NEW CITY COURT

Circular Economy and Whole Life-Cycle Carbon Assessment

chapmanbdsp

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1 Executive Summary

This Circular Economy and Whole Life Carbon Statement has been prepared to support the planning application of the proposed development at New City Court for GPE (St Thomas Street) Limited ('the Applicant'). Redevelopment to include demolition of the 1980s office buildings and erection of a 26-storey building (plus mezzanine and two basement levels), restoration and refurbishment of the listed terrace (nos. 4-16 St Thomas Street), and redevelopment of Keats House (nos. 24-26 St Thomas Street) with removal, relocation and reinstatement of the historic façade on a proposed building, to provide office floorspace, flexible office/retail floorspace, restaurant/café floorspace and a public rooftop garden, associated public realm and highways improvements, provision for a new access to the Borough High Street entrance to the Underground Station, cycling parking, car parking, service, refuse and plant areas, and all ancillary or associated works.

The building circularity for the proposed scheme follows the following principles and approach:

Conserve resources, increase efficiency and source sustainably

- Minimise the quantity of the material used such that the whole life carbon doesn't not exceed the Greater London Authority's WLC aspirational benchmarks.
- The aim is to further reduce the embodied carbon to meet Royal Institute of British Architects (RIBA) 2030 target of 500 kgCO2/sq.m.
- The use of recycled content has been maximised. It exceeds the RICS minimum guidance and the industry standards

The material will be procured sustainably. All timber or timber based products will be (Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC) certified. Suppliers with ISO 14001 or equivalent environmental management system will be used for material procurement.

Design to eliminate waste

- The building layers with longer life expectancy will be designed for longevity, flexibility and adaptability and layers with shorter life expectancy for ease of maintenance, recoverability and replacement.
- Demountable slabs and soft spots will be provided in structure to provide flexibility of use.
- Building Information Modelling and Digital Twin methods may be explored to reduce construction waste.
- No more than 7.5 m3/100m2 GIFA or 6.5 tonnes/100m2 GIFA of waste will be generated during construction works.

Manage waste sustainably

- At least 97% of the waste can be diverted from going into landfill or for incineration as per the pre-demolition desktop analysis.
- The minimum aim is to divert 90% (by tonnage) of the non-demolition waste and 95% (by tonnage) of the demolition waste from going into the landfill.
- A resource efficiency and site waste management plan will be implemented on site to minimise waste generation and then manage waste responsibly.
- A operational waste strategy will be implemented to ensure municipal waste is managed sustainably. Tenants will be provided with a recycling facility and separate food and glass bins.

2 Introduction

The objective of the report is to summarise the circular economy principles considered in the design of the scheme and the material and waste targets to be achieved at the practical completion of the project.

2.1 Description of Development

The proposed redevelopment of New City Court will include demolition of the 1980s office buildings and erection of a 26-storey building (plus mezzanine and two basement levels), restoration and refurbishment of the listed terrace (nos. 4-16 St Thomas Street), and redevelopment of Keats House (nos. 24-26 St Thomas Street) with removal, relocation and reinstatement of the historic façade on a proposed building. The new development will provide office floorspace, flexible office/retail floorspace, restaurant/café floorspace and a public rooftop garden, associated public realm and highways improvements, provision for a new access to the Borough High Street entrance to the Underground Station, cycling parking, car parking, service, refuse and plant areas, and all ancillary or associated works. The area schedule is as below:

	GIA (sq.m.)
Office	44,313
Affordable Workspace	5,017
Flexible Office / Retail	340
Food and Drink	421
Shared Rooftop Garden Access	208
Shared Facilities and Plant	5,243
Total	55,541

The new public arcade on ground floor and active frontage will be accessible for building occupiers as well as general public.

2.2 Method Statement

A holistic approach has been adopted to establish the approach and targets for the project. The focus has been to create an architecture where the circular economy principles could be embedded in the design rather than an afterthought. Having a clear understanding of the objective of the London Plan policies SI2 and SI7, the concepts of whole life carbon and circular economy were considered comprehensively. The design approach follows the following framework:

Retain – Retaining and repurposing existing building on site.
Reuse – Reusing existing structure as much as practically feasible, reusing existing transformers/generators, reusing the strip out materials on site and off site. Thus, reducing embodied carbon of the scheme.
Recycle – Recycling the waste generated from strip out and demolition as well as use recycled material for construction as much as possible.
Discussions were held with the key stakeholders for establishing an integrated approach tailored for the project in specific. Chapmanbdsp, the sustainability champions for the scheme, held focussed workshops for the team to have a collaborative discussion. Some of these are listed below:

23/06/20: Attended by AHMM (architect), AKT (structural engineer), GPE (client) and chapmanbdsp (mechanical and electrical consultant) – Sustainability workshop
11/01/21: Attended by AHMM (architect), AKT (structural engineer), GPE (client) and chapmanbdsp (mechanical and electrical consultant) – Whole Life Carbon and Circular Economy workshop
25/03/21: Attended by AHMM (architect), AKT (structural engineer) and chapmanbdsp (mechanical and electrical consultant) – Sustainability Review workshop

The strategic approach was discussed at these workshops to set the key targets and required actions for achieving those targets in practice. These discussions were followed up in the weekly design team meetings and more one to one informal discussion. The outputs of these discussions are included in Tables 1 and 2 appended to this report.

Additional workshops are to be undertaken at the detailed design stages with the team and the main contractor. This report and the targets set as a part of this process will be readdressed at further stages of the project such that the targets are delivered at the practical completion of the project.

2.3 Circular Economy Aspirations

The client is committed to optimise material use to minimise upfront embodied carbon to the limits set out by Royal Institute of British Architects (RIBA) and Low Energy Transformation Initiative (LETI) as well as minimise construction waste and divert up to 100% of the demolition and construction waste from landfill. In order to achieve this challenge, the following strategy has been proposed in agreement with the key stakeholders for the project:

- A Pre demolition audit has been carried out for the demoiltion works. The waste management strategy follows the hierarchy of prevention, reuse, recycle, recover and dispose. Based on the waste forecast, a recycling target of 97% could be achieved. A further audit will be carried out at the detailed design stage, prior to construction.
- New City Court will be assessed under BREEAM 2018 New Construction. The assessments, highest possible credits under Material and Waste categories have been targeted. Early engagement with the contractor will be sought to ensure the targeted credits are secured and if possible, pick up additional exemplary level credits. 1
- The aspiration is to divert 90% (by tonnage) of the non-demolition waste and 95% (by tonnage) of the demolition waste from going into the landfill.
- The contractor will be required to prepare a site waste management plan/resource management plan to minimise waste generated through construction activities. The waste generated on site will be monitor and segregated and managed sustainably. The target will be to produce no more than 7.5 m3/100m2 GIFA or 6.5 tonnes/100m2 GIFA during the construction.
- With regards to contributing towards circularity the recycled content within the construction elements will be maximised as much as possible. The table below indicates the minimum levels recommended by RICS guidance as compared to the recycled proportion and cement replacement in form of ground granulated blast-furnace slag (GGBS) proposed for the project.

Component	RICS guidance	New City Court
Raft foundation	20% cement replacement	75% GGBS
Pile foundation	20% cement replacement	50% GGBS
Pile wall	20% cement replacement	50% GGBS
Columns	20% cement replacement	25-50% GGBS
Slabs (PT)	20% cement replacement	25% GGBS
Slabs (non-PT)	20% cement replacement	25-50% GGBS
Steel reinforcement	97% recycled	97% recycled

Table 2-1 Proposed recycled content for the scheme

- Modern methods of construction and offsite construction opportunities to be considered during detailed design stages to further optimise the material use and reduce construction waste. As the increased proportion of GGBS can affect the curing time and therefore the construction program, offsite construction can be instrumental in overcoming these challenges.
- The design life of the building is assumed to be 60 years; however, the shell may last up to 200 years. Though it is impossible to predict what construction practices will be in effect at the end of the life of building, but it is expected that with the proposed construction at least 50% of the building material would be recoverable and reusable for future construction.

3 Strategic Approach

3.1 Existing site opportunities

The existing buildings on site do not provide financial viability for the site setting and value, the structures contained within the low rise buildings would not be able to be re-used to create the new building.

The design of the building has therefore focused on the efficiency of the new elements and their carbon impact.

A demolition contractors have carried out an audit for the waste streams arising from the strip out and demolition works and identified a waste hierarchy of prevention, reuse, recycle, recover and dispose. It also identifies the recycling and reclamation centres in proximity of the site for offsite recycle and reuse.

3.2 Proposed Design considerations

Building in Layers

The proposed scheme design has been broken down into building layers to design out waste, optimise material use and keeping building elements/materials in use after the end of their life cycle. Please refer to the summary of strategies in Table 3-1.

The design objective for the elements with longer life cycle (more than 25 years) is to design for longevity, adaptability and flexibility. The structural engineers have done a design analysis for providing soft spots in the structure to provide flexibility of use to the potential tenants and occupiers. A structural zoning has been done to locate the soft spots on each floor plate. Larger grid sizes provide an opportunity for building to be adaptable for alternate uses in the future. Composite construction makes these large grid sizes possible as well as has other benefits too. Concrete provides longevity and high thermal mass whilst steel is highly recyclable.

Building layers with shorter life expectancy (less than 25 years) will be designed for ease of maintenance, reuse and recoverability. The plant will be made accessible for replaceability and maintenance. In terms of building services, a water based wet system is proposed for the communal network thus reducing the use of refrigerant in the building. The strategy allows for multiple tenancies on each floor thus giving flexibility to potential tenants and the need for additional plant. As the site is within a Heat Network Priority Area, a plant room in the basement and sleeves in the basement wall have been provided for future connectivity to a district network. The passive design of the building has informed the overall services strategy. The proposed mixed mode system reduces the ventilation requirement and heat recovery system reduces the heating demand, thus reducing the plant requirement.

This is a shell and core development, future tenants are unknown and therefore speculative finishes such as raised access floors, grid ceilings, etc. will not be provided to avoid any wastage. The material procured for internal finishes, partitions and furniture in the landlord areas will have ingredients disclosed by the manufacturer, a disclosure organisation or a third party such as Declare label or equivalent. Biogenic material will be selected where possible. The partitions and furniture will be designed for disassembly.

All elements from the demolition that cannot be reused on site will be sent to organisations for onward reuse. Opportunities will be explored for reusing hoardings and scaffoldings. The use of Building Information Modelling in the project could be used for estimating material quantities, thus reducing over procurement and waste generation. All the packaging will be returned to the suppliers for reuse. Offsite and modern methods of construction may be considered to further optimise material use and waste minimisation.

Layer	Constituent elements	Strategies
Site	The geographical setting, urban location and external works	Retain and reuse
Substructure	Excavations, foundations, basements and ground floors	
Superstructure	Load-bearing elements above plinth including roof supporting structure	**Longevity** – durable and resilient; readiness for alternative technologies **Adaptability** – how the current needs might change in the future **Flexibility** – potential for reconfiguration of non-structural parts
Shell/Skin	The layer keeping out water, wind, heat, cold, direct sunlight and noise	
Services	Installations to ensure comfort, practicality, accessibility and safety	**Reusability** – designed to be redeployed of reused as kit of parts **Recoverability** – designed to be deconstructed and reused/recycled
Space	The layout internal walls, ceilings, floors, finishes, doors, fitted furniture	
Stuff	Anything that could fall if the building was turned upside down	Not applicable due to 'shell and core' nature of the development
Construction Stuff	Any temporary installations/works/ materials, packaging and equipment	**Reusability** – Use of re-usable hoardings **Waste minimisation, material optimisation**

Expected life > 25years

Expected life < 25years

Table 3-1 Strategies for building layers

Design Optimisation

The design team has done extensive studies to optimise the material use for the scheme. Passive design studies were undertaken to reduce the operational energy of the building. The double skin façade may add to the embodied carbon, but it offsets the ventilation requirement and provides significant operational savings. The structural engineers have undertaken feasibility studies for structural grid size and type of slabs to reduce the amount of embodied carbon contained within them. The result is post-tension slab with varying grids to suit building shape.

Recycled content has been maximised as reported in section 2.3 and 4.3. Further interventions for the reduction of embodied carbon have been listed for further investigation at the design stages. With some of the interventions, there are supply chain limitations, for example recycled aluminium. These challenges and opportunities will have to be explored further.

3.3 Operational waste

The scheme has been designed to comply with the capacity and waste managements requirements set out within the following policy documents:

- Waste Management, The Duty of Care Code of Practice (2018 update)
- The Waste (England and Wales) Regulations 2011 (as amended)
- Environment Protection Act 1990
- National Planning Policy Framework (2019)
- Department for Environment, Food and Rural Affairs (DEFRA), our waste, our resources: a strategy for England (2018)
- HM Government, A Green Future: our 25-year plan to improve the environment (2018)
- The London Plan March 2021
- London Environment Strategy (2018)
- Waste Management Strategy 2003 – 2021, Southwark (2003)

The commercial waste store will be provided at basement level one. This is the location that all residual waste, glass waste and food waste generated within the proposed development will be stored prior to collection. The following daily metric have been applied to inform the waste strategy for the development.

Commercial Use	Waste metric	Waste Composition
Office	1,100litres per 10,000sqft (NIA)	Residual Waste 50% Dry Mixed Recycling (DMR) 50%
Food & Beverage	1,100litres per 2,500sqft (NIA)	
Retail	1,100litres per 5,00sqft (NIA)	

All waste storage areas will be designed in accordance with British Standard BS5906:2005 Waste Management in buildings - Code of practice. In summary, the facilities should include the following:

- A suitable waste point in close proximity to allow washing down;
- All surfaces sealed with a suitable waterproof fi nish (vinyl, tiles etc.);
- All surfaces easy to clean;
- A suitable floor drain; and
- Suitable lighting and ventilation.

Each commercial operator will provide temporary internal waste storage within their tenanted area as part of the fit-out phases. The internal collection of waste will be maintained by an on-site Facilities Management (FM) team who will collect the waste in suitable trolleys from each tenanted commercial area as separate waste streams. Using the service lift, the on-site FM team will transfer the individual waste streams to the service yard located at basement level two.

Provision of storage for segregated food waste and glass waste is in addition to the requirements specified by the LBS Community Facilities Manager. The exact capacity required on site will be dictated by the specific business activities of the commercial tenants. Food waste and glass waste will be deposited by the on-site FM team in to 240-litre wheeled bins within the commercial waste store. It is intended that the development will promote composting by informing occupiers of the kitchen waste collection scheme within the building user guide. Information on local recycling centres and sustainable living in general will be provided within the guide provided to the occupiers.

Future tenants will submit a comprehensive waste and recycling management strategy in accordance with the BS5906:2005 Waste Management in Buildings – Code of Practice

3.4 GLA Circular Economy Statement Guidance Table -1

Aspect	Phase/ Building/ Area	Steering Approach	Explanation	Target	Supporting analysis/ studies/ surveys/ audits
Circular economy approach for new development	Design and Construction Phase/ Main Office Building	The following design principles should be adopted for the proposed scheme: • Retain, repurpose, reuse, recycle where possible to reduce the material use • Following lean design principles such as low energy demand, light weight construction • To use material efficiently optimise grid sizes, structural loads etc. • Thinking in layers and how each building layer can be designed for material efficiency • Designing for longevity and future adaptability and flexibility of use • Re-using demolition materials on-site • Using materials with high recycled content • Resilient design to last the life of the building • Prioritising sustainably sourced material e.g. FSC or PEFC certified timber, suppliers who operate a compliant environmental management system • Specifying material with compliant Environmental Product Declarations (EPDs) • Low embodied carbon construction • Design for disassembly and demountability • Minimising energy and water use during construction and operation	The following key stakeholders were engaged from the very outset of the project to consider design interventions in line with the approach: • Architect • Structural engineer • Building Services engineers • Sustainability consultants • Demolition contractors • Project managers • Client The structural engineer carried out extensive studies to maximise the use of existing basement and optimise the new structure. Operational energy studies were done to minimise energy demand and plant requirements	95%diversion from landfill at the end of life and Wate generated during construction to be no more than 7.5 m3/100m2 GIFA or 6.5 tonnes/100m2 GIFA	23/06/20: Attended by AHMM, AKT, GPE and chapmanbdsp – Sustainability workshop 11/01/21: Attended by AHMM, AKT, GPE and chapmanbdsp – Whole Life Carbon and Circular Economy workshop 25/03/21: Attended by AHMM, GPE and chapmanbdsp – Sustainability Review workshop Whole life carbon study (Section 5 of the report) Sustainability Statement BREEAM workshops on waste and materials and pre assessment Sustainable Procurement Plan AKT-II Net Zero Carbon report outlining material optimisation studies
Circular economy approach for the existing site	Main Office Building & Georgian Houses	• A Pre-demolition audit has been carried out to identify the percentage of demolition and strip out waste which can be reused or recycled on site or offsite. • Georgian Houses will be repurposed and refurbished The contractor will implement a compliant Site Waste Management Plan. Diversion of 90% (by tonnage) of the non-demolition waste and 95% (by tonnage) of the demolition waste from going into the landfill.	• Retain the existing basement as much as possible • Use durable materials with low embodied carbon. • Waste streams arising from the strip out and demolition works to be segregated. Waste hierarchy of prevention, reuse, recycle, recover and dispose to be followed • Opportunities for using strip out waste for site office to be considered	95%diversion from landfill at the end of life	AKT-II Net Zero Carbon report outlining material optimisation studies
Circular economy approach for municipal waste during operation	Main Office Building & Georgian Houses	• Provision of on-floor bins to each of the tenants. Waste segregation at source to be considered • Separate bin store for recyclable waste to be provided • Provision of a presentation area on ground floor level • Bin removal strategy and access to bin stores to be considered • Food bins to be provided to each of the tenants	• The commercial waste store will be provided at basement level two • The aim is to reduce the waste going to landfill or incineration. Therefore, waste segregation strategy is key	65%diversion from landfill at the end of life	Operational Waste Management Strategy proposed by TPP

4 Circular Economy Commitments

4.1 Key Commitments: GLA Circular Economy Statement Guidance Table 2

	Site	Substructure	Super structure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Who and When	Plan to prove and quantify
	Section A: Conserve Resources											
Minimising the quantities of materials used	Repurposing Georgian terraces building and retaining façade for Keat's House.	Retaining existing foundations for Georgian terraces. Main Building - Use of recycled aggregates for basement. Use of cement alternatives. Wherever possible (depending on the material type) the use of offcuts will be re-used i.e. straight reinforcement bars as shear legs. Structural elements optimization to reduce sizes and required material. The concrete generated through demolition is proposed to be crushed, graded, stockpiled and re-used on-site where possible and safe to do so. Materials would be used to refill some of the excavated areas to accommodate the proposed	Build structural elements with an inherent redudancy such as PT slabs (to accomodate soft-spots - tenant flexibility). Structural elements optimization to reduce sizes and required material. Standardisation of the elements will be a key driver of the design to facilitate the installation on site and minimise waste. Wherever possible (depending on the material type) the use of offcuts will be re-used i.e. straight reinforcement bars as shear legs. Wherever applicable, connections will be designed to ease the installation and disassembly; weld will be used only where needed. Connections will be also	Reduced use of aluminium for façade. GRC spandrels and surrounds powder coating instead of anodising. Considering use of recycled aluminium.	Where possible, items are to be prefabricated or assembled off-site.	Limit any finishes installed in the areas to be leased out.	Tenant's responsibility.	Use of demountable and reusable scaffolding. Contractor to operate packaging take back scheme. Avoid stockpiling.				

	Site	Substructure	Super structure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Who and When	Plan to prove and quantify
		development's new levels. Where materials are crushed, hard core would be compacted to form the piling mat for the new construction.	designed to limit the maintenance regime.									
Minimising the quantities of other resources used (energy, water, land)	The project is located on previously developed land with no impact on virgin land. A whole life carbon assessment is being undertaken.	A whole life carbon assessment is being undertaken taking a holistic view to reducing embodied and operational carbon emissions.	A whole life carbon assessment is being undertaken taking a holistic view to reducing embodied and operational carbon emissions.	Façade optimisation studies have been carried out to reduce energy use. A low heat loss form factor design reduces the exposed façade area.	Highly energy efficient services to aim for 90 kWh/m2/yr energy use intensity target and a minimum of 35% reduction over Part L.	Open plan and large spans inherently provies a flexible and adaptable space to allow tenants to fit out as per their needs.	Tenant's responsibility.	The contractor will be required to set targets and monitor energy and water use during ocnstruction (Man 03 credit).				
Specifying and sourcing materials responsibly and sustainably	A sustainable procurement plan will be established. All timber and timber based products will be FSC or PEFC certified. Prioritise products with EPDs, ISO14001, BES6001 or accredited EMS certification.	Specify materials with a higher recycled content, lower embodied carbon and water. Specify locally sourced materials. Consider specifying materials / equipment with minimal maintenance requirements. Use significant percentages of cement-replacement alternative binders, such as GGBS in concrete elements. Use concrete mixes that contain no ordinary	Specify materials with a higher recycled content, lower embodied carbon and water. Specify locally sourced materials. Consider specifying materials / equipment with minimal maintenance requirements. Use significant percentages of cement-replacement alternative binders, such as GGBS in concrete elements. Use concrete mixes that contain no ordinary portland cement	Consider the use of low embodied carbon façade cladding. Consider material procurement from manufacturers adopting cleaner manufacturing processes	Avoid refrigerant based systems. If specified then ensure the refrigerant has low GWP. CIBSE TM 65 calculations to be carried out to account for refrigerant recyling and charge	If any paints and finishes are being specified, then ensure they have low VOC content and formaldehyde levels	Tenant's responsibility.	Using only certified timber for scaffolding, hoardings etc.				

	Site	Substructure	Super structure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Who and When	Plan to prove and quantify
		portland cement where feasible. Concrete steel rebars to be 97% recycled and sourced from secondary suppliers employing EAF production processes. Recycled aggregates to be used in the basement construction.	where feasible Concrete steel rebars to be 97% recycled. Seek to maximise the use of steeel produced using EAF production processes such as rolled sections where possible.									
	Section B: Design to eliminate waste											
Designing for reusability/recoverability/longevity/adaptability/flexibility	By retaining Georgian terraces, the excavation and demolition waste is being reduced.	The Georgian terraces and the Keats House facade are being retained thus avoiding a large volume of waste generation from demolition and construction. The existing basement will be reinforced where needed so it could be reused at the end of the life of the building. All structural elements are designed for durability and a minimum design life of 50 years based on the current version of the Eurocodes The retaining wall and foundations are designed using reinforced	All structural elements are designed for durability and a minimum design life of 50 years based on the current version of the Eurocodes. Wherever required structural elements will be designed for accidental load cases such as vehicle impact, blast etc. Build structural elements with an inherent redudancy such as PT slabs (to accomodate soft-spots - tenant flexibility). Structural elements optimization to reduce sizes and required material	Materials will be specified to ensure they are durable. The design criteria to ensure the protection of the roof, will consider the material selection thoroughly for its robustness. Waterproofing detailing, profiling, drainage details, fixings and general geometry will be thoroughly assessed. Lime mortar used in brick refurbishment works for Georgian Terraces and Keats House, reducing use of cement and allow for future	Building services take into account future climate change scenarios. Future resilience provided as the development is being designed to connect to a district network in the future.	Large spans and open floor plates provide flexibility of use The location of cores consider multiple tenancies on each floor. Slab soft spots designed in for future fexlibility and adaptability of tenancy beween levels. Exposed concrete soffits also reduces wase and improves adaptablility for future tenant fitouts.	Tenant's responsibility.	Sustainable Procurement Plan to be developed. To be reviewed with contractor during pre-construction supply chain engagement.				

	Site	Substructure	Super structure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Who and When	Plan to prove and quantify
		concrete. The material is very durable and able to perform during the life time of the building The only environmental agent that will impact the substructure will be water ingress, Waterproofing system is designed to protect the structure from underground water ingress The foundations and retaining walls are made of reinforced concrete and are not susceptible to any damage due to biological agents	Wherever applicable, connections will be designed to ease the installation and disassembly; welds will be used only where needed. Connections will be also designed to limit the maintenance regime Standardisation of the elements will be a key driver of the design to facilitate the installation on site and minimise waste	disassembly. Tower facade uses GRC panels as a demountable and recyclable element.								
Designing out construction, demolition, excavation and municipal waste arising	A target benchmark for resource efficiency, i.e. m3 of waste per 100m2 or tonnes of waste per 100m2 (7.5 m3/6.5 tonnes of waste per 100 m2 GIA).	A site waste management plan will be produced and followed. Brick/block/concrete/hardcore waste will be processed off site at a recycling facility for eventual use as aggregate products such Type 6F2 for building and groundworks as well as roads and driveways.	A site waste management plan will be produced and followed. Brick/block/concrete/hardcore waste will be processed off site at a recycling facility for eventual use as aggregate products such Type 6F2 for building and groundworks as well as roads and driveways	Off-site construction/ modular components to reduce waste on site. Glass can be recycled and reused in other glass products or aggregate.	Off-site construction/ modular components to reduce waste on site.	Reuse existing furniture for site office and welfare areas for the project. Reuse existing fire extinguishers for use for the project (undertaking any testing as required).	Tenant's responsibility.	A site waste management plan to be prepared and followed on site To be reviewed with contractor during pre-construction supply chain engagement.				

	Section C: Manage Waste

	Site	Substructure	Super structure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Who and When	Plan to prove and quantify
Demolition waste (how waste from demolition of the layers will be managed)	Aim to achieve 95% diversion from landfill.	Brick/block/concrete/hardcore waste will be processed off site to be used for groundworks as well as roads and driveways. The concrete generated through demolition is proposed to be crushed, graded, stockpiled and re-used on-site where possible and safe to do so. Materials will be used to refill some of the excavated areas to accommodate the proposed development's new levels. Where materials are crushed, hard core would be compacted to form the piling mat for the new construction.	Brick/block/concrete/hardcore waste will be processed off site to be used for groundworks as well as roads and driveways. The concrete generated through demolition is proposed to be crushed, graded, stockpiled and re-used on-site where possible and safe to do so. Materials would be used to refill some of the excavated areas to accommodate the proposed development's new levels. Where materials are crushed, hard core would be compacted to form the piling mat for the new construction.	97% of the stripout waste will be reused or recycled as per the pre demolition audit prepared by strip out contractors.	97% of the stripout waste will be reused or recycled as per the pre demolition audit prepared by strip out contractors.	97% of the stripout waste will be reused or recycled as per the pre demolition audit prepared by strip out contractors.	Tenant's responsibility.	97% of the stripout waste will be reused or recycled as per the pre demolition audit prepared by strip out contractors.				
Excavation waste (how waste will be managed)	A site waste management plan will be produced and followed.	A site waste management plan will be produced and followed.	N/A	N/A	N/A	N/A	N/A	N/A				
Construction waste (how waste arising from construction of the layers will be reused or recycled)	A target benchmark for resource efficiency, i.e. m3 of waste per 100m2 or tonnes of waste per 100m2 (7.5m3/6.5 tonnes of waste per 100m2 GIA). Aim to divert	A target benchmark for resource efficiency, i.e. m3 of waste per 100m2 or tonnes of waste per 100m2 (7.5m3/6.5 tonnes of waste per 100m2 GIA). Aim to divert	A target benchmark for resource efficiency, i.e. m3 of waste per 100m2 or tonnes of waste per 100m2 (7.5m3/6.5 tonnes of waste per 100m2 GIA). Aim to divert	A target benchmark for resource efficiency, i.e. m3 of waste per 100m2 or tonnes of waste per 100m2 (7.5m3/6.5 tonnes of waste per 100m2 GIA). Aim to divert	A target benchmark for resource efficiency, i.e. m3 of waste per 100m2 or tonnes of waste per 100m2 (7.5m3/6.5 tonnes of waste per 100m2 GIA). Aim to divert	A target benchmark for resource efficiency, i.e. m3 of waste per 100m2 or tonnes of waste per 100m2 (7.5m3/6.5 tonnes of waste per 100m2 GIA). Aim to divert	Tenant's responsibility	To be reviewed with the contractor. Contractor will seggregate and monitor waste generated during contruction.				

	Site	Substructure	Super structure	Shell/Skin	Services	Space	Stuff	Construction Stuff	Summary	Challenges	Who and When	Plan to prove and quantify
	90% from landfill.	90% from landfill.	90% from landfill.	90% from landfill.	90% from landfill.	90% from landfill.						
Municipal Waste (how waste will be managed)	Refuse store with designated recycling and presenation area planned.	Refue store with designated recycling and presenation area planned.	N/A	N/A	N/A	N/A	Space will be provided for segregation of recyclables and general waste.	Contractor will seggregate and monitor waste generated during contruction.				

4.2 Numerical Targets and Commitments

The proposal applies lean design principles by reusing the existing basement and light weight construction. The recycled content within the building material has been maximised within the remit of practical feasibility and availability through the supply chain. At the detailed design stage, opportunities for further increasing the recycled content will be investigated.

The percentage of proposed recycled content is presented in Section 2.3 of this report.

Recycling and Waste reporting

The table below is based on project aspirations and the pre-demolition audit carried out by a demolition contractors for the strip out works. These values are based on a desktop study. A further demolition audit will be carried out at the design stage to cover all aspects of demolition in greater detail.

Category	Total estimate (tonnes)	%reused or recycled on site or offsite	Recycled waste in tonnes
Ferrous metals	1,000	100%	1,000
Non-Ferrous metals	42	100%	42
Plasterboard	30	100%	30
Timber	20	100%	20
Concrete, blockwork, and masonry	7,500	100%	7,500
Strip out waste	157	95%	149
Insulation	22	80%	18
Raised floor tiles	2	100%	2
Glass	75	100%	75
Bituminous Mixtures	20	100%	20
Plastic (excluding packaging)	1	100%	1
Electrical equipment	2	100%	2
Total	8,871	-	8,959
Overall % of demolition waste recycled			99.86%

4.3 Implementation Strategy

A Site Waste and Resource Management Plan (SWMP/RMP) will be prepared and implemented by the contractor including procedures and commitments to sort and divert waste from landfill, through either;

- Reusing the material on site (in-situ or for new applications)
- Reusing the material on other sites
- Salvaging or reclaiming the material for reuse
- Returning material to the supplier via a ‘take-back’ scheme
- Recovery of the material from site by an approved waste management contractor and recycled or sent for energy recovery.

Waste materials will be sorted into separate key waste groups, such as bricks, concrete, insulation, packaging, timber, electricals, plastics, glass, etc., according to the waste streams generated by the scope of the works either onsite or offsite through a licensed contractor for recovery.

The SWMP should include the target benchmark for resource efficiency i.e. 7.5m3 of waste per 100m2 or 6.5tonnes of waste per 100m2. It should also cover the following:

- Procedures and commitments for minimising non-hazardous waste in line with the benchmark
- Procedures for minimising hazardous waste
- Procedures for monitoring, measuring and reporting hazardous and non-hazardous site waste
- Procedures for sorting, reusing and recycling construction waste into defined waste groups (see additional guidance section), either on site or through a licensed external contractor
- The name or job title of the individual responsible for implementing the above

The plan should be in line with guidance provided by DEFRA, Building Research Establishment (BRE) and Waste & Resources Action Programme (WRAP). Where materials cannot be reused or recycled on-site, the contractor will identify opportunities for potential reuse off-site. Material and waste generated through construction will be stored safely and efficiently, prior either for reuse on site or removal. Any materials to be reclaimed / reused will be done so in accordance with the WRAP protocol.
The waste reports and records will be reviewed and audited periodically. They will be discussed with the Sustainability champion on site and the BREEAM assessor from time to time. At least 95% of excavation, demolition and construction waste will be diverted from landfill.

The contractor will take appropriate measures on site to further reduce the environmental impact of the construction. They will adopt the following:

- The contractor will register with the Considerate Constructor’s Scheme and aim to attain a high score in all categories
- Energy efficient equipment, services and construction methods will be adopted to reduce energy consumption.
- Water use will be minimised during operation, installation and construction processes
- Energy including fuel and water use will be recorded on site during the construction process
- Measures will be put in place to mitigate the potential for pollution from the site to land, air or water including noise and dust
- The contractor will operate as per the guidelines set by ISO 14001 Environmental Management System (or an equivalent standard) and encourage the same throughout the supply chain
- Strategic planning will be done in advance to minimise transport to and from the site to reduce greenhouse gas emissions
- Carbon footprint of material transportation should be recorded through Key Performance Indicator (KPI) sheet provided by the BREEAM assessor.

4.4 End of life strategy

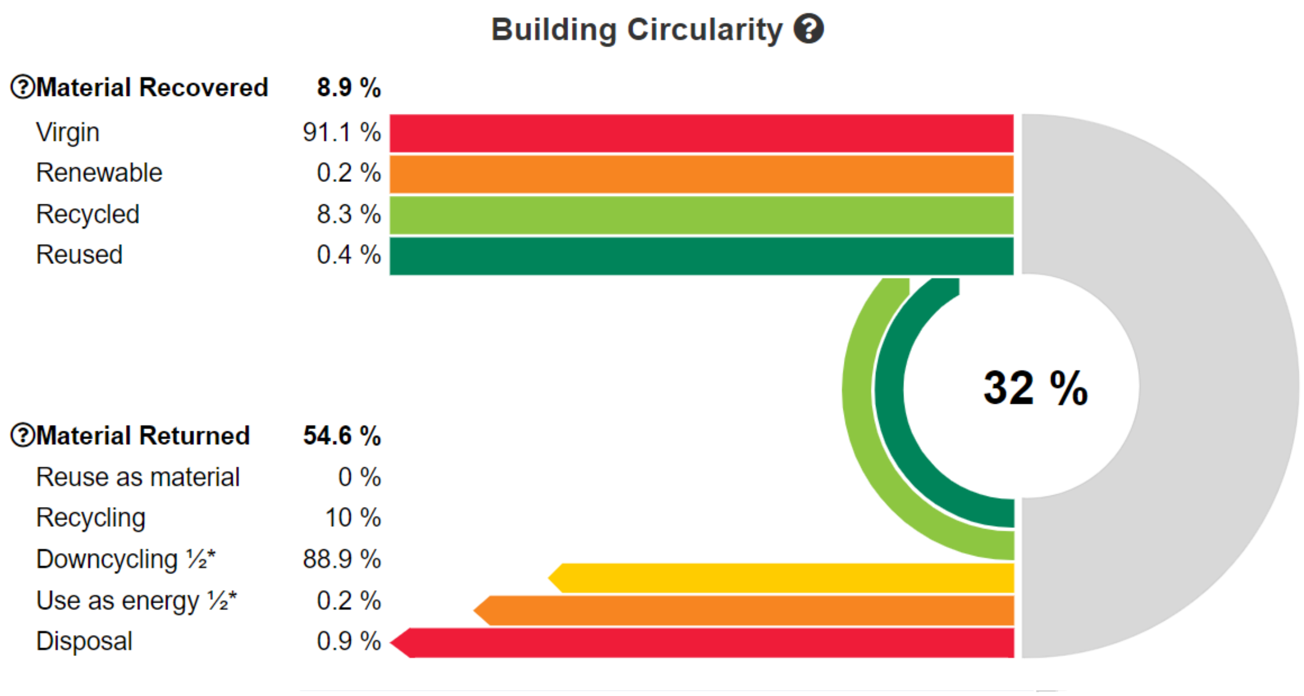
The One Click LCA Building Circularity tool was used to estimate the opportunity for returning the material at the end of life of the building. The results presented here are for the New City Court development based on the inputs used for the whole life carbon analysis of the development. The material quantity and specification inputs are in alignment with the bill of quantities prepared by the cost consultants, Alinea, for the cost plan of the development. Though, it is impossible to predict construction processes and minimum recycling rates in 60 years times but based on current practices and industry benchmarks applied by default by the One Click tool, a reasonable estimation can be done.

This building circularity is being mainly evaluated in terms of the mass of the recovered building material as compared to virgin material likely to be used in the building construction and the percentage of the material that can be returned to building construction at the end of life of the building.

Material Recovered
The calculation takes into account the reused, recycled and renewable materials to ascertain the mass of the recovered material as compared to virgin material. In the case of New City Court building the retained substructure has been taken account which is 10.9% of the total mass of the New City Court building. This was modelled on the basis of estimates provided by the structural engineer and specification of material that may have been used for new structural elements such as piles, raft, basement wall, columns etc.

The recycled content in steel, rebar, aggregates, as reported in Section 2.3, account for 24.1% of the total mass. As Ground Granulated Blast-furnace Slag (GGBS) is a by-product of iron manufacturing, it can neither be categorised as recycled or reused material. Following discussions with One Click LCA, this has been accounted under renewable material. With the proposed strategy the use of virgin material can be reduced to almost half of the building mass.

Material Returned
As mentioned earlier, it is impossible to predict the recycling rates in 60 years' time, however, it has been considered that at least current rates of recycling will be achievable in some cases e.g. steel. The rest of the inputs are based on industry benchmarks applied by the software. Through discussions with the demolition contractor at least 50% of concrete, bricks and masonry by mass are likely to be downcycled that is crushed and used as aggregate at the end of life. Thus, about 56% of the proposed building material can be returned to building construction.



5 Whole Life Carbon Assessment

Whole Life Carbon (WLC) assessment has been carried out for the assessment in line with the new London Plan Policy SI2 for the proposed New City Court development. It has been undertaken in line with the widely accepted environmental performance assessment structure illustrated in EN 15978. The quantities and specifications were taken from the cost model prepared by the cost consultants, Alinea,

The assessment includes life cycle stages: A1–A5, B1, B4, B6, B7, C1-C4; and has been done for 60-year life cycle. Due to the limited data available, B2 and B3, they were not included in this assessment.

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
x			x	x	x			x	x	x	x	x				x		

Whole Life-Cycle Embodied Carbon Assessment stages

Description of the life cycle stages and analysis scope are provided in the table below:

Life cycle stage	Analysis scope
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 taken into account. 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.
B4 Material replacement	The environmental impacts of material replacements (B4) includes 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 taken into account.
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.

Description of the life cycle stages

5.1 Results

Since at this stage, individual manufacturers EPDs are not available as yet, the current WLC analysis is based on typical materials database available on One Click LCA to give an indication of the expected performance. The concrete grades, steel grades, recycled content, etc. have been all discussed and agreed with the structural engineer. Please refer to Appendix 6.3 for the list of EPDs used. For Stage 2, the materials quantities information is quite detailed as it is aligned with the cost model, however, the figures would be expected to vary as the design develops and further studies are conducted. The WLC study shows that the embodied carbon over the life cycle is 616.3 kgCO2/m2 which is less than the GLA's Aspirational WLC benchmark of 800 kgCO2e/m^2 GIA.

The 'Assessment 1' results are based on SAP 10 carbon factors with Global Warming Potential (GWP) of electricity: 0.233 kg CO_2e/kWh. Assessment 2 illustrates the impact of predicted grid decarbonisation on the carbon emissions. The grid prediction is based on the 'Steady Progression' scenario for 2050. The GWP for this scenario is 0.061 kg CO_2e/kWh.

Embodied carbon figures broken down as per RICS categories are presented below. The detailed results can be found in Appendix 6.1 and 6.2.

	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D
Total kg CO_2e	25,627,800	10,477,344	66,807,075	699,015	-23,614,424
Total kg CO_2e/m^2 GIA	461	189	1203	13	-425

Assessment 1: Embodied carbon results with SAP 10 carbon factors

	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D
Total kg CO_2e	25,627,800	10,477,344	21,727,571	699,015	-23,614,424
Total kg CO_2e/m^2 GIA	461	189	391	13	-425

Assessment 2: Embodied carbon results with grid decarbonisation

5.2 Actions and Opportunities to reduce Embodied Carbon

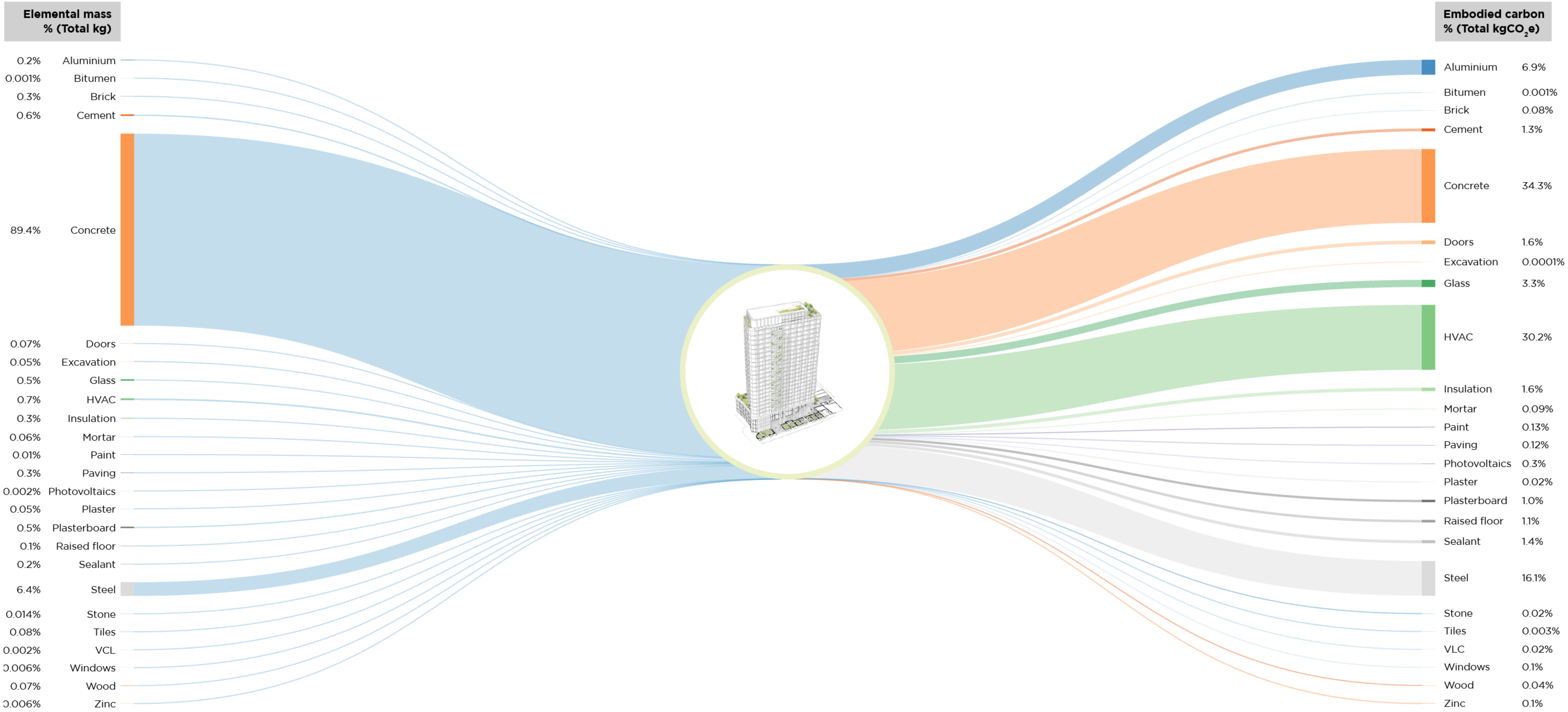
At the outset of the project GLA's WLC template with 16 principles of design was discussed and the strategies were shortlisted. This is presented in submitted GLA spreadsheet. Following those principles, the key steps taken that have been taken to reduce the whole life carbon for New City Court:

- The operational energy has been minimised following the London Plan's Energy Hierarchy such that 47% of the improvement can be achieved over Part L target. More detail can be found in the Energy Assessment.
- The existing basement is being retained and reused.
- The GGBS content in concrete has been increased from 25% to 50% for piling, 75% for raft slab.
- PT slabs have been used instead of composite metal deck and steel columns.

Opportunities

To investigate further opportunities for reducing the embodied carbon of the scheme, an investigation of elemental mass vs. embodied carbon was carried out. Please refer to the Sankey diagram for the outcome of the analysis. The elements contributing the most are concrete, steel and aluminium. Therefore, a material interventions matrix has been populated with options to reduce the use of these elements which will be further investigated at the detailed design stage. These options are as below:

- Potential for recycled aluminium. Currently, it is understood that there is shortage of recycled aluminium in the supply chain. The maximum which may be considered is 20%, however, that cannot provide significant reduction in embodied carbon.
- 70% GGBS may be considered to replace cement. However, this can significantly increase the curing time and therefore the construction programme. Therefore, this option needs to be further investigated along with offsite construction.
- Structural load reduction may be considered. It is understood that a reduction of as small as 0.5kPa can lead to significant cost and carbon savings.



6 Appendix

6.1 Assessment 1 – WLC SAP 10 scenario

Submitted separately as a standalone spreadsheet.

6.2 Assessment 2 – WLC Grid Decarbonisation scenario

Submitted separately as a standalone spreadsheet.

6.3 EPD Sources

Resource name	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country	Upstream database
Air handling unit, with heat recovery through plate heat exchanger		One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent
Aluminium framed glazed doors, double glazed, per unit	Optima	International EPD System	S-P-00480	EPD Aluminium Framed Glazed Doors	EN15804+A1	Third-party verified (as per ISO 14025)	2017	unitedKingdom	ecoinvent
Aluminium mullion-transom system		OKOBAUDAT	-	Oekobau.dat 2020-II	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany	GaBi
Autoclaved aerated concrete block	Forterra	BRE	BREG EN EPD000001	EPD Thermalite Autoclaved Aerated Concrete Block (470-770 kg/m3), Forterra Building Products Ltd 2016	EN15804+A1	Third-party verified (as per ISO 14025)	2016	unitedKingdom	ecoinvent
Bricks	Wienerberger	IBU	EPD-WIE-20130206IAB1EN	Bricks Wienerberger AS	EN15804+A1	Third-party verified (as per ISO 14025)	2014	germany	GaBi
Ceramic floor tile	Mosa	MRPI	11.1.0001.004	EPD Vloertegelcollectie Koninklijke Mosa	EN15804+A1	Third-party verified (as per ISO 14025)	2013	unitedKingdom	ecoinvent
Clay plaster		OKOBAUDAT	-	Oekobau.dat 2020-II	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany	GaBi
Coated (sub-face) preweathered rolled zinc, sheets and coils	VM	BRE	BREG EN EPDR00031	EPD COATED (on the sub-face) PREWEATHERED ROLLED ZINC – QUARTZ ZINC PLUS® and ANTHRA ZINC PLUS	EN15804+A1	Third-party verified (as per ISO 14025)	2018	france	GaBi
Concrete assembly for stairs per one metre height		One Click LCA		One Click LCA generic construction definitions				LOCAL	Other
Concrete block wall, with high density solid blocks, per m2 of wall including mortar		ICE	-	ICE database August 2019, V3.0	EN15804+A1	Self declared	2019	unitedKingdom	-
Concrete block wall, with medium density solid blocks, per m2 of wall including mortar		ICE	-	ICE database August 2019, V3.0	EN15804+A1	Self declared	2019	unitedKingdom	-
Concrete sealant, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Cooling tower	MDEGD	INIES	INIES_DTOU20190919_144524, 12449	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2019	france	ecoinvent
District heat distribution center		One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent
Double glazing windows with wooden frame	INSTITUT TECHNOLOGIQUE FCBA	INIES	INIES_CFEN20200421_091527, 16412	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2020	france	ecoinvent
Dried lumber from spruce or pine wood	Puutuoteteollisuus	RTS	RTS_27_19	RTS EPD YMPÄRISTÖSELOSTE, nro. RTS_27_19 Suomalainen kuivattu sahatavara kuusi- tai mäntypuusta	EN15804+A1	Third-party verified (as per ISO 14025)	2019	finland	ecoinvent
Electricity distribution system, cabling and central, for all building types		One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent
Emulsion matt paint for allround interior use	Dulux Trade	MRPI	1.1.00023.2017	EPD Dulux Trade Supermatt	EN15804+A1	Third-party verified (as per ISO 14025)	2017	unitedKingdom	ecoinvent
Excavation works	Required for IMPACT calculations	One Click LCA	-		EN15804	Internally verified	2013	unitedKingdom	ecoinvent
External wood door, 2,1 x 1 m		One Click LCA	-	Bionova	EN15804+A1	Internally verified	2011	LOCAL	ecoinvent
Fibre cement sheets	Rieder	UL Environment	4789090717.101.1	EPD concrete skin, öko skin and formparts	EN15804+A1	Third-party verified (as per ISO 14025)	2019	germany	GaBi
Flexible bitumen membrane/sheets for roof waterproofing, European average	European Waterproofing Association	International EPD System	S-P-00414	EPD Flexible Bitumen Sheets For Roof Waterproofing sector EPD	EN15804+A1	Third-party verified (as per ISO 14025)	2016	europe	GaBi
Floor screed mortar, cement screed	quickmix Gruppe GmbH & Co. KG	IBU	EPD-QMX-20160208-IBC1-DE	Oekobau.dat 2017-I, EPD Mineralische Werkmörtel: Estrichmörtel Zementestrich quickmix Gruppe GmbH & Co. KG	EN15804+A1	Third-party verified (as per ISO 14025)	2014	germany	GaBi
Glass wool insulation panels, unfaced, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Gypsum plaster	Bundesverband der Gipsindustrie	IBU	EPD-BVG-20140073-IAG1-DE	Oekobau.dat 2017-I, EPD GIPSPUTZ Bundesverband der Gipsindustrie e.V.	EN15804+A1	Third-party verified (as per ISO 14025)	2014	germany	GaBi

Resource name	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country	Upstream database
Gypsum plaster board, regular, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Heat distribution piping network, per m2 heated area, all building types		One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent
Heat distribution system		One Click LCA		One Click LCA generic construction definitions				LOCAL	Ecoinvent
Insulation, EPS solid foam, for ceilings, floors and perimeter insulation	IVH	IBU	EPD-IVH-20140139-IBB1-DE	Oekobau.dat 2017-I, EPD EPS-Hartschaum (Styropor ®) für Decken/Böden und als Perimeterdämmung B/P-035 Industrieverband Hartschaum e.V.	EN15804+A1	Third-party verified (as per ISO 14025)	2015	germany	GaBi
Interior wooden door, with wooden frame	Fédération de l Industrie Bois Construction	INIES	INIES_CBLO20190722_112115, 11194	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2019	france	ecoinvent
Laminated safety glass	Guardian Europe	ift Rosenheim	EPD-GFEV-GB-19.0	EPD Uncoated flat glass, laminated safety glass and coated flat glass Guardian Europe S.à.r.l.	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany, luxembourg, poland, spain, unitedKingdom	GaBi
Lightweight concrete block, with expanded clay aggregate, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Masonry cavity wall with partial fill and aircrete block + plasterboard inner leaf, U-value 0.25		One Click LCA		Part L 2016				unitedKingdom	Other
Masonry mortar, light	quick-mix	IBU	EPD-QMX-20150010-IBC1-DE	EPD Mineralische Werkmörtel: Mauermörtel Leichtmauermörtel quickmix Gruppe GmbH & Co. KG	EN15804+A1	Third-party verified (as per ISO 14025)	2015	germany	GaBi
Particleboard, uncoated	Sonae Indústria	IBU	EPD-SON-20160209-IBA1-EN	EPD	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany, portugal, southAfrica, spain, canada	ecoinvent
Pipesystem, hot and cold water supply, PEX/Alu/PEX, per m2 GFA		One Click LCA	-	Ruuska et al. 2013. Rakennusmateriaalien merkitys rakentamisen	EN15804	Internally verified	2016	LOCAL	GaBi
				ympäristövaikutusten kentässä. VTT.					
Planed timber, conifer	Treindustrien	EPD Norge	NEPD-308-179-EN	Structural timber of spruce and pine, Norwegian Wood Industry Federation	EN15804+A1	Third-party verified (as per ISO 14025)	2015	norway	ecoinvent
Plywood, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Precast concrete paving products	BPCF	IBU	EPD-BPC-20170094-CCD1-EN	EPD UK Manufactured 1 tonne of Generic Precast Concrete Paving Products (Blocks, Slabs, Channels and Kerbs) Produced by members of Interpave a product group of British Precast	EN15804+A1	Third-party verified (as per ISO 14025)	2017	unitedKingdom	GaBi
Raised access flooring system	Kingspan	International EPD System	S-P-00797	EPD Kingspan RG2 Europed	EN15804+A1	Third-party verified (as per ISO 14025)	2016	unitedKingdom	ecoinvent
Ready-mix concrete, high-strength, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Ready-mix concrete, low-strength, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Ready-mix concrete, normal strength, generic		One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2020	LOCAL	ecoinvent
Ready-mix concrete, normal-strength, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Ready-mix concrete, normal-strength, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Red brick, average production, UK	The Brick Development Association	BRE	BREG EN EPD000002	EPD BDA generic brick, The Brick Development Association 2015	EN15804+A1	Third-party verified (as per ISO 14025)	2015	unitedKingdom	ecoinvent
Reinforcement steel (rebar)	BRC	-	-	Environmental product declaration (EPD) report	EN15804+A1	Third-party verified (as per ISO 14025)	2019	unitedKingdom	ecoinvent

Resource name	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country	Upstream database
				of fabricated steel products produced in the UK by Eco-Reinforcement members					
Reinforcement steel (rebar), generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Revolving door, per unit	ASSA ABLOY	IBU	EPD-ASAB-20151118-IBA1-EN	EPD ASSA ABLOY RD300-4, Revolving door	EN15804+A1	Third-party verified (as per ISO 14025)	2015	czechRepublic	GaBi
Rock wool insulation panels, unfaced, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Rock wool/mineral wool insulation	Knauf	BRE	BREG EN EPD000097	EPD Rock Mineral Wool Insulation 106 -160 kg/cu.m, Knauf Insulation 2016	EN15804+A1	Third-party verified (as per ISO 14025)	2016	unitedKingdom	ecoinvent
Roof slate		OKOBAUDAT	-	Oekobau.dat 2020-II	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany	GaBi
Rubber underlayment, for acoustic insulation under screed layer	Scan Underlay	EPD Danmark	MD-19007-DA	MD-19007-DA Scan Underlay Production ApS	EN15804+A1	Third-party verified (as per ISO 14025)	2019	denmark	GaBi
Self levelling mortar, for floors, walls and overhead appl.	PCI Augsburg	IBU	EPD-PCI-20160262-IBE1-DE	Oekobau.dat 2017-I, EPD Ausgleichsmörtel PCI Pericret für Boden, Wand und Decke PCI Augsburg GmbH	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany	GaBi
Sewage water drainage piping network, per m2 GIFA (residential buildings)		One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent
Solar panel photovoltaic system, EU average		One Click LCA	-	One Click LCA	ISO14040	Internally verified	2015	LOCAL	ecoinvent
Steel sheets, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Steel stud internal wall assembly, 100 mm, incl. mineral wool insulation		One Click LCA		One Click LCA generic construction definitions				europe	Other
Structural steel profiles, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Structural steel profiles, generic		One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent
Top hung casement wooden window	Mumford & Wood	BRE	BREG EN EPD 000160	EDP Conservation casement windows	EN15804+A1	Third-party verified (as per ISO 14025)	2017	unitedKingdom	ecoinvent
Ventilation ducting		One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent
Ventilation system for office and care buildings		One Click LCA		One Click LCA generic construction definitions				LOCAL	Ecoinvent
Wastewater drainage system		One Click LCA		One Click LCA generic construction definitions				LOCAL	Ecoinvent
Water chiller, HVAC, French average	MDEGD	INIES	INIES_DGRO20161116_164444, 5665	MDEGD_FDES	EN15804+A1		2016	france	ecoinvent, ELCD
Water circulation radiator		One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent
Water-borne interior paints	Teknos	RTS	RTS_14_18	EPD RTS EPD, Water-borne interior paints	EN15804+A1	Third-party verified (as per ISO 14025)	2018	finland	ecoinvent
Window system, with aluminum composite profile framing, single glazed	Schüco	IBU	EPD 2082-6-201903-20190402075452-EN	EPD Schüco AWS/ADS 50.NI W x H: 6700 mm x 2380 mm for project: 12500 Herbarium - Item: V1-Vinmonopolet Schüco International KG Created by: AS Rubicon	EN15804+A1	Third-party verified (as per ISO 14025)	2019	germany	GaBi
Wooden joist floor assembly		One Click LCA		One Click LCA generic construction definitions				europe	Other
Wooden stud internal wall assembly, 100 mm, incl. mineral wool insulation		One Click LCA		One Click LCA generic construction definitions				europe	Other