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WHOLE LIFE-CYCLE CARBON ASSESSMENT

9.370 – 330 GRAY'S INN ROAD

28/02/2023 *by TKI, reviewed by SG*

EXECUTIVE SUMMARY

A Whole Life-Cycle Carbon (WLC) assessment has been undertaken for the proposed development at Gray's Inn Road within the London Borough of Camden. The WLC assessment has been carried out in accordance with the latest published GLA *'Whole Life-Cycle Carbon Assessments Guidance (March 2022).* All WLC life-cycle stages are presented in the image below.

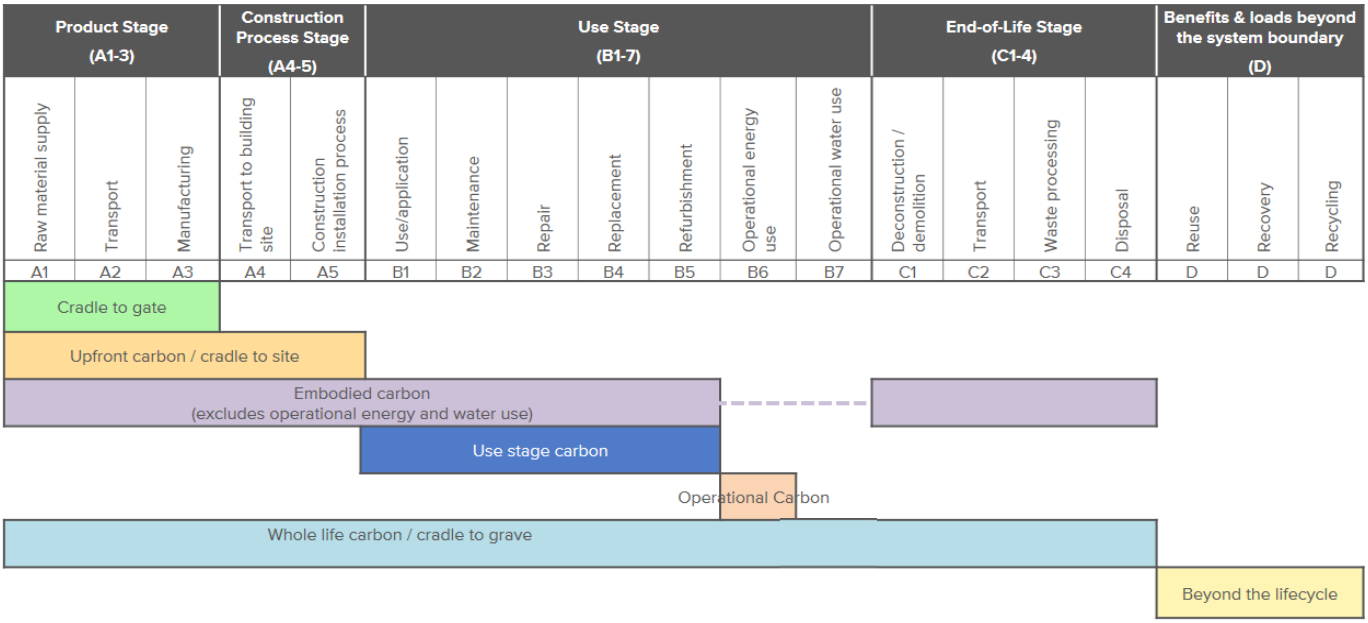


Figure 1: Life-cycle stages (modules) according to EN 15978 and terminology of carbon emissions scopes.

The estimated Whole Life-Cycle Carbon emissions of the proposed development are shown in the table below. Table 1 shows the results for estimated WLC assessment – current status of the electricity grid with SAP10 carbon factors, which is the scenario that was chosen to form the basis of design decisions.

Table 1: Estimated WLC emissions

	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D
TOTAL kg CO_2e	16,698,698	14,565,686	43,389,926	1,113,966	-6,349,846
TOTAL kg CO_2e/m^2 GIA	468	408	1,299	31	-178

INTRODUCTION

As buildings become more energy efficient, operational carbon emissions will make up a smaller proportion of a development's WLC emissions. It is therefore becoming increasingly important to calculate and reduce carbon emissions associated with other aspects of a development's life-cycle; namely, embodied carbon emissions and unregulated emissions (all operational energy uses not covered by Building Regulations, for example cooking and small power).

SITE DESCRIPTION

A S73 amendment application is being submitted for the proposed scheme at 330 Gray's Inn Road to reflect amendments to the previously consented scheme. The development description is outlined below.

Variation of Condition 2, 18, 31, 41 and 54 of planning permission ref 202/553/P for the 'Redevelopment of the former Royal National Throat, Nose and Ear Hospital site, comprising: Retention of 330 Gray's Inn Road and a two storey extension above for use as hotel (5 above ground storeys in total), demolition of all other buildings, the erection of a part 13 part 9 storey building plus upper and lower ground floors (maximum height of 15 storeys) for use as a hotel (including a cafe and restaurant); covered courtyard; external terraces; erection of a 7 storey building plus upper and lower ground floors (maximum height of 9 storeys) for use as office together with terraces; erection of a 10 storey building plus upper and lower ground floors (maximum height of 12 storeys) for use as residential on Wicklow Street and office space at lower ground and basement floors; erection of a 5 storey building plus upper and lower ground floors (maximum height of 7 storeys) for use as residential on Swinton Street and associated residential amenity space; together with a gymnasium; new basement; rooftop and basement plant; servicing; cycle storage and facilities; refuse storage; landscaping and other ancillary and associated works.' NAMELY to enable amendments to the approved drawings list to enable an uplift in office/labs floorspace, a reduction in affordable workspace, amendments to the landscape design of the residential garden, a revised entrances on Wicklow Street, a revised arrangement to the loading bay on Wicklow Street, reconfiguration at basement level of the office/labs building, and increased cycle parking provision, and additional basement level, reconfiguration of the roof level plant and enclosures, the addition of flues in addition to other associated works. A submission for variation of Condition 2, 18, 31, 41 and 54 of planning permission ref 202/553/P is proposed for the 'Redevelopment of the former Royal National Throat, Nose and Ear Hospital site.

POLICY FRAMEWORK

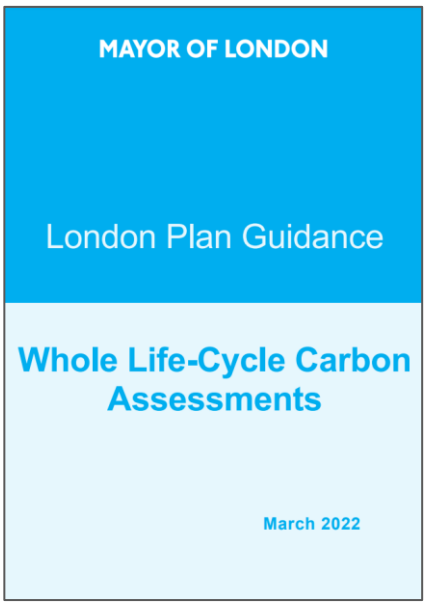
The London Plan (March 2021) has included under Policy SI2 Minimising greenhouse gas emissions, a requirement for a WLC Assessment for all referable development proposals.

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

The GLA has also published an updated London Plan Guidance report on Whole Life-Cycle Carbon Assessments (March 2022), which explains how to prepare a WLC assessment for planning applications. The guidance outlines when applicants are required to take action, this is as follows:

- Pre-application
- Stage 1 submission (i.e. RIBA Stage 2/3)
- Post-construction (i.e. upon commencement of RIBA Stage 6 and prior to the building being handed over, if applicable. Generally, it would be expected that the assessment would be received three months post-construction)

The GLA has also published a WLC assessment template which provides separate tabs detailing the information that should be submitted at each stage.



METHODOLOGY

The methodology followed in preparing this report is in line with the GLA WLC Assessments Guidance (March 2022) and the RICS professional statement titles 'Whole life carbon assessment for the built environment' (November 2017), which follows the European standard EN 15978.

The GLA's WLC assessment template has been filled in for the Detailed Planning stage. The Detailed Planning tab describes the design principles adopted in the scheme to reduce the WLC of the development. This report summarises the actions taken during Stage 1 submission (detailed application stage). This report should be read in conjunction with the WLC Assessment Template, which has been submitted as part of this planning application. The applicant recognises that the WLC calculations presented in this report will need to be revisited and amended at post-construction stage (upon commencement of RIBA Stage 6).

LIFE-CYCLE STAGES

The life-cycle stages covered by the RICS methodology refer to EN 15978, which includes a modular approach to a built asset's life-cycle, breaking it down into different stages, as shown in Table 1. The four main modules are Product stage [A1 – A3], Construction Process stage [A4 – A5], Use stage [B1 – B7] and End of Life stage [C1 – C4]. Module D consists of the potential environmental benefits or burdens of materials beyond the life of the project, this is usually reported separately to the cradle to grave modules [A – C].

Table 2 shows the life-cycle stages that were considered for the assessment and the assumptions made for some stages due to limitations of the software used.

Table 2: Life-cycle stages.

Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage				Benefits and loads beyond the system boundary		
Raw material supply	Transport	Manufacturing	Transport to building site	Installation into building	Use/application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2*	B3‡	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓

* B2 has been estimated by extrapolating the results of B3 assuming these correspond to 25% of B2 emissions as indicated in the RICS PS.
‡ B3: a repair/year% has been added for some building components (windows, MEP, finishes, and plasterboard).

BUILDING ELEMENTS

The WLC assessment covers all building elements listed in Table 4 (where applicable). Material quantities have been provided by Turner & Townsend. A minimum of at least 95% of the cost allocated to each building element category has been accounted for where information has been given in line with GLA policy.

Table 3: Building elements as per RICS NRM.

Group	Building Element	Applicable	Included
0. Demolition & facilitating works	0.1. Toxic / hazardous / contaminated material treatment	No	No
	0.2. Major demolition works	Yes	Yes
	0.3. & 0.5. Temporary / enabling works	Yes	Yes
	0.4. Specialist groundworks	Yes	Yes
1. Substructure	1.1. Substructure	Yes	Yes
2. Superstructure	2.1. Frame	Yes	Yes
	2.2. Upper floors incl. balconies	Yes	Yes
	2.3. Roof	Yes	Yes
	2.4. Stairs & ramps	Yes	Yes
	2.5. External walls	Yes	Yes
	2.6. Windows & external doors	Yes	Yes
	2.7. Internal walls & partitions	Yes	Yes
	2.8 Internal doors	Yes	Yes
3 Finishes	3.1 Wall finishes	Yes	Yes
	3.2 Floor finishes	Yes	Yes
	3.3 Ceiling finishes	Yes	Yes
4 Fittings, furnishings & equipment	4.1 Fittings, furnishings & equipment	Yes	Yes
5 Building services / MEP	5.1–5.14 Services	Yes	Yes
6 Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building unit	No	No
7 Work to existing building	7.1 Minor demolition and alteration works	No	No
8 External works	8.1 Site preparation works	No	No
	8.2 Roads, paths, pavings and surfacings	Yes	Yes
	8.3 Soft landscaping, planting, and irrigation systems	Yes	Yes
	8.4 Fencing, railings, and walls	No	No
	8.5 External fixtures	No	No
	8.6 External drainage	No	No
	8.7 External services	No	No
	8.8 Minor building works and ancillary buildings	No	No

SOFTWARE TOOLS

One Click LCA software was used to model life-cycle impacts of the project. One Click LCA uses third party background processes aggregated as mid-point indicators and stored in a number of libraries within the software which are coupled with algorithms and user inputs to output the environmental impact assessment.

One Click LCA is compliant with International Standards 14040 and 14044, and European Standard EN 15978; it is listed in the GLA WLC Assessments Guidance (March 2022), Appendix 1 as an acceptable/approved tool for whole life carbon calculations.

MATERIALS & PRODUCTS

WLC calculations have been carried out using:

- Type III environmental declarations (EPDs and equivalent) and datasets in accordance with BS EN 15804; and,
- EPDs and datasets in accordance with ISO 14025 and ISO 14040/44.

Sequestered (biogenic) carbon, in particular from timber products, has been reported separately for A1-A3 stages.

Embodied carbon is difficult to calculate for many MEP systems due to a lack of available data. Where manufacturer specific data is not available figures for embodied carbon have been taken from the closest matching system within the One Click LCA database. In cases where there are no comparable systems embodied carbon has been calculated based on the key materials used to manufacture the equipment, by weight. For the present assessment results were derived from best assumptions based on the type of development and should be updated at next design stage once MEP specifications have been produced.

GRID DECARBONISATION

As per the updated GLA WLC Assessments Guidance (March 2022), the decarbonisation assumptions are not required to account for in the WLC assessment as at present the available data is not reliable to do so accurately for embodied carbon emissions.

PRELIMINARY DISCUSSIONS

A workshop to discuss WLC reduction principles was undertaken with the design team including representatives from Architecture. The summary of the key principles applicable to the development are summarised in the Detailed Planning tab of the GLA WLC Assessment template accompanying this design note. The materials specification is staying largely the same as the consented scheme, however some key materials have been reviewed to optimise the whole life carbon assessment and reduce embodied carbon where possible.

RESULTS

ESTIMATED WLC ASSESSMENT

The Estimated WLC assessment results are shown in Table 4 and Figure 2. This shows that the majority of carbon emissions (59%) are associated with Module B6-B7, with Module A1-A5 contributing the second highest amount at 21% of WLC emissions.

Table 4: Estimated WLC emissions Assessment

Estimated WLC emissions Assessment	Sequestered (biogenic) carbon	A1-A5	B1-B5	B6-B7	C1-C4	Module D
TOTAL kg CO_2e	-80,905	16,698,698	14,565,686	43,389,926	1,113,966	-6,349,846
TOTAL kg CO_2e/m^2 GIA	-2	468	408	1,299	31	-178

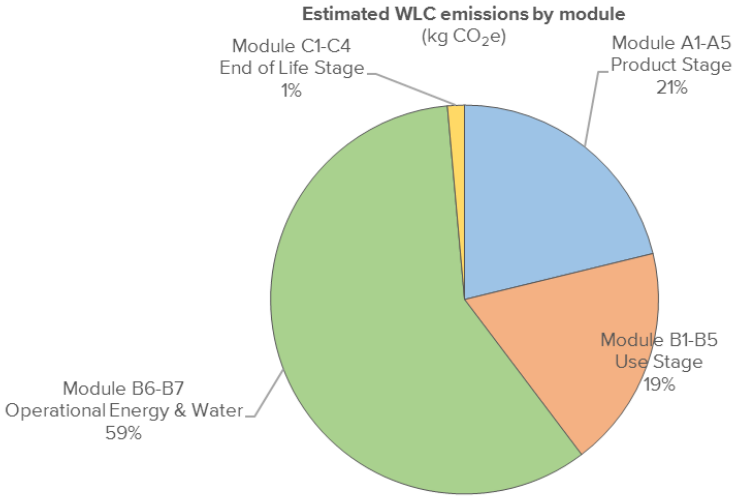


Figure 2: Estimated WLC emissions by module.

Figure 3 shows the full results of the Estimated WLC Assessment sub-divided by building element category. This scenario has been chosen to form the basis of design decisions. The results show that the highest contribution to the whole life carbon of the project is the Services (MEP), which is primarily due to the B6-B7 operational energy and water use emissions being associated with this category. The second largest contributor is the Frame and the third largest is the Finishes. Within GLA WLC assessments guidance the breakdown of a typical office development for modules A1-A5, excluding sequestration and B-C (excluding B6 & B7) is shown in Table 5.

Some options were implemented in order to reduce the building's whole life carbon emissions. These include:

- The use of 50% GGBS cement replacement for C32/40 concrete for Substructure, Frame, Upper Floors & Roofs, and 30% GGBS cement replacement in C40/50 concrete for some Upper Floors and Roofs.

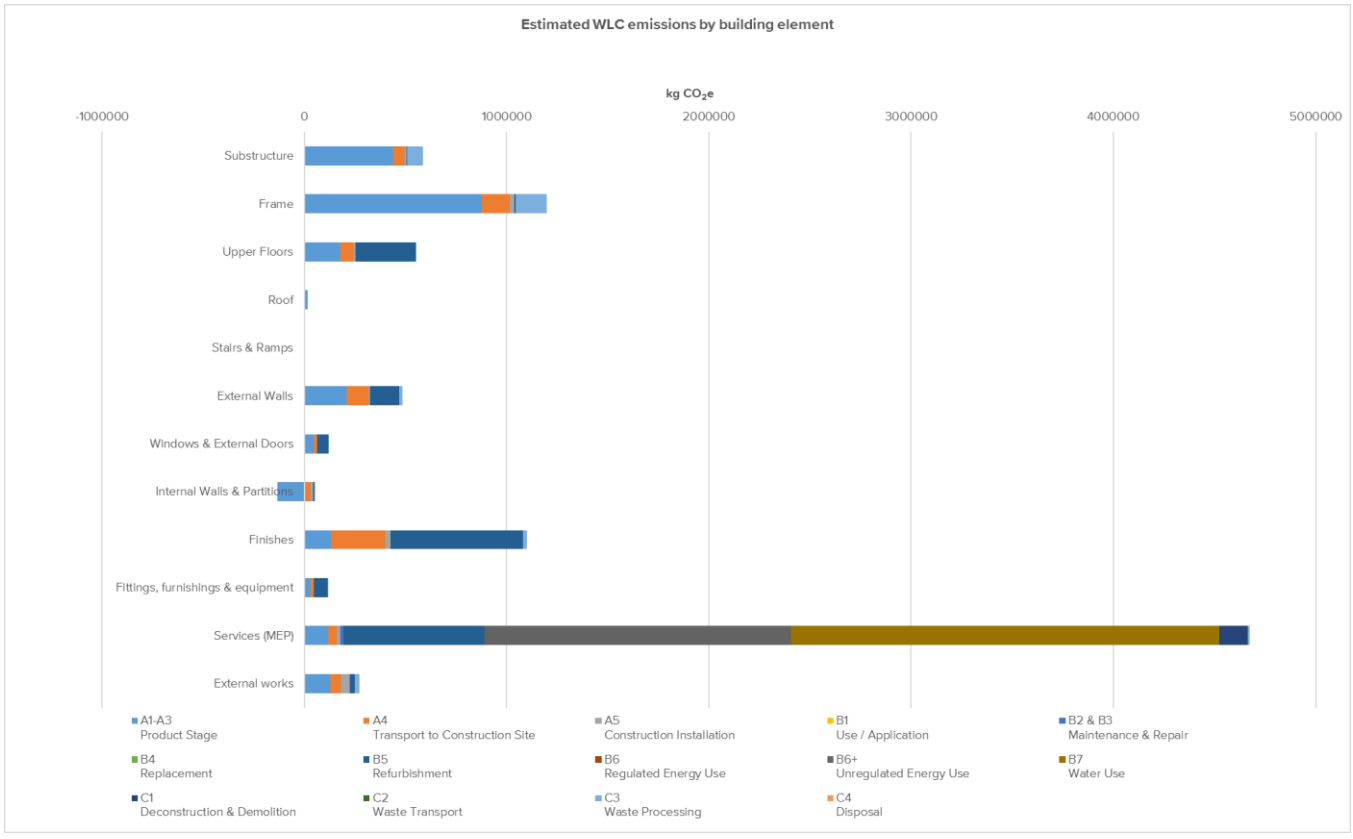


Figure 3: WLC results.

Table 5: Breakdown of a typical office development for modules A1-A5 excluding sequestration and B-C excluding B6 & B7 (GLA Whole Life-Cycle Carbon Assessments, March 2022).

	Breakdown of a typical development: office		Breakdown of 330 Gray's Inn Road (%)	
	A1-A5 (excluding sequestration)	B-C (excluding B6 & B7)	A1-A5 (excluding sequestration)	B-C (excluding B6 & B7)
Substructure	19%	1%	17%	2%
Superstructure	36%	4%	47%	15%
Internal Finishes	10%	27%	15%	29%
Finishes, Furniture & Equipment	2%	9%	5%	10%
Services / MEP	14%	35%	3%	44%
External works	2%	3%	13%	0%

BENCHMARKING

In accordance with the GLA WLC assessments guidance, the estimated emissions have been compared against the benchmark provided by the GLA in the WLC assessments guidance, Appendix 2. The results of Modules A1-A5 and B & C, have been compared against the WLC benchmark for office developments, and the Aspirational WLC benchmark which is based on the World Green Building Council's target to achieve a 40% reduction in WLC emissions by 2030.

The results in Table 6 show the WLC Benchmark figures for an office building, and estimated carbon emissions of the proposed development for the Estimate WLC emissions Assessment. The anticipated whole carbon emissions of the proposed development for modules A1-A5 are below the WLC benchmark which reflects the positive impacts of the reduction measures adopted in the scheme. This has been achieved by implementing various whole life carbon reduction measures, including:

- The use of 50% GGBS cement replacement for C32/40 concrete for Substructure, Frame, Upper Floors & Roofs, and 30% GGBS cement replacement in C40/50 concrete for some Upper Floors and Roofs.

The anticipated whole carbon emissions of the proposed development for modules B1-B5 and C are however slightly above the GLA benchmark, at the current design stage there is a high level of uncertainty with the finishes section and the mechanical services specifications in terms of specified materials as well as maintenance, repair, and replacement and disposal considerations, which is likely to have caused this discrepancy.

The following WLC reduction opportunities will be investigated at the next stage, with a view to achieving further reductions in whole life carbon:

- Hybrid Timber-Aluminium Windows
- Timber Stud Internal Partitions

The results show the estimated emissions calculated based on the information available to date and provided by the design team. These will be reviewed at the next stage when specifications are detailed.

Table 6: WLC Benchmark for apartment/hotel developments

Modules	WLC benchmark	Aspirational WLC benchmark	330 Gray's Inn Road Assessment
	Kg CO_2e per m^2 (GIA)		
A1-A5 (excluding sequestration)	<850	<500	468
B-C (excluding B6 & B7)	<350	<300	439

APPENDIX 1: ESTIMATE WLC EMISSIONS ASSESSMENT RESULTS IN FULL

Building element		KG's of carbon dioxide equivalent															
		Biogenic carbon	A1-A3 Product Stage	A4 Transport to Site	A5 Construct. works	B1 Use	B2 & B3 Mainten. & Repair	B4 Replace	B5 Refur-bish	B6 Regulated Energy Use	B6+ Unreg. Energy Use	B7 Water Use	C1 Deconst. & Demo.	C2 Waste Transport	C3 Waste Process	C4 Disposal	D Benefits & loads beyond system boundary
0.1	Demolition: Toxic / Hazardous / Contaminated Material Treatment																
0.2	Major Demolition Works												167609.8				
0.3	Temporary Support to Adjacent Structures																
0.4	Specialist Ground Works	0	616170.04	704259.99	24818.99		0							22489.85	2658.41		-169667.86
0.5	Temporary Diversion Works																
1	Substructure	0	2370512.7	168432.58	78245.9		0							98582.3	164910.77	13633.05	-581746.37
2.1	Frame	0	1870992.7	145368.92	65411.02		0							104955.61	9601.79		-526067.85
2.2	Upper Floors	0	2109856.23	140580.77	51220.55		0							94046.36	8829	19585.5	-523514.44
2.3	Roof	0	446767.36	25721.95	13355.62		4701.26	31080.22	0					18654.97	37208.47	7.28	-103740.79
2.4	Stairs & Ramps	0	44252.73	3873.32	0		0							1027.93	118.66		-19654.51
2.5	External Walls	0	1190084.36	50469.45	0		115237.66	47516.64	0					15236.19	1518.33	352.05	-172089.75
2.6	Windows & External Doors	0	697419.43	2209.21	0		387541.38	655535.8	0					7477.3	57.7	100.19	-25738.26
2.7	Internal Walls & Partitions	0	345024.79	14232.06	0		346306.44	288588.7	0					13677.01	617.83	1.38	-15017.03
2.8	Internal Doors	-62384.67	27986.78	390.91	0		0	28875.69	0					130.3	62734.67	17.7	
3	Finishes	0	2117970.65	5320.21	160341.2		232471.31	4176310.66	0					13675.05	141379.45	7.21	-1567633.01
4	Fittings, furnishings & equipment	-18115.9	662501.22	12317.51	6915.82		0	1519099.16	0					15304.72	21611.42	129.59	-2330947.18
5	Services (MEP)	-404.02	218295.06	262428.49	0	5379572	641136.04	711128.26	0	20119164.62	26224383	46377.91		28991.93	539.78	24428.8	-301145.01
6	Prefabricated Buildings & Building Units																
7	Work to Existing Building																
8	External works	0	54019.06	5030.62	0		584.67							1839.72	217.46		-12884.27

APPENDIX 2: EXCERPT FROM GLA WLC ASSESSMENT GUIDANCE

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