52 Tottenham Street

Whole Lifecycle Carbon Assessment

Ensphere Group Ltd on behalf of
Flower Island (UK) Ltd

Ensphere Group Ltd
52 Grosvenor Gardens
London, SW1W 0AU
+44 (0) 20 7846 9040
www.enspheregroup.com

ensphere

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Contents

1. Executive Summary

1.1 This Whole Lifecycle Carbon ("WLC") considers the carbon emissions resulting from the construction and use of the proposed development at 52 Tottenham Street, London W1T 4RN.

1.2 Consideration has primarily been given to the planning policy and other relevant standards and guidance. This report has been produced in consideration of policy CC1 (*Climate Change Mitigation)* of the Camden Local Plan. A Whole Lifecycle Carbon ("WLC") was calculated, for the existing and proposed building, comparing the carbon emissions resulting from the construction (embodied carbon) and the use of the buildings (operational carbon) over their lifetime.

1.3 All stages of the project have then been considered, from raw material extraction, product manufacturing, transport, and installation on site through to the operation, maintenance, and eventual material disposal of the new development.

1.4 Best available data has been used, with the acknowledgement that this assessment has been undertaken at a relatively early stage of design.

1.5 Specialist software has been used with emissions calculated using the One Click LCA software, utilising both the IMPACT compliant & BRE approved LCA calculation tools, with geometry being created and defined within IES VE 2021 and exported to the One Click tool. Operational carbon was based on SAP10 results for both buildings.

1.6 The assessment of both buildings has reviewed WLC over a 60-year period, in line with the recommended RICS approach. This identified total WLC emission related to the existing building of 800,439 $kgCO_2e$. For the proposed building, total WLC emissions were calculated at 1,182,851 $kgCO_2e$, decreasing to just 663,849 $kgCO_2e$ when decarbonisation of the electricity grid is accounted for.

1.7 The results demonstrate that redeveloping the site in line with the proposals lead to a significant carbon saving over the life cycle of the building. Recommendations have also been given to the end of this report to encourage further reductions in WLC emissions of the proposed development.

2. Introduction

2.1 Ensphere Group Ltd was commissioned by Flower Island (UK) Ltd to undertake a Whole Lifecycle Carbon Assessment for the existing and proposed development at 52 Tottenham Street, London W1T 4RN.

Site and Surroundings

2.2 The proposals relate to a site that is located on the west side of Tottenham Street in Fitzrovia, London. The site is currently used for residential (C3) with a small commercial unit at ground floor (B1).

2.3 Tottenham Street provides a connection between two much busier streets; Clevel and Street to the west and Charlotte Street to the east.

2.4 The existing building is not listed but is identified as a positive contributor to the Charlotte Street Conservation Area. It is bounded to the east by Arthur Stanley House and to the west by 30 Cleveland Street.

2.5 The site enjoys excellent transport connections and it is within a two minute walk from Goodge Street Underground Station. It is also within a ten minute walk of Warren Street underground station and Tottenham Court Road station, which will benefit from Crossrail in the near future.

Proposed Development

2.6 Development proposals include the redevelopment of the site, following demolition of the existing building, to provide a mixed use development comprising ground floor affordable workspace (Class B1), four residential units (Class C3) on the upper floors (3 x 1 Bed Units and 1 x 3 Bed Unit), alongside lower ground floor plant, cycle parking and refuse storage.

Report Objectives

2.7 To assess the carbon emissions resulting from the construction and use of the building over its entire life, to improve understanding, consistent measurement and enable comparability of results, benchmarking and target setting to achieve carbon reductions.

2.8 To meet the aim of policy CC1, this report looks to justify the demolition of the existing building, and replacing it with the proposed development, to reduce future carbon emissions resulting from the site.

3. Assessment Framework

3.1 Whole life-cycle carbon ("WLC") emissions are the carbon emissions resulting from materials, construction and use of a building over its entire life, including its demolition and disposal. A whole life carbon approach identifies the overall best combined opportunities for reducing lifetime emissions and helps to avoid unintended consequences of focusing on operational emissions alone.

Relevant Standards & Guidance

3.2 The framework for appraising the environmental impacts of the built environment is provided by BS EN 15978:2011, a European Standard now adopted at a national level. The Standard specifies the calculation method, based on Life Cycle Assessment (LCA) and other quantified environmental information, to assess the environmental performance of a building. It also gives the means for the reporting and communication of the outcome of the assessment.

3.3 The standard gives:

- The description of the object of the assessment;
- The system boundary that applies at the building level;
- The procedure to be used at the inventory analysis;
- The list of indicators and procedures for the calculations of these indicators;
- The requirements for presentation of the results in reporting and communication; and
- The requirements for the data necessary for the calculation.

3.4 In response to the challenge of ensuring consistency with the application of BS EN 15978, further work has been undertaken by organisations including the Royal Institute of Chartered Surveyors (RICS) and the Building Research Establishment (BRE), with the following references also being pertinent to this assessment:

- RICS Professional Statement – Whole Life Carbon Assessment for the Built Environment 1st Edition (RICS; ISBN 978 1 78321 208 8, November 2017); and
- BRE Global Methodology for the Environmental Assessment of Buildings Using EN 15978:2011 (Building Research Establishment; ref PN 326 Rev 0.0; January 2018)

3.5 The London Energy Transformation Initiative (LETI) was established in 2017 to support the transition of the capital's built environment to net zero carbon. For this report, consideration has been given to the LETI Climate Emergency Design Guide which was released in January 2020. The document helps to define "good" and to set clear and achievable targets in regards to the

Whole Life Carbon (Operational Carbon + Embodied Carbon) of new buildings. Pertinent to this development, it sets the following targets for medium and large-scale housing (which are more stringent than those given for commercial offices in the guide):

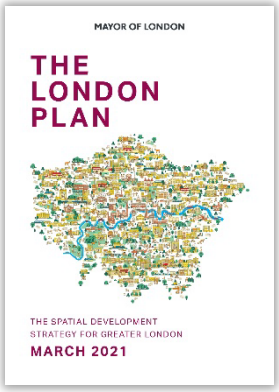
- 35kWh/m^2.yr - Energy Use Intensity (EUI) in GIA. It includes all regulated and unregulated.
- 15kWh/m^2.yr – Space Heating Demand.
- <500kgCO_2/m^2 for embodied carbon.

4. Planning Context

4.1 Local planning policy relevant to the assessment is considered below:

London Context

London Plan (2021)



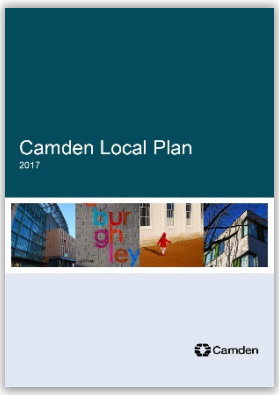
4.2 The London Plan is the overall strategic plan for London, it sets out an integrated economic, environmental, transport and social framework for development of London over the next 20-25 years. The London Plan is part of the Development Plan and covers a range of planning issues. The presented policies provide a vision for how London should sustainably grow and develop in the future. Policies considered pertinent to this report are presented below:

- Policy SI 2 *(Minimising greenhouse gas emissions)* - Major development should be net zero-carbon and minimise emissions in accordance with the following energy hierarchy: be lean, be clean, be green, be seen. A minimum on site reduction of 35% beyond Building Regulations will be required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Any short fall with the zero-carbon target should be addressed through a carbon offset payment. Development referable to the GLA should also calculate whole life-cycle carbon emissions.

4.3 The GLA has produced guidance (Whole Life-Cycle Carbon Assessments guidance, March 2022). This guidance has been written in support of London Plan Policy SI 2 and sets out a requirement for development proposals to calculate and reduce WLC emissions as part of a WLC assessment.

Local Context

Camden Local Plan (July 2017)



4.4 The Local Plan sets out the planning policies, site allocations and land designations Borough-wide and is the central document in the Borough's Development Plan.

4.5 The following policies are considered relevant to this report:

- Policy G1 (*Delivery and Location of Growth*) – promotes sustainability with regards to the efficient use of land and buildings;

- Policy D1 (*Design*) – includes a requirement for development to be sustainable with regards to design and construction;

- Policy CC1 (*Climate Change Mitigation*) – promotes zero carbon development, consideration of the Energy Hierarchy (encouraging connection to District Energy Networks), reduced reliance on transport by car and resource efficiency. All new residential development will be required to demonstrate a 19% CO2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation, unless it can be demonstrated that such provision is not feasible;

- Policy CC2 (*Adapting to Climate Change*) – requires development to seek to protect existing green space, use of SUDS, incorporating biodiverse roofs, consideration of overheating risks, encourages the use of the Home Quality Mark and Passivhaus Standards along with BREEAM "excellent" for non-domestic and refurbishment developments >500sqm and/or five or more dwellings;

- Policy CC4 *(Air quality)* - Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution, with recommended measures adopted. In locations of poor air quality, developments that introduce sensitive receptors (i.e. housing, schools) will also need to be designed to mitigate the impact;

- Policy CC5 *(Waste)* – developments need to include facilities for the storage and collection of waste and recycling, in line with Council waste targets.

Camden Planning Guidance – Energy Efficiency & Adaptation (January 2021)

4.6 This guidance provides information on key energy and resource issues within the borough and supports Local Plan Policies CC1 Climate change mitigation and CC2 Adapting to climate change.

5. Specification of the Object of Assessment

5.1 The following section outlines the parameters by which the Whole Life-Cycle Carbon Assessment has been undertaken. Specification of the boundaries is necessary to ensure consistency of approach and comparison.

Spatial Boundaries

5.2 A Whole Life-Cycle Carbon Assessment should consider all building components and works relating to the project, including any external works within the site boundary. The site boundary needs to be in line with the definition and intended use of the built asset, including all contiguous land that is associated with the project and that supports its operations.

5.3 For the proposed assessment of the 52 Tottenham Street site, the spatial boundary is consistent with the red-line site boundary presented in support of the application.

Physical Characteristics of Existing and Proposed Building

5.4 This section outlines the building parts, elements, and components to be included in a Whole Life-Cycle Carbon Assessments.

5.5 The physical characteristics of the existing building are as described in the Access Statement and include:

- One studio apartment and 3 one bedroom apartments above the commercial unit

5.6 The physical characteristics of the proposed building are as described in the Access Statement and include:

- Multi-storeys building consisting of several apartments with public realm improvements, including communal amenity and associated refuse and cycle storage.

5.7 In line with the RICS Professional Statement, new build projects assessed are considered to commence their development on a cleared, flat site for consistency purposes. Demolition works are often decoupled from new construction projects, hence the responsibility for any emissions arising from demolition is not necessarily solely attributable to the new build project.

Reference Study Period

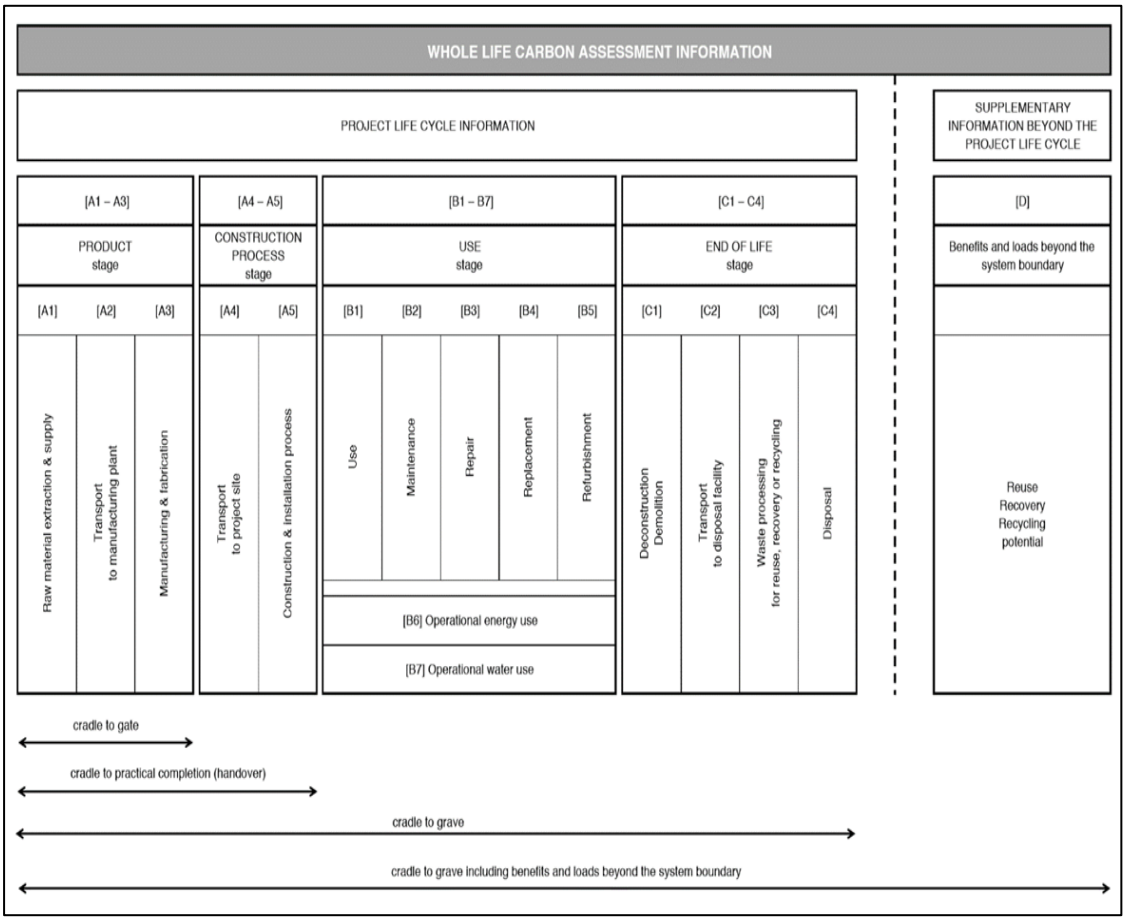
5.8 The Reference Study Period (RSP) to be used for the Whole Life-Cycle Carbon Assessment is defined by the RICS PS as being dependent on the nature of the development. Tottenham Street is a residential scheme; however, RICS PS still gives reference to the number of years referred to under non-domestic standards; including BREEAM 2014 New Construction – Mat01 Life Cycle impacts; and LEED v.4 standards whereby a 60-year study period is specified. The

RICS PS references to both the BREEAM and LEED standards are purely to ensure compatibility with other similar approaches. Furthermore, the acknowledgement of the 2014 version of BREEAM is due to the publishing date of the RICS PS; before the release of BREEAM New Construction 2018.

Life Cycle Stages - Overview

5.9 The stages are as presented in BS EN 15978:2011, the boundaries of which are all clearly defined to ensure consistency of approach and comparison between the whole life results for different projects.

Figure 5.1 Whole Life Cycle Stages (RICS PS adapt. of BS EN 15978:2011 stages)



5.10 Certain potential sources of carbon (e.g., transport emissions associated with the use stage) are outside the scope; and whilst these emissions might be picked up through other assessment (organisational carbon foot printing), they are not including within Whole Life-Cycle Carbon Assessment. This is because the WLC methodology is an assessment of the built environment only.

Units of Measurement

5.11 The units of measurement are reported in $kgCO_2$ equivalent ("$kgCO_{2e}$"). This is standard unit for measuring carbon footprints and expresses the impact of each different greenhouse gas in terms of the amount of CO_2 that would be required to create the same amount of warming. It therefore allows for the simultaneous assessment of multiple greenhouse gases.

Future Energy Projections

5.12 The energy sector is a major carbon emitter and will need to continue to decarbonise over time to be consistent with national policy targets. To enable consistency in the calculation of life cycle carbon impacts, EN15978 suggests that current practices shall apply to any future projections and does not allow for decarbonisation in the calculations. However, and in line with the RICS PS, it is important to provide a realistic estimate of the whole life carbon emissions and therefore a decarbonised future is presented separately to the non-decarbonised one. SAP10 carbon conversion factors have been used in this assessment.

6. Methodology

6.1 The Whole Life-Cycle Carbon Assessment was calculated using the One Click LCA software, utilising both the IMPACT compliant & BRE approved LCA calculation tools, with geometry being created and defined within IES VE 2021 and exported to the One Click tool.

6.2 The geometries of the building were modelled within IES VE 2021, based upon drawings provided by the architect and structures teams. Once the building's geometry had been modelled, materials were assigned to the building elements such as the floors, external walls, internal partitions, foundations, and roof.

6.3 The completed IES VE 2021 model was then imported into One Click LCA, where the appropriate datasets from the IMPACT database were automatically assigned to the model, along with their geometries.

6.4 IES VE 2021 does not allow the modelling of non-thermal elements, therefore elements such as the substructure, structural frame, retaining wall and hard landscaping were added manually into the model once it had been imported into One Click LCA.

Figure 6.1 IES Representation of the existing and proposed building

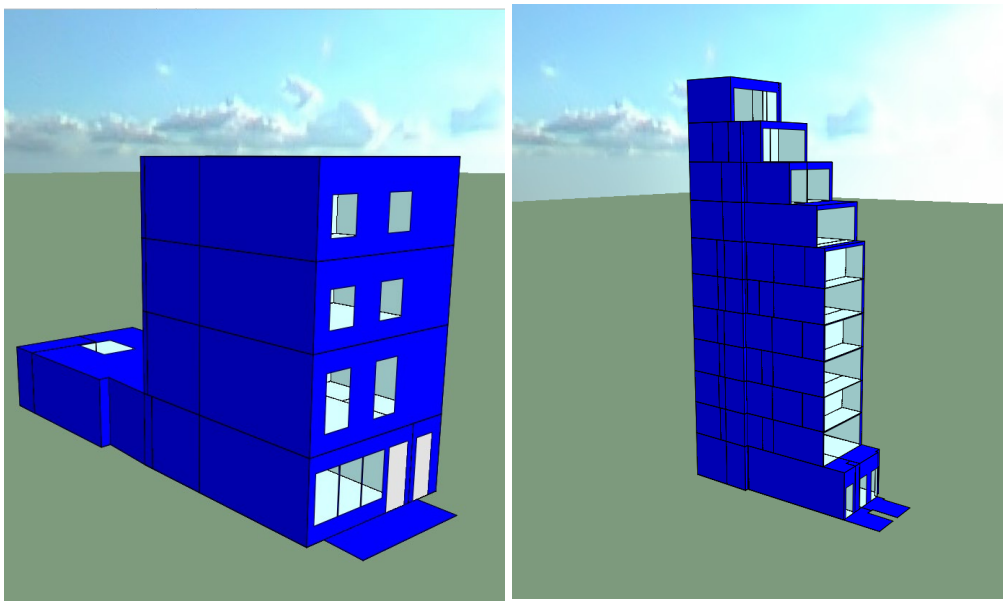


Table 6.1 WLC Primary Data Sources Summary

Lifecycle Stage		Data Source
Product Stage	A1: Raw Material Supply	IES-VE; One Click LCA database
	A2: Transport	One Click LCA database
	A3: Manufacturing	One Click LCA database
	A4: Transport to Building Site	One Click LCA database

Construction Process Stage	A5: Installation into Building	One Click LCA database
Use Stage	B1: Use / Application	One Click LCA database Submission Documents
	B2: Maintenance	One Click LCA database
	B3: Repair	One Click LCA database
	B4: Replacement	One Click LCA database
	B5: Refurbishment	One Click LCA database
	B6: Operational Energy Use	Building Regulations Part L Report SAP
	B7: Operational Water Use	BSRIA BG9-2011 (Rules of thumb) Planning Application Form
End of Life Stage	C1: Deconstruction / Demolition	One Click LCA database
	C2: Transport	One Click LCA database
	C3: Waste Processing	One Click LCA database
	C4: Disposal	One Click LCA database
Benefits & Loads Beyond the System Boundary	D: Reuse / Recovery / Recycling	One Click LCA database

7. Product Stage [A1-A3]

7.1 The product stage deals with the carbon emissions attributable to the cradle to gate processes; raw materials supply, transport, and manufacturing; and comprise:

- Raw Material Extraction & Supply [A1]
- Transport to Manufacturing Plant [A2]
- Manufacturing & Fabrication [A3]

7.2 The processes covered by [A1–A3] frequently occur in several steps, where components are manufactured and then transported to a further fabrication plant for assembly into a system; and all of these interim steps need to be taken into account.

7.3 The calculation for the carbon emissions associated with the product stage [A1-A3] requires the assignment of suitable embodied carbon factors to the given elemental material quantities, as follows:

[A1-A3] = Material quantity (a) x Material embodied carbon factor (b)

7.4 Given the early stage of assessment, technical specification is still indicative, therefore generic data, representative of standard, market average specifications have been used.

7.5 Environmental information for the product stage is defined in the product Environmental Product Declaration (EPD). But where no EPD is available, scenarios for products have been defined from cradle to gate modules according to EN15804.

7.6 The following table summarises the building materials assumptions:

Table 7.1 Building Materials- Existing building

Resource	Quantity (kg)
Foundations & Substructure	
Reinforcement steel (rebar), generic, 80% recycled content, A615	456
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 0% recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	6,577
EPS Insulation, T: 10-2400 mm, 600 x 1200 mm, 0.031 W/m2K, 16 kg/m3 (EPS-gruppen)	344
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	61,920
Plastic vapour control layer, 0.2 mm (Tommen Gram)	16
Reinforcement steel (rebar), generic, 90% recycled content, A615	2,320
Self-levelling mortar, for floors, walls and overhead appl., 3-50 mm, 1400 kg/m3, Pericret (PCI Augsburg)	2,400

Vertical Structures and Façade	
Red brick, average production, UK, 215 mm x 102.5 mm x 65 mm, 2.13 kg/unit, 1485 kg/m3 (Brick Development Association (BDA) Ltd (2019))	8,400
Flexible tile adhesivefor ceramic coverings, 2.2 kg/m2, 2.4 kg/m2, 1200 kg/m3, 1400 kg/m3, Flexmörtel® S1 Rapid, Flexmörtel® S2 Rapid (PCI Augsburg GmbH)	1,404
Masonry mortar/facing wall mortar/mortar with special properties, 1500 kg/m3, EPD coverage: >1500 kg/m3 (IWM)	1,500
Rock wool insulation panels, unfaced, generic, L = 0.037 W/mK, R = 2.70 m2K/W (15 ft2°Fh/BTU), 150 kg/m3 (9.36 lbs/ft3) (applicable for densities: 100-150 kg/m3 (6.24-9.36 lbs/ft3)), Lambda=0.037 W/(m.K)	6,600
Flexible tile adhesivefor ceramic coverings, 2.2 kg/m2, 2.4 kg/m2, 1200 kg/m3, 1400 kg/m3, Flexmörtel® S1 Rapid, Flexmörtel® S2 Rapid (PCI Augsburg GmbH)	2,200
Lightweight concrete block, with expanded clay aggregate, generic, 650 kg/m3 (40.6 lbs/ft3), 18 kg/block (39.7 lbs/block), 0.5x0.3x0.185 mm (0.019x0.012x0.007 in)	45,000
Masonry mortar/facing wall mortar/mortar with special properties, 1500 kg/m3, EPD coverage: >1500 kg/m3 (IWM)	5,800
Gypsum plaster board, regular, generic, 6.5-25 mm (0.25-0.98 in), 10.725 kg/m2 (2.20 lbs/ft2) (for 12.5 mm/0.49 in), 858 kg/m3 (53.6 lbs/ft3)	3,600
Gypsum plaster, 1100 kg/m3 (Bundesverband der Gipsindustrie)	1,100
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	27,216
Reinforcement steel (rebar), generic, 90% recycled content, A615	1,232
Finishing wall mortars, French average, 3 mm, 4.2 kg/m2, DONNEE PAR DEFAUT (DED)	260
Water-borne interior paints, 1.36 kg/L, average coverage 8-10 m2/L, Biora, Ekora, Kolibri Sand, Paneelikattomaali, Ranch, Superlateksi, Tapettipohjamaali, Teknospro, Tela, Timantti, Trend (Teknos)	51
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	68,040
Reinforcement steel (rebar), generic, 90% recycled content, A615	2,410
Finishing wall mortars, French average, 3 mm, 4.2 kg/m2, DONNEE PAR DEFAUT (DED)	260
Horizontal structures: beams, floor's, and roofs	
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	213,600
Reinforcement steel (rebar), generic, 90% recycled content, A615	9,011
Roof tiles, clay, French average, ép. 10mm, DONNEE PAR DEFAUT (DED)	4,980
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	61,650
Reinforcement steel (rebar), generic, 90% recycled content, A615	5,025

Plastic vapour control layer, 0.2 mm (Tommen Gram)	15
Planed timber, conifer (Treindustrien)	1386
Glass wool insulation panels, unfaced, generic, L = 0.031 W/mK, R = 3.23 m2K/W (18 ft2°Fh/BTU), 25 kg/m3 (1.56 lbs/ft3), (applicable for densities: 0-25 kg/m3 (0-1.56 lbs/ft3)), Lambda=0.031 W/(m.K)	620
Oriented strand board (OSB), generic, 9.5-28.5 mm (0.37-1.12 in), 610 kg/m3 (38.1 lbs/ft3), min. G4-2	760
PVC based, multi-layer, synthetic waterproofing roof sheet, non-woven glass inlay, polyester backing, 1.2 mm, Sarnafil G410EL Felt (Sika)	120
Planed timber, conifer (Treindustrien)	72
Other structures and materials	
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	14400
Reinforcement steel (rebar), generic, 90% recycled content, A615	599
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	40800
Reinforcement steel (rebar), generic, 90% recycled content, A615	1725
Porcelain WC kit (toilet and tank), 37.4 kg/unit, DURAVIT : Duraplus (023009+087920) KOHLER : Odeon Up	260
Porcelain sink, 29.6 kg/unit, 50 x 70 cm (SFISB)	330
Glazed steel sink, Long. 860 mm Larg. 500 mm Haut. 140 mm, DONNEE PAR DEFAUT (DED)	48
Shower tray made of synthetic material, French average, Long. 90 cm Larg. 90 cm, DONNEE PAR DEFAUT (DED)	96
Top hung casement wooden window, standard size: 1230 x 1480 mm, 63% wood, 29% glass, 5% steel parts, 2% paint (Mumford & Wood)	400
Doors with wooden frame, interior, DONNEE PAR DEFAUT (DED)	400
Emulsion matt paint for allround interior use, Pigment: Lightfast Pigments, binder: PVA Copolymer emulsion , solvent: Water, 1.443 kg/l, 18m2/l, 0.16 kg/m2, Supermatt White, Almond White, Gardenia, Magnolia, Light Base, Medium Base (Dulux Trade)	89
Tufted carpet tiles, 4.15 kg/m2, pile material polyamide 6 (Milliken Industrials)	830
Ceramic floor tile, 10 mm, average density 2000 kg/m3 (Mosa)	1000

Table 7.2 Building Materials- Proposed building

Resource	Quantity (kg)
Foundations & Substructure	
Reinforcement steel (rebar), generic, 80% recycled content, A615	532
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 0% recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	7668
EPS Insulation, T: 10-2400 mm, 600 x 1200 mm, 0.031 W/m2K, 16 kg/m3 (EPS-gruppen)	400
Plastic vapour control layer, 0.2 mm (Tommen Gram)	19

Self levelling mortar, for floors, walls and overhead appl., 3-50 mm, 1400 kg/m3, Pericret (PCI Augsburg)	2800
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 20% recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	72000
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 20% recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	2705
Vertical Structures and Façade	
Steel cladding tiles, 12.89 kg/m2 (L'ENVELOPPE METALLIQUE DU BATIMENT)	3,700
Red brick, average production, UK, 215 mm x 102.5 mm x 65 mm, 2.13 kg/unit, 1485 kg/m3 (Brick Development Association (BDA) Ltd (2019))	29,000
Flexible tile adhesivefor ceramic coverings, 2.2 kg/m2, 2.4 kg/m2, 1200 kg/m3, 1400 kg/m3, Flexmörtel® S1 Rapid, Flexmörtel® S2 Rapid (PCI Augsburg GmbH)	4,862
Masonry mortar/facing wall mortar/mortar with special properties, 1500 kg/m3, EPD coverage: >1500 kg/m3 (IWM)	5,211
Rock wool insulation panels, unfaced, generic, L = 0.037 W/mK, R = 2.70 m2K/W (15 ft2°Fh/BTU), 150 kg/m3 (9.36 lbs/ft3) (applicable for densities: 100-150 kg/m3 (6.24-9.36 lbs/ft3)), Lambda=0.037 W/(m.K)	22,581
Flexible tile adhesivefor ceramic coverings, 2.2 kg/m2, 2.4 kg/m2, 1200 kg/m3, 1400 kg/m3, Flexmörtel® S1 Rapid, Flexmörtel® S2 Rapid (PCI Augsburg GmbH)	7,500
Lightweight concrete block, with expanded clay aggregate, generic, 650 kg/m3 (40.6 lbs/ft3), 18 kg/block (39.7 lbs/block), 0.5x0.3x0.185 mm (0.019x0.012x0.007 in)	153,166
Masonry mortar/facing wall mortar/mortar with special properties, 1500 kg/m3, EPD coverage: >1500 kg/m3 (IWM)	20,000
Gypsum plaster board, regular, generic, 6.5-25 mm (0.25-0.98 in), 10.725 kg/m2 (2.20 lbs/ft2) (for 12.5 mm/0.49 in), 858 kg/m3 (53.6 lbs/ft3)	12,000
Gypsum plaster, 1100 kg/m3 (Bundesverband der Gipsindustrie)	3,800
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	145,800
Reinforcement steel (rebar), generic, 90% recycled content, A615	6,600
Gypsum plaster board, regular, generic, 6.5-25 mm (0.25-0.98 in), 10.725 kg/m2 (2.20 lbs/ft2) (for 12.5 mm/0.49 in), 858 kg/m3 (53.6 lbs/ft3)	24,000
Water-borne interior paints, 1.36 kg/L, average coverage 8-10 m2/L, Biora, Ekora, Kolibri Sand, Paneelikattomaali, Ranch, Superlateksi, Tapettipohjamaali, Teknospro, Tela, Timantti, Trend (Teknos)	301
Glass wool insulation panels, unfaced, generic, L = 0.031 W/mK, R = 3.23 m2K/W (18 ft2°Fh/BTU), 25 kg/m3 (1.56 lbs/ft3), (applicable for densities: 0-25 kg/m3 (0-1.56 lbs/ft3)), Lambda=0.031 W/(m.K)	2,800
Gypsum plaster board, regular, generic, 6.5-25 mm (0.25-0.98 in), 10.725 kg/m2 (2.20 lbs/ft2) (for 12.5 mm/0.49 in), 858 kg/m3 (53.6 lbs/ft3)	24,000
Structural steel profiles, generic, 80% recycled content, I, H, U, L, and T sections, S235, S275 and S355	3,104
Horizontal structures: beams, floor's, and roofs	

Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	904,800
Reinforcement steel (rebar), generic, 90% recycled content, A615	38,234
Steel sheets, generic, 80% recycled content, S235, S275 and S355	785
Hollow core concrete slabs, generic, C30/37 (4400/5400 PSI), 20% recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3), incl. reinforcement	37,100
Plastic vapour control layer, 0.2 mm (Tommen Gram)	100
EPS Insulation, T: 10-2400 mm, 600 x 1200 mm, 0.031 W/m2K, 16 kg/m3 (EPS-gruppen)	100
Ready-mix concrete, normal-strength, generic, C40/50 (5800/7300 PSI), 10% (typical) recycled binders in cement (400 kg/m3 / 24.97 lbs/ft3)	197,280
Reinforcement steel (rebar), generic, 90% recycled content, A615	16,080
Other structures and materials	
Stainless steel bicycle rack, 1.3 kg/unit, DONNEE PAR DEFAUT (MINISTERE DE L'ENVIRONNEMENT, DE L'ENERGIE ET DE LA MER - MINISTERE DU LOGEMENT ET DE L´HABITAT DURABLE)	9.1
Glazed steel sink, Long. 860 mm Larg. 500 mm Haut. 140 mm, DONNEE PAR DEFAUT (DED)	48
Porcelain WC kit (toilet and tank), 37.4 kg/unit, DURAVIT : Duraplus (023009+087920) KOHLER : Odeon Up	340
Porcelain sink, 29.6 kg/unit, 50 x 70 cm (SFISB)	270
Shower tray made of synthetic material, French average, Long. 90 cm Larg. 90 cm, DONNEE PAR DEFAUT (DED)	168
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	45,600
Reinforcement steel (rebar), generic, 90% recycled content, A615	1,867
Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)	129,600
Reinforcement steel (rebar), generic, 90% recycled content, A615	5,382
Aluminium frame window, 24.27 kg/m2, 2.3 m2/unit (Organisation professionnelle représentative des concepteurs, fabricants et installateurs de menuiseries extérieures en profilés aluminium)	2,500
Doors with wooden frame, interior, DONNEE PAR DEFAUT (DED)	988
Emulsion matt paint for allround interior use, Pigment: Lightfast Pigments, binder: PVA Copolymer emulsion , solvent: Water, 1.443 kg/l, 18m2/l, 0.16 kg/m2, Supermatt White, Almond White, Gardenia, Magnolia, Light Base, Medium Base (Dulux Trade)	3,008.52
Tufted carpet tiles, 4.15 kg/m2, pile material polyamide 6 (Milliken Industrials)	2,300
Ceramic floor tile, 10 mm, average density 2000 kg/m3 (Mosa)	2,800
Building Technology	
Air heat pump, 2,2 kW, R410A	140
Drinking water supply piping network, per m2 GIFA (residential buildings)	180

Electricity distribution system, cabling and central, for all building types, per m2 GFA	400
Sewage water drainage piping network, per m2 GIFA (residential buildings)	130
Heat distribution piping network, per m2 heated area, all building types	130

Table 7.3 Product Stage [A1-A3] Emissions ($kgCO_{2e}$)- Existing Building

	A1-A3 Product Stage
1 Substructure	7050.18
2.1 Frame	13417.25
2.2 Upper floors	8510.31
2.3 Roof	4333.17
2.4 Stairs and Ramps	1560.14
2.5 External walls	82320.41
2.6 Windows and External Doors	2414.95
2.7 Internal doors and Partitions	2092.91
2.8 Internal doors	-
3 Finishes	77.56
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	9560.71
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**131,338**

Table 7.4 Product Stage [A1-A3] Emissions ($kgCO_{2e}$)- Proposed Building

	A1-A3 Product Stage
1 Substructure	7,558
2.1 Frame	53,406
2.2 Upper floors	113,206
2.3 Roof	10,765
2.4 Stairs and Ramps	21,844
2.5 External walls	124,170
2.6 Windows and External Doors	10,978
2.7 Internal doors and Partitions	22,388
2.8 Internal doors	
3 Finishes	9,542
4 Fittings, furnishings & equipment's	89
5 Services (MEP)	14,545
6 Prefabricated buildings and building units	
7 Work to existing building	
8 External works	
Other materials	

TOTAL kg CO_{2e}	**388,491**

8. Construction Process Stage [A4-A5]

8.1 Modules [A4] and [A5] respectively capture the emissions associated with the transportation of the materials and components from the factory gate to the project site and their assembly into a building.

Transport Emissions [A4]

8.2 Transport emissions must include all stages of the journey of the products following their departure from the final manufacturing plant to the project site, taking into account any interim stops at storage depots / and / or distribution centres.

8.3 Transport emissions are calculated as follows:

[A4] = Material or system mass (a) x Transport distance (b) x Carbon conversion factor (c)

8.4 For the purposes of this WLC assessment, the One Click LCA library dataset has been used and the following emissions have been calculated in relation to the selected materials.

Table 8.1 Transport to Site [A4] ($kgCO_{2e}$) - Existing Building

	A4 Transportation to Site
1 Substructure	18
2.1 Frame	507
2.2 Upper floors	44
2.3 Roof	24
2.4 Stairs and Ramps	10
2.5 External walls	3,548
2.6 Windows and External Doors	4
2.7 Internal doors and Partitions	12
2.8 Internal doors	-
3 Finishes	1
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	21
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**4,190**

Table 8.2 Transport to Site [A4] ($kgCO_{2e}$) - Proposed Building

	A4 Transportation to Site
1 Substructure	21
2.1 Frame	2,772
2.2 Upper floors	7,218

2.3 Roof	90
2.4 Stairs and Ramps	1,397
2.5 External walls	1,231
2.6 Windows and External Doors	17
2.7 Internal doors and Partitions	134
2.8 Internal doors	
3 Finishes	54
4 Fittings, furnishings & equipment's	0
5 Services (MEP)	25
6 Prefabricated buildings and building units	
7 Work to existing building	
8 External works	
Other materials	
TOTAL kg CO_{2e}	**12,960**

Construction – Installation Process Emissions [A5]

8.5 The carbon emissions arising from any on- or off-site construction-related activities must be considered in [A5]. This includes any energy consumption for site accommodation, plant use and the impacts associated with any waste generated through the construction process, its treatment and disposal.

8.6 The RICS PS permits the use of an average figure of 1,400kgCO_{2e}/£100K of project value for building construction site emissions, in the absence of more specific information. This figure is taken from the BRE SMARTWaste KPIs and is based on the date of the publication, March 2015; and should therefore be adjusted to current value in accordance with CPI.

8.7 A similar approach is presented within One Click LCA whereby an average site impacts figure can be adopted based upon gross floor area and verified to the EN15804 standard. This accounts for a global warming potential of 30.34kgCO_{2e}/m2 before local compensation.

8.8 For the purposes of this WLC assessment, preference has been given to the One Click LCA approach.

Table 8.3 Site Operations [A5] (kgCO_{2e}) - Existing Building

	A5 Site Operations
1 Substructure	415
2.1 Frame	623
2.2 Upper floors	755
2.3 Roof	428
2.4 Stairs and Ramps	77
2.5 External walls	5,151
2.6 Windows and External Doors	-

2.7 Internal doors and Partitions	137
2.8 Internal doors	-
3 Finishes	8
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	123
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**4,190**

Table 8.4 Site Operations [A5] (kgCO_{2e}) - Proposed Building

	A5 Site Operations
1 Substructure	453
2.1 Frame	2,505
2.2 Upper floors	5,396
2.3 Roof	279
2.4 Stairs and Ramps	1,041
2.5 External walls	10,819
2.6 Windows and External Doors	-
2.7 Internal doors and Partitions	2,527
2.8 Internal doors	
3 Finishes	1,551
4 Fittings, furnishings & equipment's	2
5 Services (MEP)	255
6 Prefabricated buildings and building units	
7 Work to existing building	
8 External works	
Other materials	21,362
TOTAL kg CO_{2e}	**46,190**

9. Use Stage [B1-B7]

9.1 The use stage captures the carbon emissions associated with the operation of the built asset over its entire life cycle, from practical completion to the end of its service life. This includes any emissions relating to operational energy and water use as well as any embodied carbon impacts associated with maintenance, repair, replacement, and refurbishment of building components.

Use [B1]

9.2 The in-use module [B1] captures the emissions arising during the life of a building from its components; including any emissions arising from refrigerants, insulation blowing agents and paints; as well as accounting for the carbonation process in items containing exposed concrete and / or lime.

9.3 Carbon absorption potential by green roofs and facades should also be considered, although the absorption potential for areas <1,000m^2 is generally considered negligible.

Refrigerants

9.4 For the refrigerants, the WLC assessment has assumed, based on the use of 50 Air Source Heat Pumps and a charge of ~3kg's per unit, that the total use of the R32 refrigerant will be about 12 kg's (based upon the specifications of a generic market leading ASHP product range).

Carbonation

9.5 Cementitious materials, such as concrete, cement and mortar, absorb carbon dioxide when exposed to air. This process is the chemical reversal of the cement production process calcination phase. The amount of carbon dioxide absorbed depends on exposure of the material, duration of the exposure as well as the initial amount of cement.

9.6 The figures associated with the carbonisation have been generated through the OneClick LCA software and relate to the selection of materials (detailed above).

Vegetation Carbon Withdrawals

9.7 Vegetation carbon withdrawals have not been modelled as there is minimal soft landscaping in the existing or proposed building. It should also be noted that removals associated with vegetation are not persistent and will be lost unless the project is set up in such a way to preserve vegetation at its eventual demolition.

Table 9.1 Use [B1] ($kgCO_{2e}$) - Existing Building

	B1 Use Phase
1 Substructure	-
2.1 Frame	-
2.2 Upper floors	-
2.3 Roof	-
2.4 Stairs and Ramps	-
2.5 External walls	-
2.6 Windows and External Doors	-
2.7 Internal doors and Partitions	-
2.8 Internal doors	-
3 Finishes	-
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	-
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**-**

Table 9.2 Use [B1] ($kgCO_{2e}$) - Proposed Building

	B1 Use Phase
1 Substructure	-
2.1 Frame	-
2.2 Upper floors	-
2.3 Roof	-
2.4 Stairs and Ramps	-
2.5 External walls	-
2.6 Windows and External Doors	-
2.7 Internal doors and Partitions	-
2.8 Internal doors	-
3 Finishes	-
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	22,680
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**22,680**

Maintenance [B2]

9.8 The [B2] module accounts for the carbon emissions arising from any activities relating to the maintenance processes, including cleaning, and any products used. It also includes any emissions from the energy and water use associated with these activities.

9.9 Emissions associated with maintenance are not calculated by the One Click LCA software on the basis that there are no meaningful data sources.

9.10 The [B2] emissions follow methodology given in the GLA WLC guidance. This states that a total figure of 10 kgCO2e/m2 gross internal area (GIA) may be used to cover all building element categories, or 1 per cent of modules A1-A5, whichever is greater. These have been estimated and inputted in the One Click LCA tool.

9.11 Repair [B3] emissions are assessed (see below) by the One Click LCA software and these can therefore be used to reverse calculate (multiply by four) the [B2] emissions. Some of the [B2] emissions will also already be accounted for in the unregulated energy consumption as, for instance, this would incorporate the use of sockets for cleaning purposes. Nevertheless, the overall figure estimated from the repair emissions was employed to roughly calculate the electricity, water and fuel consumption from maintenance in the LCA tool.

Table 9.3 Maintenance [B2] ($kgCO_{2e}$) - Existing Building

	B2 Maintenance
1 Substructure	-
2.1 Frame	-
2.2 Upper floors	-
2.3 Roof	-
2.4 Stairs and Ramps	-
2.5 External walls	-
2.6 Windows and External Doors	-
2.7 Internal doors and Partitions	-
2.8 Internal doors	-
3 Finishes	-
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	2,516.4
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**2,516.4**

Table 9.4 Maintenance [B2] ($kgCO_{2e}$) - Proposed Building

	B2 Maintenance
1 Substructure	-

2.1 Frame	-
2.2 Upper floors	-
2.3 Roof	-
2.4 Stairs and Ramps	-
2.5 External walls	-
2.6 Windows and External Doors	-
2.7 Internal doors and Partitions	-
2.8 Internal doors	-
3 Finishes	-
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	4,473.6
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**4,473.6**

Repair [B3]

9.12 Module [B3] is intended to take account of the carbon emissions arising from all activities that relate to repair processes and any products used. Typically, this would require data from facilities management / maintenance strategy reports, façade access and maintenance strategy, life cycle cost reports, O&M manuals, and professional guidance.

9.13 Repair data have been entered into the software for some of the materials selected. As no details are available yet for repair, the data inputted into the tool are based on assumptions of annual rates of repair. For example, it has been assumed that 1 in 50 windows at street level may be broken every 2 years.

9.14 The default information associated with other applicable materials, based on their Environmental Product Declaration (EPD), mean that their service life is a lot shorter and thus any emissions from repair works are likely already captured by other [B] modules. Examples include the finishes and coverings, such as paint and carpet tiles, which have a service life of ~10 years. Regardless, emissions associated with repair are not expected to be significant.

Table 9.5 Repair [B3] (kgCO_{2e}) - Existing Building

	B3 Repair
1 Substructure	-
2.1 Frame	-
2.2 Upper floors	-
2.3 Roof	-
2.4 Stairs and Ramps	-
2.5 External walls	-

2.6 Windows and External Doors	1,485
2.7 Internal doors and Partitions	-
2.8 Internal doors	-
3 Finishes	-
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	-
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**1,485**

Table 9.6 Repair [B3] (kgCO_{2e}) - Proposed Building

	B3 Repair
1 Substructure	-
2.1 Frame	-
2.2 Upper floors	-
2.3 Roof	-
2.4 Stairs and Ramps	-
2.5 External walls	-
2.6 Windows and External Doors	6,676
2.7 Internal doors and Partitions	-
2.8 Internal doors	-
3 Finishes	-
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	-
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**6,676**

Material replacement and refurbishment [B4-B5]

9.15 Carbon emissions associated with the anticipated replacement of building components, including any emissions from the replacement process are captured under module [B4]. All emissions arising from the production, transportation to site and installation of the replacement items must be included. This extends to cover any losses during these processes as well as the carbon associated with component removal and end of life treatment.

9.16 Emissions from the replacement of items from the following building element groups should be reported: roof, external walls, windows and doors, finishes, fittings, furnishings & equipment, services.

9.17 Module [B5] must take into account any carbon emissions associated with any building components used in a refurbishment, including any emissions from refurbishment activities. All emissions arising from the production, transport to site and installation of the components used must be included. This includes any losses during these processes, as well as the carbon associated with their removal and end of life treatment.

9.18 The calculation of refurbishment should account for any material additions and variations, instead of like-for-like as in replacement.

9.19 It is assumed that items are being replaced on a like-for-like basis and full replacement (100%) of the items is assumed once the specified lifespan is reached.

9.20 Details for service life are automatically entered into the One Click LCA software for each of the selected building materials since it is typically quantified in the product's EPD. These emissions are accounted for in the B4 part of the lifecycle. As no refurbishment is planned for the building, it has been assumed that no change of use will occur during the service life of the project.

Table 9.7 Material replacement and refurbishment [B4-B5] ($kgCO_{2e}$) - Existing Building

	B4-B5 Material replacement and refurbishment
1 Substructure	-
2.1 Frame	-
2.2 Upper floors	7381
2.3 Roof	755
2.4 Stairs and Ramps	-
2.5 External walls	150
2.6 Windows and External Doors	2415
2.7 Internal doors and Partitions	424
2.8 Internal doors	-
3 Finishes	388
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	13889
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**25,403**

Table 9.8 Material replacement and refurbishment [B4-B5] ($kgCO_{2e}$) - Proposed Building

	B4-B5 Material replacement and refurbishment
1 Substructure	-

2.1 Frame	-
2.2 Upper floors	-
2.3 Roof	317
2.4 Stairs and Ramps	-
2.5 External walls	516
2.6 Windows and External Doors	1,037
2.7 Internal doors and Partitions	2,504
2.8 Internal doors	-
3 Finishes	33,846
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	21,034
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials	-
TOTAL kg CO_{2e}	**59,254**

Operational Energy Use [B6]

9.21 The operational carbon emissions arising from the energy use of building-integrated systems as projected and/or measured throughout the life cycle of the project must be reported under module [B6].

9.22 The operational emissions include the following:

- All emissions regulated under Part L of the Building Regulations - including space heating, hot water supply, cooling, lighting and auxiliary.
- Emissions from non-regulated building-integrated systems – including lifts, safety, securing and communications systems.
- Emissions from non-building-related systems – including ICT equipment, cooking appliances, specialist equipment – can represent a significant part of the total operational emissions and should be including where possible.
- Any impact from waste produced by operational energy use should also be considered including any treatment and transportation these might require.
- Where building operation requires fuel to be transported to the site (e.g., gas bottles, oil suppliers etc.) the transport emissions associated with the fuel delivered should be included.
- Any benefit from energy produced onsite and exported to the grid is covered within module [D].

9.23 The RICS PS states that the effect of the anticipated future grid decarbonisation should be accounted for when estimating the operational carbon impact over the life of the project. Consideration should also be given to the impact of climate change the potential affects this would have on heating and cooling demands over the life cycle.

Emissions Regulated Under Part L of the Building Regulations

9.24 An initial assessment of regulated emissions has been undertaken by Ensphere Group and is included as an appendix within the submitted energy report.

9.25 A modelling exercise of the existing building has been conducted to estimate annual emissions. This has assumed an all-gas heating and hot water system, with u-values comparable to buildings of the same time period. The existing building emissions associated with the Building Regulations are assessed to be 7,805 kg CO_2 per annum using the SAP10 carbon conversion factors. This equates to 468,280 kg CO_2 per annum over a 60-year time period.

9.26 The proposed building emissions associated with the Building Regulations are assessed to be 2,900 kg CO_2 per annum using the SAP10 carbon conversion factors. This equates 173,988 kg CO_2 per annum over a 60-year time period.

Emissions from Non-regulated Building-integrated Systems

9.27 A number of sources of emissions are excluded from the Building Regulations, notably those associated with Equipment with lifts, safety, securing and communications systems, external lighting, and other equipment's etc. The Building Regulations report provides a figure for estimated unrelated energy use and this has been used as the basis for predicting this figure.

9.28 The existing building emissions associated with the unregulated energy use are assessed to be 2,183 kg CO_2 per annum using the SAP10 carbon conversion factors. This equates to 130,993 kg CO_2 per annum over a 60-year time period.

9.29 The proposed building emissions associated with the unregulated energy use are assessed to be 7,000 kg CO_2 per annum using the SAP10 carbon conversion factors. This equates to 419,987 kg CO_2 per annum over a 60-year time period

Operational Water Use [B7]

9.30 All carbon emissions related to water supply and wastewater treatment, over the life cycle of the building (excluding water use during maintenance, repair, replacement, and refurbishment that are reported elsewhere), must be reported under module [B7].

9.31 Residential numbers have been taken from the Schedule of Plans and floor space which indicates 4 units, totalling a maximum of ~7 residential occupants in the existing building and 4 units and ~11 residents in the proposed building.

9.32 Estimates on anticipated water consumption in the UK have been made based on the values provided in Table 22 of the BSRIA Rules of thumb – Guidelines for the building services, 5th edition for the respective building type, in the absence of project specific information at early design stages. The BSRIA maximum daily total water demand for this building type (i.e., flats) equates to 120 litres / person. This should be understood as upper limits (i.e., worst case scenario) as the proposed reduced flow / flush systems should limit daily usage to 105 litres / person / day.

9.33 For the Tottenham Street site, emissions associated with operational water usage are estimated over the 60-year period to be 11,145 kg CO_2 and 17,513 kg CO_2 for existing and proposed building respectively.

10. End of Life Stage [C1 to C4]

10.1 The EoL stage commences when the built asset has reached the end of its life and will no longer be used. For the purposes of the whole life carbon assessment this is assumed to occur at the end of the reference study period of the building. The reference study period is used for consistency and comparability of results, irrespective of other factors which might determine the lifespan of the building (e.g., lease period).

10.2 Any emissions arising from decommissioning, stripping out, disassembly, deconstruction and demolition operations as well as from transport, processing and disposal of materials at the end of life of the project must be accounted for in module [C], which is subdivided as follows:

- deconstruction and demolition emissions [C1]
- transport emissions [C2]
- waste processing for reuse, recovery or recycling emissions [C3]
- disposal emissions [C4]

10.3 The carbon emissions arising from any on or off-site deconstruction and demolition activities, including any energy consumption for site accommodation and plant use, must be considered in [C1].

10.4 According to the RICS PS, an average rate of 3.4 $kgCO_{2e}/m^2$ GIA (rate from monitored demolition case studies in central London) based on aggregated data should be used in the absence of more specific information.

10.5 Any carbon emissions associated with the transportation of deconstruction and demolition arisings to the appropriate disposal site, including any interim stations, must be captured within module [C2].

10.6 The transport emissions for the discarded items should be calculated based on the following formula:

[C2] = Mass of waste to be transported (a) × Transport carbon factor (b) × Distance to disposal site (c)

10.7 The RICS PS outlines acceptable assumptions to be used in the absence of more specific data.

10.8 When materials and/or components are intended to be recovered and reused or recycled after the end of the life of the built asset, any carbon emissions associated with their treatment and processing prior to reaching the end-of-waste state must be included in module [C3].

10.9 For elements not expected to be recovered and repurposed but intended for final disposal either in landfill or incineration, an allowance for the emissions arising from their disposal must be included in [C4].

10.10 The RICS PS outlines acceptable assumptions to be used in the absence of more specific data.

10.11 Library data associated with the One Click LCA generates figures for the C1-C4 emissions on the basis of the materials selected. However, for the purpose of this report, demolition was excluded from the calculation to allow fair comparison between two buildings.

Table 10.1 End of Life stage [C1-C4] ($kgCO_{2e}$) - Existing Building

	C1-C4 End of Life stage
1 Substructure	33
2.1 Frame	732
2.2 Upper floors	2,169
2.3 Roof	3,419
2.4 Stairs and Ramps	18
2.5 External walls	5,830
2.6 Windows and External Doors	1,019
2.7 Internal doors and Partitions	21
2.8 Internal doors	
3 Finishes	0
4 Fittings, furnishings & equipment's	
5 Services (MEP)	417
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials - TOTAL	-
TOTAL kg CO_{2e}	**13,659**

Table 10.2 End of Life stage [C1-C4] ($kgCO_{2e}$) - Proposed Building

	C1-C4 End of Life stage
1 Substructure	35
2.1 Frame	3,981
2.2 Upper floors	10,331
2.3 Roof	425
2.4 Stairs and Ramps	1,999
2.5 External walls	4,437
2.6 Windows and External Doors	1,942
2.7 Internal doors and Partitions	2,248
2.8 Internal doors	
3 Finishes	5,917
4 Fittings, furnishings & equipment's	0

5 Services (MEP)	1,134
6 Prefabricated buildings and building units	
7 Work to existing building	
8 External works	
Other materials - TOTAL	
TOTAL kg CO_{2e}	**32,449**

11. Benefits & Loads Beyond the System Boundary [D]

11.1 Module [D] covers any benefits or burdens accruing from the repurposing of elements discarded from the built asset, or any energy recovered from them beyond the project's life cycle. Module [D] is intended to provide a broader picture of the environmental impacts of a project by accounting for the future potential of its components when these are repurposed i.e., recovered and reused and/ or recycled. Module [D] captures the avoided emissions (or potential loads) from utilising repurposed items to substitute primary materials. Module [D] can be used as a metric for quantifying circularity and assessing future resource efficiency.

11.2 It is communicated separately as it occurs beyond the life cycle of the project under study and also bears high inherent uncertainty regarding the future treatment of building components. In the absence of more specific data, reliance is given to the data within the One Click LCA tool.

Table 11.1 Benefits and Loads Beyond the System Boundary [D] ($kgCO_{2e}$) - Existing Building

	D Benefits and Loads Beyond the System Boundary
1 Substructure	-501
2.1 Frame	-2,536
2.2 Upper floors	-5,992
2.3 Roof	-1,676
2.4 Stairs and Ramps	-360
2.5 External walls	-20,204
2.6 Windows and External Doors	-792
2.7 Internal doors and Partitions	-374
2.8 Internal doors	-
3 Finishes	-
4 Fittings, furnishings & equipment's	-
5 Services (MEP)	-5,540
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials - TOTAL	-
TOTAL kg CO_{2e}	**-37,974**

Table 11.2 Benefits and Loads Beyond the System Boundary [D] ($kgCO_{2e}$) - Proposed Building

	D Benefits and Loads Beyond the System Boundary
1 Substructure	-129
2.1 Frame	-9,649

2.2 Upper floors	-24,550
2.3 Roof	-1,138
2.4 Stairs and Ramps	-4,747
2.5 External walls	-34,132
2.6 Windows and External Doors	-1,936
2.7 Internal doors and Partitions	-948
2.8 Internal doors	-
3 Finishes	-12,933
4 Fittings, furnishings & equipment's	-26
5 Services (MEP)	-2,139
6 Prefabricated buildings and building units	-
7 Work to existing building	-
8 External works	-
Other materials - TOTAL	-
TOTAL kg CO_{2e}	**-92,327**

12. Whole Lifecycle Carbon Assessment Results

12.1 The following presents the project Whole Life-Cycle Carbon Assessment according to RICS methodology and EN 15978.

Table 12.1 Whole Life Carbon Assessment ($kgCO_{2e}$)- Existing Building

	Biogenic carbon (kg CO2e)	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2 Maintenance	B3 Repair	B4 Material replacement	B5 Material refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO2e	D External impacts (not included in totals)
0.1 Toxic Mat.															
0.2 Demolition															
0.3 Supports															
0.4 Groundworks															
0.5 Diversion															
1 Substructure	0.0	7050.2	18.3	415.6			0.0						33.4	7517.6	-501.2
2.1 Frame	0.0	13417.3	507.2	622.6			0.0						732.2	15279.3	-2536.2
2.2 Upper Floors	0.0	8510.3	44.4	755.3			0.0	7381.1	0.0				2169.0	18860.1	-5991.6
2.3 Roof	-2894.1	4333.2	24.3	426.0			0.0	755.2	0.0				3418.9	6063.5	-1675.7
2.4 Stairs & Ramps	0.0	1560.1	9.8	77.0			0.0						18.0	1665.0	-360.4
2.5 Ext. Walls	0.0	82320.4	3546.7	5137.3			0.0	150.3	0.0				5830.0	96984.7	-20203.6
2.6 Windows & Ext. Doors	-962.6	2415.0	4.0	0.0			1485.1	2415.0	0.0				1018.9	6375.3	-792.4
2.7. Int. Walls & Partitions	0.0	2092.9	12.0	137.9			0.0	424.2	0.0				20.8	2687.8	-373.7
2.8 Int. Doors															
3 Finishes	0.0	77.6	1.1	7.9			0.0	387.8	0.0				0.2	474.6	

4 Fittings, furnishings & equipment's														
5 Services (MEP)	0.0	9560.7	21.5	123.0	2516.4	0.0	13889.1	0.0	468279.8	130992.6	11145.1	417.4	636945.5	-5539.7
6 Prefabricated														
7 Existing bldg														
8 Ext. works														
Unclassified / Other				7585.9									7585.9	
TOTAL kg CO2e	**-3856.7**	**131,337.6**	**4,189.3**	**15,288.4**	**2,516.4**	**1,485.1**	**25,402.6**	**0.0**	**468,279.8**	**130,992.6**	**11,145.1**	**13,658.8**	**800,439.1**	**-37974.5**

Table 12.2 Whole Life Carbon Assessment (kgCO_{2e})- Proposed Building

	Biogenic carbon (kg CO2e)	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2 Maintenance	B3 Repair	B4 Material replacement	B5 Material refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO2e	D External impacts (not included in totals)
0.1 Toxic Mat.															
0.2 Demolition															
0.3 Supports															
0.4 Groundworks															
0.5 Diversion															
1 Substructure	0	7558.11	21.35	452.52			0						35.28	8067.25	-128.77
2.1 Frame	0	53406.1	2771.56	2504.68			0						3980.6	62662.93	-9648.84
2.2 Upper Floors	0	113206.45	7218.49	5396.02			0						10330.74	136151.69	-24550.3
2.3 Roof	0	10765.24	90.07	279.36			0	317.01	0				424.83	11876.52	-1137.67
2.4 Stairs & Ramps	0	21843.69	1397.09	1041.03			0						1999.19	26281	-4746.58

2.5 Ext. Walls	0	124170.35	1231.42	10818.86			0	516.48	0				4436.76	141173.86	-34131.8
2.6 Windows & Ext. Doors	-1811.33	10977.62	17.4	0			6675.53	1037.06	0				1942.19	18838.47	-1935.84
2.7. Int. Walls & Partitions	0	22387.86	133.74	2526.8			0	2503.76	0				2247.74	29799.89	-948.46
2.8 Int. Doors															
3 Finishes	0	9541.63	54.39	1551.35			0	33846.03	0				5917.44	50910.83	-12933
4 Fittings, furnishings & equipment's	0	88.74	0.038	2.22			0						0.0073	91	-26.24
5 Services (MEP)	0	14545.45	24.9	255.34	22680.31	4473.6	0	21033.64	0	173988.09	419987.16	17513.41	1134.15	675636.04	-2139.24
6 Prefabricated															
7 Existing bldg															
8 Ext. works															
Unclassified / Other				21361.8										21361.8	
TOTAL kg CO2e	**-1811.33**	**388,491.2**	**12,960.5**	**46,190.0**	**22,680.3**	**4,473.6**	**6,675.5**	**59,254.0**	**-**	**173,988.1**	**419,987.2**	**17,513.4**	**32,448.9**	**1,182,851.3**	**-92326.7**

(*) Module D is not included in totals.

13. Emission Comparison (Existing vs Proposed)

13.1 Whole Life Carbon Assessment, which comprises stages [A], [B] & [C], shows that overall whole life cycle emissions of the new building is 30% times higher than the existing one. However, it is important to note that the proposed building is almost 3 times larger in area and more occupants.

13.2 Comparison of these two buildings per square meter indicates similar embodied for both schemes over the 60 years. The main difference is in relation to the operational energy use which is much lower per square meter for the proposed development which uses ASHPs than the existing building with gas fired boilers.

Table 13.1 Embodied Carbon and Operational Energy Use Emissions ($kgCO_{2e}/m^2$)

Key emissions	Existing Building	Proposed Building
Embodied Carbon/ m^2	775	814
Operational Energy Use / m^2	2,397	843

13.3 Furthermore, the operational energy use for the WLC assessment of the proposed building was calculated using SAP10 carbon factors which remain constant through time. When accounting for decarbonisation of the national grid, the whole life cycle emissions decrease to 663,849 $kgCO_2$, ~17% lower than the estimated emissions from the existing building over the next 60 years. This represents a more accurate portrayal of the proposed building emissions as the national grid is decarbonising rapidly and thus with an all electric system, the building's operational energy use will effectively become net-zero over time.

Table 13.2 Emissions summary ($kgCO_{2e}$)

Key emissions	Existing Building (SAP10)	Proposed Building (SAP10)	Decarbonised Scenario
Biogenic carbon (kg CO2e)	-3,857	-1,811	-1,811
A1-A3 Product Stage	131,338	388,491	388,491
A4 Transportation to site	4,189	12,960	12,960
A5 Site operations	15,288	46,190	46,190
B1 Use Phase		22,680	22,680
B2 Maintenance	2,516	4,474	4,474
B3 Repair	1,485	6,676	6,676
B4 Material replacement	25,403	59,254	59,254
B5 Material refurbishment	0	0	0
B6 Operational Energy use - Regulated	468,280	173,988	21,961
B6 Operational Energy use - Unregulated	130,993	419,987	53,012
B7 Operational Water use	11,145	17,513	17,513
C1-C4 End of Life stage	13,659	32,449	32,449
TOTAL kg CO2e	**800,439**	**1,182,851**	**663,849**

14. Summary

14.1 A Whole Life-Cycle Carbon Assessment has been undertaken for an existing and proposed development at 52 Tottenham Street, London.

14.2 The assessment has been undertaken on the basis of information available at RIBA Stage 2 of the design and number of assumptions for the existing building.

14.3 Consideration has been given to the planning policy requirements, in particular Policy CC1 Climate Change Mitigation of the Camden Local Plan (July 2017); as well as the GLA's guidance (Whole Life-Cycle Carbon Assessments, March 2022). The RICS Professional Statement - Whole Life Carbon Assessment for the Built Environment 1st Edition (RICS; ISBN 978 1 78321 208 8; November 2017); and BRE Global Methodology for the Environmental Assessment of Buildings Using EN 15978:2011 (Building Research Establishment; ref: PN 326 Rev 0.0; January 2018) have also been considered.

14.4 The assessment of both buildings has reviewed WLC over a 60-year period, in line with the recommended RICS approach. This identified total WLC emission related to the existing building of 800,439 $kgCO_2e$. For the proposed building, total WLC emissions were calculated at 1,182,851 kgCO2e, decreasing to just 663,849 kgCO2e when decarbonisation of the electricity grid is accounted for.

14.5 The key lifecycle stages responsible for these emissions are [B6] Operational Energy, [A1-A3] Product Stage and [B4] Material replacement.

Table 4.1 Key emissions summary ($kgCO_{2e}$)

Key emissions	Existing Building	Proposed Building (SAP10)
[B6] Operational Energy	599,272	593,975
[A1-A3] Product Stage	131,338	388,491
[B4] Material replacement	25,403	59,254

14.6 The results reveal that redeveloping the site in line with the proposals lead to a significant carbon saving over the life cycle of the building, with approximately 17% less emissions from the proposed building in a decarbonised scenario, relative to the existing. This demonstrates that the proposed development will not only enhance the local townscape with a new building that provides high quality residential accommodation, but it will also optimise resources and energy use in comparison with the existing building. Redevelopment of the site thus provides not only a socioeconomic benefit in terms of increasing housing provision, but also aligns with the environmental objectives of the Council.

15. Recommendations

15.1 The following comprises a series of recommendations to assist with further reducing the carbon emissions associated with the proposed development.

15.2 The Whole Life-Cycle Carbon Assessment has identified the following key areas as being the most significant contributors to emissions:

[A1-A3] Product Stage

15.3 These were assessed to represent 388,491 kgCO_{2e}, equating to roughly 33% of the total. These emissions are largely associated with the material choices associated with the substructure, superstructure, and external works; where decisions are also influenced by factors such as structural performance, cost and aesthetics. One potential opportunity would be to maximise the recycled content in materials specified, for instance, using GGBS cement replacement.

15.4 There may be scope to investigate alternatives with a lower carbon footprint; however, given the nature of the proposed development, the potential for significant reductions may be limited. Nevertheless, it is recommended that material options be revisited as the detail of the design develops, to review the potential extent of savings.

[B4] Material replacement

15.5 Material replacement emissions were assessed at 59,254 kgCO2e, roughly 5% of the total. These emissions are associated with the estimated lifespans associated with the selected materials and it may be feasible to identify more resilient materials products with longer lifespans.

[B6] Operational Energy Use

15.6 Operational energy use is expected to form the largest contribution to emissions (~50% of total emissions) over the buildings predicted lifetime, this figure may not however fully account for future grid decarbonisation in the UK over the next 60 years as it is based on current (SAP10) carbon conversion factors and will steadily reduce over time. When electricity decarbonisation was accounted for, this reduced total WLC emissions by approximately 44%.

15.7 Operational emissions were assessed at 173,988 kgCO2e (regulated) and 419,987 kgCO2e (unregulated); representing 15% and 36% respectively.

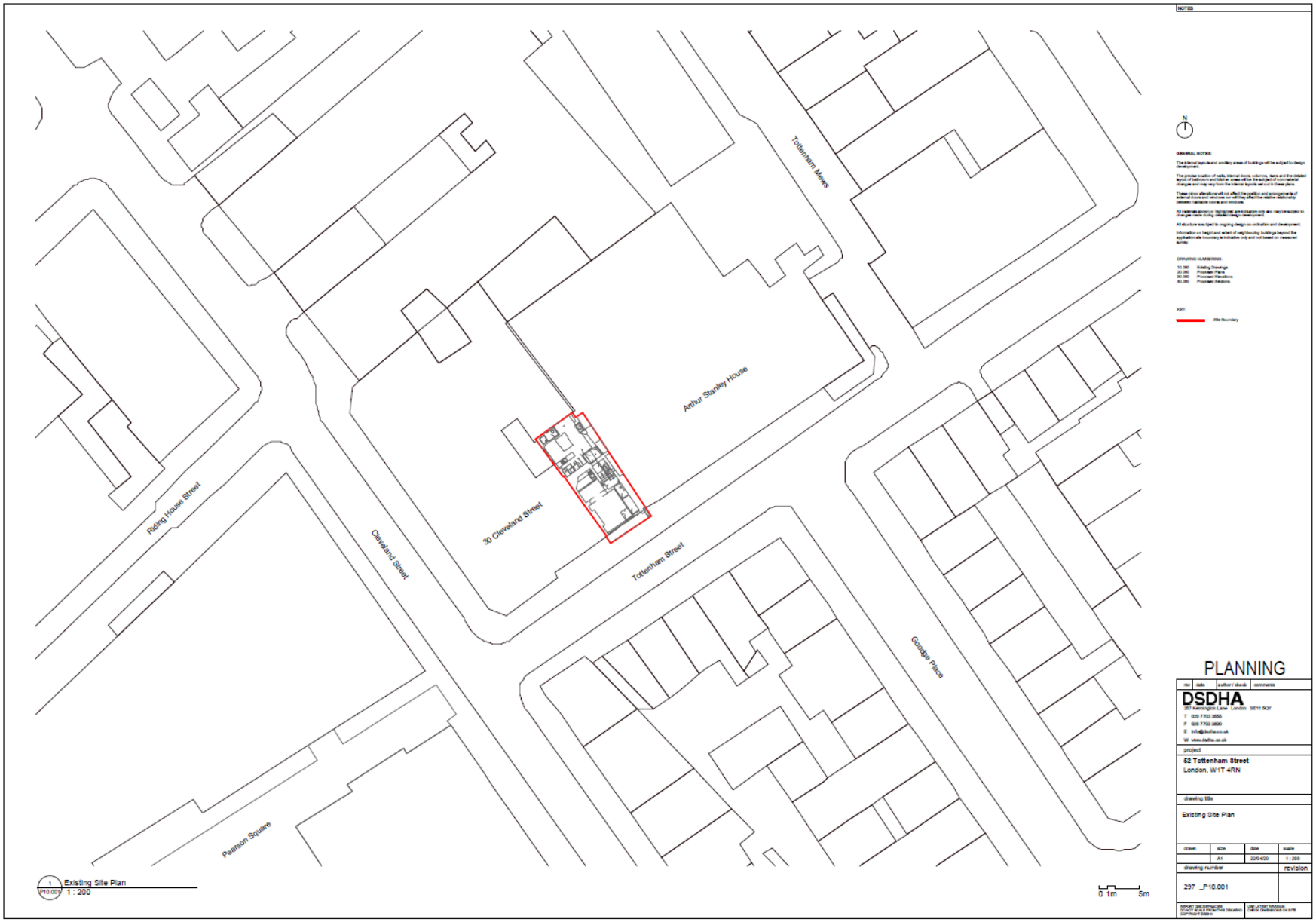
Offsetting

15.8 Acknowledging that it is not always feasible to completely eradicate WLC emissions through design decisions, consideration could be given to the potential for offsetting the impacts through

abatement measures elsewhere and / or contributions to facilitate such abatements (e.g., green tariff electricity).

Appendices

A. Site Plan


Tottenham Mews
Arthur Stanley House
30 Cleveland Street
Riding House Street
Cleveland Street
Tottenham Street
Goodge Place
Pearson Square
N
PLANNING
DSDHA
62 Tottenham Street
London, W1T 4RN
Existing Site Plan
297 _P10.001
Existing Site Plan
1 : 200
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B. Key Local Planning Policy Requirements

Local Policy Framework

Camden Local Plan (July 2017)

The Local Plan was adopted by Council on 3 July 2017 and has replaced the Core Strategy and Camden Development Policies documents as the basis for planning decisions and future development in the borough. Policies relevant to this report are presented below:

Policy G1 Delivery and Location of Growth [extract]

The Council will create the conditions for growth to deliver the homes, jobs, infrastructure and facilities to meet Camden's identified needs and harness the benefits for those who live and work in the borough.

Delivery of Growth

The Council will deliver growth by securing high quality development and promoting the most efficient use of land and buildings in Camden by:

a) Supporting development that makes best use of its site, taking into account quality of design, its surroundings, sustainability, amenity, heritage, transport accessibility and any other considerations relevant to the site;

[…]

Policy D1 Design [extract]

The Council will seek to secure high quality design in development. The Council will require that development:

[…]

c) Is sustainable in design and construction, incorporating best practice in resource management and climate change mitigation and adaptation;

d) is of sustainable and durable construction and adaptable to different activities and land uses;

[…]

Policy D2 Heritage [extract]

The Council will preserve and, where appropriate, enhance Camden's rich and diverse heritage assets and their settings, including conservation areas, listed buildings, archaeological remains, scheduled ancient monuments and historic parks and gardens and locally listed heritage assets.

[…]

Listed Buildings

Listed buildings are designated heritage assets and this section should be read in conjunction with the section above headed 'designated heritage assets'. To preserve or enhance the borough's listed buildings, the Council will:

i) resist the total or substantial demolition of a listed building;

j) resist proposals for a change of use or alterations and extensions to a listed building where this would cause harm to the special architectural and historic interest of the building; and

k) resist development that would cause harm to significance of a listed building through an effect on its setting.

Policy CC1 Climate Change Mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

a) Promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b) Require all major development to demonstrate how London Plan targets for carbon dioxide have been met;

c) Ensure that the location of the development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d) Support and encourage sensitive energy efficiency improvements to existing buildings;

e) Require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f) Expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g) Working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h) Protecting existing decentralised energy networks (e.g. at Gower Street Bloomsbury, Kings Cross, Gospel Oak, and Somers Town) and safeguarding potential network routes; and

i) Requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

Policy CC2 Adapting to Climate Change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a) The protection of existing green spaces and promoting new appropriate green infrastructure;

b) Not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of Sustainable Drainage Systems;

c) Incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d) Measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units of 500sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

<u>Sustainable Design and Construction Measures</u>

The Council will promote and measure sustainable design and construction by:

e) Ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f) Encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g) Encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve “excellent” in BREEAM domestic refurbishment; and

h) Expecting non-domestic developments of 500sqm of floorspace or above to achieve “excellent” in BREEAM assessments and encouraging zero carbon in new developments from 2019.

Policy CC3 Water and flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

a) incorporate water efficiency measures;

b) avoid harm to the water environment and improve water quality;

c) consider the impact of development in areas at risk of flooding (including drainage);

d) incorporate flood resilient measures in areas prone to flooding;

e) utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and

f) not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore

Policy CC4 Air quality

The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.

Development that involves significant demolition, construction or earthworks will also be required to assess the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan.

Policy CC5 Waste

The Council will seek to make Camden a low waste borough.

We will:

a) aim to reduce the amount of waste produced in the borough and increase recycling and the reuse of materials to meet the London Plan targets of 50% of household waste recycled/composted by 2020 and aspiring to achieve 60% by 2031;

b) deal with North London's waste by working with our partner boroughs in North London to produce a Waste Plan, which will ensure that sufficient land is allocated to manage the amount of waste apportioned to the area in the London Plan;

c) safeguard Camden's existing waste site at Regis Road unless a suitable compensatory waste site is provided that replaces the maximum throughput achievable at the existing site; and

d) make sure that developments include facilities for the storage and collection of waste and recycling.

Policy DM1 Delivery and Monitoring [extract]

The Council will deliver the vision, objectives and policies of the Local Plan by:

[…]

d) Using planning contributions where appropriate to:

i. Support sustainable development;

C. LCA Details

One Click LCA

One Click LCA is specialised software developed by Bionova Ltd, that provides the means to generate quick and accurate building level Lifecycle Assessments using designs imported from tools such as Revit, IFC (BIM), Excel, IESVE, energy models (gbXML).

Further, it provides access to one of the largest LCA database's currently available with Environmental Product Declarations (EPD) from manufacturers as well as generic materials.

There are a number of calculation tools available within the One Click LCA tool, for the purposes of this LCA the following were utilised:

- LCA for BREEAM UK – The official BRE-approved LCA in compliance with all current BREEAM UK versions, it is used to calculate the different material options for the Superstructure, Substructure and Hard landscaping.
- LCA for BREEAM UK IMPACT-compliant – This is an IMPACT-compliant LCA application according to IMPACT v5, this is used to produce the baseline LCA for the superstructure as required by the Mat01 BREEAM criteria.

IMPACT

IMPACT is a specification and database for use by software developers to incorporate into their tool, enabling a consistent Life Cycle Assessment. IMPACT compliant calculation tools work by allowing the user to attribute environmental information to drawn or scheduled items in the BIM (For the purposes of this LCA the imported IESVE data model). The quantity information imported within the BIM is multiplied by the environmental impact and/or costs 'rates' to produce an overall impact and cost for the whole (or selected part) of the design.

For the purposes of this LCA an IMPACT compliant calculation tool available through One Click LCA has been used to generate an environmental benchmark for comparison with the BREEAM LCA benchmarks.

Environmental Product Declarations (EPD)

An environmental product declaration or EPD is a document which is used to quantifiably demonstrate the environmental performance of a product. The European Standard for the generation of environmental product declarations for construction products is EN 15804 and was published by the CEN Technical Committee for the sustainability of construction works (CEN TC350 in 2012.)

EPD are generated based on data obtained through Life Cycle Assessment (LCA), with the LCA being performed using a peer-reviewed Product Category Rules (PCR) document in line with EN 15804, ISO 14025, and other related intranational standard.

EN15804:2012 & Life cycle assessment scope and system boundaries

EN 15804:2012 + A1:2013 'Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products' is a European standard that provides core product category rules (PCR) for Type III environmental declarations for any construction product and construction service. The core PCR defines the parameters to be declared and the way in which they are collated and reported, describing which stages of a product's life cycle are considered in the PED and which processes are to be included in the life cycle stages. Further information can be found on the European Committee for Standardisation's website.

Further detailed explanation of the life cycle stage and analysis score of the EN 15804 standard are as follows:

Product Stage	Description
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also considered. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.
A4 Transportation to site	A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.
A5 Construction/installation process	A5 covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state.
B1-B5 Maintenance and material replacement	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replacing new material as well as the impacts from manufacturing the replacing material as well as handling of waste until the end-of-waste state.
B6 Energy use	The considered use phase energy consumption (B6) impacts include exhaust emissions from any building level energy production as well as the environmental impacts of production processes of fuel and externally produced energy. Energy transmission losses are also considered.

B7 Water use	The considered use phase water consumption (B7) impacts include the environmental impacts of production processes of fresh water and the impacts from wastewater treatment.
C1-C4 Deconstruction	The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.
D External impacts/end-of-life benefits	The external benefits include emission benefits from recycling recyclable building waste. Benefits for re-used or recycled material types include positive impact of replacing virgin-based material with recycled material and benefits for materials that can be recovered for energy cover positive impact for replacing other energy streams based on average impacts of energy production.

D. General Notes

The report is based on information available at the time of the writing and discussions with the client during any project meetings. Where any data supplied by the client or from other sources have been used it has been assumed that the information is correct. No responsibility can be accepted by Ensphere Group Ltd for inaccuracies in the data supplied by any other party.

The review of planning policy and other requirements does not constitute a detailed review. Its purpose is as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.

No site visits have been carried out, unless otherwise specified.

This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in guidance may necessitate a re-interpretation of the report in whole or in part after its original submission.

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Ensphere Group Ltd
52 Grosvenor Gardens
London, SW1W 0AU
+44 (0) 20 7846 9040
www.enspheregroup.com