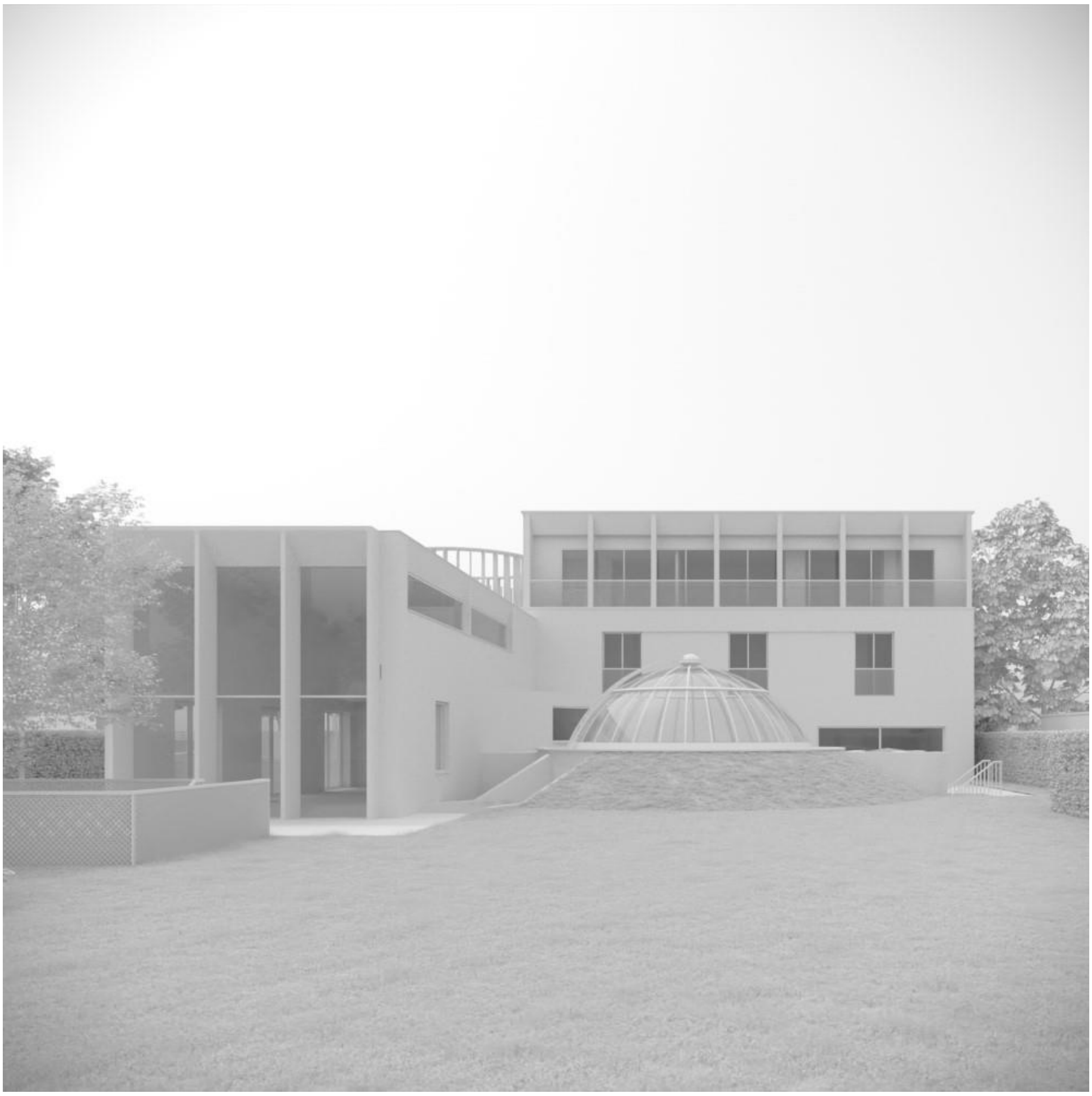
35 Temple wood Avenue NW3

Life Cycle Analysis (RICS Method)



February 2020

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Executive Summary

This report considers the carbon impact for two possible design options.

Option 1 using the 2017 consented design drawing for the construction of a new basement under the existing building and the subsequent refurbishment of the remaining structure.

Option 2 the proposed 2020 planning submission for demolishing the existing building and the construction of new underground basement of similar size.

Option 1 removes most of interior elements of the existing building only retaining the external brick block walls and some floor and roof structure. The building will be less thermal efficient and use more energy which is amplified over the 60 year life cycle.

Option 2 utilising new fabric and structure results in easier construction process and most of the building structure once crushed on site can used to stabilise the site ground works. The end result is thermal efficient new structure which will use less energy than option 1. The annual carbon usage is not huge in one year, however the saving are significant when considered over the 60 assessment period.

The final detailed design for the building services and finishes will be undertaken at the next stage, however as the building are similar size and dimension the finishes and services will very similar in each case.

Planning	2017 Consented	2020 Proposed
	Refurbishment	New Construction
Mass of Raw Material	1,642,790	2,269,353
Floor Area (m^2)	1,123	1,242
Total kg CO_2	2,193,924	1,523,628
$KgCO_2/m^2$	1,954	1,227
Biogenic Carbon storage	20,255	2,226
Improvement 60 years		31%

Table 1 Summary Results – See Section 6 for detailed breakdown of elements

Option 1 (2017 Refurbishment) use approximately 38% less building material than option 2 (2020 proposed). This is predominantly from retaining the external structure of the existing building.

Option 2 (2020 New Construction) is predicted to use release lees 31% CO_2 than option 1 this is due to the better fabric and more efficient services relying on electricity and with minimal gas.

Therefore, demolishing the existing structure and constructing a newer highly efficient building is the least carbon and more environmentally friendly option.

1 Introduction

The existing property on the site dates back to 1968 [the Pool] and 1994 [the house] respectively.

Planning consent was granted in 2018 to construct a basement under the entire house, create a new double-volume entrance/hall, an extended 2nd floor of the east-west wing and a new car lift access to the basement car park from Templewood Avenue.

There has been a subsequent application to move the pool to a new location within the site to free the house from the restrictions the pool imposes on the design and internal layout of the house. It is recognised that this is a very challenging proposal and the application has not yet been determined.

It has therefore been resolved to keep the pool in its current position, demolish the surrounding house and rebuild the property largely following the footprint and volume of the consented scheme. The new building incorporates the pool into the geometry of the house, producing a design that will contribute to the Conservation Area and make sense of the retention of the pool, albeit within a separate envelope from the original 1964/68 design.

As result of pre application planning review London Borough of Camden (LBC) inn letter dated: 04/10/2019 for Boncara, 35 Templewood Avenue, NW3 Camden planning reference number 2019/4115/PRE Date: 04/10/2019 request the following to be Life Cycle analysis to undertaken and reported on as part of formal planning application.

Section 8 - LBC Pre App - Principle of demolition

35 Templewood Avenue lies within the Redington and Frognal Conservation Area and is not mentioned in the conservation area statement as either making a positive or negative contribution to the area; however, it is noted that neighbouring building no.33 which is of a fairly similar architectural character is identified as detracting from the character of the area.

The existing building is not considered to be of a particularly high standard of architectural quality or materials. The building's contribution to the character of the conservation area is limited, and is in fact harmful to the setting of the Grade II Listed Schreiber pool given its proximity. As such, the principle of demolition is likely to be considered acceptable provided the revised proposals provide heritage benefits in terms of the relationship between the new house and pool.

Any future proposal for the demolition of the existing building must also be mindful of Policy CC1 (Climate Change Mitigation), in particular, points (e) and (f)) which requires all proposals involving substantial demolition to demonstrate that it is not possible to retain and improve the existing building. Paragraph 8.16 of the Local Plan describes how the construction process and new materials employed in developing buildings are major consumers of resources and can produce large quantities of waste and carbon emissions. The possibility of sensitively altering or retrofitting buildings should always be strongly considered before demolition is proposed.

As such, any proposal to demolish the existing building would need to be fully justified in terms of the *optimisation of resources and energy use in comparison with the existing building. Where the demolition of a building cannot be avoided, LBC will expect developments to divert 85% of waste from landfill and comply with the Institute for Civil Engineer's*

Demolition Protocol and either reuse materials on-site or salvage appropriate materials to enable their reuse off-site. LBC will also require developments to consider the specification of materials and construction processes with low embodied carbon content. It is necessary to understand resource efficiency when comparing the overall impact of a new development with that of refurbishing an existing building. The stages to assess include:

- *production of materials and components (raw material extraction, material production, wastage and waste processing, transportation)*
- *construction stage (transport, storage of products, wastage and waste processing, energy and water use in construction, ancillary materials)*
- *use stage (energy and water used in operation, maintenance, repair, replacement and refurbishment)*
- *End of life stage (de-construction or demolition, transport, waste processing, disposal of waste).*

When comparing the carbon impacts of a new development and a refurbished scheme, the applicant should include the following within the scope of the assessment:

Refurbished scheme	*New Scheme*
Embodied carbon of any new materials used within the refurbishment (do not include the carbon content of the existing building materials as these are considered 'spent'). *Expected operational carbon emissions of the refurbished scheme over the expected lifetime of the building (60 years is typical)*	*Embodied carbon of all materials used within the development.* *Expected operational carbon emissions from the new scheme over the expected lifetime of the building (60 years is typical)*

Embodied carbon is calculated by finding the quantity of all materials needed for the building's lifetime and multiplying this by the carbon factor (expressed in kg CO_2e *per kg of material/product) for each material to produce the embodied carbon figure. Please refer to policy CC1 (e) and CPG Energy efficiency and adaptation.*

As part of the pre-application submission, additional reasoning for the proposed demolition has been provided. The document sets out how the erection of a replacement dwelling provides the opportunity to construct a highly sustainable house and 'fully integrate the pool into the architecture of the house'. The report describes how the intention for the proposed building is for it to be constructed of highly sustainable building fabric, with aspirations for Passivehaus accreditation, energy generation, green roofs, dedicated cycle storage provision, Sustainable urban drainage, water conservation and re-use, low and zero carbon technologies efficient cooling, heating and lighting, measures to reduce overheating and limit excessive solar gain etc. Provided these measures are incorporated into future proposals, and demonstrated through a sustainability report providing a comparison between the existing and proposed buildings with demonstrable energy and sustainability gains, the proposed demolition is likely to be considered acceptable.

Site

The property is a large detached single dwelling house (within Use Class C3) located at the junction of Templewood Avenue and west Heath Road. The site is located approximately 400m west of Whitestone Pond and approximately 800m north of the centre of Hampstead. The site lies opposite Hampstead Heath (west Heath) which is directly accessible from west Heath Road.

The site is located within the Reddington and Frognal Conservation Area and with Sub-Area 4 ‘Reddington Road and Templewood Avenue’. The area is characterised by large individual dwelling houses set within their own identifiable plots.

The existing dwelling house on the site is comprised by two integrally linked (but identifiable) elements

- an “L-Shaped” red brick structure
- a semi subterranean swimming pool and above ground a glass domed roof

This statement provides the background information relating to the sizes and location of the local utilities.

The existing house (Boncara) on the site (no.35 Templewood Avenue) is a 3-storey house with a basement, of modern design in red brick with stone banding, which was built in the 1990’s.

This modern house was constructed in the eastern part of the former garden of the Grade II listed Schreiber House (no.9 west Heath Road), which was built in 1962-4 to designs by the architect James Gowan for the furniture designer Chaim Schreiber. In 1968 an external sunken and domed swimming pool, also designed by Gowan, was constructed to the east of the house on land that now comes under the ownership of no.35 Templewood Avenue which forms part of the statutory listing of the Schreiber House. The large modern three-bedroom red brick house at no.35 Templewood Avenue surrounds the listed swimming pool on the south and east sides.

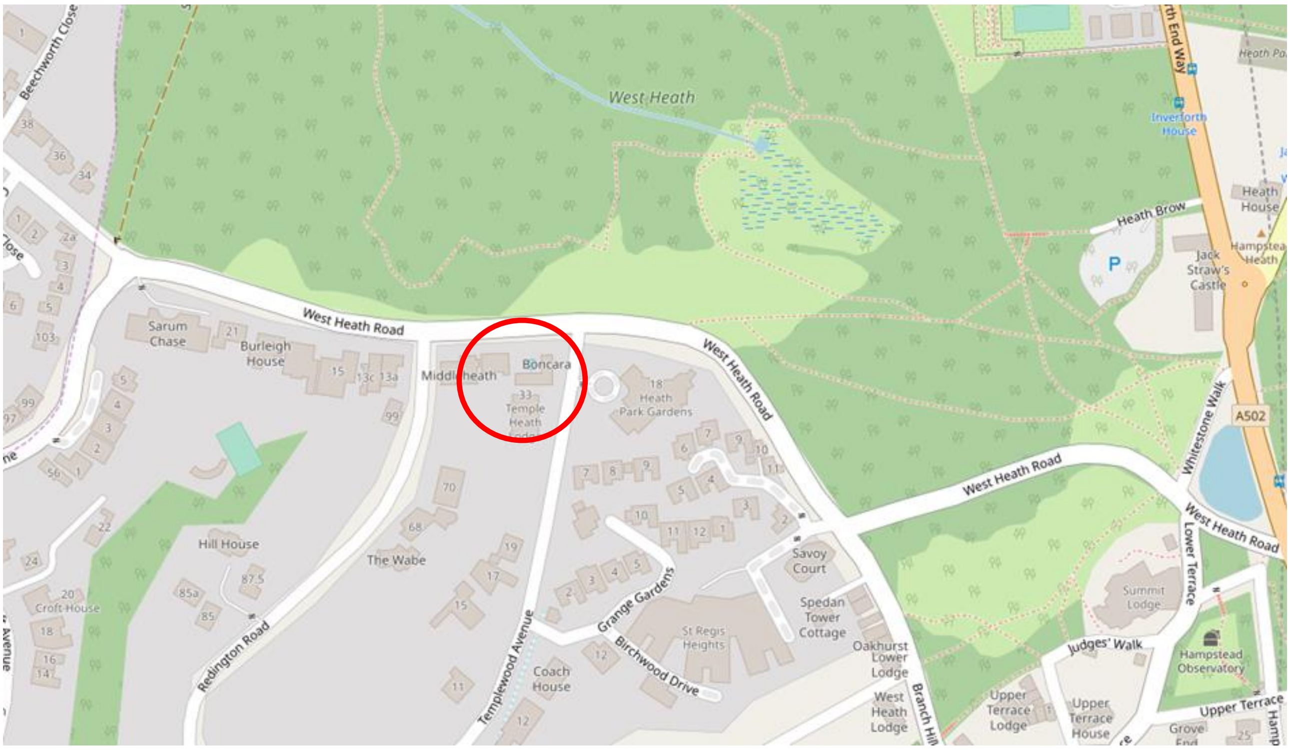

Figure 1 - 35 Templewood Avenue, London. NW3 7UY. (OpenStreetMap)

There have been previous planning applications in 2004 to modify the three-bedroom house and a second application in 2017 for the excavation of a new basement level and the erection of a two-storey extension to the south-eastern corner of the site. This proposal was granted planning permission in 2018. It included a new lift, stairwell, and extension to the third-floor level as well as refurbishment of the listed swimming pool and associated landscaping.

The current proposed development is to demolish the existing non-listed red brick three-bedroom house and rebuild a new five-bedroom property largely following the footprint and volume of the previously consented scheme. The new family house will sit comfortably within the 0.1 ha site and incorporates the pool building into the geometry of the proposed house. The new house will make architectural sense for the retention and reuse of the listed pool building as a formal and function/event room in its current location. The proposed building is designed with the aim of adding an aesthetic contribution towards the Conservation Area.

2 Planning Polices

2.1 It is expected that new developments will be constructed to the highest standards of sustainable design and construction as proposed by the GLA London Plan (2016) and the London Borough of Camden, Local Plan (2017). These policies are designed to promote the inclusion of on-site renewable energy production, and the use of decentralised energy systems. This approach will help reduce the dependency on conventional fuels for electricity and heating needs and will contribute towards achieving regional and national CO_2 reduction targets, hence mitigating climate change. These policies relate to major projects with over ten Domestic units and / or Non-Domestic projects over 1,000m^2 in area.

Greater London Policies (major developments) March 2015:

- Policy 5.1 Climate Change
- Policy 5.2 Minimising Carbon Dioxide emissions
- Policy 5.3 Sustainable Design and Construction
- Policy 5.6 Decentralised Energy in Development Proposals, Planning
- Policy 5.7 Renewable Energy Strategy
- Policy 5.9 Overheating and Cooling
- Policy 5.15 Water Use and Supplies

2.2 The energy assessment must fully comply with Policies 5.2 to 5.9 inclusive and, recognising the integrated nature of the London Plan policies, take account the relevant design i.e. spatial, air quality, transport and climate change adaptation policies in the Plan.

London Borough of Camden - Sustainability and Climate Change Polices.

Policy CC1 Climate Change Mitigation – Energy efficiency and carbon emission reduction, Carbon neutral developments and connection to district heat networks.

Policy CC2 Adapting to climate change – summertime over heating Risk

Policy CC3 Water and flooding – SUD options

Policy CC4 Air quality - Reduction of polluting emission sources and provision of cleaner ventilation systems

Policy CC5 Waste – Reduction of waste in construction, use and demolition.

Policy A4 Noise and vibration - External Noise Report - Use of acoustic glass, ventilation and building fabric.

2.3 The Council aims to tackle the causes of climate change in the Borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable energy technologies.

2.4 Climate change and minimising the use of resources – there are links between poor health and wellbeing and the ability to heat a home cost effectively and ensuring that the home does not overheat in hot weather. Policies CC1 Climate change mitigation and CC2 Adapting to Climate Change will seek to ensure that buildings are designed to be more energy efficient and to deal effectively with changes to our climate such as better winters and hotter summers.

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.

LBC 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 emissions 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, LBC 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, King's 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.

Resource efficiency, demolition and retrofitting existing buildings

Resource efficiency and demolition

Given the significant contribution existing buildings make to Camden's CO_2 emissions, the Council will support proposals that seek to sensitively improve the energy efficiency of existing buildings. Further guidance on how the energy performance of existing homes in conservation areas can be improved without harming the character and appearance of the area can be found in our supplementary planning documents ('Energy efficiency planning guidance for conservation areas' and 'Retrofitting planning guidance'). Policy D2 Heritage further explains that the Council will take into consideration the public benefits gained from the improved energy efficiency of existing buildings.

The construction process and new materials employed in developing buildings are major consumers of resources and can produce large quantities of waste and carbon emissions. The possibility of sensitively altering or retrofitting buildings should always be strongly considered before demolition is proposed.

Many historic buildings display qualities that are environmentally sustainable and have directly contributed to their survival, for example the use of durable, natural, locally sourced materials, 'soft' construction methods, good room proportions, natural light and ventilation and ease of alteration.

All proposals for substantial demolition and reconstruction should be fully justified in terms of the optimisation of resources and energy use, in comparison with the existing building. Where the demolition of a building cannot be avoided, LBC will expect developments to divert 85% of waste from landfill and comply with the Institute for Civil Engineer's Demolition Protocol and either reuse materials on-site or salvage appropriate materials to enable their reuse off-site.

LBC will also require developments to consider the specification of materials and construction processes with low embodied carbon content.

LBC will expect all developments, whether for refurbishment or redevelopment, to optimise resource efficiency by: • reducing waste;

- • reducing energy and water use during construction;
- • minimising materials required;
- • using materials with low embodied carbon content; and
- Enabling low energy and water demands once the building is in use.

Embodied carbon

Embodied carbon is the carbon impact associated with the production, transport, assembly, use and disposal of materials. This will include consideration of maintenance and repair but does not include the carbon emissions associated with the energy used for heating, lighting or cooling in the completed building (please see Policy T4 Sustainable movement of goods and materials).

Additionally, the Council will expect developers to consider the service life of buildings and their possible future uses to optimise resource efficiency. The durability and lifespan of the buildings' components should be matched to its likely service life, and where appropriate the building should be designed to be flexible in terms of adaptation to future alternative uses in order to avoid the need for future demolition.

As part of the assessment of resource efficiency, all developments involving five or more dwellings and/or more than 500 sqm gross internal floor spaces are encouraged to assess the embodied carbon emissions associated with the development within the energy and sustainability statement. Where such an assessment has been completed LBC would encourage that the results are logged on the WRAP embodied carbon database in order to contribute to the embodied carbon knowledge base.

Further guidance on resource efficiency and embodied carbon assessment can be found in supplementary planning document Camden Planning Guidance on sustainability.

3 Purpose of the study:

Policy CC1 (Climate Change Mitigation), in particular, points (e) and (f)) which requires all proposals involving substantial demolition to demonstrate that it is not possible to retain and improve the existing building. Paragraph 8.16 of the Local Plan describes how the construction process and new materials employed in developing buildings are major consumers of resources and can produce large quantities of waste and carbon emissions. The possibility of sensitively altering or retrofitting buildings should always be strongly considered before demolition is proposed.

Project type:

Comparison of the approved 2017 including new extensive underground basement and retained external building structure with proposed demolition and construction of new house similar sized house and basement.

Assessment method: EN 15978:2011

Assessed building, general information:

Building area:

	2017 Refurbishment	2020 New Build
Basement	311.0 m²	110.9 m²
Ground	309.0 m²	591.2 m²
First Second	214.0 m²	278.1 m²
Second	214.0 m²	155.3 m²
Third	75.0 m²	106.7 m²
Total	1,123.0 m²	1,242.2 m²

Table 2 Two building options GIA

		2017 Refurbishment		2020 New Construction	
Level	Element	Replacement	Construction	Replacement	Construction
Basement	External Wall	New	Concrete	New	Concrete
Basement	Internal Wall	New	Block + Brick	New	Block + Brick
Basement	Floor	New	Concrete	New	Concrete
Basement	Windows	New	Double Glazed	New	Double Glazed
Basement	Internal Doors	New	Wood	New	Wood
Basement	External Doors	New		New	
Ground	External Wall	Existing		NEW	
Ground	Internal Wall	New	Block + Brick	New	Metal Stud
Ground	Floor	New	Concrete	New	Concrete
Ground	Windows	New	Double Glazed	New	Double Glazed

		2017 Refurbishment		2020 New Construction	
Ground	Internal Doors	New	Wood	New	Wood
Ground	External Doors	New		New	
First	External Wall	Existing		NEW	
First	External Wall	New	Concrete	New	Concrete
First	Internal Wall	New	Block + Brick	New	Metal Stud
First	Floor	Existing		NEW	
First	Windows	New	Double Glazed	New	Double Glazed
First	Internal Doors	New	Wood	New	Wood
First	External Doors	New		New	
Top Floor	External Wall	New	Metal Frame	New	Metal Frame
Top Floor	Internal Wall	New	Metal Frame	New	Metal Stud
Top Floor	Floor	Existing		new	
Top Floor	Windows	New	Double Glazed	New	Double Glazed
Top Floor	Internal Doors	New	Wood	New	Wood
Top Floor	External Doors	New	Wood & Glass	New	Wood & Glass
Roof		New	Steel frame and wood joist	New	Concrete

Table 3 Summary of measure Elements

Extent of use: Domestic family property for 6 to eight people with ability to sleep 10 on the first and second floors and another 4 potential for up to 4 staff in the separate self-contained basement level guest accommodation.

Required service life:

The type of building general undergoes major refurbishment, between twenty to thirty year life cycle. The calculation is for 60 year life cycle with one major refurbishment period.

Life cycle impact assessment result summary

The life cycle assessment was calculated using One Click LCA. The results are summarized in the following table. The results represent the total life cycle impact during 30 year / 60-year service life.

4 The life cycle assessment scope and system boundaries

In the assessment following life cycle stages according to EN 15804:2012 were included:

	Element	REF	2017	2020
Product Stage	Raw material supply	A1	335662	215,402
	Transport	A2		
	Manufacturing	A3		
Construction Process Stage	Transport to building site	A4	17086	29,153
	Installation into building	A5		
Use Stage	Use/application	B1		17,680
	Maintenance	B2		
	Repair	B3	4616	
	Replacement	B4		
	Refurbishment	B5		
	Operational energy use	B6	1,813,515	1,233,148
	Operational water use	B7	1,818	1,938
End-of-Life Stage	Deconstruction/demolition	C1	21226	26,307
	Transport	C2		
	Waste processing	C3		
	Disposal	C4		
Benefits and loads beyond the system boundary	Reuse	D	-68151	−241501
	Recovery	D		
	Recycling	D		

Table 4 Summary RCIS Life Cycle method

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

Element	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 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.

Element	Description
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 taken into account.
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 waste water 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 includes 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.

Table 5 Description of life style stages

5 Analysis material scope

The LCA analysis included the basic construction elements, the fixture fittings and building service details are not consider at this early planning stage and are assumed to be similar in both buildings.

Element	2017 Refurbishment	2020 New Construction
SUPERSTRUCTURE		
Frame	Concrete basement walls	Concrete basement walls
Upper floors	New Ground floor above basement all other floor retained	New RC Floor Slabs
Roof	New Steel Frame with Wood Joist	Prefabricated concrete beams
Stairs	New wood Stairs	New Concrete stairs
External Walls	Retain existing external wall	New LCT brick wall construction
Windows & External doors	New	New
Internal Walls and Partitions	New internal layout. weight supporting walls retained	New
Internal Doors	New Wood door	New Wood door

Table 6 Building elements compared in LCA Model

Environmental data sources

One Click LCA EN-15978 tool was used in the assessment. The tool supports CML (2002 - November 2012 or newer) methodology and all assessed impact categories. All of the datasets in the tool follow EN 15804 standard. A complete list of data sources is presented in attachment 1.

Project data sources and assumptions

The proposed building was calculated in One Click LCA based on design data from provide by the Architects and structural energy Revit BIM models

6 Detailed assessment results

2017 New Basement and Major Refurbishment of Existing Building

	A1-A3 Product Stage	A4-A5 Construction process stage	B1 Use Phase	B3 Repair	B4 Replacement	B6 Operational Energy use	B7 Operational Water use	C1-C4 End of Life stage	Module D (not included in totals)	TOTAL kg CO_2e
1 Substructure	140,102	5,986		0				8,511	−19047	154,598
2.1-2.4 Superstructure	108,310	5,405		0	527			8,001	−22297	122,243
2.5-2.6 Superstructure	83,125	405		0	3,466			4,440	−26401	91,437
2.7-2.8 Superstructure	4,125	18		0	622			274	−406	5,040
3 Finishes										
4 Fittings, furnishings & equipment's										
5 Services (MEP)										
8 External works										
Other materials - TOTAL										
Site, energy and water		5,273				1813 515	1,818			1,821,038
TOTAL kg CO_2e	335,662	17,086		0	4,616	1,813,515	1,818	21,226	−68151	2,193,924

Table 7 Whole life summary table 2017 Refurbishment

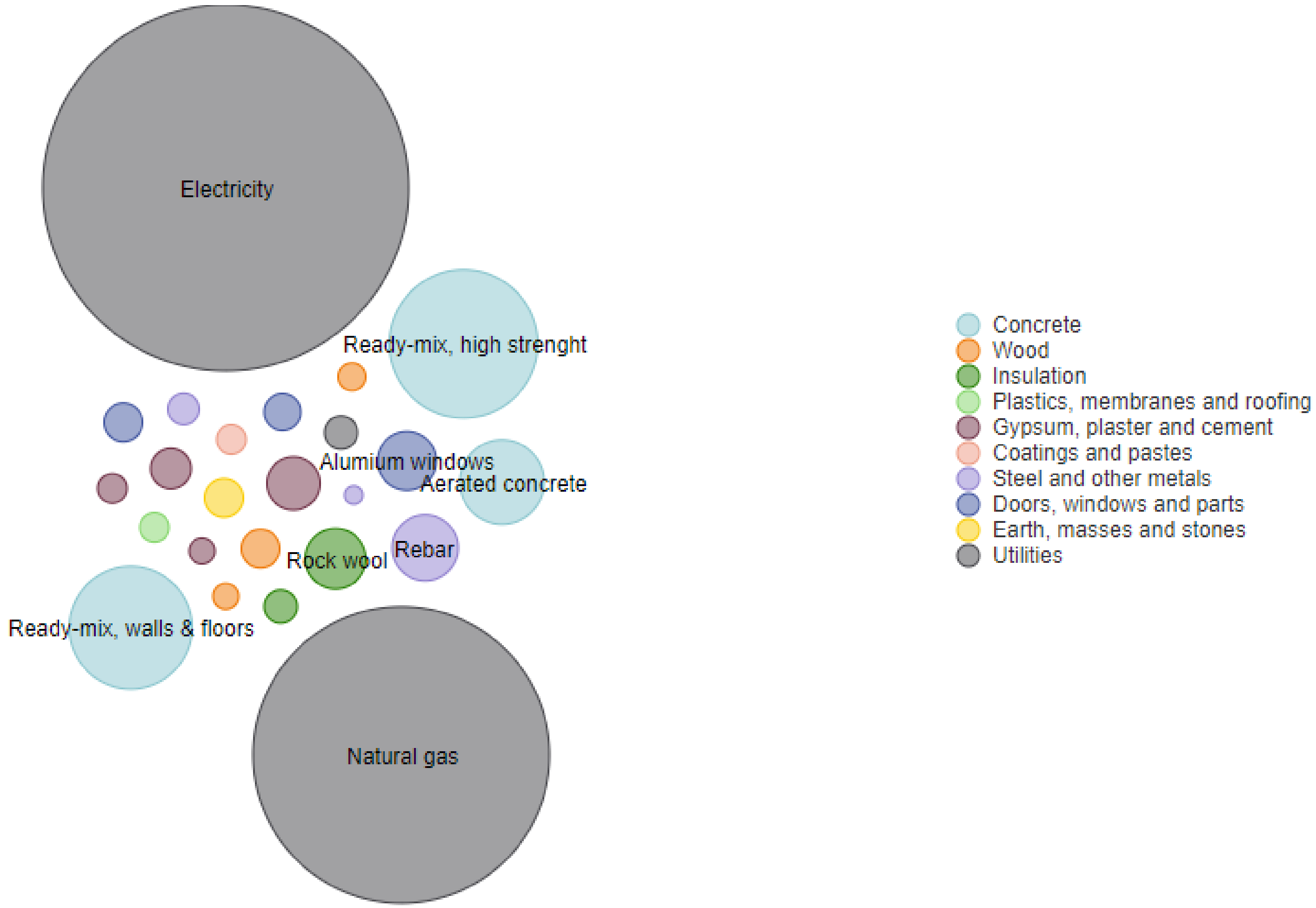

Figure 2 2017 Refurbishment Bubble Chart Total Life Cycle Impact (kgCO_2)

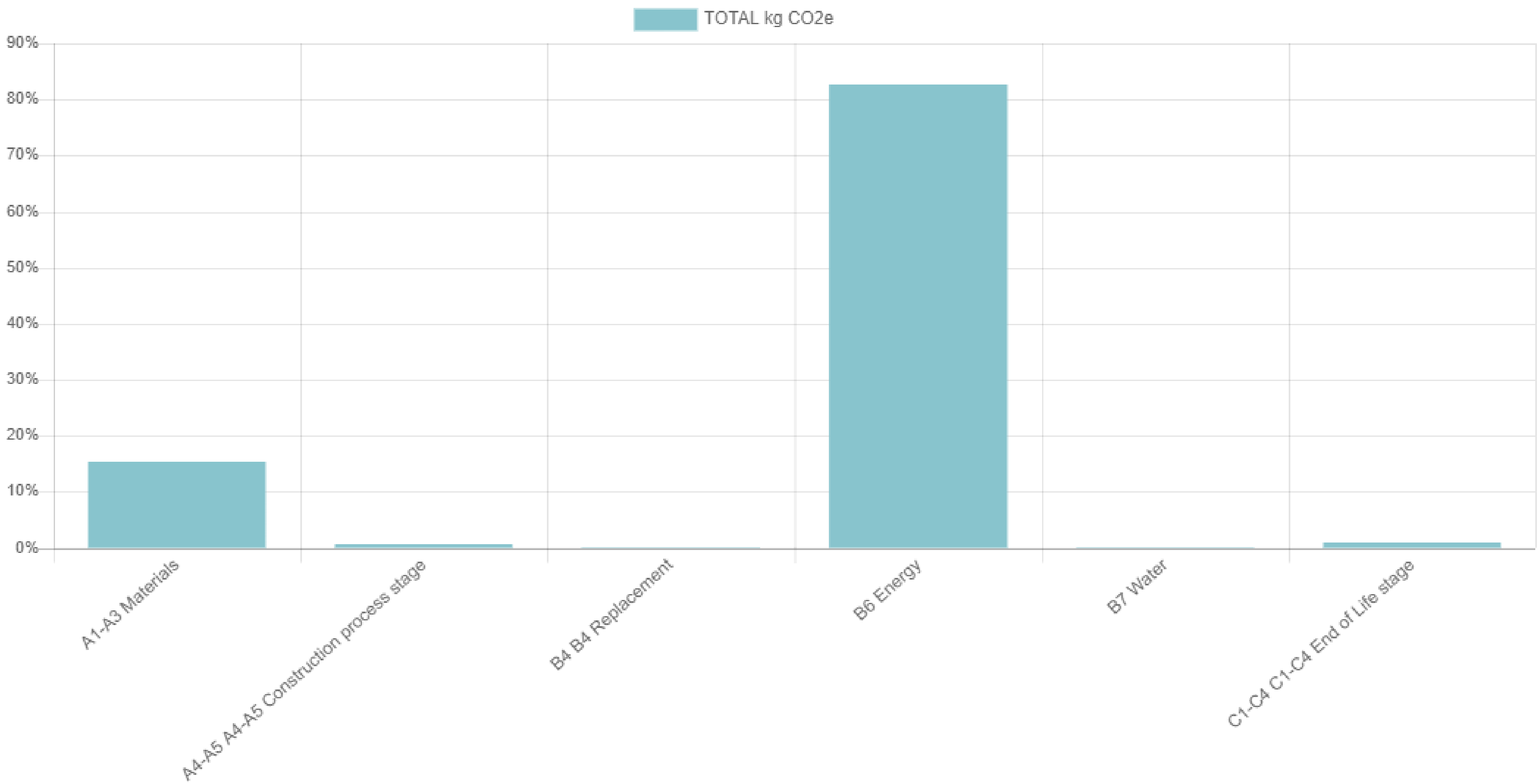

Figure 3 2017 Refurbishment – Results by Life Cycle Stage

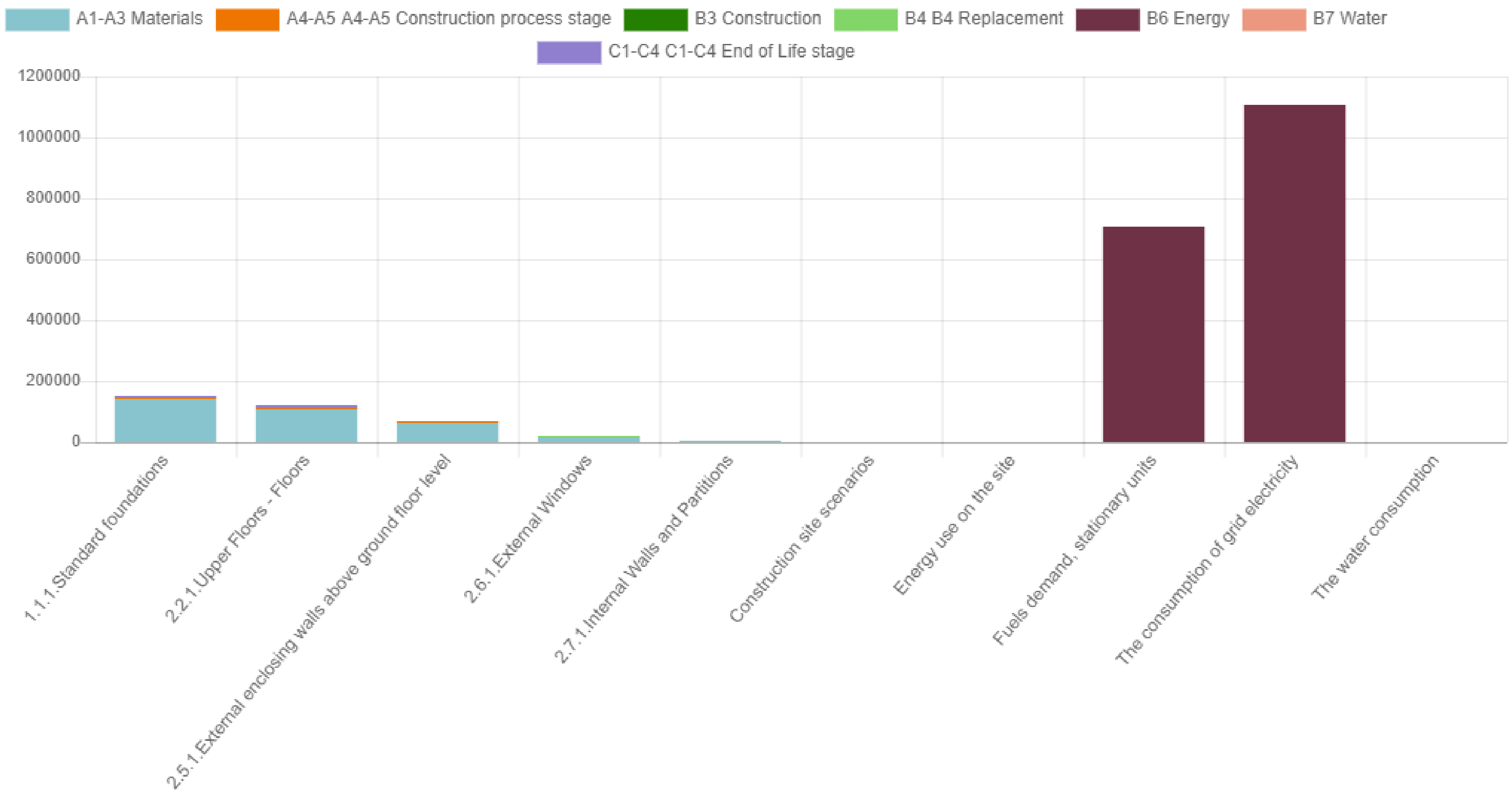

Figure 4 2017 Refurbishment Total kgCO$_2$ Grouped by RICS Category.

2020 Demolish existing Building constructs new basement and House.

	A1-A3 Product Stage	A4-A5 Construction process stage	B1 Use Phase	B3 Repair	B4 Replacement	B6 Operational Energy use	B7 Operational Water use	C1-C4 End of Life stage	Module D (not included in totals)	TOTAL kg CO_2e
1 Substructure	30,358	2,445		0				3,476	−7 488	36,279
2.1-2.4 Superstructure	131,508	13,873		0				19,724	−41 712	165,105
2.5-2.6 Superstructure	777	4		0	820			20	−42	1,621
2.7-2.8 Superstructure	17,948	789		0	6,964			2,052	−3 601	27,753
3 Finishes										
4 Fittings, furnishings & equipment's										
5 Services (MEP)										
8 External works										
Other materials - TOTAL	34,811	167		0	9,895			1,035	−7 925	45,909
Site, energy and water		11,875				1,233,148	1,938		−180 733	1,246,961
TOTAL kg CO_2e	215,402	29,153		0	17,680	1,233,148	1,938	26,307	−241501	1,523,628

Table 8 2020 New Construction - Whole life summary table 2020 New Construction.

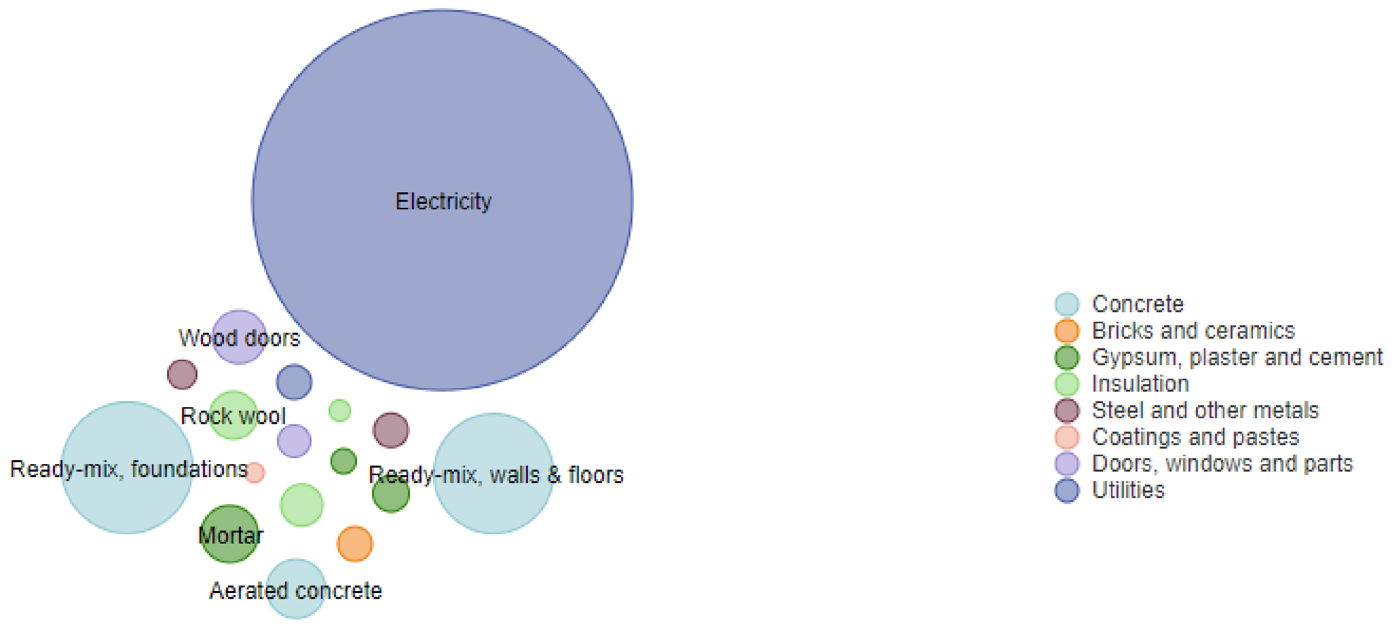

Figure 5 2020 New Construction - Bubble Chart Total Life Cycle Impact (kgCO_2)

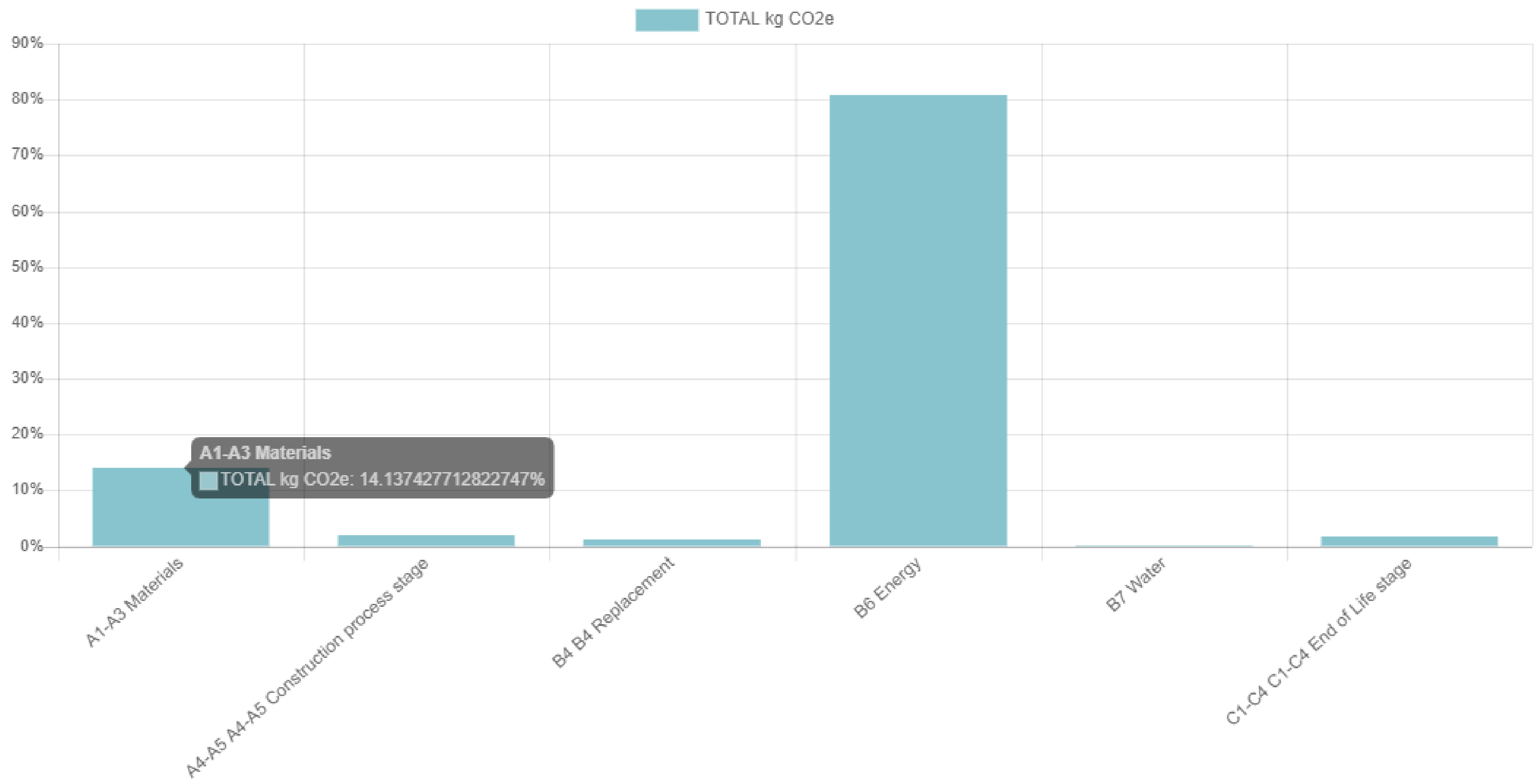

Figure 6 2020 New Construction – Results by Life Cycle Stage #

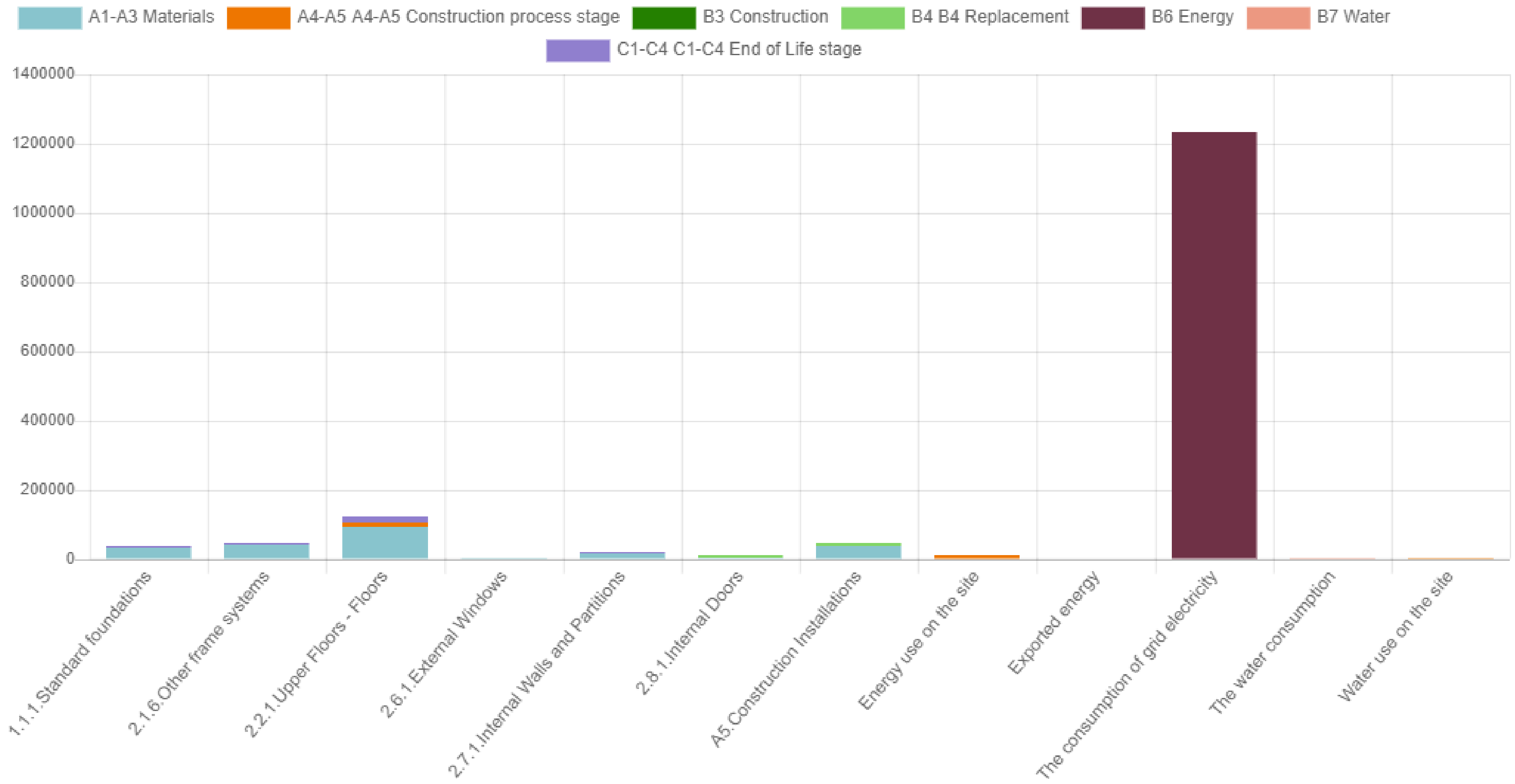

Figure 72020 New Construction Total kgCO_2 Grouped by RICS Category

7 Description of One Click LCA calculation tool

The calculations were performed with One Click LCA calculation tool. The software is fully compliant with EN 15978 standard. One Click LCA has been third party verified by ITB for compliancy with the following LCA standards: EN 15978, ISO 21931–1 and ISO 21929, and data requirements of ISO 14040 and EN 15804. You can find the official letters of compliancy here: https://www.oneclicklca.com/wp-content/uploads/2016/11/360optimi-verification-ITB-Certificate-scanned-1.pdf.

ITB is a certification organization and a Notified Body (EC registration nr. 1488) to the European Commission designated for construction product certification. Polish Accreditation Board assures the independence and impartiality of ITB services (Accreditation Certificates are: AB 023, AC 020, AC 072, and AP 113). ITB activities are conducted in accordance to the requirements of the following assurance standards: ISO 9001, ISO/IEC 27001, ISO/IEC 17025, EN 45011, and ISO/IEC 17021.

Attachment 1, sources:

Resource name	Technical spec	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country	Upstream database	Density	Product Category Rules (PCR)	Notes about PCR	Download EPD
2 Way Inward Opening Window	Frame: 105 mm, 64.4 kg, 1.23x1.48 m		Lian Trevarefabrikk	EPD Norge	NEPD-329-212-NO	NEPD-329-212-NO 2-veis innadslaende apningsvindu	EN15804	Verified	2015	[norway]	ecoinvent		NPCR014 rev.1 windows and doors	Only with EN15804	This feature is available under license Business Download EPD
Bricks	226x104x60, 226x85x60 mm	NF with holes & solid, RF	Wienerberger	IBU	EPD-WIE-20130206-IAB1-EN	Bricks Wienerberger AS	EN15804	Verified	2014	[germany]	GaBi	1700	Bricks, 07-2013	Only with EN15804	This feature is available under license Business Download EPD
Exterior wooden door and windows, with aluminium elements	137mm, U = 0.65W/m2.K	LUMIA	MINCO	INIES	INIES_IFEN20190725_070639, 11039	FDES	EN15804	Verified	2018	[france]	ecoinvent		EN15804	EN15804	This feature is available under license Business Download EPD

Table 9 Environmental Data Sources

Resource name	Technical spec	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country	Upstream database	Density	Product Category Rules (PCR)	Notes about PCR	Download EPD
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	IBU	EPD-PCI-20160117-IBE1-DE	Oekobau.dat 2017-I, EPD Verformungsfähiger Fliesenkleber PCI Flexmörtel® S1 Rapid Hochverformungsfähiger Fliesenkleber PCI Flexmörtel® S2 Rapid	EN15804	verified	2016	[germany]	GaBi	1300	Mineralische Werkmörtel, 07.2014 (PCR geprüft und zugelassen durch den unabhängigen Sachverständigenrat)	Only with EN15804	This feature is available under license Business - Download EPD
Glass wool insulation panels, unfaced, generic	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)			One Click LCA	-	One Click LCA	EN15804	-	2018	[LOCAL]	ecoinvent	25	EN15804	-	
Gypsum plaster	1100 kg/m3		Bundesverband der Gipsindustrie	IBU	EPD-BVG-20140073-IAG1-DE	Oekobau.dat 2017-I, EPD GIPSPUTZ Bundesverband der Gipsindustrie e.V.	EN15804	Verified	2014	[germany]	GaBi	1100	Mineralische Werkmörtel, 10-2012	Only with EN15804	This feature is available under license Business - Download EPD

Table 10 Environmental Data Sources