







Achieving Net Zero Carbon in Our Existing Housing Stock



### **Document Control**

Revision	Description	Originator	Approved	Date
A00	Submission to Cambridge City Council	Feilden+Mawson LLP	JE	28/05/2021
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Feilden+Mawson Achieving Net Zero Carbon in Our Existing Housing Stock May 2021



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### **Executive Summary**

This document has been prepared by Feilden+Mawson (F+M), to provide a high-level cost estimate to facilitate Cambridge City Council's (CCC) housing stock achieving net zero carbon (in use<sup>1</sup>). Working in collaboration with Enhabit and Richard Utting Associates, this high-level review has been accomplished by looking at the cost of common property 'archetypes' within the housing stock. 3 levels of intervention have been investigated for each archetype and compared with CCC's current planned works programme to provide an indicative cost uplift to achieve those increased levels of efficiency / carbon reduction, namely: CCC Retrofit Plus, EnerPHit (the Passivhaus retrofit standard) and Net Zero Carbon.

Detailed cost information and associated energy credentials for each archetype and their respective intervention level are summarised and can be found in the Archetypes section of this report, with supporting data in Appendix C. The Qualifications section lists out all assumptions and caveats given the high-level nature of this study. Other detailed studies may be conducted in the future to investigate properties in more detail, but this currently sits outside the scope of this report.

Based upon the detail and associated qualifications within this document, please refer to Table 1 adjacent, which gives an indication of how much capital it may cost CCC beyond the current planned works programme 'baseline' to upgrade the entire housing stock, one property at a time. Figures are also included for anticipated total annual maintenance, annual replacement cost and tenant typical energy cost per annum.

Of course, it is recognised that a retrofit programme of work would not be implemented in this way, nor would all properties be completed at the same time. Recognising the difficultly and practicalities of retrofitting CCC's entire housing stock, it is acknowledged that the implementation of works would likely be undertaken in smaller batches, say: 50, 100 or 200 units. Table 2 breaks down the anticipated reduced cost which may apply in retrofitting schemes of these sizes, , applying a 2% saving for 50-unit schemes, 3% for 100 and 5% for 200-unit schemes.

Notwithstanding the large sums of money required to uplift the housing stock to these higher levels of intervention, there are funding streams available to help soften the burden and it is suggested that these are fully investigated prior to rolling out any future pilot and/ or retrofit upgrade projects.

	Capital uplift	Annual Maintenance	Annual Replacement	Tenant Typical Energy Cost <sup>2</sup>
CCC Retrofit Plus	£362.9 M	£1.4 M	£3.53 M	£692.45pa
EnerPHit (Certified)	£504.8 M	£2.8 M	£4.06 M	£525.17pa
Net Zero Carbon	£504.1 M	£2.8 M	£4.19 M	£514.79pa

Cost uplift beyond baseline (£)

Table 1: retrofitting the housing stock one property at a time

#### Cost uplift beyond baseline (£)

	Capital uplift - 50 units	Capital uplift - 100 units	Capital uplift - 200 units
CCC Retrofit Plus	£355.66 M	£352.03 M	£344.77 M
EnerPHit (Certified)	£494.71 M	£489.66 M	£479.56 M
Net Zero Carbon	£494.02 M	£488.98 M	£478.9 M

Table 2: retrofitting the housing stock in batches of 50, 100 or 200

<sup>1</sup> Net Zero carbon in use is based upon a Dwelling Emission Rate (DER) of Okg/m2/a. This makes no allowance for embodied carbon emissions generated prior to use of a building, which sits outside the scope of this report. For further details, refer to the Qualifications section of this report and Appendix D.

<sup>2</sup> Typical tenant energy cost per annum takes the mean average of the 7no. archetype properties modelled.



#### Scope

#### A. Baseline Modelling

The following 7no. property archetypes have been selected for review, modelling and assessment to achieve 3 roadmap levels of retrofit intervention, namely; CCC Retrofit Plus, EnerPHit and Net Zero Carbon:

**Archetype 1:** 2-bed maisonette. [Example property: 11 Wheaton House, Cambridge CB1 1BS]

**Archetype 2:** 1-bed low-rise flat. [Example property: 155 Ditton Fields, Cambridge CB5 8QH]

**Archetype 3:** 1-bed medium-rise flat. [Example property: Mid-floor type C Flat, Arbury Road, Cambridge CB4 2JB]

**Archetype 4:** 1-bed post war bungalow. [Example property: 83 Ekin Road, Cambridge CB5 8PT]

**Archetype 5:** 2-bed pre-1945 semi. [Example property: 38 Akeman Street, Cambridge CB4 3HG]

**Archetype 6:** 2-bed post-1945 semi. [Example property: 3 Neptune Close, Cambridge CB4 2TP]

**Archetype 7:** 2-bed post-1945 Victorian end terrace. [Example property: 38 Abbey Road, Cambridge CB5 8HQ]

These example properties have been selected on the basis, of a reasonable level of information being available to enable their assessment and modelling thereof, and they represent those units across the housing stock within the broad archetype category. As a minimum, scalable plans have been provided with accompanying photos and/or elevation drawings. Properties have then been modelled utilising SAP 8.92, SAP 10.1 (Beta version<sup>3</sup>) and the Passivhaus Planning Package (PHPP) to provide a baseline, derived from unit makeup, construction type, building age and available EPC records.

#### B. Energy / Carbon Reduction

A number of solutions have been considered for retrofitting the archetypes towards attaining the targeted levels of intervention which includes: Air Source Heat Pumps (ASHP), District ASHP, Photovoltaics (PV), differing insulation / fabric performances including airtightness review and thermal bridging reduction, all whilst avoiding decanting of tenants wherever possible.

In targeting the differing levels of intervention, each, is measured against the Decent Homes Standard, which is the level to which CCC is currently retrofitting properties. The aforementioned modelling software is utilised to ensure consistency and comparison in this regard and by measuring in this way, it provides a clear 'uplift' comparator from those costs currently being expended in CCC's current planned works programme.

Such costs cover capital expenditure, annual maintenance, annual replacement cost and typical energy cost to tenants to ensure that the 'real cost' of upgrade can be considered holistically.

<sup>3</sup> it should be noted that the SAP 10 Beta version software has been utilised in the absence of the official software being released at the time of compiling this report. This software update is expected to be released in the latter part of 2021.



Archetypes



# Archetype 1 - 28 maisonette 66m<sup>2</sup>

### Non-Decant

Based on modelling of 11 Wheaton House



## CCC Retrofit Plus

Dwelling Emission Rate in kgCO2/m2/a = 22.7

Capital Cost Uplift beyond base = 526.69%

Typical annual maintenance cost = £210/a

Typical annual replacement cost = £530/a

Resident typical annual energy cost = £648.80/a

Carbon reduction Part L 2013 = 23.60%

Carbon reduction SAP 10.1 = -90.60%

SAP rating = 82B

Decenthomes
Carbon reduction Part L 2013 = -126.7%
Carbon reduction SAP 10.1 = -1025.17%

SAP rating = 78C Dwelling Emission Rate in kgCO2/m2/a = 26.74 Capital Cost Uplift beyond base = n/aTypical annual maintenance cost = £110/a Typical annual replacement cost = £375/a

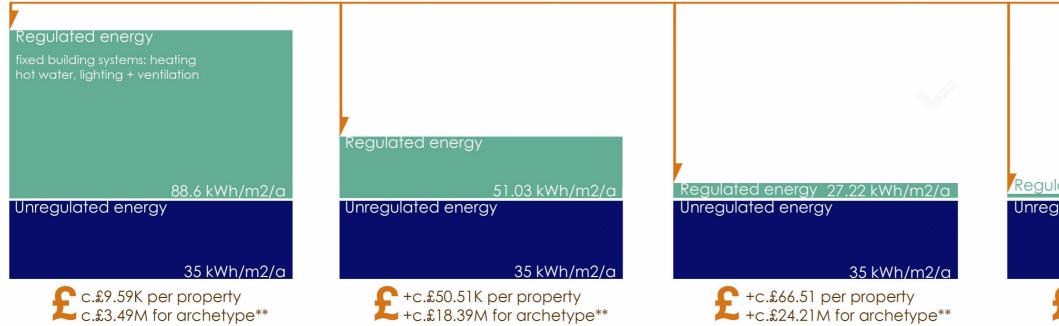
Resident typical annual energy cost = £772.82/a

EnerPHit

	Carbon reduction SAP 10.1 = 112.41%
	SAP rating = 100A
Dv	Dwelling Emission Rate in kgCO2/m2/a = -2.1
	Capital Cost Uplift beyond base = 693.53%
1	Typical annual maintenance cost = <b>£460/a</b>
	Typical annual replacement cost = £610/a
Reside	Resident typical annual energy cost = <b>£530.94/a</b>

Carbon reduction Part L 2013 = 99%

Decent Homes baseline measure entails triple glazing and gas boiler replacement for heating and hot water only



\*\* For multiple properties in a retrofit scheme, please refer to the Executive Summary section for an indication of possible cost savings TBC through detailed proposals as part of any scheme going forward

### 364 units across housing stock in broad category

VIItra-high levels of fabric performance Heat pumps for heating + hot water Solar Technology for energy generation Mechanical Ventilation w. Heat Recovery

# Net Zero Carbon

Carbon reduction Part L 2013 = 66.2% Carbon reduction SAP 10.1 = 99.59% SAP rating = **95A** welling Emission Rate in kgCO2/m2/a = 0.06Capital Cost Uplift beyond base = 636.18% Typical annual maintenance cost = £460/a Typical annual replacement cost = £490/a dent typical annual energy cost = £669.84/a Net Zero Carbon is based upon a Dwelling Emission Rate (DER) in SAP10.1 of 0kg CO2/m2/a\*

### Regulated energy 43.05 kWh/m2/a Unregulated energy

### 35 kWh/m2/a

+c.£61.01K per property  $\mathbf{L}$  +c.£22.21M for archetype\*\*

# Archetype 2 - 1B low rise flat 49m<sup>2</sup>

### Non-Decant

Based on modelling of 155 Ditton Fields

Carbon reduction Part L 2013 = -102%

Carbon reduction SAP 10.1 = -230.55%

Capital Cost Uplift beyond base = n/a

Dwelling Emission Rate in kgCO2/m2/a = TBC

Typical annual maintenance cost = £110/a

Typical annual replacement cost = £375/a

Resident typical annual energy cost = £845.28/a

SAP rating = 72C

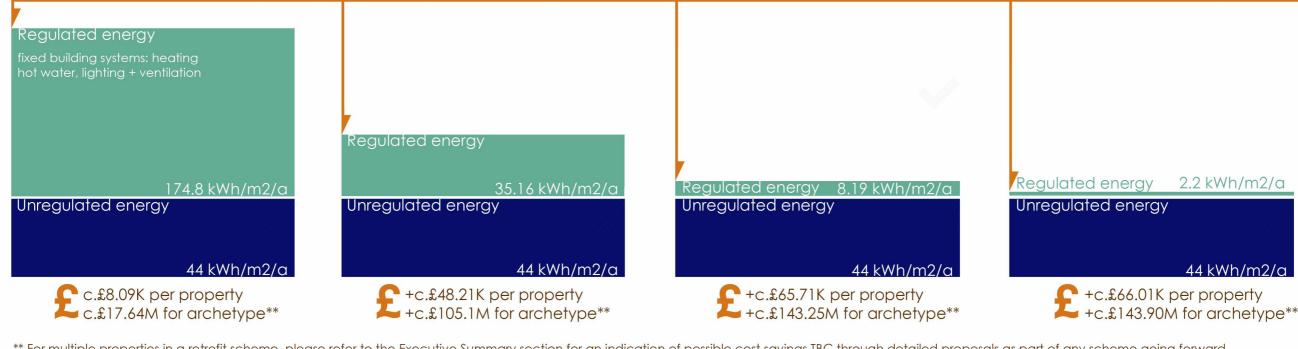


Carbon reduction Part L 20	Carbon reduction Part L 2013 = 32.4%
Carbon reduction SAP 10.	Carbon reduction SAP 10.1 = 59.39%
SAP ro	SAP rating = <b>79C</b>
Dwelling Emission Rate in kgCO2/m	Dwelling Emission Rate in kgCO2/m2/a = <b>5.82</b>
Capital Cost Uplift beyond base	Capital Cost Uplift beyond base = <b>595.92%</b>
Typical annual maintenance cos	Typical annual maintenance cost = <b>£210/a</b>
Typical annual replacement cos	Typical annual replacement cost = £530/a
Resident typical annual energy cost =	esident typical annual energy cost = £613.49/a

Decent Homes baseline measure entails triple glazing and gas boiler replacement for heating and hot water only

Residen

013 = 77.6% Carbon reduction Part L 2013 = 88% .1 = 89.04% Carbon reduction SAP 10.1 = 94.7% rating = 90B SAP rating = 92A Dwelling Emission Rate in kgCO2/m2/a = 0.76n2/a = 1.57 = 812.24% Capital Cost Uplift beyond base = 815.95% ost = £410/a Typical annual maintenance cost = £410/a ost = £610/a Typical annual replacement cost = £640/a £440.58/a Resident typical annual energy cost = £402.26/a Net Zero Carbon is based upon a Dwelling Emission Rate (DER) in SAP10.1 of 0kg CO2/m2/a\*



\*\* For multiple properties in a retrofit scheme, please refer to the Executive Summary section for an indication of possible cost savings TBC through detailed proposals as part of any scheme going forward

### 2180 units across housing stock in broad category

VIItra-high levels of fabric performance Heat pumps for heating + hot water Solar Technology for energy generation Mechanical Ventilation w. Heat Recovery

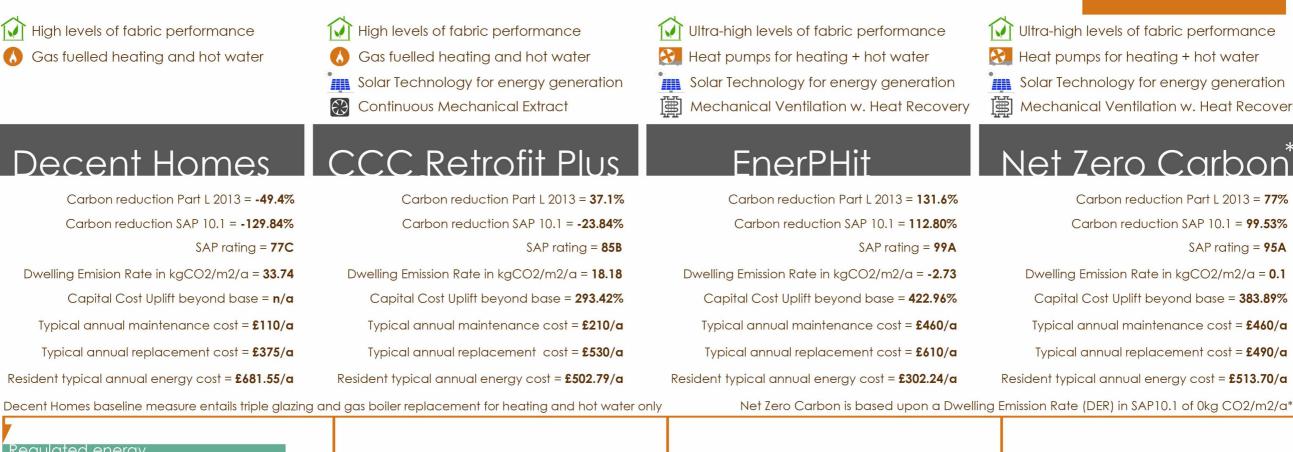
# Net Zero Carbon

# Archetype 3 - 1B medium rise flat 50m<sup>2</sup>

Based on modelling of mid-floor type C flat, Arbury Road

1

### Non-Decant





\*\* For multiple properties in a retrofit scheme, please refer to the Executive Summary section for an indication of possible cost savings TBC through detailed proposals as part of any scheme going forward

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### 1030 units across housing stock in broad category

VIItra-high levels of fabric performance Heat pumps for heating + hot water Solar Technology for energy generation Mechanical Ventilation w. Heat Recovery

# Net Zero Carbon

Carbon reduction Part L 2013 = 77% Carbon reduction SAP 10.1 = 99.53% SAP rating = **95A** Dwelling Emission Rate in kgCO2/m2/a = 0.1Capital Cost Uplift beyond base = 383.89% Typical annual maintenance cost = £460/a Typical annual replacement cost = £490/a Resident typical annual energy cost = £513.70/a

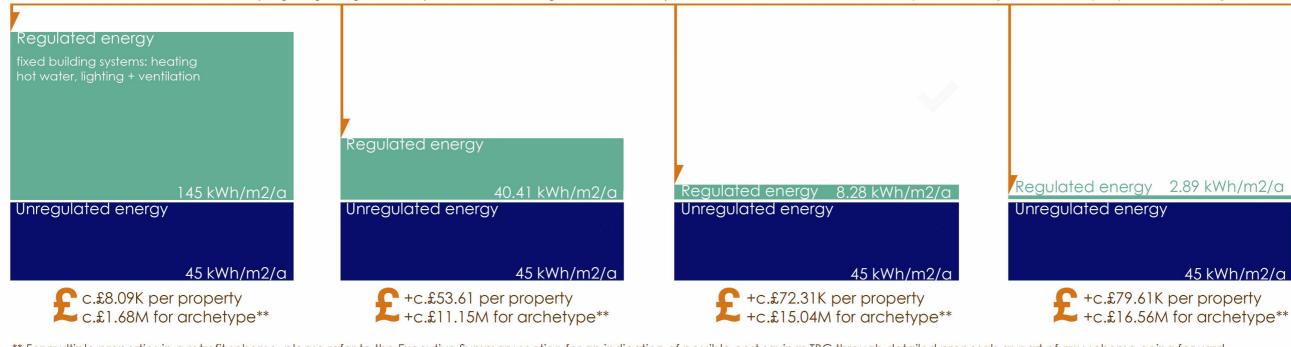
## Regulated energy 38.85 kWh/m2/a Unregulated energy 34 kWh/m2/a

+c.£56.01K per property L +c.£57.69M for archetype\*\*

# Archetype 4 - 18 post war bungalow 43m<sup>2</sup>

Non-Decant

Ultra-high lev	🚺 Ultra-high levels of fabric performance	High levels of fabric performance	High levels of fabric performance
🚷 Heat pumps	没 Heat pumps for heating + hot water	🚷 Heat pumps for heating + hot water	💧 Gas fuelled heating and hot water
Solar Techno	Solar Technology for energy generation	Solar Technology for energy generation	
Mechanical	Mechanical Ventilation w. Heat Recovery	Continuous Mechanical Extract	
Net Ze	EnerPHit	CCC Retrofit Plus	Decent Homes
Carbo	Carbon reduction Part L 2013 = 80.6%	Carbon reduction Part L 2013 = <b>33.7%</b>	Carbon reduction Part L 2013 = -52.1%
Carbo	Carbon reduction SAP 10.1 = 86.32%	Carbon reduction SAP 10.1 = <b>42.97%</b>	Carbon reduction SAP 10.1 = -210.67%
	SAP rating = <b>90B</b>	SAP rating = <b>76C</b>	SAP rating = <b>73C</b>
Dwelling Emiss	Dwelling Emission Rate in kgCO2/m2/a = 1.67	Dwelling Emission Rate in kgCO2/m2/a = 7.38	Dwelling Emission Rate in kgCO2/m2/a = <b>40.76</b>
Capital Cos	Capital Cost Uplift beyond base = 893.82%	Capital Cost Uplift beyond base = <b>662.67%</b>	Capital Cost Uplift beyond base = <b>n/a</b>
Typical annu	Typical annual maintenance cost = <b>£410/a</b>	Typical annual maintenance cost = <b>£210/a</b>	Typical annual maintenance cost = £110/a
Typical ann	Typical annual replacement cost = £610/a	Typical annual replacement cost = £530/a	Typical annual replacement cost = <b>£375/a</b>
Dwelling typical o	Dwelling typical annual energy cost = £356.58/a	Dwelling typical annual energy cost = £576.69/a	Resident typical annual energy cost = £722.96/a
lling Emission Rate (DE	Net Zero Carbon is based upon a Dwe	ng and gas boiler replacement for heating and hot water only	Decent Homes baseline measure entails triple glazir



\*\* For multiple properties in a retrofit scheme, please refer to the Executive Summary section for an indication of possible cost savings TBC through detailed proposals as part of any scheme going forward

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208 units across housing stock in broad category

evels of fabric performance os for heating + hot water nology for energy generation al Ventilation w. Heat Recovery

# ero Carbon

oon reduction Part L 2013 = 88.4% rbon reduction SAP 10.1 = 92.81% SAP rating = 91B ission Rate in kgCO2/m2/a = 0.92 ost Uplift beyond base = 984.05% nual maintenance cost = £410/a nnual replacement cost = £830/a al annual energy cost = £364.62/a DER) in SAP10.1 of 0kg CO2/m2/a\*

# Archetype 5 - 28 pre-1945 semi 106m<sup>2</sup>

Based on modelling of 38 Akeman Street

### Non-Decant

High levels of fabric performance	High levels of fabric performance	Ultra-high levels of fabric performance	Ultra-high
💧 Gas fuelled heating and hot water	🚱 Heat pumps for heating + hot water	没 Heat pumps for heating + hot water	🚷 Heat pum
	Solar Technology for energy generation	Solar Technology for energy generation	Solar Tecl
	Continuous Mechanical Extract	Mechanical Ventilation w. Heat Recovery	Mechania
Decent Homes	CCC Retrofit Plus	EnerPHit	Net 7
Carbon reduction Part L 2013 = <b>-77.2%</b>	Carbon reduction Part L 2013 = 44.1%	Carbon reduction Part L 2013 = 66%	Ca
Carbon reduction SAP 10.1 = <b>-252.66%</b>	Carbon reduction SAP 10.1 = 53.21%	Carbon reduction SAP 10.1 = 80%	Co
SAP rating = <b>68D</b>	SAP rating = 77C	SAP rating = <b>88B</b>	
Dwelling Emission Rate in kgCO2/m2/a = <b>41.12</b>	Dwelling Emission Rate in kgCO2/m2/a = <b>5.24</b>	Dwelling Emission Rate in kgCO2/m2/a = 2.24	Dwelling Er
Capital Cost Uplift beyond base = <b>n/a</b>	Capital Cost Uplift beyond base = <b>548.13%</b>	Capital Cost Uplift beyond base = 775.30%	Capital (
Typical annual maintenance cost = £110/a	Typical annual maintenance cost = £210/a	Typical annual maintenance cost = <b>£410/a</b>	Typical c
Typical annual replacement cost = £375/a	Typical annual replacement cost = £530/a	Typical annual replacement cost = £610/a	Typical o
Resident typical annual energy cost = £1164.42/a	Resident typical annual energy cost = £880.90/a	Resident typical annual energy cost = £751.83/a	Resident typic
Decent Homes baseline measure entails triple glazing	g and gas boiler replacement for heating and hot water only	Net Zero Carbon is based upon a Dwelli	ng Emission Rate

Decent Homes base Regulated energy Regulated energy 34.59 kWh/m2/a 131.93 kWh/m2/a Regulated energy 8.28 kWh/m2/a Unregulated energy Unregulated energy Unregulated energy 31 kWh/m2/a 31 kWh/m2/a 31 kWh/m2/a £ +c.£97.61K per property +c.£96.63M for archetype\*\* +c.£69.01K per property C c.£12.59K per property +c.£68.32M for archetype\*\* L c.£12.46M for archetype\*\*

\*\* For multiple properties in a retrofit scheme, please refer to the Executive Summary section for an indication of possible cost savings TBC through detailed proposals as part of any scheme going forward

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990 units across housing stock in broad category

gh levels of fabric performance Imps for heating + hot water chnology for energy generation nical Ventilation w. Heat Recovery

# Zero Carbon

Carbon reduction Part L 2013 = 93.2% Carbon reduction SAP 10.1 = 94.11% SAP rating = 92A Emission Rate in kgCO2/m2/a = 0.66al Cost Uplift beyond base = 801.51% annual maintenance cost = £410/a al annual replacement cost = £720/a bical annual energy cost = £611.12/a e (DER) in SAP10.1 of 0kg CO2/m2/a\*



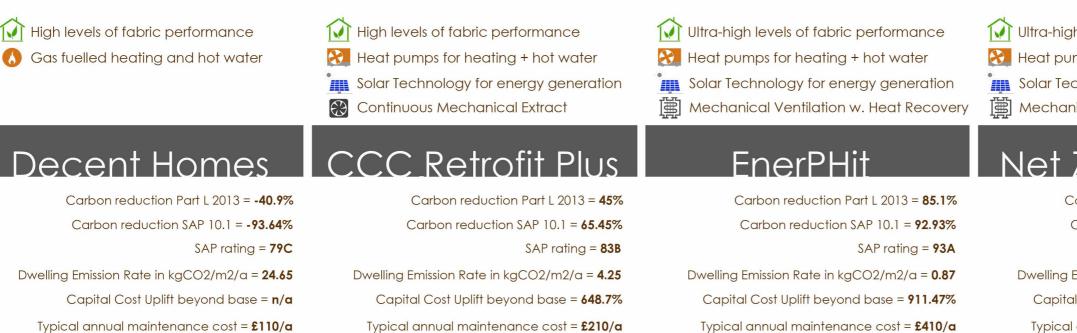
# Archetype 6 - 2B post-1945 semi 65m<sup>2</sup>

### Non-Decant

Based on modelling of 3 Neptune Close

Typical annual replacement cost = £375/a

Resident typical annual energy cost = £781.01/a

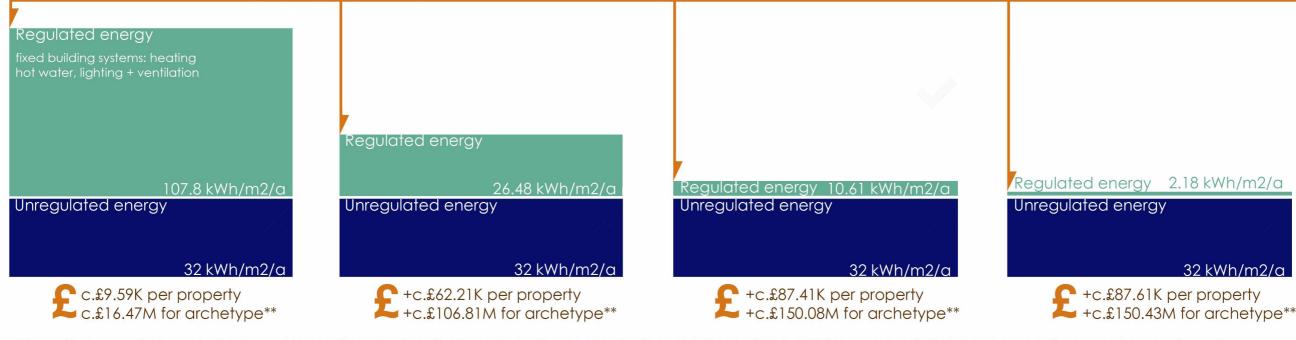


Typical annual replacement cost = £530/a

Resident typical annual energy cost = £599.92/a

Decent Homes baseline measure entails triple glazing and gas boiler replacement for heating and hot water only

Carbon reduction Part L 2013 = 89.2% Carbon reduction SAP 10.1 = 94.72% SAP rating = 94A Dwelling Emission Rate in kgCO2/m2/a = 0.65 Capital Cost Uplift beyond base = 913.56% Typical annual maintenance cost = £410/a Typical annual replacement cost = £610/a Typical annual replacement cost = £640/a Resident typical annual energy cost = £419.59/a Resident typical annual energy cost = £393.07/a Net Zero Carbon is based upon a Dwelling Emission Rate (DER) in SAP10.1 of 0kg CO2/m2/a\*



\*\* For multiple properties in a retrofit scheme, please refer to the Executive Summary section for an indication of possible cost savings TBC through detailed proposals as part of any scheme going forward

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### 1717 units across housing stock in broad category

VIItra-high levels of fabric performance Heat pumps for heating + hot water Solar Technology for energy generation Mechanical Ventilation w. Heat Recovery

# Net Zero Carbon

# Archetype 7 - 2B post-1945 Victorian e.t.

Based on modelling of 38 Abbey Road

1

# 126m<sup>2</sup>

\*\*\*Decant

High levels of fabric performance High levels of fabric performance Ultra-high levels of fabric performance  $\bigcirc$ 🚷 Heat pumps for heating + hot water Gas fuelled heating and hot water Heat pumps for heating + hot water Solar Technology for energy generation Solar Technology for energy generation Ē  $\mathfrak{G}\mathfrak{I}$ Continuous Mechanical Extract Mechanical Ventilation w. Heat Recovery Decent Homes CCC Retrofit Plus EnerPHit Carbon reduction Part L 2013 = -79.5% Carbon reduction Part L 2013 = 39.9% Carbon reduction Part L 2013 = 59.6% Carbon reduction SAP 10.1 = -230.53% Carbon reduction SAP 10.1 = 50.56% Carbon reduction SAP 10.1 = 72.16% SAP rating = 76C SAP rating = 80C SAP rating = 88B Dwelling Emission Rate in kgCO2/m2/a = 26.96 Dwelling Emission Rate in kgCO2/m2/a = 5.24 Dwelling Emission Rate in kgCO2/m2/a = 2.24 Capital Cost Uplift beyond base = n/a Capital Cost Uplift beyond base = 378.41% Capital Cost Uplift beyond base = 503.15% Typical annual maintenance cost = £110/a Typical annual maintenance cost = £210/a Typical annual maintenance cost = £410/a Typical annual replacement cost = £375/a Typical annual replacement cost = £610/a Typical annual replacment cost = £530/aResident typical annual energy cost = £1336.19/a Resident typical annual energy cost = £1024.55/a Resident typical annual energy cost = £874.44/a

Net Zero Carbon is based upon a Dwelling Emission Rate (DER) in SAP10.1 of 0kg CO2/m2/a\* Decent Homes baseline measure entails triple glazing and gas boiler replacement for heating and hot water only Regulated energy Regulated energy 113.1 kWh/m2/a 22.96 kWh/m2/a Regulated energy 10.74 kWh/m2/a Unregulated energy Unregulated energy Unregulated energy 27 kWh/m2/a 27 kWh/m2/a 27 kWh/m2/a +c.£73.41K per property 🜔 +c.£55.21K per property C c.£14.59K per property +c.£12.04M for archetype\*\* +c.£9.05M for archetype\*\* c.£2.39M for archetype\*\*

\*\* For multiple properties in a retrofit scheme, please refer to the Executive Summary section for an indication of possible cost savings TBC through detailed proposals as part of any scheme going forward \*\*\* Due to the requirement to install invasive internal wall insulation (IWI), this property MUST be decanted. Decant costs are included in the above figures as advised by Cambridge City Council

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164 units across housing stock in broad category

Ultra-high levels of fabric performance Heat pumps for heating + hot water Solar Technology for energy generation Mechanical Ventilation w. Heat Recovery

# Net Zero Carbon

Carbon reduction Part L 2013 = 88.9% Carbon reduction SAP 10.1 = 93.63% SAP rating = 92A Dwelling Emision Rate in kgCO2/m2/a = 0.66 Capital Cost Uplift beyond base = 560.73% Typical annual maintenance cost = £410/aTypical annual replacement cost = £780/a Resident typical annual energy cost = £648.95/a



### Qualifications

Given the high-level nature of this study, a number of assumptions and caveats are made in order to qualify the data presented. Should future detailed studies be conducted following this report, such gualifications can be amended accordingly to suit the increased level of detail and those constraints associated with such (a) project(s).

The following has been assumed / allowed for within this study:

#### Archetypes

- Archetypes 1-6 have been developed on the basis of a non-decant solution with works being carried out with tenants remaining in situ.
- Archetype 7 deals with a building type with external facades of merit / ornate detailing, requiring the need to utilise internal wall insulation for thermal / airtightness upgrade. Accordingly, this invasive archetype requires tenant decant to facilitate, costs of which are included within the Archetype sheets, and supported via data in Appendix C.
- Those 521no. properties within CCC's stock, which are of a non-traditional construction (i.e. timber frame, steel frame, Easyform) are excluded from this study.
- An allowance for multiple stock upgrades has been made on the premise that retrofit projects are to be implemented in batches of circa. 200, 100 or 50 units. Accordingly, a % cost reduction factor is applied in this regard and summarised within the Executive Summary of this report, which is supported via data in Appendix C.

#### Levels of intervention

The following headline measures are proposed for each level of intervention beyond the baseline. For full building fabric details and arrangement, please refer to the architectural construction details contained within Appendix A:

- The Decent Homes Standard (DHS) baseline measure allows for the following which CCC is currently implementing in their programme of works:
  - □ Installation of triple-glazed<sup>4</sup> windows / doors [*u-value of 0.12W/m*<sup>2</sup>K] (with trickle vents);
  - Gas combi-boiler replacement;
  - Assumed airtightness of 8m<sup>3</sup>/hr/m<sup>2</sup>@50Pa

- CCC Retrofit Plus includes the following retrofit upgrades beyond DHS:
  - □ 90mm mineral wool EWI with 70mm ground floor XPS perimeter trench insulation installed down to foundation top (mitigating cold bridging)/u-value = 0.22W/ $m^2$ K];
  - Existing roof insulation to remain (as with DHS)  $[u-value = 0.15W/m^2K];$
  - ASHP heating / hot water system (replacing gas), albeit new individual gas boilers are proposed to flats;
  - Continuous mechanical extract ventilation (MEV) system:
  - 1kWp PV array to roof;
- Assumed airtightness of 5m<sup>3</sup>/hr/m<sup>2</sup>@50Pa EnerPHit includes the following retrofit upgrades
- beyond CCC Retrofit Plus: Installation of sand/cement render coat over
  - existing wall substrate (externally) and into door/window reveals to facilitate a robust airtightness layer;
  - □ Increased mineral wool EWI thickness from 90mm to 250mm (to be installed over render coat) and increase in ground floor XPS perimeter trench insulation thickness to  $120 \text{mm} [u - value = 0.15 W/m^2 K];$
  - Increase in mineral wool roof insulation thickness to 500mm [u-value =  $0.09W/m^2K$ ], vertical insulation installation at gables / party walls to mitigate thermal bridging, installation of 200mm PIR insulation to eaves to counteract pinch-point and installation of airtightness membrane suitably taped to trusses and down to face of new external render;
- Communal ASHP heating / hot water system to flats (replacing individual gas boilers) with HIU metering;
- Mechanical Ventilation with Heat Recovery (MVHR) replacing MEV solution in CCC Retrofit Plus:
- □ Increased PV array to roof to 2kWp;
- □ Airtightness of 1m<sup>3</sup>/hr/m<sup>2</sup>@50Pa in accordance with EnerPHit criteria.
- Net Zero Carbon includes the following retrofit upgrades beyond EnerPHit:
  - PV array tailored to achieve net zero carbon (in some instances this, is a lesser amount than that proposed for the lower interventions);

#### Technologies excluded from this study

- PV battery technology has not been included within this study. It is acknowledged that whilst they are a good thing and would certainly give CCC the opportunity to trade energy at council level, in terms of SAP10 software, the use of them does not reduce carbon, albeit there is a benefit to the SAP level and energy cost to the tenant. Furthermore, the current cost of battery technology is prohibitive, with it difficult to justify the payback.
- GSHPs have not been considered within this study. This is generally due to a lack of available space and anticipated services within the ground which will likely contribute to an expense groundworks package. Capital cost would therefore undoubtedly be much higher than with an ASHP installation (and for no real efficiency benefit), plus you're unlikely to recover the capital outlay. Furthermore, GSHPs are more expensive to maintain in use.
- Solar Thermal (for hot water generation) has not been considered within this study. Whilst it is acknowledged that as you reduce your heating load (with higher levels of intervention), heating demand goes down, but domestic hot water demand does not. This would suggest that the installation of solar thermal is a good thing, but such an installation must be undertaken to a high standard to ensure optimum efficiency, plus it is considered more difficult to install in a retrofit scenario (especially where tenants are not decanted). With enhanced levels of maintenance needed and the technology being at odds with available roof space, PV has prevailed in making net zero carbon an attainable level.
- WWHR has been discounted within this study on the basis that much of the housing stock contains either wetrooms, or where showers do feature over baths, they are connected via a flexi-hose to the taps. Furthermore, there is no current benefit within SAP10 to install these.

#### Included

- Annual maintenance costs allow for: □ servicing of gas boilers (in the case of flats under CCC Retrofit), circa £110pa;
  - ASHPs (in the case of all other scenarios), circa £110pa:
  - MVHR (in the case of EnerPHit and Net Zero levels), circa £200pa;

is decarbonised.

□ HIU metering (in the case of flats under communal ASHP heating systems to EnerPHit and Net Zero levels), circa £50 a unit/pa; PV panels (in the case of all interventions beyond the baseline), circa £100pa (based on

2no. cleaning visits per year each at circa 50). An allowance of 5% of project cost, ex VAT is made to cover consultancy fees etc. to achieve the intervention level sought. This allowance includes the following:

□ Airtightness tests (as described in the final bullet point below);

□ PAS2035 Retrofit Coordinator role<sup>5</sup>;

Consultancy fees, namely:

- □ Architect / project manager construction detailing, Building Regulations, Project Management / contract administration and planning submissions (where required);
- Energy consultant SAPs / EPCs, PHPP modelling and thermal bridging (psi) calculations:
- □ QS:

П

EnerPHit certification (EnerPHit level only); Thermographic modelling pre- and post-retrofit across all levels of intervention (as required for quality assurance under PAS2035);

 Post-completion monitoring to measure carbon in use (allowance for equipment and data management).

2no. air tests have been allowed for the CCC Retrofit Plus standard in accordance with PAS2035 recommendations; 3no. air tests have been allowed for the EnerPHit and Net Zero Carbon levels as recommended for all Passivhaus projects;

<sup>4</sup> It is understood that the installation of new triple glazed windows / doors is being implemented under the DHS without necessarily taking the opportunity to consider how external / internal wall insulation may one day be connected. This is deemed a missed opportunity to maximise building performance and minimise future reworks as the housing stock

<sup>5</sup> The PAS2035 Retrofit Coordinator Role is allowed for at c. £1000 per property. This assumes a number of properties will be retrofitted in tandem to achieve a cost at around this level, but larger schemes may bring some savings. Of course, CCC may take the view that they would wish to train up internal personnel with the right experience to assume this role rather than appoint externally?



#### Other exclusions / caveats

- Carbon reduction percentages as noted on the Archetype sheets are measurable against a new build property under current UK Building Regulations. Accordingly, those measures for Decent Homes (and in some cases, CCC Retrofit Plus) present a negative number which simply means that the dwelling falls short of a comparable new build property.
- For archetypes 1 (Wheaton House) and 3 (Arbury Road), we have assumed individual gas boiler replacements for the CCC Retrofit Plus level on the basis of a less-invasive installation. However, communal ASHPs replace existing individual gas boilers for the EnerPHit and Net Zero levels which will be much more disruptive to tenants. In this instance, HIU metering will supplement the installation, costs of which are included within the 'included' heading above and within those summary costs in the Archetype section of this report.
- Flats / maisonettes which form part of a larger building are more difficult to retrofit in isolation and therefore require a "blanket" approach for upgrade. To do so successfully would require Cambridge City Council owning the freehold / all properties. This would facilitate installation of external wall insulation for instance across the facades of all properties. Similarly, the installation of PV arrays on the roof would benefit all properties within the block. In terms of heating systems, a communal / district system may be the most appropriate approach and whilst this currently falls outside the scope of this body of work, it can be investigated as part of any detailed study going forward.
- Existing loft insulation assumed to comprise 300mm of mineral wool across the entire housing stock. This is the basis upon which the CCC Retrofit Plus intervention is measured.
- Where existing external walls feature cavity construction, it is assumed that these cavities are fully filled with a blown insulation (or similar) and this is the basis upon which further thermal insulation is proposed via external or internal application.
- External wall insulation allows for a rendered finish in all cases. If planning dictates a like-for-like brick finish, then a suitable product will need to be identified going forward as part of any pilot or similar scheme.

- All levels of intervention above the baseline includes PV arrays on the roof planes. Whilst there is no real reason within the energy standard for EnerPHit to install PV, this may be necessary to meet the Primary Energy demand under the standard, hence this is included as part of this study.
- PV array size as listed within the Archetypes section of this report assumes that the roof is of sufficient size to accommodate. Available roof area / shapes haven't been interrogated as part of this theoretical study.
- All PV panels have been modelled on a theoretical west-facing roof to give a worst-case scenario. Should orientation of properties as part of any future retrofit project be located on a south or SE/ SW roof plane, this may improve the figures making net zero attainable for less money.
- For flats and maisonettes which form part of a wider residential block, the ability to install PV on the roof assumes that Cambridge City Council owns the Freehold and therefore has the right to install over collective properties.
- Typical annual replacement costs covers the cost of boilers, ASHPs, PVs and MVHR (where relevant) by taking the capital cost and dividing this across the number of years in use, before replacement.
- Centralised mechanical extract ventilation (or cMEV) systems are proposed to CCC Retrofit Plus solutions. This would typically entail a unit to be sited in the loft space (where available) with an exhaust to air via a tile or ridge vent and with extract ductwork to the unit from bathroom and kitchen. The bathroom (which is assumed to be sited on the upper level generally) would entail a simple duct through the ceiling, whilst the route from kitchen (assumed to be on the lower level) would require a duct drop, ideally-sited discretely to the corner of a room (hallway?). This would be suitably boxed in and routed through the wall to the kitchen. This arrangement may not lend itself to every situation but should suffice at this high-level costing stage. The unit could combine with an intelligent trickle vent system in window heads to monitor personnel room usage and would open / close to suit.
- Planning and Building Control costs have not been accounted for.
- Any requirements for tanking / waterproofing solutions due to external raised ground levels has not been considered in this study.

- No allowance has been made for building condition surveys nor the remediation thereof.
- The SAP 10.1 Beta software hasn't been officially released as yet, and hence the energy running costs worksheet is based upon SAP 9.82, but this isn't envisaged to differ greatly when released later in 2021.
- The definition of Net Zero Carbon (in use) for the purposes of this report is based upon a dwelling emission rate (DER) of 0 kgCO<sup>2</sup>/m<sup>2</sup>/a inserted into the SAP software. However, due to metabolic gains in SAP (table 5) being higher, this drives down the heat load, which in turn results in the carbon reduction % appearing less than 100.
- Unregulated energy is defined as plug-in appliances such as kettles and TVs etc plus cooking. It is important to bear in mind that one person living in a 50m<sup>2</sup> flat or in a 500m<sup>2</sup> house will probably use similar amounts of unregulated energy (the same number of cups of tea or hours watching TV), but on a per sq m floor area basis, the flat will have an unregulated energy consumption (kWh/m<sup>2</sup>/a) per sq.m ten times higher than the house. Accordingly, unregulated levels are shown as consistent across all interventions for a given archetype.
- Further to the above, it is assumed that CCC will not replace white goods in properties, hence, no reduction is shown as might be expected for EnerPHit / Net Zero levels. Notwithstanding this, it should be noted that unregulated energy becomes more important as regulated decreases as can be evidenced in the Archetype bar charts. This may require further discussion / consideration by CCC.
- For unregulated energy, we have assumed a cost of 18p per kWh to calculate cost in use. This is added to those regulated energy costs to provide resident typical annual energy costs per archetype.
- It should be noted that smaller properties (with the exception of flats which are measured as one entity), will struggle to reach the EnerPHit standard to certification level; this is particularly true given the non-decant Archetypes (1-6) which results in large heat losses through uninsulated solid ground floors and hence, increased heat demand. Accordingly, decant will be necessary to facilitate the upgrade of such to incorporate insulation and reduce the heat load to acceptable EnerPHit levels. Of course, if certification is not a requirement, then this becomes less of an issue.

 No allowance for a Clerk of Works (CoW) has been made. It is expected that the Retrofit Coordinator for any given project will undertake quality checks in accordance with PAS2035, but for larger schemes, a CoW may be necessary due to the increased scale to ensure quality control is maintained at the required level?

No allowance has been made within this study for difficult junctions as may be required as part of any detailed scheme going forward, such as the likes of narrow passageways preventing / reducing the ability to install EWI.



- The following assumptions also apply:
  - It is assumed that no access issues will be encountered by contractors to any of the dwellings;
  - Individual archetype costs are priced individually as a 'standalone project', with a cost saving % applied for schemes of c.50, 100 & 200;
  - No overlap for concurrent working is allowed for with the exception of scaffolding costs being shared for EWI, triple glazing installation and roof insulation modifications as applicable;
  - 'Normal' market conditions have been assumed with no allowance for the unknown impact of Brexit and/or Covid-19;
  - The baseline cost measure has been benchmarked against the Decent Homes Standard and with that of the work currently being undertaken to 38 Akeman Street. Other Archetypes have been benchmarked against this on a pro-rata basis
- The following exclusions also apply:
  - Demolition of any existing buildings;
  - Asbestos survey and removal;
  - Abnormal ground conditions (such as piling or ground stabilisation);
  - Remediation of contaminated land;
  - Archaeological investigations;
  - Diversion of existing services and drains;
  - Off-site services and drains (including mains extensions or infrastructure upgrades)
  - Site investigations (other than minor trial pits), topographical surveys, arboricultural surveys and/or and other specialist surveys not otherwise listed as included in this document;
  - □ Legal expenses;
  - Finance Charges;
  - Value Added Tax;
  - Any works associated with the requirements of the Party Wall etc Act 1996,
  - Any works outside site boundaries (unless otherwise noted);
  - Any future changes to Building Regulations;
  - Cut and fill exercises, including retaining walls and features to remove excess level changes (if applicable);
  - Removal and replacement of made ground;
  - Interest charges of capital borrowed;
  - Future tender price inflation beyond Q2 of 2021.

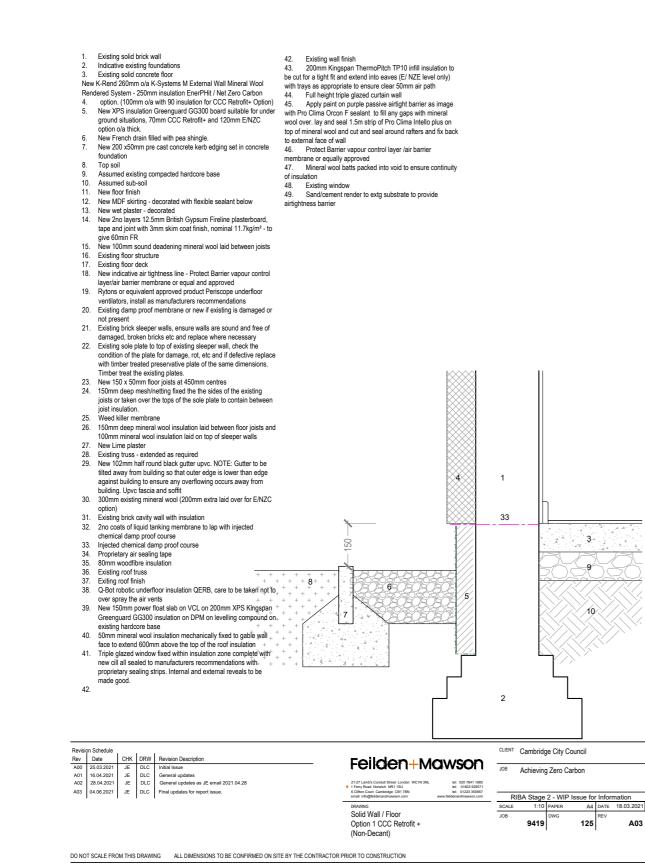
### Considerations for future detail retrofit / pilot schemes

- Condition of properties to be established as part of any future retrofit scheme/s (and remediated as necessary) prior to developing appropriate proposals.
- For flats, it will be necessary to consider plant space for communal ASHP. Furthermore, the location of PV inverters is a consideration as they do not fair particularly well outside of the thermal envelope, hence cold roof spaces are not recommended.
- MVHR distribution (to EnerPHit and Net Zero levels) will be especially important in those properties where tenants are not decanted. It is assumed that such distribution will be achieved via an externally sited installation within an insulated enclosure, with duct runs located 'within' the EWI zone providing supply / extract to / from rooms with minimal disruption to tenants. MVHR distribution to flats may prove more problematic, dependant upon the configuration of the building and the ease (or not) of accessing all rooms from the external envelope.
- It should be noted that for EnerPHit certification particularly, solar orientation of properties could have a marked effect on the heating demand over the course of a given year, so it is expected that there will be variances in this regard.
- For all properties, PV array sizing will need to be reviewed against available roof space, making allowance for orientation, shading objects, rooftop obstructions (i.e. chimneys), hipped /valley and intersecting roof arrangements. Accordingly, the amount of actual PV may vary on a dwelling-bydwelling or building-by-building basis making some properties more difficult to achieve the higher levels of intervention than others.



Appendix A - Indicative Architectural Construction details





Indicative existing foundations Existing solid concrete floor New K-Rend 260mm o/a K-Systems M External Wall Mineral Wool Rendered System - 250mm insulation EnerPHit / Net Zero Carbon 4. option. (100mm o/a with 90 insulation for CCC Retrofit+ Option)

### New XPS insulation Greenguard GG300 board suitable for unde ground situations, 70mm CCC Retrofit+ and 120mm E/NZC

- option o/a thick. New French drain filled with pea shingle. New 200 x50mm pre cast concrete kerb edging set in concrete
  - foundation
  - Top soil Assumed existing compacted hardcore base
- Assumed sub-soil

11.

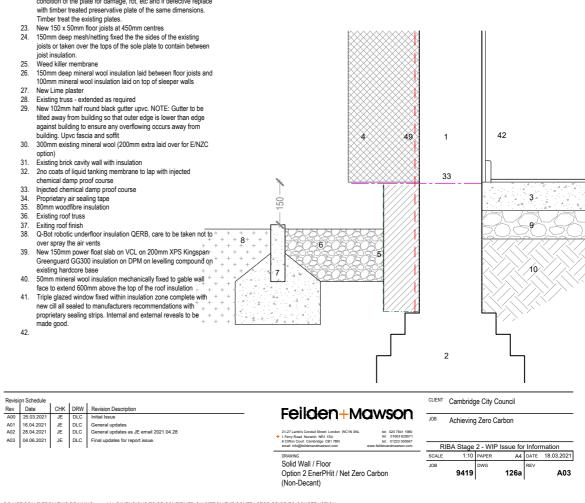
Existing solid brick wall

- New floor finish
- New MDF skirting decorated with flexible sealant below New wet plaster decorated New 2no layers 12.5mm British Gypsum Fireline plasterboard, 12
- 14
- tape and joint with 3mm skim coat finish, nominal 11.7kg/m<sup>2</sup> to give 60min FR New 100mm sound deadening mineral wool laid between joists
- 15. Existing floor structure
- Existing floor deck
- 18. New indicative air tightness line - Protect Barrier vapour control
- layer/air barrier membrane or equal and approved 19. Rytons or equivalent approved product Periscope underfloor
- ventilators, install as manufacturers recommendations 20. Existing damp proof membrane or new if existing is damaged or
- 21. Existing brick sleeper walls, ensure walls are sound and free of
- damaged, broken bricks etc and replace where necessary
- Existing sole plate to top of existing sleeper wall, check the condition of the plate for damage, rot, etc and if defective replace
- , ioist insulation.

- tilted away from building so that outer edge is lower than edge

- new cill all sealed to manufacturers recommendations with proprietary sealing strips. Internal and external reveals to be

A03



Feilden+Mawson Achieving Net Zero Carbon in Our Existing Housing Stock May 2021

DO NOT SCALE FROM THIS DRAWING ALL DIMENSIONS TO BE CONFIRMED ON SITE BY THE CONTRACTOR PRIOR TO CONSTRUCTION

200mm Kingspan ThermoPitch TP10 infill insulation to be cut for a tight fit and extend into eaves (E/ NZE level only) with trays as appropriate to ensure clear 50mm air path

Existing wall finish

to external face of wall

48. Existing window

of insulation

membrane or equally approved

42.

43.

 44. Full height triple glazed curtain wall
 45. Apply paint on purple passive airtight barrier as image
 with Pro Clima Orcon F sealant to fill any gaps with mineral wool over, lav and seal 1.5m strip of Pro Clima Intello plus on top of mineral wool and cut and seal around rafters and fix back

46. Protect Barrier vapour control layer /air barrier

47. Mineral wool batts packed into void to ensure continuity

49. Sand/cement render to extg substrate to provide airtightness barrier

2. 3. New H Rende 4. 5.	Indicative Existing so K-Rend 26 ered Syste option. (1 New XPS	olid cond Omm o/a em - 250r 00mm o insulatio uations,	found rete fl K-Sy nm in /a with n Gre		Existing wall finish     Existing wall finish     200mm Kingspan ThermoPitch TP10 infill insulation to     be cut for a tight fit and extend into eaves (E/ NZE level only)     with trays as appropriate to ensure clear 50mm air path     Full height triple glazed curtain wall     Apply paint on purple passive airtight barrier as image     with Pro Clima Orcon F sealant to fill any gaps with mineral     wool over. Iay and seal 1.5m strip of Pro Clima Intello plus on	28
6. 7.	New Fren New 200 >	ch drain k50mm p		vith pea shingle. st concrete kerb edging set in concrete	top of mineral wool and cut and seal around rafters and fix back to external face of wall 46. Protect Barrier vapour control layer /air barrier	
	foundation Top soil	1			membrane or equally approved	
9.	Assumed		comp	acted hardcore base	47. Mineral wool batts packed into void to ensure continuity	
	Assumed				48. Existing window	
	New floor		door	rated with flexible sealant below	49. Sand/cement render to extg substrate to provide	
	New wet p				airtightness barrier	
14.	New 2no l tape and j	ayers 12 oint with	.5mm	British Gypsum Fireline plasterboard, skim coat finish, nominal 11.7kg/m² - to		1
	give 60mii		eab h	dening mineral wool laid between joists		
	Existing flo					
	Existing flo					
				ess line - Protect Barrier vapour control		
19.	Rytons or	equivale	nt app	ne or equal and approved proved product Periscope underfloor nufacturers recommendations	[	
20.	Existing da not preser	amp pro nt	of mer	nbrane or new if existing is damaged or		
				ells, ensure walls are sound and free of etc and replace where necessary		
2.	Existing so condition of	ole plate of the pla	to top ate for	of existing sleeper wall, check the damage, rot, etc and if defective replace ervative plate of the same dimensions.		
	Timber tre	eat the ex	isting	plates.		
24.	150mm de	ep mesl	n/netti	pists at 450mm centres ng fixed the the sides of the existing ops of the sole plate to contain between		
	joist insula					
	Weed kille					
		ineral wo		ol insulation laid between floor joists and ulation laid on top of sleeper walls		
			endec	as required		
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30.	building. L 300mm ex option)			wool (200mm extra laid over for E/NZC		
				with insulation		
				ng membrane to lap with injected		
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	80mm wo		nsulati	on		
	Existing ro					
	Exiting roo Q-Bot rob		rfloor	insulation QERB, care to be taken not to		
	over spray					
9.	New 150m	nm powe	r float	slab on VCL on 200mm XPS Kingspan		4
				lation on DPM on levelling compound on		
	existing ha 50mm mir			lation mechanically fixed to gable wall		
J.				bove the top of the roof insulation		
	Triple glaz new cill all	zed wind I sealed	ow fix to mai	ed within insulation zone complete with nufacturers recommendations with . Internal and external reveals to be		
	made goo		suipe			100000
2.	0					
vision	Schedule					CLIENT Cambridge City Council
v	Date	СНК [		Revision Description	Feilden+Mawson	
	25.03.2021 16.04.2021		DLC	Initial Issue General updates		JOB Achieving Zero Carbon
· •	16.04.2021 28.04.2021			General updates General updates as JE email 2021.04.28	21-27 Lamb's Conduit Street London WC1N 3NL tel: 020 7841 1980	-
	04.06.2021			Final updates for report issue.		RIBA Stage 2 - WIP Issue for Information
					DRAWING	SCALE 1:10 PAPER A4 DATE 18.03.2021
					Solid Wall, Gable / Verge Detail	JOB DWG REV
					Option 1 - Retrofit +	9419 131a A03
					Non-Decant	

1.	Existing solid brick wall	42. Existing wall finish
2.	Indicative existing foundations	43. 200mm Kingspan
3. Nov	Existing solid concrete floor	be cut for a tight fit and ext
	K-Rend 260mm o/a K-Systems M External Wall Mineral Wool dered System - 250mm insulation EnerPHit / Net Zero Carbon	with trays as appropriate to
4.	option. (100mm o/a with 90 insulation for CCC Retrofit+ Option)	44. Full height triple gla
5.	New XPS insulation Greenguard GG300 board suitable for under	<ol> <li>Apply paint on purp with Pro Clima Orcon F sea</li> </ol>
	ground situations, 70mm CCC Retrofit+ and 120mm E/NZC	wool over. lay and seal 1.5
	option o/a thick.	top of mineral wool and cut
6.	New French drain filled with pea shingle.	to external face of wall
7.	New 200 x50mm pre cast concrete kerb edging set in concrete	46. Protect Barrier vap
	foundation	membrane or equally appre
B.	Top soil	47. Mineral wool batts
9.	Assumed existing compacted hardcore base	of insulation
10. 11.	Assumed sub-soil New floor finish	48. Existing window
12.	New MDF skirting - decorated with flexible sealant below	49. Sand/cement rende
3.	New wet plaster - decorated with hexible sealaht below	airtightness barrier
4.	New 2no layers 12.5mm British Gypsum Fireline plasterboard,	
	tape and joint with 3mm skim coat finish, nominal 11.7kg/m <sup>2</sup> - to	
	give 60min FR	
15.	New 100mm sound deadening mineral wool laid between joists	
16.	Existing floor structure	
7.	Existing floor deck	
8.	New indicative air tightness line - Protect Barrier vapour control	
19.	layer/air barrier membrane or equal and approved	
9.	Rytons or equivalent approved product Periscope underfloor ventilators, install as manufacturers recommendations	
20.	Existing damp proof membrane or new if existing is damaged or	
	not present	
21.	Existing brick sleeper walls, ensure walls are sound and free of	
	damaged, broken bricks etc and replace where necessary	
22.	Existing sole plate to top of existing sleeper wall, check the	
	condition of the plate for damage, rot, etc and if defective replace	
	with timber treated preservative plate of the same dimensions.	
23.	Timber treat the existing plates. New 150 x 50mm floor joists at 450mm centres	
24.	150mm deep mesh/netting fixed the the sides of the existing	
	joists or taken over the tops of the sole plate to contain between	
	joist insulation.	
25.	Weed killer membrane	
26.	150mm deep mineral wool insulation laid between floor joists and	
_	100mm mineral wool insulation laid on top of sleeper walls	
27.	New Lime plaster	
28.	Existing truss - extended as required	$\sim$
29.	New 102mm half round black gutter upvc. NOTE: Gutter to be	(
	tilted away from building so that outer edge is lower than edge against building to ensure any overflowing occurs away from	-/
	building. Upvc fascia and soffit	$\sim$
30.	300mm existing mineral wool (200mm extra laid over for E/NZC	()
	option)	- (
31.	Existing brick cavity wall with insulation	$\sim$
32.	2no coats of liquid tanking membrane to lap with injected	5
	chemical damp proof course	(
33.	Injected chemical damp proof course	2
34.	Proprietary air sealing tape	7
35. 36.	80mm woodfibre insulation	(
30. 37.	Existing roof truss Exiting roof finish	7
38.	Q-Bot robotic underfloor insulation QERB, care to be taken not to	
	over spray the air vents	
39.	New 150mm power float slab on VCL on 200mm XPS Kingspan	=
	Greenguard GG300 insulation on DPM on levelling compound on	
	existing hardcore base	
40.	50mm mineral wool insulation mechanically fixed to gable wall	
	face to extend 600mm above the top of the roof insulation	
<b>1</b> 1.	Triple glazed window fixed within insulation zone complete with	

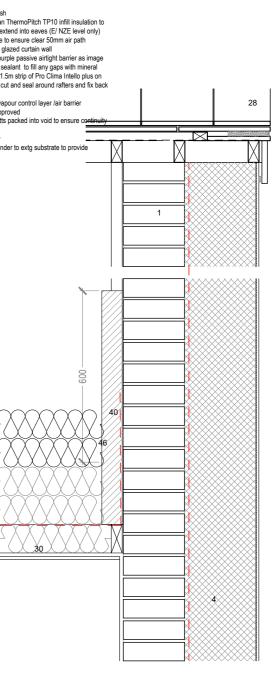
 rupe giazzed window tixed within insulation zone complete wi new cill all sealed to manufacturers recommendations with proprietary sealing strips. Internal and external reveals to be made good. 42.

Revisi	on Schedule			
Rev	Date	CHK	DRW	Revision Description
A00	25.03.2021	JE	DLC	Initial Issue
A01	16.04.2021	JE	DLC	General updates
A02	28.04.2021	JE	DLC	General updates as JE email 2021.04.28
A03	04.06.2021	JE	DLC	Final updates for report issue.

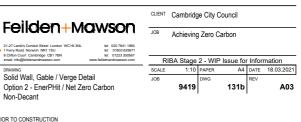


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- Representative of air tightness



- Existing solid brick wall
- Indicative existing foundations Existing solid concrete floor
- New K-Rend 260mm o/a K-Systems M External Wall Mineral Wool
- Rendered System 250mm insulation EnerPHit / Net Zero Carbon
- option. (100mm o/a with 90 insulation for CCC Retrofit+ Option) New XPS insulation Greenguard GG300 board suitable for under ground situations, 70mm CCC Retrofit+ and 120mm E/NZC
- option o/a thick.
- New French drain filled with pea shingle. New 200 x50mm pre cast concrete kerb edging set in concrete
- Top soil
- Assumed existing compacted hardcore base Assumed sub-soil
- 11 New floor finish
- New MDF skirting decorated with flexible sealant below 13. New wet plaster - decorated
- New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m<sup>2</sup> to 14
- give 60min FR New 100mm sound deadening mineral wool laid between joists 15.
- 16. Existing floor structure
- Existing floor deck
- New indicative air tightness line Protect Barrier vapour control
- layer/air barrier membrane or equal and approved Rytons or equivalent approved product Periscope underfloor 19.
- ventilators, install as manufacturers recommendations
- 20. Existing damp proof membrane or new if existing is damaged or
- not present 21. Existing brick sleeper walls, ensure walls are sound and free of
- damaged, broken bricks etc and replace where necessary 22. Existing sole plate to top of existing sleeper wall, check the condition of the plate for damage, rot, etc and if defective replace
- with timber treated preservative plate of the same dimensions. Timber treat the existing plates. 23. New 150 x 50mm floor joists at 450mm centres
- 150mm deep mesh/netting fixed the the sides of the existing joists or taken over the tops of the sole plate to contain between 24 ioist insulation.
- Weed killer membrane 25
- 150mm deep mineral wool insulation laid between floor joists and 26 100mm mineral wool insulation laid on top of sleeper walls 27
- New Lime plaster
- Existing truss extended as required 28 29 New 102mm half round black gutter upvc. NOTE: Gutter to be tilted away from building so that outer edge is lower than edge against building to ensure any overflowing occurs away from
- building. Upvc fascia and soffit 30. 300mm existing mineral wool (200mm extra laid over for E/NZC option) 31 Existing brick cavity wall with insulation
- 32. 2no coats of liquid tanking membrane to lap with injected chemical damp proof course
- Injected chemical damp proof course
   Proprietary air sealing tape
- 35. 80mm woodfibre insulation
- 36 Existing roof truss
- 37. Exiting roof finish
- 38. Q-Bot robotic underfloor insulation QERB, care to be taken not to
- over spray the air vents 39. New 150mm power float slab on VCL on 200mm XPS Kingspan Greenguard GG300 insulation on DPM on levelling compo
- existing hardcore base 40. 50mm mineral wool insulation mechanically fixed to gable wall face to extend 600mm above the top of the roof insulation

General updates General updates as JE email 2021.04.28

DO NOT SCALE FROM THIS DRAWING ALL DIMENSIONS TO BE CONFIRMED ON SITE BY THE CONTRACTOR PRIOR TO CONSTRUCTION

nal updates for report issue

- 41. Trible alazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips. Internal and external reveals to be
- made good 42

Rev Date A00 25.03.202

6.04.2021 8.04.2021

.06.202

CHK DRW

44. Full height triple glazed curtain wall
 45. Apply paint on purple passive airtight barrier as image
 with Pro Clima Orcon F sealant to fill any gaps with mineral

42.

43.

- wool over. lay and seal 1.5m strip of Pro Clima Intello plus on top of mineral wool and cut and seal around rafters and fix back to external face of wall
- 46. Protect Barrier vapour control layer /air barrier
- membrane or equally approved 47. Mineral wool batts packed into void to ensure continuity

200mm Kingspan ThermoPitch TP10 infill insulation to

be cut for a tight fit and extend into eaves (E/ NZE level only) with trays as appropriate to ensure clear 50mm air path

of insulation

Existing wall finish

48. Existing window 49. Sand/cement render to extg substrate to provide airtightness barrier

Assume eaves insulation can be fitted from external scattold Assume extg eaves extends far enough to accept EWI. Potential for odd EWI detailing if semi-detached houses are owned by the adjoining property.

30

31

Feilden+Mawson

Cavity Wall and Pitched Roof

Option 1 - CCC Retrofit +

¥.

1 Ferry 6 Clifts email:

DRAWIN

Non-Decant

28

CLIENT Cambridge City Council

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RIBA Stage 2 - WIP Issue for Informa

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A4 DATE 18.03.2021

A03

option o/a thick. top of mineral wool and cut and seal around rafters and fix back New French drain filled with pea shingle. New 200 x50mm pre cast concrete kerb edging set in concrete to external face of wall 46. Protect Barrier vapour control layer /air barrier membrane or equally approved 47. Mineral wool batts packed into void to ensure continuity Top soil Assumed existing compacted hardcore base Assumed sub-soil of insulation 48. Existing window New floor finish Sand/cement render to extg substrate to provide New MDF skirting - decorated with flexible sealant below airtightness barrier New wet plaster - decorated New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m<sup>2</sup> - to 14 aive 60min FR 15 New 100mm sound deadening mineral wool laid between joists 16. Existing floor structure Existing floor deck
 New indicative air tightness line - Protect Barrier vapour control laver/air barrier membrane or equal and approved Rytons or equivalent approved product Periscope underfloor ventilators, install as manufacturers recommendations 20. Existing damp proof membrane or new if existing is damaged or not present Existing brick sleeper walls, ensure walls are sound and free of Existing solution of existing solution in the solution of existing solution of e condition of the plate for damage, rot, etc and if defective replace with timber treated preservative plate of the same dimensions. Timber treat the existing plates. New 150 x 50mm floor joists at 450mm centres
 150mm deep mesh/netting fixed the the sides of the existing joists or taken over the tops of the sole plate to contain betwee joist insulation. 25. Weed killer membrane 150mm deep mineral wool insulation laid between floor joists and 100mm mineral wool insulation laid on top of sleeper walls 26. 27. New Lime plaster Existing truss - extended as required existing rafters to be 29. New 102mm half round black gutter upvc. NOTE: Gutter to be tilted away from building so that outer edge is lower than edge against building to ensure any overflowing occurs away from extended to allow for insulation as reg'd building. Upvc fascia and soffit 30. 300mm existing mineral wool (200mm extra laid over for E/NZC

- option)
- Existing brick cavity wall with insulation
   2no coats of liquid tanking membrane to lap with injected
- chemical damp proof course Injected chemical damp proof course
- 33. 34. Proprietary air sealing tape
- 35. 80mm woodfibre in
- 36. Existing roof truss
- Exiting roof finish
   Q-Bot robotic underfloor insulation QERB, care to be taken pot to
- over spray the air vents
- New 150mm power float slab on VCL on 200mm XPS Kingspan Greenguard GG300 insulation on DPM on levelling compound on 29 existing hardcore base 40. 50mm mineral wool insulation mechanically fixed to gable wall
- face to extend 600mm above the top of the roof insulation
- 41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips. Internal and external reveals to be made good.

42

#### Revision Schedul Rev Date A00 25.03.20 CHK DRW Re Feilden+Mawson ial Issue neral updates ral updates as JE email 2021.04.2 4 06 20 nal updates for report issue Cavity Wall and Pitched Roof Option 2 - EnerPHit / Net Zero Carbon Non-Decant

28

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ЭK

- Existing solid brick wall Indicative existing foundations
  - Existing solid concrete floor
  - New K-Rend 260mm o/a K-Systems M External Wall Mineral Wool Rendered System 250mm insulation EnerPHit / Net Zero Carbon
  - option. (100mm o/a with 90 insulation for CCC Retrofit+ Option)

42.

44

45.

Existing wall finish

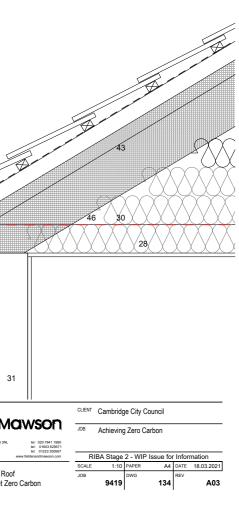
with travs as appropriate to ensure clear 50mm air path

New XPS insulation Greenguard GG300 board suitable for under ground situations, 70mm CCC Retrofit+ and 120mm E/NZC

Existing Wall tinish
 200mm Kingspan ThermoPitch TP10 infill insulation to be cut for a tight fit and extend into eaves (E/ NZE level only)

Full height triple glazed curtain wall Apply paint on purple passive airtight barrier as image with Pro Clima Orcon F sealant to fill any gaps with mineral wool over. Iay and seal 1.5m strip of Pro Clima Intello plus on

Assume eaves insulation upgrade and additional roof insulatio can all be accessed from external scaffold Can an be accessed norm external scandou Potential for odd EWI detailing if semi-detached houses are owned by the adjoining property. If existing window heads are hard up against u/s of roof newly extended roof projection may clash - potential for lowering of window heads.



- Indicative existing foundations Existing solid concrete floor
- New K-Rend 260mm o/a K-Systems M External Wall Mineral Wool
- Rendered System 250mm insulation EnerPHit / Net Zero Carbon option. (100mm o/a with 90 insulation for CCC Retrofit+ Option)
- New XPS insulation Greenguard GG300 board suitable for under ground situations, 70mm CCC Retrofit+ and 120mm E/NZC option o/a thick.
- New French drain filled with pea shingle.
- New 200 x50mm pre cast concrete kerb edging set in concrete oundation
- Top soil
- Assumed existing compacted hardcore base Assumed sub-soil
- 11 New floor finish
- New MDF skirting decorated with flexible sealant below
- 13 New wet plaster - decorated
- New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m<sup>2</sup> - to give 60min FR New 100mm sound deadening mineral wool laid between joists
- 16. Existing floor structure
- Existing floor deck New indicative air tightness line - Protect Barrier vapour control
- layer/air barrier membrane or equal and approved Rytons or equivalent approved product Periscope underfloor 19
- ventilators, install as manufacturers recommendations
- 20. Existing damp proof membrane or new if existing is damaged or
- not present 21. Existing brick sleeper walls, ensure walls are sound and free of
- damaged, broken bricks etc and replace where necessary Existing sole plate to top of existing sleeper wall, check the condition of the plate for damage, rot, etc and if defective replace
- with timber treated preservative plate of the same dimensions. Timber treat the existing plates. New 150 x 50mm floor joists at 450mm centres 23.
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- Weed killer membrane 25.
- 26. 150mm deep mineral wool insulation laid between floor joists and 100mm mineral wool insulation laid on top of sleeper walls
- 27. New Lime plaster
- Existing truss extended as required
   New 102mm half round black gutter upvc. NOTE: Gutter to be
- tilted away from building so that outer edge is lower than edge against building to ensure any overflowing occurs away from building. Upvc fascia and soffit
- 30. 300mm existing mineral wool (200mm extra laid over for E/NZC option) Existing brick cavity wall with insulation
- 2no coats of liquid tanking membrane to lap with injected
- chemical damp proof course
- 33 Injected chemical damp proof course Proprietary air sealing tape
- 35. 80mm woodfibre insulation
- Existing roof truss 37. Exiting roof finish
- 38. Q-Bot robotic underfloor insulation QERB, care to be taken not to over spray the air vents
- New 150mm power float slab on VCL on 200mm XPS Kingspan Greenguard GG300 insulation on DPM on levelling compound on
- existing hardcore base 40. 50mm mineral wool insulation mechanically fixed to gable wall face to extend 600mm above the top of the roof insulation
- 41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips. Internal and external reveals to be

on Description

eneral updates as JE email 2021.04.28

eneral updates

CHK DRW Revision D JE DLC Initial Issue

- made good
- 42

Revision Schedule

Rev Date A00 25.03.202

A02 28.04.202

16.04.202

 44. Full height triple glazed curtain wall
 45. Apply paint on purple passive airtight barrier as image
 with Pro Clima Orcon F sealant to fill any gaps with mineral wool over. lay and seal 1.5m strip of Pro Clima Intello plus on

43.

top of mineral wool and cut and seal around rafters and fix back

Existing wall finish

- to external face of wall 46. Protect Barrier vapour control layer /air barrier
- membrane or equally approved 47. Mineral wool batts packed into void to ensure continuity of insulation

Existing wain minim
 200mm Kingspan ThermoPitch TP10 infill insulation to be cut for a tight fit and extend into eaves (E/ NZE level only) with trays as appropriate to ensure clear 50mm air path

- 48. 49.
- Existing window Sand/cement render to extg substrate to provide airtightness barrier

Existing solid brick wall

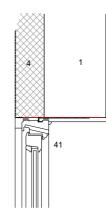
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- Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips. Internal and external reveals to be made good
- Revision Schedul Date 25.03.2021 16.04.2021 Feilden+Mawson neral updates A02 28.04.202 General updates as JE email 2021.04.28 orwich NR1 1SU Cambridge CB1 7BN DRAWIN Window Head / Jamb Solid Wall Option 2- EnerPHit / Net Zero Carbon



Window Head / Jamb Solid Wall JOE 9419 135 Option 1 - CCC Retrofit + Non-Decant DO NOT SCALE FROM THIS DRAWING ALL DIMENSIONS TO BE CONFIRMED ON SITE BY THE CONTRACTOR PRIOR TO CONSTRUCTION

Feilden+Mawson

tel: 01603 62957 tel: 01223 350567



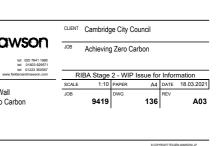
CLIENT Cambridge City Council

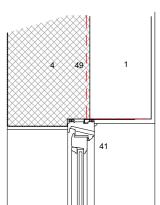
JOB Achieving Zero Carbon

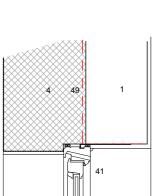
RIBA Stage 2 - WIP Issue for Information

A4 DATE 18.03.2021

A03







47. Mineral wool batts packed into void to ensure continuity

 44. Full height triple glazed curtain wall
 45. Apply paint on purple passive airtight barrier as image
 with Pro Clima Orcon F sealant to fill any gaps with mineral wool over, lav and seal 1.5m strip of Pro Clima Intello plus on top of mineral wool and cut and seal around rafters and fix back

200mm Kingspan ThermoPitch TP10 infill insulation to be cut for a tight fit and extend into eaves (E/ NZE level only) with trays as appropriate to ensure clear 50mm air path

Existing wall finish

to external face of wall

48. Existing window

airtightness barrier

membrane or equally approved

Protect Barrier vapour control layer /air barrie

Sand/cement render to extg substrate to provide

42.

43.

46.

49.

of insulation

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- option o/a thick.
- New French drain filled with pea shingle. New 200 x50mm pre cast concrete kerb edging set in concrete
- foundation Top soil
- Assumed existing compacted hardcore base
- Assumed sub-soil New floor finish

- New MDF skirting decorated with flexible sealant below
   New wet plaster decorated
   New 2no layers 12.5mm British Gypsum Fireline plasterboard,
- tape and joint with 3mm skim coat finish, nominal 11.7kg/m<sup>2</sup> to give 60min FR
- 15. New 100mm sound deadening mineral wool laid between joists
- Existing floor structure 17. Existing floor deck
- 18. New indicative air tightness line Protect Barrier vapour control
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- Timber treat the existing plates.
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   150mm deep mesh/netting fixed the the sides of the existing joists or taken over the tops of the sole plate to contain between
- joist insulation. Weed killer membrane 25.
- 26 150mm deep mineral wool insulation laid between floor joists and 100mm mineral wool insulation laid on top of sleeper walls
- 27. New Lime plaster
- Existing truss extended as required
   New 102mm half round black gutter upvc. NOTE: Gutter to be tilted away from building so that outer edge is lower than edge against building to ensure any overflowing occurs away from
- building. Upvc fascia and soffit 30. 300mm existing mineral wool (200mm extra laid over for E/NZC
- option) 31. Existing brick cavity wall with insulation
- 2no coats of liquid tanking membrane to lap with injected
- chemical damp proof course
- 33. Injected chemical damp proof course
- Proprietary air sealing tape
- 35. 80mm woodfibre insulation Existing roof truss
- 37. Exiting roof finish
- 38. Q-Bot robotic underfloor insulation QERB, care to be taken not to
- over spray the air vents New 150mm power float slab on VCL on 200mm XPS Kingspan
- Greenguard GG300 insulation on DPM on levelling compound on existing hardcore base
- 50mm mineral wool insulation mechanically fixed to gable wall face to extend 600mm above the top of the roof insulation

CHK DRW Revision Description

Initial Issue eneral update:

General updates as JE email 2021.04.28

nal updates for report issue

 Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips. Internal and external reveals to be

made good

Revision Schedule

 Rev
 Date

 A00
 25.03.2021

 A01
 16.04.2021

A02 28.04.2021

42.

of insulation 48. Existing window airtightness barrier

Existing wall finish

42.

43.

DO NOT SCALE FROM THIS DRAWING ALL DIMENSIONS TO BE CONFIRMED ON SITE BY THE CONTRACTOR PRIOR TO CONSTRUCTION

 44. Full height triple glazed curtain wall
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200mm Kingspan ThermoPitch TP10 infill insulation to

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Existing solid brick wall

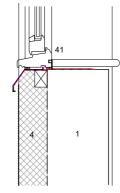
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- Proprietary air sealing tape
   80mm woodfibre insulation
- 36. Existing roof truss
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- existing hardcore base 40. 50mm mineral wool insulation mechanically fixed to gable wall face to extend 600mm above the top of the roof insulation
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made good. 42

Date 25.03.202 16.04.2021 CHK DRW R Rev A00 A01 neral update DLC 8.04.2021 General updates as JE email 2021.04.28



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CLIENT Cambridge City Council

JOB Achieving Zero Carbon

SCALE

RIBA Stage 2 - WIP Issue for Information

A4 DATE 18.03.2021

A03

Feilden+Mawson

1 Ferry Road Norwich NR1 1SU 6 Cliffon Court Cambridge CB1 7BN email: info@felifenandmource

Window Cill Solid Wall

Option 1- Retrofit +

Non-Decant

200mm Kingspan ThermoPitch TP10 infill insulation to be cut for a tight fit and extend into eaves (E/ NZE level only) with trays as appropriate to ensure clear 50mm air path

Existing wall finish

to external face of wall

48. Existing window

membrane or equally approved

42.

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44.

46.

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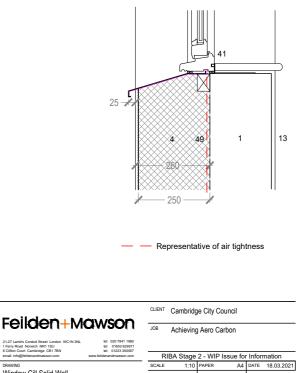
of insulation

Full height triple glazed curtain wall Apply paint on purple passive airtight barrier as image with Pro Clima Orcon F sealant to fill any gaps with mineral wool over. lay and seal 1.5m strip of Pro Clima Intello plus on top of mineral wool and cut and seal around rafters and fix back

Protect Barrier vapour control layer /air barrier

Mineral wool batts packed into void to ensure continuity

Sand/cement render to extg substrate to provide



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A03

- Existing solid brick wall Indicative existing foundations Existing solid concrete floor

- Existing solid concerter noon
   New K-Rend 260mm o/a K-Systems M External Wall Mineral Wool
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23 of 33

Appendix B - SAP Summary





11 Whe	aton House	Gnd Floor				
Zero Carbon Comm	unal ASHP					
Floor	Gnd	31m2	External	W/m2K	5 m2	
Walls	Walls Cavity Wa		0.15	W/m2K	36.37 m2	
Roof				W/m2K	31 m2	
Triple Glazing			0.8	W/m2K	14.13 m2	
Heating	Commu	nal ASHP				
Ventilation	Zehnder	Comfoair 200	MVHR			
Airtightness	membra	ne in loft etc	1	m3@50Pa		
Renewables	PV	West	0.55	kWp		
Thermal Bridges	Canopy			m		
	Gutter E	aves		m		
	Window Sills		8.4	m		
	Gable			m		
	Party Ga	ble		m		
	Gnd Floo	or Perimeter	8.84	m		
Thermal Bridges wil	I need some	e works doing to	them, either	removal or n	nitigation	
Cavity Walls if filled	, might allov	v EWI if they ha	ve been done	to a good sta	andard, otherwise IW	/I
which becomes inva	asive and ex	pensive.				
U-value done on EV	/I of CWI wa	all, this needs m	entioning in th	ne report.		
The "greenhouse" n	eeds dealin	g with as well.				
Modelled 190mm n	nineral wool	conductivity 0.	032W/mK			
Carbon Reduction P	Part L 2013		66.20%	with PV	53.80% without F	v
Carbon Reduction S	AP 10.1		99.59%	with PV	92.26% without F	v
Total Energy Cost			£254.04		8.47	DER
Regulated Energy			43.05	kWh/m2/yr	0.06	DER
Unregulated Energy			35	kWh/m2/yr	95A	SAP

Local Plan +				Regulated Energy
				Unregulated Energy
Floor	Left untouched	0.6 W/m2K	m2	Base Case
Walls	Cavity Walls**	0.22 W/m2K	36.37 m2	
Roof		W/m2K	31 m2	Floor
Triple Glazing		0.8 W/m2K	14.13 m2	Walls
Heating	Keep gas boiler			Roof
Ventilation	Aereco	MEV	allow £2000 for install	Triple Glazing
Airtightness	membrane in loft etc	5 m3@50Pa		Heating
Renewables	PV West	1 kWp		Ventilation
Thermal Bridges	Canopy	m		Airtightness
	Gutter Eaves	m		Renewables
	Window Sills	8.4 m		Thermal Bridges
	Gable	m		
	Party Gable	m		
	Gnd Floor Perimeter	8.84 m		
Thermal Bridges wi	I need some works doing to	them, either removal or n	nitigation	
Cavity Walls if filled	, might allow EWI if they ha	ve been done to a good sta	andard, otherwise IWI	
	asive and expensive.	0		
	VI of CWI wall, this needs m	entioning in the report.		Cavity Walls filled a
	m mineral wool conductivit			
Carbon Reduction P		23.60% with PV	-8.79% without PV	
Carbon Reduction S		-90.60% with PV	-96.81% without PV	
Total Energy Cost		£233.00	13.38 DER	Carbon Reduction
Regulated Energy		51.03 kWh/m2/yr		Carbon Reduction
Unregulated Energy	,	35 kWh/m2/yr		Total Energy Cost
Enerphit ASHP	Communal ASHP	55 KWII/III2/ yi	020 JAI	Regulated Energy
Encipine Asin	Commaniar Asim			Unregulated Energy
Floor	Left untouched	0.6 W/m2K	m2	office and a second sec
Walls	Cavity Walls**	0.15 W/m2K	31 m2	
Roof	Cavity Walls	W/m2K	31 m2	
Triple Glazing		0.8 W/m2K	14.13 m2	
Heating	ASHP	0.0 W/IIIZK	14.13 112	
Ventilation	Zehnder Q350	MVHR		
Airtightness	membrane in loft etc	1 m3@50Pa		
Renewables	PV West	2 kWp		
Thermal Bridges	Canopy	m		
	Gutter Eaves	m		
	Window Sills	8.4 m		
	Gable	m		
	Party Gable	m		
	Gnd Floor Perimeter	8.84 m		
Thermal Bridges wi	I need some works doing to	them, either removal or n	nitigation	
Cavity Walls if filled	, might allow EWI if they ha	ve been done to a good sta	andard, otherwise IWI	
which becomes inv	asive and expensive.			
U-value done on EV	VI of CWI wall, this needs m	entioning in the report.		
Modelled 190mm n	nineral wool conductivity 0.	032W/mK		
Carbon Reduction F	art L 2013	99.00% with PV	53.80% without PV	
	40 10 1	112 410/th DV/	04.0C0/	
Carbon Reduction S	AP 10.1	112.41% with PV	94.86% without PV	

### ergy Left untouched Cavity Walls\*\* Keep gas boiler untouched membrane in loft etc PV Canopy Gutter Eaves Window Sills

ed assumed

ion Part L 2013 ion SAP 10.1 st gv ergy

	27.22 kWh/m2/yr	-2.1	DER
	35 kWh/m2/yr	100A	SAP
Left untouched	0.6 W/m2K	m2	
Cavity Walls**	0.55 W/m2K	0 m2	
	W/m2K	31 m2	
	0.8 W/m2K	14.13 m2	
Keep gas boiler			
untouched	Extract		
membrane in loft etc	8 m3@50Pa		
PV	0 kWp		
Canopy	m		
Gutter Eaves	m		
Window Sills	8.4 m		
Gable	m		
Party Gable	m		
Gnd Floor Perimeter	8.84 m		
sumed			
art L 2013	-26.70% without PV	22.2	DER
AP 10.1	-125.17% without PV	26.74	DER
	£357.02	78C	SAP
	88.6 kWh/m2/yr		
	35 kWh/m2/yr		

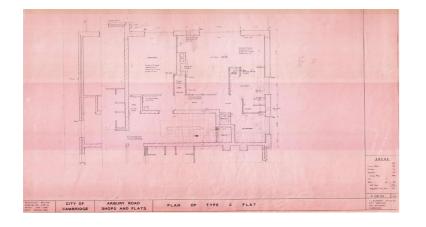


#### 155 Ditton Fields

Zero Carbon ASHP					
Floor	Left untouched	0.6	W/m2K	48.6 m2	
Walls	Solid Walls?	0.15	W/m2K	49 m2	
Roof	Flat	0	W/m2K	0 m2	
Triple Glazing		0.8	W/m2K	7.29 m2	
Heating	ASHP				
Ventilation	Zehnder Q350	MVHR			
Airtightness	membrane in loft	etc 1	m3@50Pa		
Renewables	PV West	2.4	kWp		
Thermal Bridges	Canopy	1	m		
	Gutter Eaves	0	m		
	Window Sills	4.8	m		
	Gable	0	m		
	Party Perimeter	28	m		
	Gnd Floor Perime	ter 28	m		
Thermal Bridges wi	II need some works o	loing to them, eithe	r removal or	mitigation	
Headers and streto	hers, presumed to be	e solid walls			
Modelled 190mm	mineral wool conduct	tivity 0.032W/mK			
Carbon Reduction F	art L 2013	88%	with PV	27.10% without P	v
Carbon Reduction S	AP 10.1	94.70%	with PV	60.64% without P	v
Total Energy Cost		£14.18		3.77	DER
Regulated Energy		2.2	kWh/m2/yr	0.76	DER
Unregulated Energy	1	44	kWh/m2/yr	92A	SAP

Local Plan +	ASHP				Walls	Solid Walls
					Roof	
Floor	Left untouched	0.6 W/m2K	48.6 m2		Triple Glazing	
Walls	Solid Walls	0.22 W/m2K	49 m2		Heating	Keep gas boiler
Roof		0 W/m2K	0 m2		Ventilation	untouched
Triple Glazing		0.8 W/m2K	7.29 m2		Airtightness	membrane in loft etc
Heating	ASHP				Renewables	PV
Ventilation	Aereco	MEV a	llow £1000 for insta	II	Thermal Bridges	Canopy
Airtightness	membrane in loft	etc 5 m3@50Pa				Gutter Eaves
Renewables	PV West	1 kWp				Window Sills
Thermal Bridges	Canopy	1 m				Gable
	Gutter Eaves	0 m				Party Perimeter
	Window Sills	4.8 m				Gnd Floor Perimeter
	Gable	0 m				
	Party Perimeter	28 m			Headers and streto	hers, presumed to be sol
	Gnd Floor Perimet					
Thermal Bridges wil		oing to them, either removal or r	nitigation		Carbon Reduction F	Part L 2013
•	ers, presumed to be	•	0		Carbon Reduction S	
Modelled EWI 90mm					Total Energy Cost	
Carbon Reduction Pa		32.40% with PV	7.20% without P	W	Regulated Energy	
Carbon Reduction SA		59.39% with PV	45.15% without P		Unregulated Energy	,
Total Energy Cost	10.1	£225.41	43.13% without 1 20.76	DER	on eguideed Energy	1
Regulated Energy		35.16 kWh/m2/yr	5.82	DER		
Unregulated Energy		44 kWh/m2/yr	5.82 79C	SAP		
Enerphit ASHP		44 KW/1/112/ÿI	750	JAr		
Ellerphilt ASHP						
Floor	Left untouched	0.6 W/m2K	48.6 m2			
Walls	Solid Walls	0.15 W/m2K	49 m2			
Roof	400mm mineral w		0 m2			
Triple Glazing		0.8 W/m2K	7.29 m2			
Heating	ASHP	0.0 11/11/21	7.25 112			
Ventilation	Zehnder Q350	MVHR				
Airtightness	membrane in loft					
•						
Renewables		2 kWp				
Thermal Bridges	Canopy Cuttor Favor	1 m				
	Gutter Eaves Window Sills	0 m 4.8 m				
	Gable	0 m				
	Party Perimeter	28 m				
	Gnd Floor Perimet					
-		oing to them, either removal or r	nitigation			
	ers, presumed to be					
Carbon Reduction Pa	irt L 2013	77.60% with PV	27.10% without P	v		
Carbon Reduction SA	P 10.1	89.04% with PV	60.64% without P	v		
Total Energy Cost		£52.50	6.88	DER		
Regulated Energy		8.19 kWh/m2/yr	1.57	DER		
Unregulated Energy		44 kWh/m2/yr	90B	SAP		
Base Case	Gas					
Floor	Left untouched	0.6 W/m2K				
			48.6 m2			

	1.5	5 W/m2K	49	m2		
	(	) W/m2K	0	m2		
	0.8	3 W/m2K	7.29	m2		
	extract					
etc	8	3 m3@50Pa				
	(	) kWp				
	1	Lm				
	(	) m				
	4.8	3 m				
	(	) m				
	28	3 m				
ter	28	3 m				
solid	walls					
	-102.00%	6 without PV		42.86	DER	
	-230.55%	6 without PV		48.36	DER	
	£457.20	)		72C	SAP	
	174.8	3 kWh/m2/yr				
	44	1 kWh/m2/yr				



Arbury Road 1 Bed

Floor	First Floor	0 W/m2K	50 m2	
Walls	Solid Walls	0.15 W/m2K	39 m2	
Roof	Party Floor	0 W/m2K	50 m2	
Triple Glazing	r arty rioor	0.8 W/m2K	9.8 m2	
Heating	Communal Heat Pump			
Ventilation	Zehnder Comfoair 200	MVHR		
Airtightness	membrane in loft etc	1 m3@50Pa		
Renewables	PV West	0.5 kWp		
Thermal Bridges	Balcony	0 m		
	Gutter Eaves	0 m		
	Window Sills	6.8 m		
	Gable	0 m		
	Party Floor/ Rafter	65 m		
	Gnd Floor Perimeter	0 m		
Thermal Bridges wi	II need some works doing to	o them, either removal or r	nitigation	
Modelled 190mm r	nineral wool conductivity 0	.032W/mK		
Carbon Reduction F	Part L 2013	77.00% with PV	64.70% without F	v
Carbon Reduction S	AP 10.1	99.53% with PV	94.89% without F	v
Total Energy Cost		£207.70	7.09	DER
Regulated Energy		38.85 kWh/m2/yr	0.1	DER
Unregulated Energy	/	34 kWh/m2/yr	95A	SAP
Local Plan +	Gas			
Floor	First Floor	0 W/m2K	50 m2	
Walls	Solid Walls	0.3 W/m2K	39 m2	

Triple Glazing			0.8	W/m2K	9.8 m2	
Heating	Keep gas boiler					
Ventilation	Aereco		MEV		allow £1000 for insta	ll
Airtightness	membrane in lo			m3@50Pa		
Renewables	PV We	st		kWp		
Thermal Bridges	Balcony			m		
	Gutter Eaves		-	m		
	Window Sills		6.8			
	Gable		-	m		
	Party Floor/ Ra		65			
	Gnd Floor Perir			m		
Thermal Bridges will r		-			r mitigation	
Modelled EWI 90mm		nductivity (	-			
Carbon Reduction Par				with PV	1.50% without F	
Carbon Reduction SAI	P 10.1			with PV	-30.59% without F	
Total Energy Cost			£196.79		13.34	DER
Regulated Energy				kWh/m2/y		DER
Unregulated Energy			34	kWh/m2/y	r 85B	SAP
Enerphit Communal A	SHP					
Floor	First Floor		0	W/m2K	50 m2	
Walls	Solid Walls			W/m2K	39 m2	
Roof	Party Floor			W/m2K	50 m2	
Triple Glazing	,			W/m2K	9.8 m2	
Heating	Communal ASH	IP				
Ventilation			MVHR			
Airtightness	membrane in lo	oft etc	1	m3@50Pa		
Renewables	PV We	st		kWp		
Thermal Bridges	Canopy		0	m		
•	Gutter Eaves		0	m		
	Window Sills		6.8	m		
	Gable		0	m		
	Party Floor/ Ra	fter	65	m		
	Gnd Floor Perir	neter	0	m		
Thermal Bridges will r	need some works	doing to t	hem, eithe	r removal o	r mitigation	
Bear in mind that a sr	nall flat with ASH	IP would ne	eed HWC a	nd also outs	ide space for ASHP u	nit
probably not practica	I and therefore s	ome form (	of commun	ity heating	required at a guess.	
Carbon Reduction Par	rt L 2013	131.6%	SAP 100A	with PV	82.60% without P	v
Carbon Reduction SAI	P 10.1	112.80%	SAP 94A	with PV	94.32% without P	v
Total Energy Cost		-£3.76			-9.72	DER
Regulated Energy			-14.90	kWh/m2/y	r -2.73	DER
Unregulated Energy			34	kWh/m2/y	r 99A	SAP
Base Case	Gas					
Floor	First Floor		•	W/m2K	F0 m2	
Floor	First Floor			W/m2K	50 m2	
Walls	Solid Walls Party Floor			W/m2K W/m2K	39 m2	
Doof	Farty FIOOr		0	vv/m2K	50 m2	
Roof	r arcy r loor		0.0		0.0 m2	
Roof Triple Glazing Heating	Keep gas boiler		0.8	W/m2K	9.8 m2	

Airtightness	membrane in loft etc	8 m3@50Pa		
Renewables	PV	0 kWp		
Thermal Bridges	Balcony	0 m		
	Gutter Eaves	0 m		
	Window Sills	6.8 m		
	Gable	0 m		
	Party Floor/ Rafter	65 m		
	Gnd Floor Perimeter	0 m		
Carbon Reduction F	Part L 2013	-49.40% without PV	31.68	DER
Carbon Reduction S	SAP 10.1	-129.84% without PV	33.74	DER
Total Energy Cost		£375.55	77C	SAP
Regulated Energy		123.36 kWh/m2/yr		
Unregulated Energy	/	34 kWh/m2/yr		



### 83 Ekin Road

Zero Carbon ASHP			
Floor	Left untouched	0.6 W/m2K	42.85 m2
Walls	Cavity Walls**	0.15 W/m2K	51.76 m2
Roof	500mm mineral wool	0.09 W/m2K	42.85 m2
Triple Glazing		0.8 W/m2K	9.27 m2
Heating	ASHP		
Ventilation	Zehnder Q350	MVHR	
Airtightness	membrane in loft etc	1 m3@50Pa	
Renewables	PV West	2.3 kWp	
Thermal Bridges	Canopy	1.5 m	
	Gutter Eaves	15.7 m	
	Window Sills	5.4 m	
	Gable	6.4 m	
	Party Gable	6.4 m	
	Gnd Floor Perimeter	22.1 m	
Thermal Bridges wil	I need some works doing to	o them, either removal or	mitigation
Cavity Walls if filled	, might allow EWI if they ha	ave been done to a good s	tandard, otherwise IWI
which becomes inv	asive and expensive.		
U-value done on EV	VI of CWI wall, this needs m	nentioning in the report.	
Modelled 190mm n	nineral wool conductivity 0	.032W/mK	
Carbon Reduction Part L 2013		88.40% with PV	31.30% without PV
Carbon Reduction S	AP 10.1	92.81% with PV	51.00% without PV
Total Energy Cost		£16.32	4.09 DER
Regulated Energy		2.89 kWh/m2/yr	0.92 DER

Unregulated Energy		45 kWh/m2/yr	91B	SAP	Total Energy Cost	
Local Plan +	ASHP				Regulated Energy	
					Unregulated Energy	/
Floor	Left untouched	0.6 W/m2K	42.85 m2		Base Case	Gas
Walls	Cavity Walls**	0.22 W/m2K	51.76 m2			
Roof	300mm mineral wo		42.85 m2		Floor	Left unto
Triple Glazing		0.8 W/m2K	9.27 m2		Walls	Cavity W
Heating	ASHP				Roof	300mm r
Ventilation	Aereco		allow £2000 for insta	all	Triple Glazing	
Airtightness	membrane in loft e	etc 5 m3@50Pa			Heating	Keep gas
Renewables	PV West	1 kWp			Ventilation	untouche
Thermal Bridges	Canopy	1.5 m			Airtightness	membrar
	Gutter Eaves	15.7 m			Renewables	PV
	Window Sills	5.4 m			Thermal Bridges	Canopy
	Gable	6.4 m				Gutter Ea
	Party Gable	6.4 m				Window
	Gnd Floor Perimete					Gable
Thermal Bridges wi	ll need some works doi	ing to them, either removal o	r mitigation			Party Gab
		ey have been done to a good	standard, otherwise	IWI		Gnd Floor
which becomes inv	asive and expensive.					
		ds mentioning in the report.			Cavity Walls filled a	ssumed
Modelled EWI 90m	m mineral wool condu	ctivity 0.032W/mK				
Carbon Reduction F		33.70% with PV	10.30% without I			
Carbon Reduction S	AP 10.1	42.97% with PV	34.08% without I	ν		
Total Energy Cost		£228.39	23.48	DER	Carbon Reduction F	Part L 2013
Regulated Energy		40.41 kWh/m2/yr	7.38	DER	Carbon Reduction S	SAP 10.1
Unregulated Energy	/	45 kWh/m2/yr	76C	SAP	Total Energy Cost	
Enerphit ASHP					Regulated Energy	
					Unregulated Energy	/
Floor	Left untouched	0.6 W/m2K	42.85 m2			
Walls	Cavity Walls**	0.15 W/m2K	51.76 m2			
Roof	500mm mineral wo	ool 0.09 W/m2K	42.85 m2			
Triple Glazing		0.8 W/m2K	9.27 m2			
Heating	ASHP					
Ventilation	Zehnder Q350	MVHR				
Airtightness	membrane in loft e	etc 1 m3@50Pa				
Renewables	PV West	2 kWp				
Thermal Bridges	Canopy	1.5 m				
	Gutter Eaves	15.7 m				
	Window Sills	5.4 m				
	Gable	6.4 m				
	Party Gable	6.4 m				
	Gnd Floor Perimete	er 22.1 m				
Thermal Bridges wi	ll need some works doi	ing to them, either removal o	r mitigation			
Cavity Walls if filled	, might allow EWI if the	ey have been done to a good	standard, otherwise	IWI		
which becomes inv	asive and expensive.					
U-value done on EV	VI of CWI wall, this nee	eds mentioning in the report.				
Modelled 190mm r	nineral wool conductiv	ity 0.032W/mK				
					1	
Carbon Reduction R	Part L 2013	80.60% with PV	30.90% without I	PV		

	£46.88	6.88	DER	
	8.28 kWh/m2/yr	1.67	DER	
	45 kWh/m2/yr	90B	SAP	
Gas				
Left untouched	0.6 W/m2K	42.85 m2		
Cavity Walls	0.55 W/m2K	51.76 m2		
300mm mineral wool	0.15 W/m2K	42.85 m2		
	0.8 W/m2K	9.27 m2		
Keep gas boiler				
untouched	Extract			
membrane in loft etc	8 m3@50Pa			
PV	0 kWp			
Canopy	1.5 m			
Gutter Eaves	15.7 m			
Window Sills	5.4 m			
Gable	6.4 m			
Party Gable	6.4 m			
Gnd Floor Perimeter	22.1 m			
sumed				
rt L 2013	-52.10% without PV	36.66	DER	
P 10.1	-210.67% without PV	40.76	DER	
	£374.66	73C	SAP	
	145.0 kWh/m2/yr			
	45 kWh/m2/yr			



38	Akeman	Street

Floor	Left unto	ouched	0.6	W/m2K	44 m2			
Walls	Solid Wa	lls EWI	0.2	W/m2K	80.19 m2			
Roof	500mm i	mineral wool	0.09	W/m2K	36 m2	Sloping/Flat	10.1	
Triple Glazing			0.8	W/m2K	19.81 m2	u-values	0.15W/m2K	
Heating	ASHP							
Ventilation	Zehnder	Q350	MVHR					
Airtightness	membra	ne in loft etc	1	m3@50Pa				
Renewables	PV	West	3.4	kWp				
Thermal Bridges	Canopy		0	m		65.93		
	Gutter Eaves		19	m	32.36			
	Window Sills		10.6	m				
	Gable		4	m		98.29		
	Party Ga	ble	11	m				
	Gnd Floo	r Perimeter	20.8	m				
Thermal Bridges	will need s	some works d	loing to the	em. either r	emoval or mitig	ation		
Modelled 190mn			-		0			
Carbon Reduction	n Part L 20	013	93.20%	with PV	34.3% witho	ut PV		
Carbon Reduction	n SAP 10.1	L	94.11%	with PV	59.82% witho	ut PV		
Total Energy Cost	t		£19.64			2.6	DER	
Regulated Energy	/		-3.93	kWh/m2/	yr	0.66	DER	
Unregulated Ener	rgy		31	kWh/m2/	yr	92A	SAP	

Floor	Left untouched	0.6 W/m2K	44 m2		1	Heating	Keep gas boil
Walls	Solid Walls EWI	0.3 W/m2K	80.19 m2			Ventilation	untouched
Roof	300mm mineral wool	0.15 W/m2K	36 m2	Sloping/Flat	10.1	Airtightness	membrane in
Triple Glazing		0.8 W/m2K	19.81 m2	u-values	0.15W/m2K	Renewables	PV
Heating	ASHP	0.0 00/11/21	15.01 112	u values	0.15 00/11/210	Thermal Bridges	
Ventilation	Aereco	MEV	allow £2000 for	install		incina bridges	Gutter Eaves
Airtightness	membrane in loft etc	5 m3@50Pa	2000 101	matan			Window Sills
Renewables	PV West	1 kWp					Gable
Thermal Bridges		0 m					Party Gable
incinia briages	Gutter Eaves	19 m					Gnd Floor Pe
	Window Sills	10.6 m					
	Gable	4 m					
	Party Gable	11 m				Carbon Reductio	n Part I 2013
	Gnd Floor Perimeter	20.8 m				Carbon Reductio	
Thormal Bridges	will need some works d		moval or mitiga	tion		Total Energy Cos	
•	mm mineral wool cond	•	moval of fillinga			Regulated Energy	
Carbon Reduction		44.10% with PV	27 -	70% without PV		Unregulated Energ	
Carbon Reduction		53.21% with PV		13% without PV			157
		£289.42	45	13% WITHOUT PV 14.69	DER		
Total Energy Cost Regulated Energy		1289.42 34.59 kWh/m2/yi		5.24	DER		
Unregulated Energy		34.59 kwn/m2/yi 31 kWh/m2/yi		5.24 77C	SAP		
Enerphit ASHP	бү	51 KVVII/III2/VI		770	JAP		
Enerphic ASHP							
Floor	Left untouched	0.6 W/m2K	44 m2				
Walls	Solid Walls EWI	0.2 W/m2K	80.19 m2				
Roof	500mm mineral wool	0.09 W/m2K	36 m2	Sloping/Flat			
Triple Glazing		0.8 W/m2K	19.81 m2	u-values	0.15W/m2K		
Heating	ASHP						
Ventilation	Zehnder Q350	MVHR					
Airtightness	membrane in loft etc	1 m3@50Pa					
Renewables	PV West	2 kWp					
Thermal Bridges	17	0 m					
	Gutter Eaves	19 m					
	Window Sills	10.6 m					
	Gable	4 m					
	Party Gable	11 m					
	Gnd Floor Perimeter	20.8 m					
•	will need some works d	•	moval or mitiga	tion			
	n mineral wool conduct						
Carbon Reduction		66.00% with PV	33.2% withou				
Carbon Reduction		80% with PV	59.82% withou				
Total Energy Cost		£160.35		8.93	DER		
Regulated Energy		8.28 kWh/m2/y		2.24	DER		
Unregulated Ener	ψ,	31 kWh/m2/yi	-	88B	SAP		
Base Case	Gas						
	Left untouched	0.6 W/m2K	44 m2				
Floor			00.40				
	Solid Walls	1.5 W/m2K	80.19 m2		1		
Floor Walls Roof	Solid Walls 300mm mineral wool	1.5 W/m2K 0.15 W/m2K	80.19 m2 36 m2	Sloping/Flat	10.1		

Feilden+Mawson Achieving Net Zero Carbon in Our Existing Housing Stock May 2021

extract			
8	m3@50Pa		
0	kWp		
0	m		
19	m		
10.6	m		
4	m		
11	m		
20.8	m		
-77.20%	without PV	32.47	DER
-252.66%	without PV	41.12	DER
£572.94		68D	SAP
131.93	kWh/m2/yr		
31	kWh/m2/yr		



3 Neptune Close

WI
v
v
DER
DER
-

Unregulated Energy		32 kWh/m2/yr	94A SAP	Carbon
Local Plan +	ASHP			Total E
-		0.0111/01/		Regulat
Floor	Left untouched	0.6 W/m2K	32.3 m2	Unregu
Walls	Cavity Walls**	0.22 W/m2K	82.61 m2	Base Ca
Roof	300mm mineral wool	0.15 W/m2K	32.3 m2	
Triple Glazing		0.8 W/m2K	15.03 m2	Floor
Heating	ASHP	N/5)/		Walls
Ventilation	Aereco		llow £1000 for install	Roof
Airtightness	membrane in loft etc	5 m3@50Pa		Triple (
Renewables	PV West	1 kWp		Heating
Thermal Bridges	Canopy	0 m		Ventila
	Gutter Eaves	13.34 m		Airtight
	Window Sills	10.9 m		Renew
	Gable	6.66 m		Therma
	Party Gable	6.66 m		
	Gnd Floor Perimeter	16.3 m		
Thermal Bridges wi	II need some works doing t	to them, either removal or n	nitigation	
Cavity Walls if filled	l, might allow EWI if they h	ave been done to a good sta	andard, otherwise IWI	
which becomes inv	asive and expensive.			
U-value done on EV	VI of CWI wall, this needs r	nentioning in the report.		
Modelled EWI 90m	m mineral wool conductivi	ty 0.032W/mK		Cavity
Carbon Reduction P	Part L 2013	45.00% with PV	24.40% without PV	
Carbon Reduction S	SAP 10.1	65.45% with PV	53.01% without PV	
Total Energy Cost		£225.52	15.58 DER	
Regulated Energy		26.48 kWh/m2/yr	4.25 DER	Carbon
Unregulated Energy	/	32 kWh/m2/yr	83B SAP	Carbon
Enerphit ASHP				Total E
				Regula
Floor	Left untouched	0.6 W/m2K	32.3 m2	Unregu
Walls	Cavity Walls**	0.15 W/m2K	82.61 m2	
Roof	500mm mineral wool	0.09 W/m2K	32.3 m2	
Triple Glazing		0.8 W/m2K	15.03 m2	
Heating	ASHP			
Ventilation	Zehnder Q350	MVHR		
Airtightness	membrane in loft etc	1 m3@50Pa		
Renewables	PV West	2 kWp		
Thermal Bridges	Canopy	0 m		
-	Gutter Eaves	13.34 m		
	Window Sills	10.9 m		
	Gable	6.66 m		
	Party Gable	6.66 m		
	,	16.3 m		
	Gnd Floor Perimeter		nitigation	
Thermal Bridges wi	Gnd Floor Perimeter Il need some works doing t	o them, either removal or n		
•	II need some works doing t		andard otherwise IM/I	
Cavity Walls if filled	ll need some works doing t I, might allow EWI if they h	to them, either removal or n ave been done to a good sta	andard, otherwise IWI	
Cavity Walls if filled which becomes inve	ll need some works doing t I, might allow EWI if they h asive and expensive.	ave been done to a good sta	andard, otherwise IWI	
Cavity Walls if filled which becomes inv U-value done on EV	II need some works doing t I, might allow EWI if they h asive and expensive. VI of CWI wall, this needs r	ave been done to a good stan	andard, otherwise IWI	
Cavity Walls if filled which becomes inv U-value done on EV	II need some works doing t I, might allow EWI if they h asive and expensive. VI of CWI wall, this needs r nineral wool conductivity C	ave been done to a good stan	42.60% without PV	

bon Reduction SAF	P 10.1
al Energy Cost	
gulated Energy	
regulated Energy	
se Case	Gas
or	Left untouched
ills	Cavity Walls**
of	300mm mineral wo
ole Glazing	
ating	Keep gas boiler
ntilation	untouched
tightness	membrane in loft e
newables	PV
ermal Bridges	Canopy
	Gutter Eaves
	Window Sills
	Gable
	Party Gable
	Gnd Floor Perimete
vity Walls filled assu	umed

bon Reduction Part L 2013 bon Reduction SAP 10.1 cal Energy Cost gulated Energy regulated Energy

92.93% with PV	68.05% without P	V
£45.19	4.22	DER
10.61 kWh/m2/yr	0.87	DER
32 kWh/m2/yr	93A	SAP
0.6 W/m2K	32.3 m2	
0.55 W/m2K	82.61 m2	
0.15 W/m2K	32.3 m2	
0.8 W/m2K	15.03 m2	
extract		
8 m3@50Pa		
0 kWp		
0 m		
13.34 m		
10.9 m		
6.66 m		
6.66 m		
16.3 m		
-40.90% without PV	27.65	DER
-93.64% without PV	24.65	DER
£406.61	79C	SAP
107.8 kWh/m2/yr		
32 kWh/m2/yr		
	£45.19 10.61 kWh/m2/yr 32 kWh/m2/yr 0.6 W/m2K 0.55 W/m2K 0.15 W/m2K 0.8 W/m2K extract 8 m3@50Pa 0 kWp 0 m 13.34 m 10.9 m 6.66 m 6.66 m 16.3 m	£45.19       4.22         10.61 kWh/m2/yr       0.87         32 kWh/m2/yr       93A         0.6 W/m2K       32.3 m2         0.55 W/m2K       82.61 m2         0.15 W/m2K       32.3 m2         0.8 W/m2K       15.03 m2         extract       8 m3@50Pa         0 kWp       0 m         13.34 m       10.9 m         6.66 m       6.66 m         16.3 m       16.3 m



38 Abbey Road

Zero Carbon							
Floor	Q Bot		0.35	W/m2K	50 m2		
Walls	Solid Wa	lls IWI	0.55	W/m2K	83.85 m2		
Roof	Sloping F	Roof	0.15	W/m2K	35 m2	Flat Ceiling	0.09W/m2l
Triple Glazing			0.8	W/m2K	11.81 m2	500mm m	neral wool
Heating	ASHP					33m2	
Ventilation	Zehnder	Q350 N	<b>NVHR</b>				
Airtightness	membra	ne in loft et	1	m3@50Pa			
Renewables	PV	West	4.15	kWp			
Thermal Bridges	Canopy		0	m			
	Gutter Ea	aves	22	m			
	Window	Sills	13.6	m			
	Gable		27	m			
	Party Ga	ble	14	m			
	Gnd Floo	r Perimeter	23.4	m			
Thermal Bridges v	will need s	ome works d	oing to the	em, either	removal or mitig	ation	
IWI to be deploy	ed, 80mm	woodfibre ar	nd lime pla	asters	-		
Carbon Reduction	n Part L 20	13	88.90%	with PV	37.30% withou	it PV	
Carbon Reduction	n SAP 10.1		93.63%	with PV	54.31% withou	it PV	
Total Energy Cost			£36.59			2.47	DER
Regulated Energy			2.04	kWh/m2/y	٧r	0.66	DER
Unregulated Ener	gv		27	kWh/m2/y	٧r	92A	SAP

Local Plan +	ASHP					
Floor	Q Bot	0.35	W/m2K	50 m2		
Walls	Solid Walls IWI	0.55	W/m2K	83.85 m2		
Roof	Sloping Roof	0.18	W/m2K	35 m2	Flat Ceiling	0.15W/m2k
Triple Glazing		0.8	W/m2K	11.81 m2	300mm mir	neral wool
Heating	ASHP				33m2	
Ventilation	Aereco I	MEV		allow £2000 for in	stall	
Airtightness	membrane in loft et	5	m3@50Pa			
Renewables	PV West	1	kWp			
Thermal Bridges	Canopy	0	m			
-	Gutter Eaves	22	m			
	Window Sills	13.6	m			
	Gable	27	m			
	Party Gable	14	m			
	Gnd Floor Perimeter	23.4	m			
Thermal Bridges v	vill need some works d	oing to th	em, either re	emoval or mitigation	on	
Carbon Reduction	Part L 2013	39.90%	with PV	27.50%	without PV	
Carbon Reductior	SAP 10.1	50.56%	with PV	41.57%	without PV	
Total Energy Cost		£412.19			13.38	DER
Regulated Energy		22.96	kWh/m2/yr		3.96	DER
Unregulated Ener	gy	27	kWh/m2/yr		80C	SAP
Enerphit SAP 10 A	SHP					
Floor	Q Bot	0.35	W/m2K	50 m2		
Walls	Solid Walls IWI	0.55	W/m2K	83.85 m2		
Roof	Sloping Roof	0.15	W/m2K	35 m2	Flat Ceiling	0.09W/m2H
Triple Glazing		0.8	W/m2K	11.81 m2	500mm mir	neral wool
Heating	ASHP				33m2	
Ventilation	Zehnder Q350	MVHR				
Airtightness	membrane in loft etc	1	m3@50Pa			
Renewables	PV West	2	kWp			
Thermal Bridges	Canopy	0	m			
	Gutter Eaves	22	m			
	Window Sills	13.6	m			
	Gable	27	m			
	Party Gable	14	m			
	Gnd Floor Perimeter	23.4	m			
Thermal Bridges v	vill need some works d	oing to th	em, either re	emoval or mitigation	on	
College Book and		E0 C00/	with PV	35% without P	'V	
Carbon Reduction	i Part L 2013	59.00%				
Carbon Reduction				54.31% without P	v	
	SAP 10.1			54.31% without P	V 8.99	DER
Carbon Reduction	SAP 10.1	72.16% £262.08				DER DER
Carbon Reduction Total Energy Cost	SAP 10.1	72.16% £262.08 10.74	with PV		8.99	
Carbon Reduction Total Energy Cost Regulated Energy	SAP 10.1	72.16% £262.08 10.74	with PV kWh/m2/yr		8.99 2.24	DER
Carbon Reductior Total Energy Cost Regulated Energy Unregulated Ener	SAP 10.1	72.16% £262.08 10.74 27	with PV kWh/m2/yr		8.99 2.24	DER
Carbon Reductior Total Energy Cost Regulated Energy Unregulated Ener Base Case	sap 10.1	72.16% £262.08 10.74 27 0.7	with PV kWh/m2/yr kWh/m2/yr		8.99 2.24	DER
Carbon Reductior Total Energy Cost Regulated Energy Unregulated Energy Base Case Floor	SAP 10.1 gy Untouched	72.16% £262.08 10.74 27 0.7 1.5	with PV kWh/m2/yr kWh/m2/yr W/m2K	50 m2	8.99 2.24 88B	DER

Heating Keep gas boiler Ventilation untouched ex Airtightness membrane in loft et Renewables PV Thermal Bridges Canopy Gutter Eaves Window Sills Gable Party Gable Gnd Floor Perimeter Carbon Reduction Part L 2013 Carbon Reduction SAP 10.1 Total Energy Cost Regulated Energy Unregulated Energy

Feilden+Mawson Achieving Net Zero Carbon in Our Existing Housing Stock May 2021

		33m2	
xtract			
8	m3@50Pa		
0	kWp		
0	m		
22	m		
13.6	m		
27	m		
14	m		
23.4	m		
-79.50%	without PV	27.85	DER
-230.53%	without PV	27.5	DER
£723.83		76C	SAP
113.10	kWh/m2/yr		
27	kWh/m2/yr		

Appendix C - Quantity Surveyor's report



### Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study



Version: C

No.	Description	Area	Unit	Cost / m <sup>2</sup>	Total	Notes
1	Net Zero Housing Study Cambridge City Council					
2	Option 1. Local Plan Plus				459,000	
3	Option 2. Passivhaus Certification				602,000	
4	Option 3. Net Zero Carbon on-site				610,000	
	Total				1,671,000	

### Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study

**Option 1. Local Plan Plus** 



Version: C

lo.	Description	Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTA
1	Option 1: Local Plan Plus					
2	Archetype 1				60,100	
4	Archetype 2				56,300	
6	Archetype 3				57,400	
8	Archetype 4				61,700	
10	Archetype 5				81,600	
12	Archetype 6				71,800	
14	Archetype 7				69,800	
16	Sub Total				458,700	
	Total				458,700	
le D	ate: 04 June 2021	Prepared by	Richard Littin	g Associates LLP		Pa

Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study

**Option 1. Local Plan Plus** 



Version: C			Archetyp			CONSTRUCTION CONSULTA
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 1					
2	Detail 125				11,690	
3	Detail 133				4,230	
4	Detail 135				7,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Centralised MEV	1	No	2,500.00	2,500	
7	1kWp PV array to west facing roof				2,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Sub Total				38,420	
10	Location factor uplift			3.00	1,150	
11	Preliminaries			17.00	6,730	
12	Oh&p			8.00	3,700	
13	Consultancy fees			5.00	2,500	
14	Contingency			10.00	5,250	
15	Airtightness test	2	No	100.00	200	
16	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
17	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
18	Typical annual replacement costs - PV, MVHR & Heating	1	No	530.00	530	
	Carry Forward				60,080	

Issue Date: 04 June 2021

Prepared by Richard Utting Associates LLP

stimate: Feasib	RUF					
ersion: C lo.	Description	Quantity	Archetype Unit	1 Rate	Amount	CONSTRUCTION CONSULTAI
0.	Brought Forward	Quantity	Unit	Nate		NOLES
	Brought Forward				60,080	
	Total				60,080	

**Option 1. Local Plan Plus** 



	on: C		Archetyp			CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (90mm insulation)	36	m2	200.00	7,200	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. 70mm thickness.	14	m3	125.00	1,750	
4	6. New french drain filled with pea shingle	12	m	100.00	1,200	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	12	m	45.00	540	
6	Prep works	1	No	1,000.00	1,000	
	Total				11,690	

	nate: Feasibility Study				RUP	
ers No.	on: C Description	Archetype 1 Quantity Unit Rate			Amount	CONSTRUCTION CONSULTAN
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	47. Mineral wool batts packed into void to ensure continuity of insulation	35	m2	95.00	3,325	
	Total				4,225	

stin	ct: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Option		Plan Plus	RUA	
versi No.	on: C Description	Quantity	Archetyp Unit	Rate	Amount	Notes
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	14	m2	500.00	7,000	
	Total				7,000	
ue D	ate: 04 June 2021	Prenared by	Richard Littin	g Associates LLP		Page

	nate: Feasibility Study		<b>A</b>			
ersi o.	on: C Description	Quantity	Archetyp Unit	e 1 Rate	Amount	CONSTRUCTION CONSULTA Notes
						noits
2	PV @ £2,000 per KW	1	Item	2,000.00	2,000	
		Total			2,000	

**Option 1. Local Plan Plus** 



Version: C			Archetyp	e 2		CONSTRUCTION CONSULTA
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 2					
2	Detail 125				12,310	
3	Detail 133				4,610	
4	Detail 135				3,500	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Centralised MEV	1	No	2,500.00	2,500	
7	1kWp PV array to west facing roof				2,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Sub Total				35,920	
10	Location factor uplift			3.00	1,080	
11	Preliminaries			17.00	6,290	
12	Oh&p			8.00	3,460	
13	Consultancy fees			5.00	2,340	
14	Contingency			10.00	4,910	
15	Airtightness test	2	No	100.00	200	
16	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
17	Typical annual PV, MVHR & Heating system maintenance costs	1	No	600.00	600	
18	Typical annual replacement costs - PV, MVHR & Heating	1	No	530.00	530	
	Carry Forward				56,330	

Issue Date: 04 June 2021

stimate: Feasib	o Housing Study Cambridge CC pility Study		1. Local Pl	CONSTRUCTION CONSULTANT		
ersion: C Io.	Description	Archetype 2 Quantity Unit Rate			Amount	
10.		Quantity	Onit	Nale		notes
	Brought Forward				56,330	
	Total				56,330	

**Option 1. Local Plan Plus** 



Versi	on: C		Archetyp	e 2		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (90mm insulation)	40	m2	200.00	8,000	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. 70mm thickness.	16	m3	125.00	2,000	
4	6. New french drain filled with pea shingle	9	m	100.00	900	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	9	m	45.00	405	
6	Prep works	1	No	1,000.00	1,000	
	Total				12,305	

	nate: Feasibility Study				RUF	
ersi lo.	ion: C Description	Archetype 2 Quantity Unit Rate			Amount	CONSTRUCTION CONSULTAN
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	47. Mineral wool batts packed into void to ensure continuity of insulation	39	m2	95.00	3,705	
	Total				4,605	

stin	ect: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Option	n 1. Local		RUA	
	ion: C		Archetyp		CONSTRUCTION CONSULTANT	
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	7	m2	500.00	3,500	
	Total				3,500	
ue D	Date: 04 June 2021	Prepared by	Richard Uttin	g Associates LLP		Page

	nate: Feasibility Study on: C			Archotype			
0.	Description		Quantity	Archetype 2 Unit Rate		Amount	Notes
2	PV @ £2,000 per KW		1	No	2,000.00	2,000	
		Total				2,000	

**Option 1. Local Plan Plus** 



	Version: C		Archetyp			CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 3					
2	Detail 125				11,540	
3	Detail 133				4,610	
4	Detail 135				5,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Centralised MEV	1	No	2,500.00	2,500	
7	1kWp PV array to west facing roof				2,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Sub Total				36,650	
10	Location factor uplift			3.00	1,100	
11	Preliminaries			17.00	6,420	
12	Oh&p			8.00	3,530	
13	Consultancy fees			5.00	2,390	
14	Contingency			10.00	5,010	
15	Airtightness test	2	No	100.00	200	
16	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
17	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
18	Typical annual replacement costs - PV, MVHR & Heating	1	No	530.00	530	
	Carry Forward				57,430	

stimate: Feasib ersion: C	Housing Study Cambridge CC ility Study		1. Local Pl Archetype	RUP		
0.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward		••••		57,430	
	Total				57,430	

Project: Net Zero Housing Study Cambridge CC
Estimate: Feasibility Study

**Option 1. Local Plan Plus** 



## Version: C Archetype 3 Description Quantity Unit Rate Amount No. Notes 2 4. External wall mineral wool rendered system (90mm 39 m2 200.00 7,800 insulation) 5. XPS insulation greenguard GG300 board suitable for 2,000 16 125.00 3 m3 under ground situations. 70mm thickness. 6. New french drain filled with pea shingle 12 100.00 1,200 4 m 7. New 200 x 50mm pre cast concrete kerb edging set 12 45.00 540 5 m in concrete foundation Prep works 6 Total 11,540

	nate: Feasibility Study			Plan Plus		CONSTRUCTION CONSULTANT
ersi No.	ion: C Description	Quantity	Archetyp Unit	e 3 Rate	Amount	
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	47. Mineral wool batts packed into void to ensure continuity of insulation	39	m2	95.00	3,705	
	Total				4,605	

oject: Net Zero Housing Study Cambridge CC stimate: Feasibility Study	Option	n 1. Local I			RUA
ersion: C	O	Archetype		CONSTRUCTION CONSULTAN	
o. Description	Quantity	Unit	Rate	Amount	Notes
2 41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	10	m2	500.00	5,000	
Total				5,000	
e Date: 04 June 2021	Prepared by	Richard Utting	g Associates LLP		Page

Estimate: Feasibility Study /ersion: C				Archetype			
0.	Description		Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTA Notes
2	PV @ £2,000 per KW		1	No	2,000.00	2,000	
		Total				2,000	

**Option 1. Local Plan Plus** 



Version: C			Archetyp			CONSTRUCTION CONSULT
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 4					
2	Detail 125				14,480	
3	Detail 133				4,990	
4	Detail 135				4,500	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Centralised MEV	1	No	2,500.00	2,500	
7	1kWp PV array to west facing roof				2,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Sub Total				39,470	
10	Location factor uplift			3.00	1,180	
11	Preliminaries			17.00	6,910	
12	Oh&p			8.00	3,810	
13	Consultancy fees			5.00	2,570	
14	Contingency			10.00	5,390	
15	Airtightness test	2	No	100.00	200	
16	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
17	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
18	Typical annual replacement costs - PV, MVHR & Heating	1	No	530.00	530	
	Carry Forward				61,660	

Issue Date: 04 June 2021

stimate: Feasibi	Housing Study Cambridge CC lity Study		1. Local Pl			KUP
ersion: C	Description	Overtity	Archetype	4 Dete	A	CONSTRUCTION CONSULTA
0.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				61,660	
	Total				61,660	

**Option 1. Local Plan Plus** 



Versi	on: C		Archetyp	e 4		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (90mm insulation)	43	m2	200.00	8,600	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. 70mm thickness.	17	m3	125.00	2,125	
4	6. New french drain filled with pea shingle	19	m	100.00	1,900	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	19	m	45.00	855	
6	Prep works	1	No	1,000.00	1,000	
	Total				14,480	

	nate: Feasibility Study		A	- 4		
ers Io.	ion: C Description	Quantity	Archetyp Unit	e 4 Rate	Amount	CONSTRUCTION CONSULTAI
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	47. Mineral wool batts packed into void to ensure continuity of insulation	43	m2	95.00	4,085	
	Total				4,985	

Projec Stima Versic	ct: Net Zero Housing Study Cambridge CC ate: Feasibility Study	Optio	n 1. Local			RUA
No.	Description	Quantity	Archetyp Unit	Rate	Amount	CONSTRUCTION CONSULTAN Notes
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	9	m2	500.00	4,500	
	Total				4,500	
e Da	te: 04 June 2021	Prepared by	Richard Uttin	g Associates LLP		Page

Estimate: Feasibility Study /ersion: C				Archetype			
0.	Description		Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW		1	No	2,000.00	2,000	
		Total				2,000	

**Option 1. Local Plan Plus** 



lo.	on: C Description	Quantity	Archetyp Unit	Rate	Amount	CONSTRUCTION CONSULTA
1	Archetype 5					
					22,000	
2	Detail 125				22,900	
3	Detail 133				4,320	
4	Detail 135				10,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Centralised MEV	1	No	2,500.00	2,500	
7	1kWp PV array to west facing roof				2,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Sub Total				52,720	
10	Location factor uplift			3.00	1,580	
11	Preliminaries			17.00	9,230	
12	Oh&p			8.00	5,080	
13	Consultancy fees			5.00	3,430	
14	Contingency			10.00	7,200	
15	Airtightness test	2	No	100.00	200	
16	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
17	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
18	Typical annual replacement costs - PV, MVHR & Heating	1	No	530.00	530	
	Carry Forward				81,570	

ersion: C			Archetype		CONSTRUCTION CONSULTAI	
0.	Description	Quantity	Unit	Rate	Amount	Notes
I	Brought Forward				81,570	
	Total				81,570	

Project: Net Zero Housing Study Cambridge CC
Estimate: Feasibility Study

**Option 1. Local Plan Plus** 



## Version: C Archetype 5 Description Quantity Unit Rate Amount No. Notes 2 4. External wall mineral wool rendered system (90mm 80 m2 200.00 16,000 insulation) 5. XPS insulation greenguard GG300 board suitable for 32 125.00 4,000 3 m3 under ground situations. 70mm thickness. 6. New french drain filled with pea shingle 20 100.00 2,000 4 m 7. New 200 x 50mm pre cast concrete kerb edging set 20 45.00 900 5 m in concrete foundation Prep works 6 Total 22,900

Estimate: Feasibility Study /ersion: C				-		
ers Io.	ion: C Description	Quantity	Archetyp Unit	e 5 Rate	Amount	CONSTRUCTION CONSULTAI
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	47. Mineral wool batts packed into void to ensure continuity of insulation	36	m2	95.00	3,420	
	Total				4,320	

stin	ect: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Optio	n 1. Local				
	ion: C		Archetyp			CONSTRUCTION CONSULTAN	
No.	Description	Quantity	Unit	Rate	Amount	Notes	
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	20	m2	500.00	10,000		
	Total				10,000		
	late: 04 June 2021	Prepared by	Richard Uttin	g Associates LLP		Page	

	nate: Feasibility Study on: C			Archetype			
0.	Description		Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTAI
2	PV @ £2,000 per KW		1	No	2,000.00	2,000	
		Total				2,000	

**Option 1. Local Plan Plus** 



Version: C			Archetyp		•	CONSTRUCTION CONSUL
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 6					
2	Detail 125				19,300	
3	Detail 133				3,940	
4	Detail 135				7,500	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Centralised MEV	1	No	2,500.00	2,500	
7	1kWp PV array to west facing roof				2,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Sub Total				46,240	
10	Location factor uplift			3.00	1,390	
11	Preliminaries			17.00	8,100	
12	Oh&p			8.00	4,460	
13	Consultancy fees			5.00	3,010	
14	Contingency			10.00	6,320	
15	Airtightness test	2	No	100.00	200	
16	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
17	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
18	Typical annual replacement costs - PV, MVHR & Heating	1	No	530.00	530	
	Carry Forward				71,850	

Estimate: Feasibility Study Version: C			Archetype			
0.	Description	Quantity	Unit	Rate	Amount	Notes
1	Brought Forward				71,850	
	Total				71,850	
	, otai					

Project: Net Zero Housing Study Cambridge CC
Estimate: Feasibility Study

**Option 1. Local Plan Plus** 



## Version: C Archetype 6 Description No. Quantity Unit Rate Amount Notes 2 4. External wall mineral wool rendered system (90mm 68 m2 200.00 13,600 insulation) 5. XPS insulation greenguard GG300 board suitable for 27 125.00 3,375 3 m3 under ground situations. 70mm thickness. 6. New french drain filled with pea shingle 16 100.00 1,600 4 m 7. New 200 x 50mm pre cast concrete kerb edging set 16 45.00 720 5 m in concrete foundation Total 19,295

Estimate: Feasibility Study /ersion: C						RUF
vers No.	ion: C Description	Quantity	Archetyp Unit	e 6 Rate	Amount	CONSTRUCTION CONSULTAI
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	47. Mineral wool batts packed into void to ensure continuity of insulation	32	m2	95.00	3,040	
	Total				3,940	

stim	ct: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Option	n 1. Local			RUA
versi No.	on: C Description	Quantity	Archetyp Unit	e 6 Rate	Amount	CONSTRUCTION CONSULTAN
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	15	m2	500.00	7,500	
	Total				7,500	
ue D	ate: 04 June 2021	Prepared by	Richard Uttin	g Associates LLP		Page

	nate: Feasibility Study ion: C			Archetype			
0.	Description		Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTA Notes
2	PV @ £2,000 per KW		1	No	2,000.00	2,000	
		Total				2,000	

**Option 1. Local Plan Plus** 



Version: C			Archetyp			CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 7					
2	Detail 132				13,500	
3	Detail 133				4,230	
4	Detail 135				6,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Centralised MEV	1	No	2,500.00	2,500	
7	1kWp PV array to west facing roof				2,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Sub Total				39,230	
10	Location factor uplift			3.00	1,180	
11	Preliminaries			17.00	6,870	
12	Oh&p			8.00	3,780	
13	Consultancy fees			5.00	2,550	
14	Contingency			10.00	5,360	
15	Airtightness test	2	No	100.00	200	
16	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
17	Tenant decant	1	No	8,500.00	8,500	
18	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
19	Typical annual replacement costs - PV, MVHR & Heating	1	No	530.00	530	
	Carry Forward				69,800	

Issue Date: 04 June 2021

ersion: C			Archetype		CONSTRUCTION CONSULT	
0.	Description	Quantity	Unit	Rate	Amount	Notes
1	Brought Forward				69,800	
	Total				69,800	

tim	ct: Net Zero Housing Study Cambridge CC nate: Feasibility Study	udy					
	on: C	0	Archetyp		A	CONSTRUCTION CONSULTAN	
0.	Description	Quantity	Unit	Rate	Amount	Notes	
2	Internal wall insulation (no detail available)	90	m2	150.00	13,500		
		Total			13,500		
• D	ate: 04 June 2021	Dropored by	Dichard Littia	g Associates LLP		Page	

	nate: Feasibility Study		<b>A</b>	- 7	RUA	
ers Io.	ion: C Description	Archetype 7 Quantity Unit Rate			Amount	CONSTRUCTION CONSULTAN
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	47. Mineral wool batts packed into void to ensure continuity of insulation	35	m2	95.00	3,325	
	Total				4,225	

Estim	ct: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Optio		Plan Plus	RUA	
	on: C		Archetyp			CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	12	m2	500.00	6,000	
	Total				6,000	
sue Da	ate: 04 June 2021			g Associates LLP		Page

	ate: Feasibility Study			Archetype			
0.	Description		Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTANT
2	PV @ £2,000 per KW		1	No	2,000.00	2,000	
		Total				2,000	

**Option 2. Passivhaus Certification** 



Version: C

Version: C Description		Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTAN Notes
1 Option 2: Passivhaus certification						
2 Archetype 1					76,100	
4 Archetype 2					73,800	
6 Archetype 3					76,300	
8 Archetype 4					80,400	
10 Archetype 5					110,200	
12 Archetype 6					97,000	
14 Archetype 7					88,000	
16	Sub Total				601,800	
	Total				601,800	
sue Date: 04 June 2021		Prepared by	Richard Uttin	g Associates LLP		

**Option 2. Passivhaus Certification** 



Version: C			Archetyp	e 1		CONSTRUCTION CONSULTAI
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 1					
2	Detail 126a				15,440	
3	Detail 134				7,030	
4	Detail 135				7,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Comfoair 200 MVHR system	1	No	1,500.00	1,500	
7	2kWp PV array to west facing roof				4,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	36	m2	60.00	2,160	
10	Sub Total				48,130	
11	Location factor uplift			3.00	1,440	
12	Preliminaries			17.00	8,430	
13	Oh&p			8.00	4,640	
14	Consultancy fees			5.00	3,130	
15	Contingency			10.00	6,580	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	EnerPHit Certification	1	No	1,000.00	1,000	
18	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
19	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
	Carry Forward				75,490	

Issue Date: 04 June 2021

	nate: Feasibility Study				RUA	
	on: C		Archetyp			CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward		1		75,490	
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				76,100	



Versi	Version: C		Archetyp	e 1		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	36	m2	275.00	9,900	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	14	m3	200.00	2,800	
4	6. New french drain filled with pea shingle	12	m	100.00	1,200	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	12	m	45.00	540	
6	Prep works	1	No	1,000.00	1,000	
	Total				15,440	



Versi	on: C		Archetyp	e 1		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus option)	35	m2	50.00	1,750	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	35	m2	125.00	4,375	
	Total				7,025	

oject: Net Zero Housing Study Cambridge CC timate: Feasibility Study	Option 2. F	Passivhau	s Certification		RUA
rsion: C		Archetyp		CONSTRUCTION CONSULTAN	
o. Description	Quantity	Unit	Rate	Amount	Notes
2 41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	14	m2	500.00	7,000	
Total				7,000	
e Date: 04 June 2021	Prepared by	Richard Uttin	g Associates LLP		Pag

Proje Estin	ct: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Option 2. F	Passivhau	s Certification	RUA	
Versi	on: C		Archetyp	e 1		CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	
Issue D	ate: 04 June 2021	Prepared by	Richard Uttin	g Associates LLP	1	Page 51

**Option 2. Passivhaus Certification** 



Versi	/ersion: C		Archetyp	e 2		CONSTRUCTION
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 2					
2	Detail 126a				16,510	
3	Detail 134				7,730	
4	Detail 135				3,500	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
7	2kWp PV array to west facing roof				4,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	40	m2	60.00	2,400	
10	Sub Tota	ıl			46,640	
11	Location factor uplift			3.00	1,400	
12	Preliminaries			17.00	8,170	
13	Oh&p			8.00	4,500	
14	Consultancy fees			5.00	3,040	
15	Contingency			10.00	6,370	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	EnerPHit Certification	1	No	1,000.00	1,000	
18	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
19	Typical annual PV, MVHR & heating system maintenance costs	1	No	600.00	600	
	Carry Forward	d			73,260	

Issue Date: 04 June 2021

	nate: Feasibility Study			KUA		
	on: C		Archetype		<b>A</b> 1	CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				73,260	
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				73,870	



	on: C		Archetyp			CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	40	m2	275.00	11,000	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	16	m3	200.00	3,200	
4	6. New french drain filled with pea shingle	9	m	100.00	900	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	9	m	45.00	405	
6	Prep works	1	No	1,000.00	1,000	
	Total				16,505	

## **Option 2. Passivhaus Certification**



Versi	on: C		Archetyp	e 2		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for passivhaus option)	39	m2	50.00	1,950	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	39	m2	125.00	4,875	
	Total				7,725	

Issue Date: 04 June 2021

roject: Net Zero Housing Study Cambridge CC stimate: Feasibility Study	Option 2. F	Passivhaus	RUA		
ersion: C		Archetype		CONSTRUCTION CONSULTANT	
lo. Description	Quantity	Unit	Rate	Amount	Notes
2 41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	7	m2	500.00	3,500	
Total				3,500	
e Date: 04 June 2021	Prepared by	Richard Utting	g Associates LLP		Pag

Proje Estin	ect: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Option 2. I	Passivhau	s Certification		RUA
Versi	ion: C		Archetyp	e 2	CONSTRUCTION CONSULTANTS	
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	
	Total				4,000	
Issue D	ate: 04 June 2021	Prepared by	Richard Uttin	ng Associates LLP		Page 57

**Option 2. Passivhaus Certification** 



	ion: C		Archetyp			CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 3					
2	Detail 126a				16,670	
3	Detail 134				7,730	
4	Detail 135				5,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder comfoair 200 MVHR system	1	No	1,500.00	1,500	
7	2kWp PV array to west facing roof				4,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	39	m2	60.00	2,340	
10	Sub Total				48,240	
11	Location factor uplift			3.00	1,450	
12	Preliminaries			17.00	8,450	
13	Oh&p			8.00	4,650	
14	Consultancy fees			5.00	3,140	
15	Contingency			10.00	6,590	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	EnerPHit Certification	1	No	1,000.00	1,000	
18	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
19	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
	Carry Forward				75,660	

Issue Date: 04 June 2021

	nate: Feasibility Study		<b>.</b> .	KUA		
	on: C		Archetype		<b>A</b>	CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward	1			75,660	
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				76,270	



Versi	on: C		Archetyp	e 3		CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	39	m2	275.00	10,725	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	16	m3	200.00	3,200	
4	6. New french drain filled with pea shingle	12	m	100.00	1,200	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	12	m	45.00	540	
6	Prep works	1	No	1,000.00	1,000	
	Total				16,665	

## **Option 2. Passivhaus Certification**



Versi	on: C		Archetyp	e 3		CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus option)	39	m2	50.00	1,950	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	39	m2	125.00	4,875	
	Total				7,725	

Issue Date: 04 June 2021

	nate: Feasibility Study		Anchotun			
ers Io.	ion: C Description	Quantity	Archetype Unit	Rate	Amount	CONSTRUCTION CONSULTA
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	10	m2	500.00	5,000	
	Total				5,000	

imate: Feasibilit sion: C		۸ro	hetype				
	Description	Quar		Jnit	Rate	Amount	CONSTRUCTION CONSULTAN Notes
PV @ £2,000	-	1		No	4,000.00	4,000	
		Total				4,000	

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**Option 2. Passivhaus Certification** 



Version: C			Archetyp	e 4		CONSTRUCTION CONSULTA
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 4					
2	Detail 126a				18,980	
3	Detail 134				8,430	
4	Detail 135				4,500	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
7	2kWp PV array to west facing roof				4,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	43	m2	60.00	2,580	
10	Sub Total				50,990	
11	Location factor uplift			3.00	1,530	
12	Preliminaries			17.00	8,930	
13	Oh&p			8.00	4,920	
14	Consultancy fees			5.00	3,320	
15	Contingency			10.00	6,970	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	EnerPHit Certification	1	No	1,000.00	1,000	
18	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
19	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
	Carry Forward				79,800	

Issue Date: 04 June 2021

Description Brought Forward Typical annual replacement costs - PV, MVHR &	Quantity	Archetype Unit			CONSTRUCTION CONSULTA
Brought Forward	Quantity	Unit		A	NI - (
ypical annual replacement costs - PV, MVHR &			Rate	Amount	Notes
ypical annual replacement costs - PV, MVHR &				79,800	
leating	1	No	610.00	610	
Total				80,410	
	∴ 04 June 2021	• 04 June 2021			



	on: C		Archetyp			CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	43	m2	275.00	11,825	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	17	m3	200.00	3,400	
4	6. New french drain filled with pea shingle	19	m	100.00	1,900	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	19	m	45.00	855	
6	Prep works	1	No	1,000.00	1,000	
	Total				18,980	

## **Option 2. Passivhaus Certification**



Versi	ion: C	Archetype 4				
No.	Description	Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTANT Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus option)	43	m2	50.00	2,150	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	43	m2	125.00	5,375	
	Total				8,425	

Issue Date: 04 June 2021

Estimate: Feasibility Study Version: C			A	- 4			
ersi lo.	Description	Archetype 4 Quantity Unit Rate Amour			Amount	nount Notes	
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	9	m2	500.00	4,500		
	Total				4,500		

Version: C			Archet	ype 4		CONSTRUCTION CONSULTAN
)_	Description		Quantity Unit Rate Amount			Notes
PV @ £2,000	) per KW	1	No	4,000.00	4,000	
		Total			4,000	

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**Option 2. Passivhaus Certification** 



Version: C			Archetyp	e 5		CONSTRUCTION CONSUL
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 5					
2	Detail 126a				32,300	
3	Detail 134				7,200	
4	Detail 135				10,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
7	2kWp PV array to west facing roof				4,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	80	m2	60.00	4,800	
10	Sub Total				70,800	
11	Location factor uplift			3.00	2,120	
12	Preliminaries			17.00	12,400	
13	Oh&p			8.00	6,830	
14	Consultancy fees			5.00	4,610	
15	Contingency			10.00	9,680	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	EnerPHit Certification	1	No	1,000.00	1,000	
18	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
19	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
	Carry Forward				109,580	

Issue Date: 04 June 2021

Estimate: Feasibility Study /ersion: C			A	F		
ersi No.	Ion: C Description	Quantity	Archetype Unit	Rate	Amount	CONSTRUCTION CONSULTAI
10.	Brought Forward	Quantity	Unit	Nate	109,580	Notes
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				110,190	



Versi	on: C		Archetyp	e 5		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	80	m2	275.00	22,000	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	32	m3	200.00	6,400	
4	6. New french drain filled with pea shingle	20	m	100.00	2,000	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	20	m	45.00	900	
6	Prep works	1	No	1,000.00	1,000	
	Total				32,300	

Project: Net Zero Housing Study Cambridge CC	
Estimate: Feasibility Study	



Versi	on: C		Archetyp	e 5		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for passivhaus option)	36	m2	50.00	1,800	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	36	m2	125.00	4,500	
	Total				7,200	

Estimate: Feasibility Study /ersion: C				s Certification	KUA		
ersı lo.	on: C Description	Quantity	Archetype Unit	e 5 Rate	Amount	CONSTRUCTION CONSULTA	
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	20	m2	500.00	10,000	Notes	
	Total				10,000		

Estimate: Feasibility Study Version: C			Archety	ne 5		
			ity Unit	Rate	Amount	CONSTRUCTION CONSULTANT Notes
PV @ £2,000	per KW	1	No	4,000.00	4,000	
		Total			4,000	

Oution 0. Desciulation Contification



**Option 2. Passivhaus Certification** 



Versi	on: C	Archetype 6				CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 6					
2	Detail 126a				27,420	
3	Detail 134				6,500	
4	Detail 135				7,500	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
7	2kWp PV array to west facing roof				4,000	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	68	m2	60.00	4,080	
10	Sub Total				62,000	
11	Location factor uplift			3.00	1,860	
12	Preliminaries			17.00	10,860	
13	Oh&p			8.00	5,980	
14	Consultancy fees			5.00	4,030	
15	Contingency			10.00	8,470	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	EnerPHit Certification	1	No	1,000.00	1,000	
18	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
19	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
	Carry Forward				96,340	

Issue Date: 04 June 2021

Estimate: Feasibility Study Version: C			Arobotum			
ersi lo.	Description	Quantity	Archetype Unit	Rate	Amount	CONSTRUCTION CONSULTA Notes
0.	Brought Forward		Unit	Nate	96,340	Notes
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				96,950	

**Option 2. Passivhaus Certification** 



Versi	on: C		Archetyp	e 6		CONSTRUCTION CONSULTANTS		
No.	Description	Quantity	Unit	Rate	Amount	Notes		
2	4. External wall mineral wool rendered system (180mm insulation)	68	m2	275.00	18,700			
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	27	m3	200.00	5,400			
4	6. New french drain filled with pea shingle	16	m	100.00	1,600			
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	16	m	45.00	720			
6	Prep works	1	No	1,000.00	1,000			
	Total				27,420			

## **Option 2. Passivhaus Certification**



Versi	on: C		Archetyp	e 6		CONSTRUCTION CONSULTAN		
No.	Description	Quantity	Unit	Rate	Amount	Notes		
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900			
3	30. 300mm existing mineral wool (200mm extra laid over for passivhaus option)	32	m2	50.00	1,600			
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	32	m2	125.00	4,000			
	Total				6,500			

	nate: Feasibility Study		Archatura			
ers No.	ion: C Description	Quantity	Archetype Unit	Rate	Amount	CONSTRUCTION CONSULTA Notes
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	15	m2	500.00	7,500	
	Total				7,500	

Version: C			Archety	pe 6		CONSTRUCTION CONSULTAN
).			tity Unit	Rate	Amount	Notes
PV @ £2,000	) per KW	1	No	4,000.00	4,000	
		Total			4,000	

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**Option 2. Passivhaus Certification** 



Version: C			Archetyp			CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 7					
2	Detail 129a / 130a				4,700	
3	Detail 132				13,500	
4	Detail 133				4,580	
5	Detail 135				6,000	
6	Air source heat pump	1	No	7,500.00	7,500	
7	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
8	2kWp PV array to west facing roof				4,000	
9	General scaffolding allowance	1	No	3,500.00	3,500	
10	Additional external wall render	85	m2	60.00	5,100	
11	Sub Total				50,380	
12	Location factor uplift			3.00	1,510	
13	Preliminaries			17.00	8,820	
14	Oh&p			8.00	4,860	
15	Consultancy fees			5.00	3,280	
16	Contingency			10.00	6,880	
17	Pressurisation / Depressurisation tests	3	No	180.00	540	
18	EnerPHit Certification	1	No	1,000.00	1,000	
19	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
20	Tenant decant	1	No	8,500.00	8,500	
	Carry Forward				86,770	

Issue Date: 04 June 2021

Prepared by Richard Utting Associates LLP

Project: Net Zero Housing Study Cambridge CC
Estimate: Feasibility Study

**Option 2. Passivhaus Certification** 



lo.	Description	Archetype 7 Description Quantity Unit Rate Amount				
10.		Quantity	Unit	Nale		Notes
1	Brought Forward				86,770	
21	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
22	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				87,980	

Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study		Option 2. F	Passivhaus	RUA		
	ion: C		Archetype			CONSTRUCTION CONSULTAN
о.	Description	Quantity	Unit	Rate	Amount	Notes
2	Qbot to ground floor	47	m2	100.00	4,700	
		Total			4,700	

## **Option 2. Passivhaus Certification**



# 

Version: C			Archetype		CONSTRUCTION CONSULTANTS	
о.	Description	Quantity	Unit	Rate	Amount	Notes
2	Internal wall insulation (no detail available)	90	m2	150.00	13,500	
	1	Fotal			13,500	

Project: Net Zero Housing Study Cambridge CC	
Estimate: Feasibility Study	

### **Option 2. Passivhaus Certification**



# Version: C Archetype 7 Description Unit No. Quantity Rate Amount Notes 2 29. New 102mm half round black gutter upvc. Upvc 10 90.00 900 m fascia and soffit. 43. 150mm Kingspan Thermopitch TP10 infill insulation 35 105.00 3,675 3 m2 to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path. Total 4,575

	nate: Feasibility Study on: C		Arohotum			
ersi lo.	Description	Quantity	Archetyp Unit	Rate	Amount	CONSTRUCTION CONSULTA Notes
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	12	m2	500.00	6,000	
	Total				6,000	

Proje Estin	ect: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Option 2. F	Passivhau	s Certification		RUA
Versi	ion: C		Archetyp	e 7	CONSTRUCTION CONSULTANTS	
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	
					4,000	
Issue D	ate: 04 June 2021	Prepared by	Richard Uttin	ng Associates LLP		Page 88

Option 3. Net Zero Carbon on-site



Version: C

No.	Description	Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULT
1	Option 3: Net Zero Carbon on-site					
2	Archetype 1				70,600	
4	Archetype 2				74,100	
6	Archetype 3				70,600	
8	Archetype 4				87,700	
10	Archetype 5				113,500	
12	Archetype 6				97,200	
14	Archetype 7				96,400	
16	Sub Total				610,100	
	Total				610,100	
ue D	ate: 04 June 2021	Propared by	Dichard Littin	g Associates LLP		Pa

Option 3. Net Zero Carbon on-site



Versi	Version: C		Archetyp	e 1		CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 1					
2	Detail 126a				15,440	
3	Detail 134				7,030	
4	Detail 135				7,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Comfoair 200 MVHR system	1	No	1,500.00	1,500	
7	0.55kWp PV array to west facing roof				1,100	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	36	m2	60.00	2,160	
10	Sub Total				45,230	
11	Location factor uplift			3.00	1,360	
12	Preliminaries			17.00	7,920	
13	Oh&p			8.00	4,360	
14	Consultancy fees			5.00	2,940	
15	Contingency			10.00	6,180	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
18	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
19	Typical annual replacement costs - PV, MVHR & Heating	1	No	494.00	490	
	Carry Forward				70,620	

Issue Date: 04 June 2021

Prepared by Richard Utting Associates LLP

stimate: Feasik	o Housing Study Cambridge CC bility Study	Option 3. N		KUA		
ersion: C			Archetype			CONSTRUCTION CONSULTA
lo.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				70,620	
	Total				70,620	
e Date: 04 June	9 2021	Prepared by I				Pag

## Option 3. Net Zero Carbon on-site



Versi	on: C		Archetyp	e 1		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	36	m2	275.00	9,900	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	14	m3	200.00	2,800	
4	6. New french drain filled with pea shingle	12	m	100.00	1,200	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	12	m	45.00	540	
6	Prep works	1	No	1,000.00	1,000	
	Total				15,440	

### **Option 3. Net Zero Carbon on-site**



Versi	on: C		Archetyp	e 1		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus & Zero carbon option)	35	m2	50.00	1,750	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	35	m2	125.00	4,375	
	Total				7,025	

Estimate: Feasibility Study Version: C			•			
ersı lo.	on: C Description	Quantity	Archetype Unit	e 1 Rate	Amount	CONSTRUCTION CONSULTAN
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	14	m2	500.00	7,000	
	Total				7,000	

Version: C			Archetyp		CONSTRUCTION CONSULTAN	
-	Description	Quant		Rate	Amount	Notes
PV @ £2,0	00 per KW	1	No	1,100.00	1,100	
		Total			1,100	

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Outlos 2 Not Zone Cont  **Option 3. Net Zero Carbon on-site** 



#### Version: C Archetype 2 Description Unit No. Quantity Rate Amount Notes Archetype 2 1 Detail 126a 2 16,510 7,730 3 Detail 134 Detail 135 3,500 4 Air source heat pump 7,500.00 7,500 5 1 No Zehnder Q350 MVHR system 1,500 6 1 No 1.500.00 7 2.4kWp PV array to west facing roof 4,800 8 General scaffolding allowance No 3.500.00 3,500 1 40 60.00 9 Additional external wall render m2 2,400 Sub Total 47,440 10 Location factor uplift 3.00 1,420 11 8,310 12 Preliminaries 17.00 13 Oh&p 8.00 4,570 3,090 14 Consultancy fees 5.00 15 Contingency 10.00 6,480 16 Pressurisation / Depressurisation tests 3 No 180.00 540 PAS2035 Retrofit Coordinator Role 1,000.00 1,000 17 No 1 Typical annual maintenance costs - PV, MVHR & 18 1 No 600.00 600 Heating Typical annual replacement costs - PV, MVHR & 640 19 No 642.00 1 Heating **Carry Forward** 74,090

Issue Date: 04 June 2021

Prepared by Richard Utting Associates LLP

roject: Net Zero stimate: Feasib	Option 3. N		RUA				
ersion: C		Archetype 2					
ю.	Description	Quantity	Unit	Rate	Amount	Notes	
I	Brought Forward		1		74,090		
	Total				74,090		

### Option 3. Net Zero Carbon on-site



Versi	on: C		Archetype	e 2	CONSTRUCTION CONSULTA	
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	40	m2	275.00	11,000	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	16	m3	200.00	3,200	
4	6. New french drain filled with pea shingle	9	m	100.00	900	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	9	m	45.00	405	
6	Prep works	1	No	1,000.00	1,000	
	Total				16,505	

### **Option 3. Net Zero Carbon on-site**



Versi	on: C		Archetyp	e 2	CONSTRUCTION CONSULTANT	
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus & Zero carbon option)	39	m2	50.00	1,950	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	39	m2	125.00	4,875	
	Total				7,725	

Estimate: Feasibility Study /ersion: C			Archetype	. 2		
lo.	Description	Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTAI
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	7	m2	500.00	3,500	
	Total				3,500	

Quantity 1 Total	UnitRateNo4,800.00	Amount           4,800           4,800	Notes
1		4,800	Notes
	No 4,800.00		
Total		4,800	
	Prepared by	Prepared by Richard Utting Associates LLP	Prepared by Richard Utting Associates LLP

No.

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**Option 3. Net Zero Carbon on-site** 



#### Version: C Archetype 3 Description Unit Quantity Rate Amount Archetype 3 Detail 126a 16,670 7,730 Detail 134 Detail 135 5,000 7,500.00 7,500 Air source heat pump 1 No Zehnder comfoair 200 MVHR system 1,500 1 No 1.500.00 0.5kWp PV array to west facing roof 1,000 General scaffolding allowance No 3.500.00 3,500 1 39 60.00 2,340 Additional external wall render m2 Sub Total 45,240 Location factor uplift 3.00 1,360 7,920 Preliminaries 17.00 Oh&p 8.00 4,360 2,940 Consultancy fees 5.00 Contingency 10.00 6,180 Pressurisation / Depressurisation tests 3 No 180.00 540 PAS2035 Retrofit Coordinator Role 1,000.00 1,000 No 1

Typical annual maintenance costs - PV, MVHR & 18 1 Heating Typical annual replacement costs - PV, MVHR & 19 1 Heating **Carry Forward** 

Prepared by Richard Utting Associates LLP

No

No

600.00

490.00

600

490

70,630

roject: Net Zero stimate: Feasib	Option 3. N		KUP				
ersion: C		Archetype 3					
10.	Description	Quantity	Unit	Rate	Amount	Notes	
I	Brought Forward		1		70,630		
	Total				70,630		

### Option 3. Net Zero Carbon on-site



Versi	on: C		Archetyp	e 3		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	39	m2	275.00	10,725	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	16	m3	200.00	3,200	
4	6. New french drain filled with pea shingle	12	m	100.00	1,200	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	12	m	45.00	540	
6	Prep works	1	No	1,000.00	1,000	
	Total				16,665	

### **Option 3. Net Zero Carbon on-site**



Versi	on: C		Archetyp	e 3		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus & Zero carbon options)	39	m2	50.00	1,950	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	39	m2	125.00	4,875	
	Total				7,725	

	nate: Feasibility Study ion: C		Archetype	3			
lo.	Description	Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTAN	
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	10	m2	500.00	5,000		
	Total				5,000		

Proje Estim	ct: Net Zero Housing Study Cambridge CC nate: Feasibility Study	Option 3. I	Net Zero C	arbon on-site		RUA
Versi	on: C		Archetyp	e 3		CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	1,000.00	1,000	
	Total				1,000	
Issue Da	ate: 04 June 2021	Prepared by	Richard Uttin	g Associates LLP	<u> </u>	Page 107

Option 3. Net Zero Carbon on-site



Versi	on: C		Archetyp	e 4		CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 4					
2	Detail 126a				18,980	
3	Detail 134				8,430	
4	Detail 135				4,500	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
7	4.7kWp PV array to west facing roof				9,400	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	43	m2	60.00	2,580	
10	Sub Total				56,390	
11	Location factor uplift			3.00	1,690	
12	Preliminaries			17.00	9,870	
13	Oh&p			8.00	5,440	
14	Consultancy fees			5.00	3,670	
15	Contingency			10.00	7,710	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
18	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
19	Typical annual replacement costs - PV, MVHR & Heating	1	No	826.00	830	
	Carry Forward				87,740	

Issue Date: 04 June 2021

Prepared by Richard Utting Associates LLP

Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study		Option 3. N		RUA		
ersion: C			Archetype		CONSTRUCTION CONSULTA	
0.	Description	Quantity	Unit	Rate	Amount	Notes
I	Brought Forward				87,740	
	Total				87,740	
e Date: 04 June	2021	Prepared by				

### Option 3. Net Zero Carbon on-site



Versi	on: C		Archetyp	e 4		CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	43	m2	275.00	11,825	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	17	m3	200.00	3,400	
4	6. New french drain filled with pea shingle	19	m	100.00	1,900	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	19	m	45.00	855	
6	Prep works	1	No	1,000.00	1,000	
	Total				18,980	

### **Option 3. Net Zero Carbon on-site**



Versi	on: C		Archetyp	e 4		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus & Zero carbon options)	43	m2	50.00	2,150	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	43	m2	125.00	5,375	
	Total				8,425	

Estimate: Feasibility Study Version: C			A				
ers lo.	on: C Description	Archetype 4 Quantity Unit Rate			Amount	CONSTRUCTION CONSULTAN	
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	9	m2	500.00	4,500		
	Total				4,500		

roject: Net Zero Housing Study Ca stimate: Feasibility Study	ambridge CC Of			arbon on-site		M RUA
ersion: C			Archetype	CONSTRUCTION CONSULTAN		
lo. Descripti	ion Qu	antity	Unit	Rate	Amount	Notes
2 PV @ £2,000 per KW		1	No	9,400.00	9,400	
	Total				9,400	
ue Date: 04 June 2021	Pr	repared by I	Richard Utting	g Associates LLP		Page 1

Option 3. Net Zero Carbon on-site



Versi	Version: C		Archetyp	e 5		CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 5					
2	Detail 126a				32,300	
3	Detail 134				7,200	
4	Detail 135				10,000	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
7	3.4kWp PV array to west facing roof				6,800	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	80	m2	60.00	4,800	
10	Sub Total				73,600	
11	Location factor uplift			3.00	2,210	
12	Preliminaries			17.00	12,890	
13	Oh&p			8.00	7,100	
14	Consultancy fees			5.00	4,790	
15	Contingency			10.00	10,060	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
18	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
19	Typical annual replacement costs - PV, MVHR & Heating	1	No	722.00	720	
	Carry Forward				113,510	

Issue Date: 04 June 2021

Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study		Option 3. N	let Zero Ca Archetype			
ersion: C						
lo.	Description	Quantity	Unit	Rate	Amount	Notes
I	Brought Forward	1	I		113,510	
	Total				113,510	
I	2021	I				

### Option 3. Net Zero Carbon on-site



Versi	on: C		Archetyp	e 5		CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	80	m2	275.00	22,000	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	32	m3	200.00	6,400	
4	6. New french drain filled with pea shingle	20	m	100.00	2,000	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	20	m	45.00	900	
6	Prep works	1	No	1,000.00	1,000	
	Total				32,300	

### **Option 3. Net Zero Carbon on-site**



Versi	on: C		Archetyp	e 5		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus & Zero Carbon options)	36	m2	50.00	1,800	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	36	m2	125.00	4,500	
	Total				7,200	

stir	ect: Net Zero Housing Study Cambridge CC nate: Feasibility Study			arbon on-site		RUA
	ion: C		Archetyp			CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	20	m2	500.00	10,000	
	Total				10,000	
ue D	Date: 04 June 2021	Prepared by	Richard Uttin	g Associates LLP		Page 1

Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study		.ς ορ		let Zero C	RUA		
ersion: C		-		Archetype	CONSTRUCTION CONSULTA		
<b>D.</b>	Description	Qua	antity	Unit	Rate	Amount	Notes
PV @ £2,00	0 per KW		1	No	6,800.00	6,800	
		Total				6,800	

Option 3. Net Zero Carbon on-site



Versi	on: C		Archetyp	e 6		CONSTRUCTION CONSULTANTS
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 6					
2	Detail 126a				27,420	
3	Detail 134				6,500	
4	Detail 135				7,500	
5	Air source heat pump	1	No	7,500.00	7,500	
6	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
7	2.4kWp PV array to west facing roof				4,800	
8	General scaffolding allowance	1	No	3,500.00	3,500	
9	Additional external wall render	68	m2	60.00	4,080	
10	Sub Total				62,800	
11	Location factor uplift			3.00	1,880	
12	Preliminaries			17.00	11,000	
13	Oh&p			8.00	6,050	
14	Consultancy fees			5.00	4,090	
15	Contingency			10.00	8,580	
16	Pressurisation / Depressurisation tests	3	No	180.00	540	
17	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
18	Typical annual maintenance costs - PV, MVHR & Heating	1	No	600.00	600	
19	Typical annual replacement costs - PV, MVHR & Heating	1	No	642.00	640	
	Carry Forward				97,180	

Issue Date: 04 June 2021

Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study			let Zero Ca Archetype	RUA		
ersion: C			CONSTRUCTION CONSULTAN			
lo.	Description	Quantity	Unit	Rate	Amount	Notes
1	Brought Forward				97,180	
	Total				97,180	
I	2021					

### Option 3. Net Zero Carbon on-site



Versi	on: C		Archetyp	e 6		CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (180mm insulation)	68	m2	275.00	18,700	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. Thickness 120mm.	27	m3	200.00	5,400	
4	6. New french drain filled with pea shingle	16	m	100.00	1,600	
5	7. New 200 x 50mm pre cast concrete kerb edging set in concrete foundation	16	m	45.00	720	
6	Prep works	1	No	1,000.00	1,000	
	Total				27,420	

### **Option 3. Net Zero Carbon on-site**



Versi	on: C		Archetyp	e 6		CONSTRUCTION CONSULTAN	
No.	Description	Quantity	Unit	Rate	Amount	Notes	
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900		
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus & Zero Carbon options)	32	m2	50.00	1,600		
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	32	m2	125.00	4,000		
	Total				6,500		

ers	nate: Feasibility Study ion: C		Archetyp	e 6		
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	15	m2	500.00	7,500	
	Total				7,500	

stimate: Feasibility Study /ersion: C				Archotype	RUF		
o.	Description		Quantity	Archetype 6 Unit Rate		Amount	CONSTRUCTION CONSULTA
	PV @ £2,000 per KW		1	No	4,800.00	4,800	
		Total				4,800	

Option 3. Net Zero Carbon on-site



Version: C			Archetyp	e 7		CONSTRUCTION CONSULTAN
No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 7					
2	Detail 129a / 130a				4,700	
3	Detail 132				13,500	
4	Detail 133				6,330	
5	Detail 135				6,000	
6	Air source heat pump	1	No	7,500.00	7,500	
7	Zehnder Q350 MVHR system	1	No	1,500.00	1,500	
8	4.15kWp PV array to west facing roof				8,300	
9	General scaffolding allowance	1	No	3,500.00	3,500	
10	Additional external wall render	85	m2	60.00	5,100	
11	Sub Total				56,430	
12	Location factor uplift			3.00	1,690	
13	Preliminaries			17.00	9,880	
14	Oh&p			8.00	5,440	
15	Consultancy fees			5.00	3,670	
16	Contingency			10.00	7,710	
17	Pressurisation / Depressurisation tests	3	No	180.00	540	
18	PAS2035 Retrofit Coordinator Role	1	No	1,000.00	1,000	
19	Tenant decant	1	No	8,500.00	8,500	
	Carry Forward				94,860	

Issue Date: 04 June 2021

Project: Net Zero Housing Study Cambridge CC	
Estimate: Feasibility Study	

Option 3. Net Zero Carbon on-site



о.	Description	Archetype 7 Description Quantity Unit Rate Amount				Notes
0.		Quantity	Unit	Nale		Notes
1	Brought Forward		1		94,860	
20	Typical annual maintenance costs - PV, MVHR & Heating	1	No	782.00	780	
21	Typical annual replacement costs - PV, MVHR & Heating	1	No	782.00	780	
	Total				96,420	

Project: Net Zero Housing Study Cambridge CC Estimate: Feasibility Study /ersion: C			Option 3. N		RUP		
				Archetype		• •	CONSTRUCTION CONSULTAI
lo.	Description		Quantity	Unit	Rate	Amount	Notes
2	Qbot to ground floor		47	m2	100.00	4,700	
		Total				4,700	

Project: Net Zero Housing Study Cambridge CC
Estimate: Feasibility Study

# Option 3. Net Zero Carbon on-site



#### Varaian. C

sion: C			Archetype			CONSTRUCTION CONSULTA
. Des	cription	Quantity	Unit	Rate	Amount	Notes
Internal wall insulation (no	o detail available)	90	m2	150.00	13,500	
	Тс	otal			13,500	

### **Option 3. Net Zero Carbon on-site**



Versi	on: C		Archetyp	e 7		CONSTRUCTION CONSULTANT
No.	Description	Quantity	Unit	Rate	Amount	Notes
2	29. New 102mm half round black gutter upvc. Upvc fascia and soffit.	10	m	90.00	900	
3	30. 300mm existing mineral wool (200mm extra laid over for Passivhaus option)	35	m2	50.00	1,750	
4	43. 150mm Kingspan Thermopitch TP10 infill insulation to be cut for a tight fit and extend into eaves. With trays as appropriate to ensure clear 50mm air path.	35	m2	105.00	3,675	
	Total				6,325	

	nate: Feasibility Study ion: C		Archetype	7			
0.	Description	Quantity	Unit	Rate	Amount	CONSTRUCTION CONSULTAN	
2	41. Triple glazed window fixed within insulation zone complete with new cill all sealed to manufacturers recommendations with proprietary sealing strips.	12	m2	500.00	6,000		
	Total				6,000		

Estimate: Feasibility Study /ersion: C				Anchotun	RUF		
nsion: C D.	Description		Quantity	Archetype 7 Unit Rate		Amount	CONSTRUCTION CONSULTA
	€ £2,000 per KW		1	No	8,300.00	8,300	
		Total				8,300	

### Appendix D - Definition of Zero Carbon in the Home

#### UKGBC April 2019

Current buildings in the UK are responsible for nearly a third of all UK carbon emissions and it is recognised that this is not compatible in a zero-carbon world that we have to achieve if we are to avert the worst effects of Climate Change.

Globally, with current CO2 concentrations already double those found in the pre-industrial era we are probably already beyond various tipping points and profound changes to our climate and oceans are already "baked in". That does not mean that we should carry on living a high carbon lifestyle when we have the knowledge and technologies to change our ways.

There is a consensus that all buildings by 2050 at the latest must be "zero-carbon"; where there is no consensus currently is the definition of "zero-carbon" for buildings. Firstly, we need to sub-divide carbon emissions into two categories. Counting and evaluating embodied carbon of a new building's fabric is in its infancy in the UK and although it will be hugely important in the medium term, current definitions of zero-carbon in buildings almost always ignore it.

The operational carbon emissions of keeping the building warm/ cool and providing hot water is generally the emphasis of achieving zero-carbon. Again, this is often sub-divided into regulated and unregulated energy consumption, the argument being that the constructor cannot be expected to understand/ design for the amount of electricity consumed running washing machines, TV's and the like.

Overall, we get pie charts like those adjacent, found in the UKGBC report "Net Zero Carbon Buildings: A Framework Definition"; it can be discerned that regulated operational carbon emissions may be as little as 24% of the total carbon emissions produced by the building from cradle to grave. Most zero carbon ambitions in residential projects use SAP software as the basis of the calculation and that only covers regulated energy consumption. Passivhaus PHPP software models all the energy consumed in the home, but not embodied energy, but nonetheless a more accurate representation of the operational carbon emissions of the building over its lifetime.

It is to be noted that the Cambridge "Sustainable Housing Standard Options" has the subheading of "Operational Energy" and that SAP10.1 software is the basis of the calculations. In the background to this subject is the energy sources that homes will be depending on in 2030 and 2050 and their carbon emissions. It would appear that it is a twohorse race between hydrogen supplied via the current gas grid and electricity.

Hydrogen, currently 98% of global hydrogen supplies come from energy intensive processes of extracting hydrogen from coal or natural gas and in the future capturing the resulting carbon emissions and burying them under the North Sea and similar geological formations elsewhere. This report is not going to delve into the merits or otherwise of this. Suffice to say that National Grid fully intend to supply 20% hydrogen 80% natural gas into the gas grid from 2030 and that all gas supplied by 2050 will be 100% hydrogen. If, and it is a huge if, this can be done in a truly zero carbon way, then by 2050 any mains gas supplied to homes will be zero carbon.

Electricity, as is well known with the phasing our of coal fired power plants and the construction of offshore windfarms is getting greener year on year. Carbon intensity of the electricity grid has dropped from 500g/ kWh to about 130g/kWh last year and the projections are for 2030 to reach about 85g/kWh with BEIS predicting as low as 67g/kWh by 2040.

The electricity Grid ambition is to be able to supply 100% renewable electricity for periods of time by 2025. With increases in battery storage and demand side management tools coming to the fore, this ambition is easily realisable. The electricity generators fully expect to be zero carbon by 2050.

It is our opinion that this dramatic fall in Grid carbon emissions signals the Electrification of Heat as the clearest route to decarbonisation of heating – and the use of heat pumps as the only practical and economic route to achieve Net-Zero.

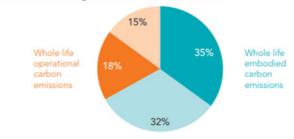
So, what impact do the above paragraphs have on Cambridge City Council's ambitions? Could all existing homes be left as is and simply wait for the electricity and gas grids to become carbon neutral and effectively allow the energy suppliers to do all the heavy lifting of ensuring that the housing stock is zero carbon? By 2030? By 2050?

By 2030? No, the gas grid will still be 80% natural gas and the electricity grid will still have a carbon intensity of ~85g/kWh, therefore reducing energy consumption in the home and installing renewable energy generation would be required to meet the City's ambitions for 2030. By 2050? Yes potentially, however we estimate due to the inefficiencies of hydrogen production that the cost to the consumer per kWh will be double today's costs and therefore improving the thermal performance would be required to ensure that more people do not fall into fuel poverty.

For electricity, the issue is more about the supply constraint of the Grid itself to supply three times more energy over the course of a year than current outputs and so again maximising the efficiency of the home becomes paramount.



Speculative office building with Cat A fit out; central London





Typical warehouse shed with office space (15% by area); London perimeter, UK



