the benchmarks as a basis for this but are encouraged to go further, where possible.

Outline, reserved matters and hybrid applications

3.2.8 Less information will be available for outline planning applications, but applicants are expected to provide as much information as possible in line with the above requirements. All building elements should be included in the assessment. While specific materials and products may not be known at this stage, applicants should (as far as possible) follow the order of preference set out in section 2.7 to provide the information.

3.2.9 Applications for reserved matters will require a WLC assessment in accordance with the planning application submission requirements. Applicants will be required to review the information provided at outline stage and update any default values used as far as possible.

3.2.10 For hybrid applications, applicants should complete one WLC assessments for the outline application and one for the detailed application.

[20] https://www.becd.co.uk/

Software tools

3.2.11 A list of suitable software tools has been provided in Appendix 1. This list is not exhaustive as software tools are regularly updated. Applicants wishing to use an alternative tool to those listed should ensure that it meets the requirements of this guidance and that:

- it covers the assessment scope from BS EN 15978
- the scope covers modules A-C. Module D must still be assessed but as the majority of available tools do not include module D by default at the moment, this can be done outside the software (see paragraph 3.2.13)
- the database from which the life-cycle assessment information is sourced is based on data sources that reflect the country of origin of the material selected.

3.2.12 Regardless of which software tool is used, MEP equipment should be estimated at product level using CIBSE TM65 where possible during planning application stage. If detailed information is not available at the time of planning submission for certain items, default values in the software tools could be used to calculate the carbon baseline. For the post-construction assessment it is mandatory to update the calculation of MEP systems emissions following CIBSE TM65 and using details provided by MEP suppliers.

Calculating module D

3.2.13 If the selected software does not automatically calculate figures for module D, the figures should be reported as potential savings under module D, reported in $kgCO_2e/m^2$ and calculated as follows (see also RICS PS Section 3.5.5 for more examples):

- For a particular component that is being re-used on a new site (e.g. a steel beam), the figures for modules A1-A3 should be used plus an allowance for transport to the future site.
- If the structural frame is kept, the figures from both the product and construction stages should be used (modules A1-A5), plus an allowance against any avoided deconstruction, using the figures for modules C1, C2 and C4.

3.3 Post-construction stage

3.3.1 The post-construction WLC assessment should be appropriately secured via planning condition or legal agreement between the local authority and the applicant at planning stage. Draft wording has been shared with local authorities for this purpose and is also available on the WLC pages of the GLA's website.[21]

3.3.2 At this final stage of the WLC assessment process, applicants should complete the post-construction tab of the WLC assessment template and submit it to the GLA at: ZeroCarbonPlanning@london.gov.uk prior to occupation of the development. This should be submitted along with any associated evidence. The subject line of the email should read: WLC assessment for [insert planning reference]. Applicants are also encouraged to submit their WLC assessments to the Built Environment Carbon Database.[22]

3.3.3 The post-construction WLC assessment will require the information listed in Box 5.

Box 5 – Post-construction stage information requirements

1. An update of the information provided at planning submission stage (see paragraph 3.2.2) using the actual WLC carbon emission figures. Applicants will need to update the WLC calculation results for all modules based on the actual materials, products and systems.[23] For example, for modules A1-A5 the actual transportation emissions from the delivery of materials, removal of waste and site work emissions. The 'material quantities and end-of-life scenarios' table and modules C3 and D of the 'GWP for all life-cycle modules' table should align with the post-construction Circular Economy Statement.
2. A comparison of the post-construction results with the WLC emissions baseline reported at planning submission stage and an explanation for the difference, including any design changes that may have impacted on the results. A text box has been provided in the template for this purpose.
3. A comparison of the post-construction results with the WLC benchmarks with an explanation for the difference. A text box has been provided in the template for this purpose.
4. A summary of the lessons learnt that will inform future projects. This should include what went well and what could be improved next time to achieve WLC reductions. For example, early engagement with the client on the WLC objectives of the scheme went well, and an improvement would be agreeing

[21] https://www.london.gov.uk/what-we-do/planning/london-plan/london-plan-guidance/whole-life-cycle-carbon-assessments-guidance

[22] https://www.becd.co.uk/

[23] it is mandatory to update the calculation of MEP systems emissions following CIBSE TM65 and using details provided by MEP suppliers

across project teams a set of WLC targets for the biggest carbon impacts of the scheme.

5. To support the results provided in the template, the following minimum evidence requirements should be submitted at the same time:

a) site energy (including fuel) use record

b) contractor confirmation of as-built material quantities and specifications

c) record of material delivery including distance travelled and transportation mode (including materials for temporary works)

d) waste transportation record including waste quantity, distance travelled and transportation mode (including materials for temporary works) broken down into material categories used in the assessment

e) a list of product-specific EPDs for the products that have been installed. The data collected at this stage will provide an evidence base that could help inform future industry-wide benchmarks or performance ratings for building typologies.

3.4 Scrutiny of assessments

3.4.1 The GLA (and local authorities, as appropriate) will scrutinise assessments for:

- Completeness – has the WLC assessment template been completed in full?
- technical quality – does the assessment use the appropriate baseline, assessment tools and methodology?
- reduction in WLC emissions – has the applicant demonstrated that actions have been taken to reduce WLC emissions?
- level of ambition – do the estimated and actual WLC emissions fall within, or improve upon, the benchmarks?

Appendix 1 Software tools

Tool	Country of origin	Applicable to UK?	Project type	Online/offline	Scope	Data source
One Click LCA	Finland	Yes	Buildings and infrastructure	Online software	Modules A-C (+D)	Built-in with access to some of the most widely spread local EPD databases, including Ecoinvent which contains generic LCA data.
eToolLCD	Australia	Yes	Buildings and infrastructure	Online software	Modules A-C (+D)	Uses Ecoinvent database (EPDs) which includes data by the Building Research Establishment (BRE) in the UK.
Tally	USA	Yes	Buildings	Both	Modules A-C	Uses Gabi database which contains EPDs and US generic data.
Sturgis Carbon Calculator	UK	Yes	Buildings	Offline software	Modules A-C	EPD database built over more than 10 years of practice in the UK. It allows the possibility to input additional EPDs manually.

Appendix 2 Benchmarks

A2.1.1 The WLC benchmarks are based on previous project assessments carried out by Cundall and Targeting Zero and have been cross-referenced with data provided by LETI, eTool, One Click, Hilson Moran, Price & Myers, and Arup. These assessments were Shell and Core, and CAT A finishes; and followed the RICS PS in terms of the scope of assessment, and material baseline assumptions and specifications. All life-cycle modules apart from B6, B7 (operational energy and operational water) and module D are included. The analysis underpinning the WLC benchmarks is set out in the table below.

Figure A2.1 Details of the assessments underpinning the WLC benchmarks

Method of assessment	BS EN 15978
Life-cycle modules	A1-A5, B1-5, C1-C4
Assessment scope (> 95 per cent of the cost allocated to each building element category has been accounted for in the assessment)	Substructure Superstructure: Frame Superstructure: Upper floors Superstructure: Roof Superstructure: Stairs and ramps Superstructure: External walls Superstructure: Windows and external doors Superstructure: Internal walls and partitions Superstructure: Internal doors Internal finishes FFE Services (MEP) External works
Material carbon data quality	EPD in accordance with EN 15804
Material specification assumption	RICS Professional Statement

Material lifespan assumption	RICS Professional Statement
Material end-of-life scenarios	RICS Professional Statement
Grid decarbonisation	Not accounted for

A2.1.2 The WLC benchmarks should be used as a guide by all applicants. The benchmarks provide a range rather than a set value and are broken down into life-cycle modules. Projects with higher WLC emissions than the benchmarks should carefully examine how they can reduce WLC emissions. The WLC assessment template provides space for applicants to explain how and why any variations exist.

A2.1.3 A further set of aspirational WLC benchmarks have been developed which are based on a 40 per cent reduction in WLC emissions on the first set of WLC benchmarks. This is based on the World Green Building Council's target to achieve a 40 per cent reduction in WLC emissions by 2030. Applicants who wish to go further are encouraged to consider how they can achieve reductions in line with the aspirational benchmarks.

A2.1.4 Module B6 has not been included in the benchmarks as it is regulated through Part L and subject to the Mayor's net zero target. Modules B7 and D have also not been included in the benchmarks, due to a lack of available data. Applicants will therefore not be able to compare their module B6, B7 or D estimates. Over time, as more data is collected by the GLA and by industry more widely and as data quality improves, these benchmarks will evolve to become more accurate and comprehensive.

Table A2.1 WLC benchmarks (excluding modules B6, B7 and D)

Offices*			
Modules	**WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Aspirational WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Breakdown of a typical development**
A1-A5 (excluding sequestration)	<950	<600	Substructure: 19 per cent Superstructure: 36 per cent Façade: 17 per cent Internal finishes: 10 per cent FFE: 2 per cent Services/MEP: 14 per cent External works: 2 per cent
B-C (excluding B6 & B7)	<450	<370	Substructure: 1 per cent Superstructure: 4 per cent Façade: 21 per cent Internal finishes: 27 per cent FFE: 9 per cent Services/MEP: 35 per cent External works: 3 per cent

Offices*			
Modules	**WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Aspirational WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Breakdown of a typical development**
A-C (excluding B6 & B7, including sequestration)	<1400	<970	Substructure: 13 per cent Superstructure: 25 per cent Façade: 18 per cent Internal finishes: 16 per cent FFE: 5 per cent Services/MEP: 21 per cent External works: 2 per cent

Residential			
Modules	**WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Aspirational WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Breakdown of a typical development**
A1-A5 (excluding sequestration)	<850	<500	Substructure: 21 per cent Superstructure: 33 per cent Façade: 18 per cent Internal finishes: 10 per cent FFE: 1 per cent Services/MEP: 16 per cent External works: 1 per cent
B-C (excluding B6 & B7)	<350	<300	Substructure: 6 per cent Superstructure: 6 per cent Façade: 34 per cent Internal finishes: 19 per cent FFE: 3 per cent Services/MEP: 30 per cent External works: 2 per cent

Residential			
Modules	**WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Aspirational WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Breakdown of a typical development**
A-C (excluding B6 & B7, including sequestration)	<1200	<800	Substructure: 17 per cent Superstructure: 25 per cent Façade: 23 per cent Internal finishes: 12 per cent FFE: 1 per cent Services/MEP: 20 per cent External works: 2 per cent

Schools, universities etc.			
Modules	**WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Aspirational WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Breakdown of a typical development**
A1-A5 (excluding sequestration)	<750	<500	Substructure: 33 per cent Superstructure: 30 per cent Façade: 13 per cent

Schools, universities etc.			
Modules	**WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Aspirational WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Breakdown of a typical development**
			Internal finishes: 6 per cent Services/MEP: 11 per cent External works: 7 per cent
B-C (excluding B6 & B7)	<250	<175	Substructure: 2 per cent Superstructure: 4 per cent Façade: 37 per cent Internal finishes: 14 per cent Services/MEP: 29 per cent External works: 14 per cent
A-C (excluding B6 & B7, including sequestration)	<1000	<675	Substructure: 25 per cent Superstructure: 24 per cent Façade: 19 per cent Internal finishes: 9 per cent Services/MEP: 15 per cent External works: 8 per cent

Retail*			
Modules	**WLC benchmark (kgCO_2e/m^2 GIA)**	**Aspirational WLC benchmark (kgCO_2e/m^2 GIA)**	**Breakdown of a typical development**
A1-A5 (excluding sequestration)	<850	<550	Substructure: 35 per cent Superstructure: 38 per cent Façade: 9 per cent Internal finishes: 5 per cent FFE: 1 per cent Services/MEP: 6 per cent External works: 6 per cent
B-C (excluding B6 & B7)	<200	<140	Substructure: 0 per cent Superstructure: 5 per cent Façade: 18 per cent Internal finishes: 22 per cent FFE: 8 per cent Services/MEP: 40 per cent External works: 7 per cent

Retail*			
Modules	**WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Aspirational WLC benchmark ($kgCO_2e/m^2$ GIA)**	**Breakdown of a typical development**
A-C (excluding B6 & B7, including sequestration)	<1050	<690	Substructure: 28 per cent Superstructure: 32 per cent Façade: 11 per cent Internal finishes: 8 per cent FFE: 2 per cent Services/MEP: 13 per cent External works: 6 per cent

* Separate use classes for commercial uses including retail and offices have now been replaced by use class E. The most relevant building typology or use should be selected in providing data. Amendments to the assessment template will be considered once the related changes to Building Regulations are published.

Appendix 3 Further guidance

- Energy Assessment Guidance
- Circular Economy Statement Guidance
- 'Be Seen' Energy Monitoring Guidance
- BS EN 15978
- BS EN 15804
- RICS Professional Statement: Whole Life-Cycle Carbon Assessment for the Built Environment – 2017
- RIBA Guidance: Embodied and Whole Life-Cycle Carbon assessment for architects.
- CIBSE TM65 Embodied carbon in building services: A calculation methodology
- Targeting Zero: Embodied and Whole Life-Cycle Carbon explained – RIBA Publishing
- PAS 2080 – carbon management in infrastructure framework
- Advancing Net Zero; Net Zero Carbon Buildings: UKGBC
- Bringing embodied carbon upfront: World Green Building Council
- LETI Embodied Carbon Primer
- A full list of Historic England's technical guidance on energy efficiency and historic buildings can be found here: https://historicengland.org.uk/content/docs/advice/technical-conservation-guidance-and-research-brochure-pdf/