

Lifecycle CO₂ analysis and sustainability case for demolition

186 Creighton Avenue

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Lifecycle CO₂ Analysis

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186 Creighton Avenue

Lifecycle CO₂ Analysis

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Executive Summary

186 Creighton Avenue

Lifecycle CO₂ Analysis

Brief and Findings

There are three key elements to the brief:

1. To consider the case for demolition from both a practical and sustainability viewpoint.

Page 6 notes the key reasons why the proposed new property outweighs the benefits of refurbishing or retaining the existing dwelling. The new dwelling will stand for much longer, make a positive impact in terms of carbon emissions, occupant health, water use and efficient use of floor space.

2. To consider the impact in terms of life-cycle carbon emissions for two scenarios at 186 Creighton Avenue: Scenario 1 - refurbishing the existing building to Part L standards, and Scenario 2 – demolition of the existing building and a new build.

- The study concludes the new build, scenario 2 has lower carbon emissions over a 50-year lifecycle, with scenario 2 emitting **209,862 KgCO₂** less on site.
- Scenario 2 has a larger the internal floor area of scenario 1 and is new build, therefore more embodied carbon emissions. The embodied energy of the materials in the Scenario 2 is **2.97 times** greater than in the scenario 1, which is **37,568 KgCO₂** more, however this compensates with the savings on the operational phase.
- The carbon emissions of the operational phase of Scenario 1 is **25 times** that in scenario 2, which is **249,509 KgCO₂** more. This makes the scenario 2 the most carbon efficient in the long term.

3. Ensure carbon emissions of the scheme are low across the whole lifecycle of the project.

- Page 13 of the report addresses this and concludes that the refurbishment emits more carbon emissions than the new build scenario over 50 years. When analysed on a Kg CO₂ per m² basis, the new build scenario 2 is even more carbon efficient.
- In addition, the new build has been assessed in two building methods – traditional brick and block and the selected proposed construction method: full timber frame cassette with cellulose insulation.

Key findings

- The proposed dwelling is of an exemplary standard and will:
 - Save approx. 1,460,000 litres of water over 50 years.
 - Create a more efficient useable space
 - Be healthier and lighter space for people to live.
 - Be more accessible, and;
 - Will last much longer than refurbishment in the future.
 - The current dwelling cannot be upgraded to a satisfactory standard
 - Importantly, the new build scenario can be considered much more sustainable from both a long-term carbon emission point of view.
 - Scenario 2 is inline with London plan targets on carbon emissions, notably 35% beyond Part L building regulations CO₂ levels.
 - Overall carbon emissions lower in the new build scenario when analysed over 50 years. If looked at further in the future this carbon saving of Scenario 2 would continue to increase dramatically.
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Introduction

186 Creighton Avenue

Lifecycle CO₂ Analysis

Introduction

Green Tiger Sustainability has been appointed to analyse the Lifecycle carbon emissions and the case for demolition of the existing and building a more efficient new home at 186 Creighton Avenue.

Justification that the demolition of the existing dwelling and erection of a new dwelling is required. To have a case, the long-term sustainability of the site should be improved and needs to be demonstrated. In addition to detailing if the existing dwelling can be upgraded to a satisfactory standard.

The case for demolition from a sustainability point of view can be made if a comparison of the long-term carbon emission impact between a refurbished only scheme of the existing dwelling and the proposed demolition and new build can be made.

Aim

This document Aims to:

- Make a case for demolition and re-development – from both practical and sustainability viewpoints.
- Consider the impact in terms of Life-cycle carbon emissions for two scenarios at 186 Creighton Avenue, this environmental impact will be measured in KgCO₂ and KgCO₂ per metre square:
 - o Scenario 1 - refurbishing the existing building or;
 - o Scenario 2 – demolition of the existing building, building a new build dwelling.
- Establish and analyse the CO₂ impact of the two cases to determine the relative impact and consider the case for demolition from a carbon emission viewpoint

Caveats

The methodology used in this report has been clearly defined and the data used has been attributed to the source.

There are several ways to undertake Life Cycle Analysis, one being the methodology we have developed. There is no set national calculation methodology or specific LCA software (unless specified in policy). However, fundamentals and core elements of both ISO14044 and BS EN 15978 have been followed in this report, with a focus on the key factors: cradle to gate embodied CO₂ and in-use regulated emissions - some less impactful sub-stages are not included in this analysis.

Core elements of the building has been analysed in embodied carbon calculations – services, landscaping and finishes have not been taken into account in either scenario, due to them being predominantly unknown. Note that sequestered carbon is not factored, which would further reduce emissions of natural or wooden structures.

Specifications of the dwellings analysed are not finalised at this early development stage. Where we have made assumptions, we have assumed the worst-case value.

Case for Demolition & New Build

186 Creighton Avenue

Introduction

A case for demolition and redevelopment is made to:

- Confirm existing house can't be upgraded to a satisfactory standard, and;
- Provides reasonable standard of accommodation – including practicality and importantly long-term sustainability.

Current dwelling

The current dwelling cannot be upgraded to a satisfactory standard from a practical or longevity point of view. The existing property was built around 1935 and is approximately 87 years old and, whilst many pre-war dwellings stand longer, the life expectancy of a property such as this is 60 years (BRE).

The current dwelling survey details potential damp in kitchen area, windows/joinery in disrepair and finishing upgrades required. Electrical and plumbing services are also in disrepair and require replacement. The property has an inefficient use of space and the layout is poor for movement through the dwelling. If the property could not be redeveloped, the home-owner has no incentive to upgrade the current dwelling beyond building regulations (i.e. Part L for existing buildings), or at all, keeping carbon emissions very high.

Alignment with Policy on emissions

New builds in Haringey should meet a minimum carbon emission target 35% beyond building regulations Part L – under the London Plan guidance and local policy requires 100% overall carbon reduction, through on-site means first and contribution to Haringey offset fund for remaining emissions.

A refurbishment of the existing single dwelling would need to meet Part L building regulations in terms of energy, which are less rigorous than the standard of new build regulations and considerably lower than the London Plan/local new build requirements. As demonstrated in the long term CO₂ analysis in this report, the new timber-frame building will go far beyond building regulations (**91.7%** over Part L) and contribute to much lower carbon emissions in the long term over the refurbishment scenario, in keeping with the borough's wider aims.

Water use

The dwelling is required to meet building regulations of 125 litres/person/day, but will go beyond and target 105 litres/person/day. Based on 4 people living in the dwelling this could lead to 1,460,000 litres of water saved over 50 years in the new build scenario. Note that this is based on standard fittings (WCs, Bath, Shower, taps and washing machine / dishwasher only).

Local Employment

The design team are committed to employing local firms to carry out works if planning permission on the proposed new build is granted. Although small, this will add to local economic growth and employment opportunities.

A Better dwelling

The proposed dwelling will be an exemplar sustainable development for the local area– see the Design and Access Statement for more design details.

The proposed new build scenario will incorporate much more space, making better use of the building footprint, with a much healthier amount of natural light and a higher air change rate in the dwelling - contributing to better occupant health. The new dwelling will have a spacious design, surpassing M4 access requirements, it will be much more efficient and stand for much longer, making a positive impact in terms of carbon emissions, water and access.

Furthermore, composting facilities, rainwater collection and live energy display devices – encouraging lower energy use from appliances will be implemented.

Lifecycle Methodology

186 Creighton Avenue

Lifecycle CO₂ Analysis

Introduction

The below section provides a step-by-step description of the project methodology.

Brief

The brief is to analyse and then compare the carbon intensity of two scenarios of development on the site at 186 Creighton – a refurbishment of the existing building (Scenario 1) and a new build development (Scenario 2).

A particular focus is to be placed on a whole life cycle analysis, which encompasses all stages of development from the sourcing of the materials, the activity during construction works and the operations of the building. The outcome will help determine if there is a case for demolition based on long-term carbon emissions of the scheme. Wider sustainability issues should also be considered.

Life Cycle modelling

The two scenarios have information relating to the development such as architectural drawings, consultant reports and official Part L 2021 documentation. The drawings are provided in the planning application.

Green Tiger Sustainability has modelled the two scenarios, taking into account the construction type, volume of materials, materials used, activity during construction works and operational usage using energy modelling.

A detailed breakdown of the data input for each case study is provided, as well as a further breakdown of the carbon factors relating to materials and fuel is provided in Appendix 1.

Analysis of Carbon Emissions

Green Tiger Sustainability has broken down the whole life carbon emissions and provided the embodied carbon, carbon relating to construction works and the operational carbon using the same methodology for both scenarios.

The embodied carbon and site works calculations are based on drawings and information from the project Architects, XUL Architecture, together with recognised data from the Environment Agency, Bath University ICE database, Greenspec and DEFRA.

The operational carbon is based on Standard Assessment Procedure (SAP) modelling using architectural drawings, proposed specifications and Part L. This study will look at the Carbon emissions of life cycles over 50 years.

The study will have two types of comparative analysis, one comparing the whole environmental impact over the entire life cycle of the buildings, and also we are comparing the environmental impact per metre square of construction, as the new build, scenario 2, adds more m² of living space.

Embodied CO₂ of services (expect Solar Panels), landscaping and finishes have not been taken into account in either scenario.

Comparative Analysis of Carbon intensity

A comparison of life cycle emissions between the refurbishment scenario and new build scenario is made to indicate the respective carbon intensity of developments.

This will indicate which development shows the higher carbon emissions over a 50-year lifecycle.

Calculation & Modelling Overview

186 Creighton Avenue

Lifecycle CO₂ Analysis

Background

Life Cycle Analysis (LCA) is a methodology for assessing the environmental performance of a product (i.e. building) over its life cycle, often referred to as cradle-to-grave analysis. The term cradle in this project refers to the extraction of raw materials. For the purpose of this report the Life Cycle will be from 'cradle' to 50 years of building operation, as the focus of the report is on the embodied carbon in the finished building and a defined time of operation. Building operation beyond 50 years has not been taken into account.

LCA can be measured in terms of energy or carbon emissions. All data in this report refers to carbon emissions throughout all processes.

Scenario 1 - Refurbishment

The existing dwelling at 186 Creighton Avenue was built around 1935. It is a four bedroom dwelling. A full refurbishment of the property would be required, with new floor. The sustainability targets for this are to meet Part L 2021 standards. The following works would need to be undertaken to meet Part L for existing dwellings:

- Walls insulated to U-value of 0.30
- Floor insulated to U-value of 0.25
- Roof insulated to U-value of 0.16
- Windows replaced with U-value of 1.4
- Boiler upgraded to minimum 84% efficient and 250-litre tank

Scenario 2 – demolition of the existing building, building a new build.

The proposed timber frame new build incorporates a larger and more functional space. An air Source Heat Pump will supply heat and hot water and Solar PV will be maximised. The following works would need to be undertaken:

- Demolition of existing building
- U-values: Walls – 0.14 / Roof 0.11 / Floor 0.10 / Windows 0.71 average
- Air permeability to 0.18 m²/m³/hr @ 50pa
- MVHR ventilation throughout
- Highly efficient Air Source Heat Pump w/underfloor heating
- Solar PV maximised with 7.2 kWp across the roof area

Modelling Data

Building data input

- Construction plans, drawings, elevations and measurements
- Construction Method Statements

Benchmark data

- Environmental agency – All material volume to weight factors
- Bath University Inventory of Carbon and Energy (ICE) V2.0, 1.6 – CO₂ factors
- Greenspec and DEFRA – where noted

Model

- Combined building data and benchmark data (See Appendices)
- SAP 10 and SAP 10 (2022) emission factors

Information in appendix

- All model data and calculations

1. Refurbishment Embodied Carbon 186 Creighton Avenue

Embodied energy breakdown

Below are the key figures and distribution of embodied carbon in the materials needed to refurbish 186 Creighton Avenue.

As concrete deteriorates over time, the refurbishment requires a new concrete slab added, which along with a new roof and windows, are the key carbon emissions in the this scenario. A new gas boiler and distribution system is added in this scenario.

All insulation would be upgraded to a minimum U-value of Part L and carries high-embodied carbon throughout the scheme.

Phase 01- Production of Materials / Embodied							
Components	Material	Area (m2)	Depth (m)	Weight factor (kg/m3)	Total Weight (kg)	Carbon Factor kgCO2/Kg	KgCO2
Ground Floor							
Insulation	Polyurethane	97.78	0.100	30.00	293.34	4.26	1,249.63
Membrane	Plastic	97.78	0.003	1,470.00	431.21	3.13	1,349.69
Concrete slab	General Concrete	97.78	0.200	2,000.00	39,112.00	0.11	4,302.32
Exterior Wall							
Insulation	Polyurethane	199.67	0.100	30.00	599.01	4.26	2,551.78
Finshes	Plasterboard	199.67	0.012	950.00	2,276.24	0.38	864.97
Interior Wall							
Insulation	Polyurethane	59.90	0.100	30.00	179.70	4.26	765.53
Finishes	Plasterboard	59.90	0.012	950.00	682.87	0.38	259.49
Roof							
Insulation	Rockwool	102.73	0.250	100.00	2,568.25	1.05	2,696.66
Timber - new structure	General Timber	102.73	0.080	480.00	3,944.83	0.41	1,617.38
Membrane	Plastic	102.73	0.003	1,470.00	453.04	3.13	1,418.01
Finishes	Plasterboard	102.73	0.012	950.00	1,171.12	0.38	445.03
Slate	Slate	102.73	0.003	2,700.00	832.11	0.06	49.93
Doors							
All Doors	General Timber	17.58	0.050	480.00	421.92	0.46	194.09
Windows							
Windows Double glazed (4+4/8/8 mm)	Timber frames	5.70	0.080	480.00	219.06	0.41	89.82
	Glass	47.54	0.008	2,500.00	950.80	1.27	1,207.52
TOTAL EMBODIED CO2 EMISSIONS					54,135.52		19,061.84

1. Refurbishment Lifecycle Carbon 186 Creighton Avenue

Introduction

The following section looks at the carbon emissions throughout the life cycle of the building. This is broken into three figures – Embodied carbon in the physical structure, carbon associated with construction works and the actual occupation and operation of the building.

Description of Stages

Embodied carbon – The previous page of this report showed the embodied carbon associated with the physical structure of the development.
Construction works – The carbon emissions of construction works takes into account the energy from site plant, material and staff transportation and construction waste disposal, based on benchmark data.
Operations - The operational carbon has been calculated using SAP to determine the yearly Dwelling Emission Rate of the building if refurbished to part L building regulations.

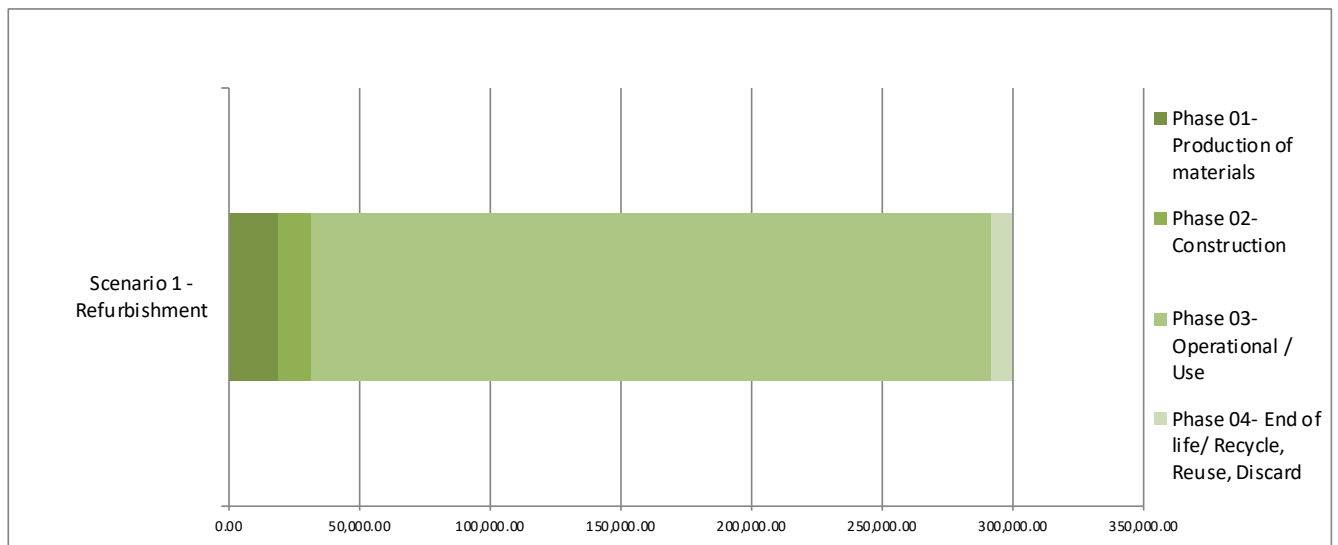
Observations

The embodied carbon and carbon emissions from construction account for less than a tenth of emissions over a 50 year life-cycle. Operational emissions are very high.

Summary Table

	kgCO ₂
Phase 01- Production of materials	19,061.84
Phase 02- Construction	12,475.20
Phase 03- Operational / Use	259,884.31
Phase 04- End of life/ Recycle, Reuse, Discard	8,079.20
TOTAL	299,500.55

Summary Graph



2. New Build

Embodied Carbon

186 Creighton Avenue

Embodied energy breakdown

Below are the key figures and distribution of embodied carbon in the materials needed build the proposed new property at 186 Creighton Avenue.

In order to lower carbon emissions in the build, a timber frame will be the main structure (with partial supporting steel). Sustainable insulation cellulose has been selected in the majority.

The concrete slabs, brick outer finish work and glass account for the majority of the carbon emissions. Concrete emissions could be reduced further using a lower impact concrete where possible.

Phase 01 - Production of Materials / Embodied							
Components	Material	Area (m2)	Depth (m)	Weight factor	Total Weight (kg)	Carbon Factor	KCO2
Foundation							
Concrete (average depth)	General concrete	37.80	0.800	2,000.00	60,480.00	0.11	6,652.80
Timber Frame							
Timber Frame	General Timber	162.80	0.200	480.00	15,628.61	0.46	7,189.16
Steel Supports							
Steel beams	General Steel	19.46	0.007	7,800.00	1,062.52	1.77	1,880.65
Ground Slab							
Concrete slab	General concrete	149.60	0.150	2,000.00	44,880.00	0.11	4,936.80
Membrane	Plastic	149.60	0.003	1,470.00	453.04	3.13	1,418.01
Hardcore	Stone Gravel	149.60	0.200	1,800.00	53,856.00	0.02	915.55
Floor							
Insulation	Cellulose	309.70	0.250	3.30	255.50	0.11	27.08
Timber Floors	General Timber	309.70	0.080	480.00	11,892.48	0.46	5,470.54
Internal Finish	General Timber	309.70	0.001	480.00	148.66	0.46	68.38
Exterior Wall							
Insulation	Cellulose	344.39	0.200	3.30	227.30	0.11	24.09
Timber Boarding	OSB	344.39	0.003	480.00	495.92	0.46	228.12
External Brick finish	Clay Brick	344.39	0.100	1,700.00	58,546.30	0.22	12,880.19
Internal finish	Plasterboard	344.39	0.012	950.00	3,926.05	0.38	1,491.90
Interior Wall							
Insulation	Cellulose	137.76	0.080	3.30	36.37	0.11	3.85
Internal finish	Plasterboard	137.76	0.024	950.00	3,140.84	0.38	1,193.52
Doors							
All Doors	General Timber	20.78	0.050	480.00	498.61	0.46	229.36
Roof							
Insulation	Cellulose	159.90	0.300	3.30	158.30	0.11	16.78
Timber roof	General Timber	159.90	0.080	480.00	6,140.16	0.46	2,824.47
Membrane	Plastic	159.90	0.003	1,470.00	705.16	3.13	2,207.15
Slate	Slate	159.90	0.003	2,700.00	1,295.19	0.06	77.71
Windows							
Windows Triple glazed (4+4+4/8/5 mm)	Timber Frames	8.84	0.080	480.00	339.53	0.46	156.19
	glass	88.42	0.024	2,500.00	5,305.20	1.27	6,737.60
Solar PV							
Solar Panels	Monocrystalline	18.00				200.00	3,600.00
TOTAL EMBODIED CO2 EMISSIONS					269,471.73		56,629.92

2. New Build Lifecycle Carbon 186 Creighton Avenue

Introduction

The following section looks at the carbon emissions throughout the life cycle of the building. This is broken into three figures – Embodied carbon in the physical structure, carbon associated with construction works and the actual occupation and operation of the building.

Description of Stages

Embodied carbon – The previous page of this report showed the embodied carbon associated with the physical structure of the development.
Construction works – The carbon emissions of construction works takes into account the energy from site plant, material and staff transportation and construction waste disposal, based on benchmark data.
Operations - The operational carbon has been calculated using SAP to determine the yearly Dwelling Emission Rate (DER).

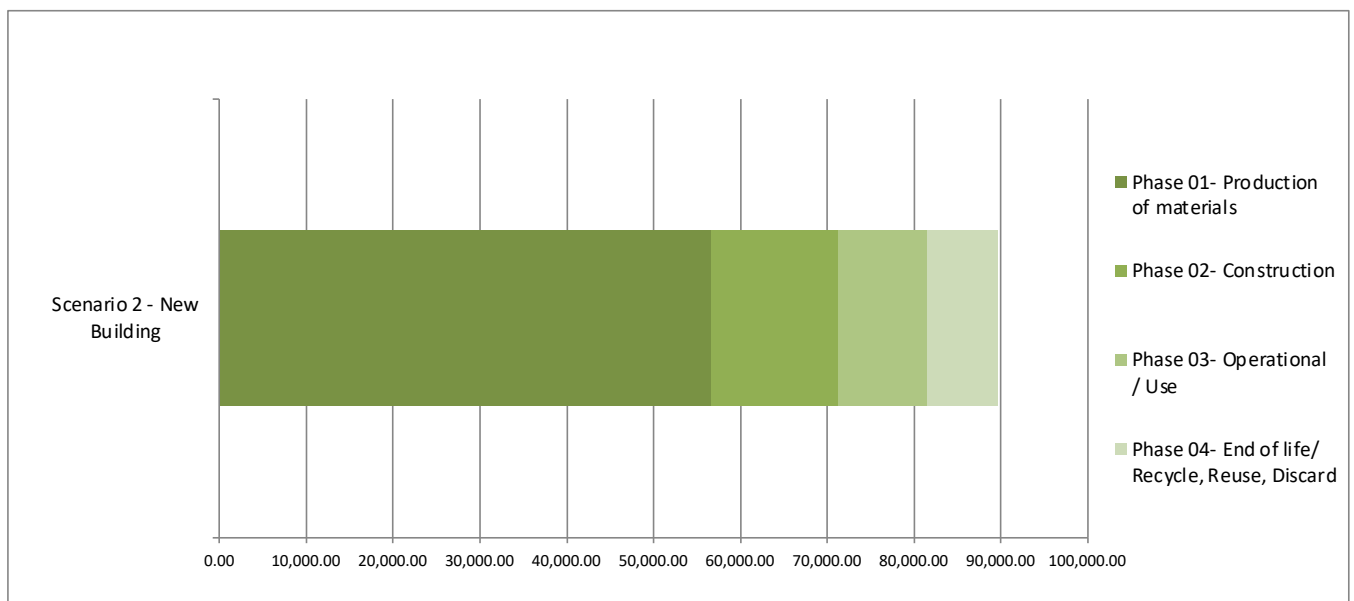
Observations

The embodied carbon and construction works are considerable and are equivalent to the operational carbon over 50 years.

Summary Table

	kgCO2
Phase 01- Production of materials	56,629.92
Phase 02- Construction	14,554.40
Phase 03- Operational / Use	10,374.95
Phase 04- End of life/ Recycle, Reuse, Discard	8,079.20
TOTAL	89,638.47

Summary Graph



Lifecycle Analysis New Build - Timber Vs Traditional build 186 Creighton

Introduction

In addition to the selected construction method of timber frame, brick and block was also tested - the following section compares the results of a traditional build (brick and block) with the selected wooden structure.

Summary Table

	New Build – Traditional Brick and Block	New Build – Timber frame
Phase 01- Production of materials	97,623.35	56,629.92
Phase 02- Construction	24,950.40	14,554.40
Phase 03- Operational / Use	23,227.50	10,374.95
Phase 04- End of life/ Recycle, Reuse, Discard	10,079.20	8,079.20
TOTAL	155,880.45	89,638.47

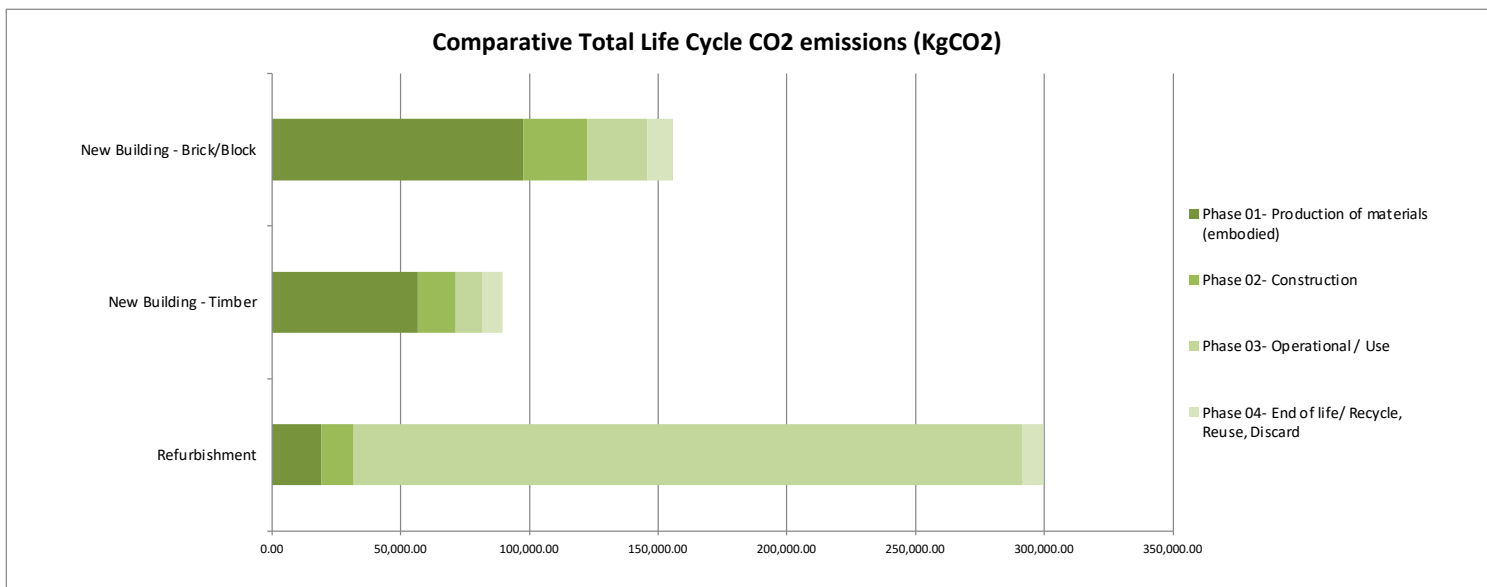
Comparative Analysis

There are numerous observations from the data:

- The embodied CO2 emissions are almost **twice as high** for the new build made of traditional (brick and block) construction – primarily due to the high energy used in brick, blocks and standard insulation.
- The operational carbon emissions from the timber framed building are **much lower** than traditional build – this is primarily due to the assured low air-tightness (toward PassivHaus) that can be achieved with the proposed timber frame system.
- Construction emissions are lower in timber frame as it is **more efficient** through pre-fabrication, with less time and machinery on site.
- Taking embodied, construction and operational emissions into account, the traditional build emits more CO2 and **timber frame is selected**.

Summary Graph

The below graph compares the two new build lifecycle emission next to the refurbishment scenario also, for perspective:



Lifecycle Analysis New Build Vs Refurb 186 Creighton Avenue

Introduction

The following section analyses the results of the two case studies (refurbishment to Part L and new build Timber frame) in order to directly compare the two scenarios.

Comparative Analysis

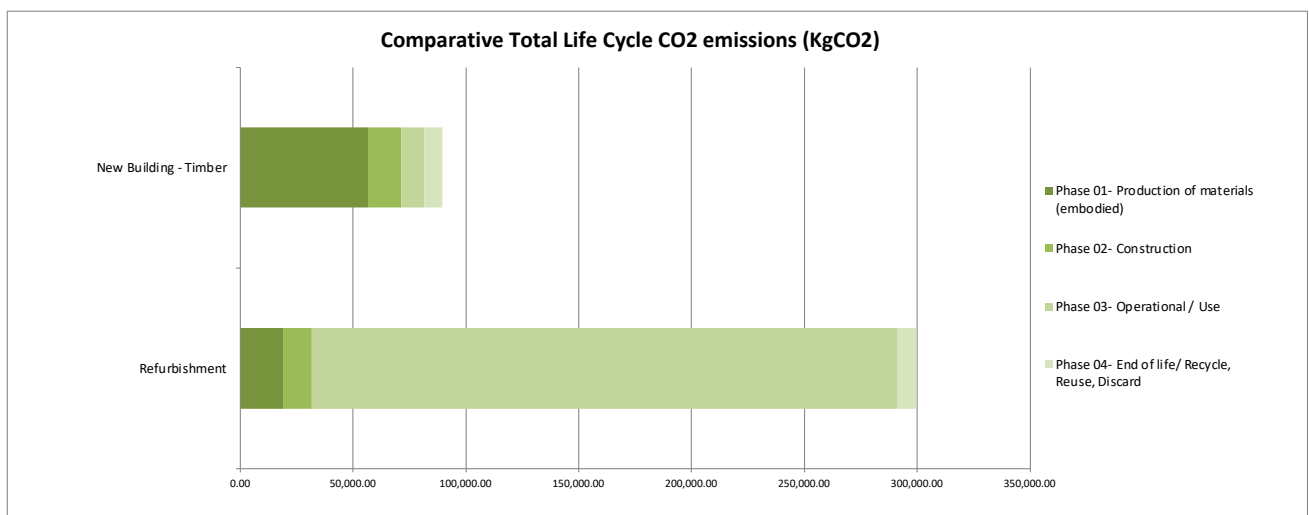
There are numerous observations from the data and can be seen in the chart below:

- The embodied CO₂ emissions are **2.97 times** more in new build scenario 2 than scenario 1, this means **37,568 KgCO₂** more.
- The operational carbon emissions from the refurbishment are **25 times** more than the new build over 50 years, this means **249,509 KgCO₂** more.
- When the KgCO₂ as analysed per m², The new build scenario 2 is over **4 times** as efficient, with **289 kgCO₂ /m²** emissions as appose to the refurbishment which emits **1,202 KgCO₂ /m²**
- Taking embodied, construction and operational emissions into account, the refurbishment scenario 1 emits much **3.3 times more carbon** - which is a difference of the overall carbon emission impact of the two scenarios is **209,862 kgCO₂ over 50 years** more in the refurbishment scenario.
- If analysed beyond 50 years, the savings from new build scheme would continue to grow, and the differences in the two scenarios would continue to favour the new build.

Summary Table

	Scenario 1 - Refurbishment	Scenario 2 - New Build TIMBER
Phase 01- Production of materials	19,061.84	56,629.92
Phase 02- Construction	12,475.20	14,554.40
Phase 03- Operational / Use	259,884.31	10,374.95
Phase 04- End of life/ Recycle, Reuse, Discard	8,079.20	8,079.20
TOTAL	299,500.55	89,638.47

Summary Graph



Conclusion

186 Creighton Avenue

Lifecycle CO₂ Analysis

Key findings

- The new build scenario can be considered much more sustainable from a long-term carbon emission point of view.
 - The current dwelling cannot be easily upgraded to a satisfactory standard for the desired development.
 - The proposed dwelling is of an exemplary standard and will:
 - Save approx. 1,460,000 litres of water over 50 years.
 - Create a more efficient useable space
 - Be healthier and lighter space for people to live.
 - Be more accessible, and;
 - Will last much longer than refurbishment into the future.
 - Scenario 2 is inline with London plan targets on carbon emissions, notably over 35% beyond Part L building regulations CO₂ levels.
 - The proposed development goes **91.7%** beyond building regulations and can be considered an outstanding low carbon and low impact building (see energy strategy assessment for further details).
 - Overall carbon emissions lower in the new build scenario when analysed over 50 years. If looked at further in the future this carbon saving of Scenario 2 would continue to increase dramatically.
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Appendix 1 CO₂

Emission calculations

186 Creighton Avenue

Area							
Ground Floor	97.78	m2					
Exterior Walls	199.67	m2					
Interior Walls	59.90	m2					
Roof	102.73	m2					
Exterior Door	5.60	m2					
Interior Doors	11.98	m2					
Windows Glass area	47.54	m2					
Windows Frame area	5.70	m2					
Scenario 1 - Refurbishment							
Phase 01- Production of Materials / Embodied							
Components	Material	Area (m2)	Depth (m)	Weight factor (kg/m3)	Total Weight (kg)	Carbon Factor kgCO2/Kg	KgCO2
Ground Floor							
Insulation	Polyurethane	97.78	0.100	30.00	293.34	4.26	1,249.63
Concrete slab	General Concrete	97.78	0.200	2,000.00	39,112.00	0.11	4,302.32
Exterior Wall							
Insulation	Polyurethane	199.67	0.100	30.00	599.01	4.26	2,551.78
Finishes	Plasterboard	199.67	0.012	950.00	2,276.24	0.38	864.97
Interior Wall							
Insulation	Polyurethane	59.90	0.100	30.00	179.70	4.26	765.53
Finishes	Plasterboard	59.90	0.012	950.00	682.87	0.38	259.49
Roof							
Insulation	Rockwool	102.73	0.250	100.00	2,568.25	1.12	2,876.44
Finishes	Plasterboard	102.73	0.012	950.00	1,171.12	0.38	445.03
Doors							
All Doors	General Timber	17.58	0.050	480.00	421.92	0.41	172.99
Windows							
Windows Double glazed (4+4/8/8 mm)	Timber frames	5.70	0.080	480.00	219.06	0.41	89.82
	Glass	47.54	0.016	2,500.00	1,901.60	1.27	2,415.03
TOTAL EMBODIED CO2 EMISSIONS					49,425.12		15,993.03

Phase 02- Construction					
Construction Side works time					
Time	6.00	Months			
Carbon Factor per months	2,000.00	KgCO2/Per months			
TOTAL	12,000.00	kgCO2			
Site Travel					
Assume average travel distance per day	15.00	Km			
Amount of Vans per day (4 staff per van)	5.00	Und			
Transportation emissions Van (4 staff per van)	0.24	KgCO2/Km			
Day per months on site	22.00	Days			
Time of construction	6.00	Months			
Total of days in site	132.00				
Total of Km per month	1,980.00	Km/Months			
TOTAL EMISSIONS	475.20				
TOTAL EMBODIED CO2 EMISSIONS					
Site works energy	12,000.00	kgCO2			
Staff Travel	475.20	kgCO2			
TOTAL	12,475.20	kgCO2			
	98.31	KgCO2/m2			
Phase 03- Operational / Use					
SAP Results show a DER (dwelling emission rate)	33.34	kgCO2/m2/yr			
Total floor area of proposed	126.90	m2			
Total CO2 emissions	4,230.85	kgCO2			
Over 30 year period	4,230.85	30	126,925.38	kgCO2	
Over 40 year period	4,230.85	40	169,233.84	kgCO2	
Over 50 year period	4,230.85	50	211,542.30	kgCO2	
			1,667.00	kgCO2/m2	
Phase 04- End of life /Recycle, Reuse, Discard					
End of Life works time					
Time	4.00	Months			
Carbon Factor per months	2,000.00	KgCO2/Per months			
TOTAL	8,000.00	kgCO2			
Site Travel					
Assume average travel distance per day	15.00	Km			
Amount of Vans per day (4 staff per van)	5.00	Und			
Transportation emissions Van (4 staff per van)	0.24	KgCO2/Km			
Day per months on site	22.00	Days			
Time of Demo	1.00	Months			
Total of days in site	22.00				
Total of Km per month	330.00	Km/Months			
TOTAL EMISSIONS	79.20				
TOTAL EMBODIED CO2 EMISSIONS					
Site works energy	8,000.00	kgCO2			
Staff Travel	79.20	kgCO2			
TOTAL	8,079.20	kgCO2			
	63.67	kgCO2/m2			

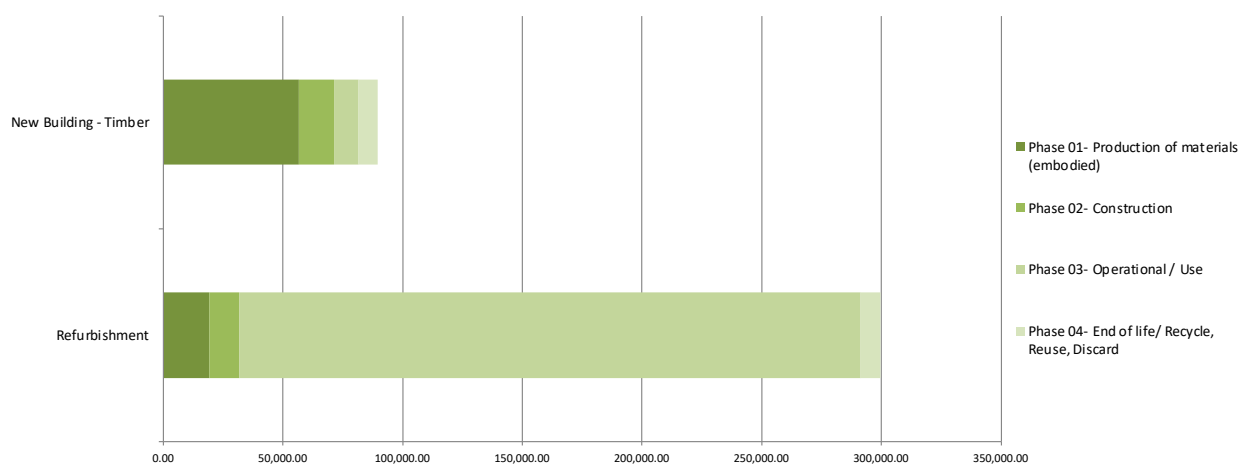
Area							
Wall Perimeter	91.38	m					
Foundations	54.83	m2					
Ground Slab	334.00	m2					
Basement wall mass	13.68	m3					
Timber Structure	210.05	m2					
Floor Area	575.50	m2					
Exterior Walls	424.22	m2					
Interior Walls	169.69	m2					
Exterior Doors	7.00	m2					
Interior Doors	16.97	m2					
Roof	384.52	m2					
Windows Glass area	88.42	m2					
Windows Frame area	8.84	m2					
Scenario 2 - New Building							
Phase 01 - Production of Materials / Embodied							
Components	Material	Area (m2)	Depth (m)	Weight factor	Total Weight (kg)	Carbon Factor	KCO2
Foundation							
Concrete foundation	General concrete	54.83	1.000	2,000.00	109,656.00	0.11	12,062.16
Basement							
Steel Reinforcements (calc m3)	General Steel	13.68	1.000	120.00	1,641.60	1.77	2,905.63
Steel Frame							
Steel Supports	General Steel	7.31	0.100	7,800.00	5,702.11	1.77	10,092.74
Timber Frame							
Timber Frame	General Timber	210.05	0.200	480.00	20,164.61	0.41	8,267.49
Ground Slab							
Concrete slab	General concrete	334.00	0.150	2,000.00	100,200.00	0.11	11,022.00
Hardcore	Stone Gravel	334.00	0.200	1,800.00	120,240.00	0.02	2,044.08
Floors							
Insulation	Cellulose	575.50	0.250	3.30	474.79	0.11	50.33
Timber Floors	General Timber	241.50	0.010	480.00	1,159.20	0.41	475.27
Internal Finish	General Timber	575.50	0.001	480.00	276.24	0.41	113.26
Exterior Wall (non basement)							
Insulation	Cellulose	424.22	0.200	3.30	279.99	0.11	29.68
Timber Boarding	OSB	424.22	0.003	480.00	610.88	0.41	250.46
External finish	Render	103.00	0.010	1,900.00	1,957.00	0.21	416.84
External finish	Aluminium (recycled)	164.00	0.007	2,700.00	3,099.60	1.81	5,610.28
External finish	Copper (recycled)	49.00	0.006	8,600.00	2,528.40	2.71	6,851.96
External finish	Bamboo	297.00	0.020	480.00	2,851.20	0.41	1,168.99
External finish	Limestone	94.00	0.015	1,900.00	2,679.00	0.78	2,089.62
Internal finish	Plasterboard	424.22	0.012	950.00	4,836.11	0.38	1,837.72
Interior Wall							
Insulation	Cellulose	169.69	0.080	3.30	44.80	0.11	4.75
Internal finish	Plasterboard	169.69	0.024	950.00	3,868.89	0.38	1,470.18
Doors							
All Doors	General Timber	23.97	0.050	480.00	575.25	0.41	235.85
Roof							
Insulation	Cellulose	309.52	0.300	3.30	306.42	0.11	32.48
Timber roof	General Timber	59.52	0.080	480.00	2,285.57	0.41	937.08
Green Roof	Concrete + soil	250.00	0.200	2,000.00	100,000.00	0.11	11,000.00
Membrane	Plastic	309.52	0.003	1,470.00	1,364.98	3.13	4,272.40
EPDM	Rubber	59.52	0.003	1,500.00	267.84	2.85	763.34
Pool							
Steel Reinforcements (calc m3)	Steel	10.00	1.000	110.00	1,100.00	1.77	1,947.00
Insulation	Polyurethane insulation	58.50	0.100	30.00	175.50	4.26	747.63
Concrete	Concrete	58.50	0.200	2,000.00	23,400.00	0.11	2,574.00
Windows							
Windows Triple glazed (4+4+4/8/5 mm)	Frames	8.84	0.080	480.00	339.53	0.46	156.19
	glass	230.39	0.024	2,500.00	13,823.40	1.27	17,555.72
TOTAL EMBODIED CO2 EMISSIONS					525,908.90		106,985.13

Phase 02 - Construction					
Construction - Site works (demolition, power, deliveries and associated works)					
Time	6.00	Months			
Carbon Factor per months	2,000.00	KgCO2/Per months			
TOTAL	12,000.00	kgCO2			
Site Travel					
Assume average travel distance per	15.00	Km			
Amount of Vans per day (4 staff per van)	5.00	Und			
Transportation emissions Van (4 staff per van)	0.24	KgCO2/Km			
Day per months on site	22.00	Days			
Time of construction	6.00	Months			
Total of days in site	132.00				
Total of Km per month	1,980.00	Km/Months			
TOTAL EMISSIONS	475.20				
TOTAL EMBODIED CO2 EMISSIONS					
Site works energy	12,000.00	kgCO2			
Staff Travel	475.20	kgCO2			
TOTAL	12,475.20	kgCO2			
	21.68	KgCO2/m2			
Phase 03 - Operational / Use					
SAP Results show a DER (dwelling e	3.28	kgCO2/m2/yr			
Total floor area of proposed	575.50	m2			
Total CO2 emissions	1,887.64	kgCO2			
Over 30 year period	1,887.64	30	56,629.20	kgCO2	
Over 40 year period	1,887.64	40	75,505.60	kgCO2	
Over 50 year period	1,887.64	50	94,382.00	kgCO2	
			164.00	kgCO2/m2	
Phase 04- End of life / Recycle, Reuse, Discard					
End of Life works time					
Time	4.00	Months			
Carbon Factor per months	2,000.00	KgCO2/Per months			
TOTAL	8,000.00	kgCO2			
Site Travel					
Assume average travel distance per	15.00	Km			
Amount of Vans per day (4 staff per van)	5.00	Und			
Transportation emissions Van (4 staff per van)	0.24	KgCO2/Km			
Day per months on site	22.00	Days			
Time of Demo	1.00	Months			
Total of days in site	22.00				
Total of Km per month	330.00	Km/Months			
TOTAL EMISSIONS	79.20				
TOTAL EMBODIED CO2 EMISSIONS					
Site works energy	8,000.00	kgCO2			
Staff Travel	79.20	kgCO2			
TOTAL	8,079.20	kgCO2			
	14.04	KgCO2/m2			

COMPARE TOTAL LIFE CYCLE CO2 EMISSIONS

	Refurbishment	New Building - Timber
Phase 01- Production of materials (embodied)	19,061.84	56,629.92
Phase 02- Construction	12,475.20	14,554.40
Phase 03- Operational / Use	259,884.31	10,374.95
Phase 04- End of life/ Recycle, Reuse, Discard	8,079.20	8,079.20
TOTAL	299,500.55	89,638.47

Comparative Total Life Cycle CO2 emissions (KgCO2)



	Scenario 1 - Refurbishment	Scenario 2 - New Building
Phase 01- Production of materials	76.50	182.85
Phase 02- Construction	50.07	47.00
Phase 03- Operational / Use	1,043.00	33.50
Phase 04- End of life/ Recycle, Reuse, Discard	32.42	26.09
TOTAL	1,201.99	289.44

Comparative Total Life Cycle CO2 emissions (KgCO2/m2)

