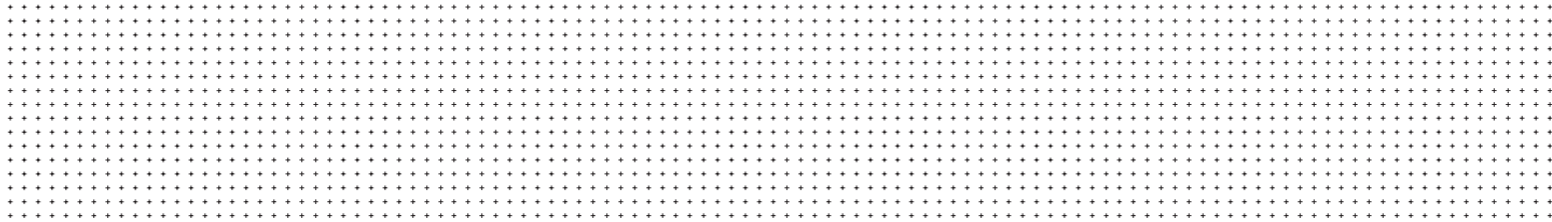


Feilden+Mawson



Achieving Net Zero Carbon in
Our Existing Housing Stock
9419/ A01
May 2021



Document Control

Revision	Description	Originator	Approved	Date
A00	Submission to Cambridge City Council	Feilden+Mawson LLP	JE	28/05/2021
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Contents

Executive Summary

Scope

Archetypes

Qualifications

Appendix A - Indicative Architectural Construction details

Appendix B - SAP Summary

Appendix C - Quantity Surveyor's report

Appendix D - Definition of Zero Carbon in the Home

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 use¹). 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 difficulty 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.

¹ Net Zero carbon in use is based upon a Dwelling Emission Rate (DER) of 0kg/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.

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

Cost uplift beyond baseline (£)

	Capital uplift	Annual Maintenance	Annual Replacement	Tenant Typical Energy Cost ²
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

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

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 version³) 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.

³ 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 - 2B maisonette

Based on modelling of 11 Wheaton House

66m²

Non-Decant

364 units across housing stock in broad category

- High levels of fabric performance
- Gas fuelled heating and hot water

- High levels of fabric performance
- Gas fuelled heating and hot water
- Solar Technology for energy generation
- Continuous Mechanical Extract

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

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

Decent Homes

CCC Retrofit Plus

EnerPHit

Net Zero Carbon*

Carbon reduction Part L 2013 = **-126.7%**
Carbon reduction SAP 10.1 = **-1025.17%**
SAP rating = **78C**

Carbon reduction Part L 2013 = **23.60%**
Carbon reduction SAP 10.1 = **-90.60%**
SAP rating = **82B**

Carbon reduction Part L 2013 = **99%**
Carbon reduction SAP 10.1 = **112.41%**
SAP rating = **100A**

Carbon reduction Part L 2013 = **66.2%**
Carbon reduction SAP 10.1 = **99.59%**
SAP rating = **95A**

Dwelling Emission Rate in kgCO₂/m²/a = **26.74**
Capital Cost Uplift beyond base = **n/a**
Typical annual maintenance cost = **£1110/a**
Typical annual replacement cost = **£375/a**
Resident typical annual energy cost = **£772.82/a**

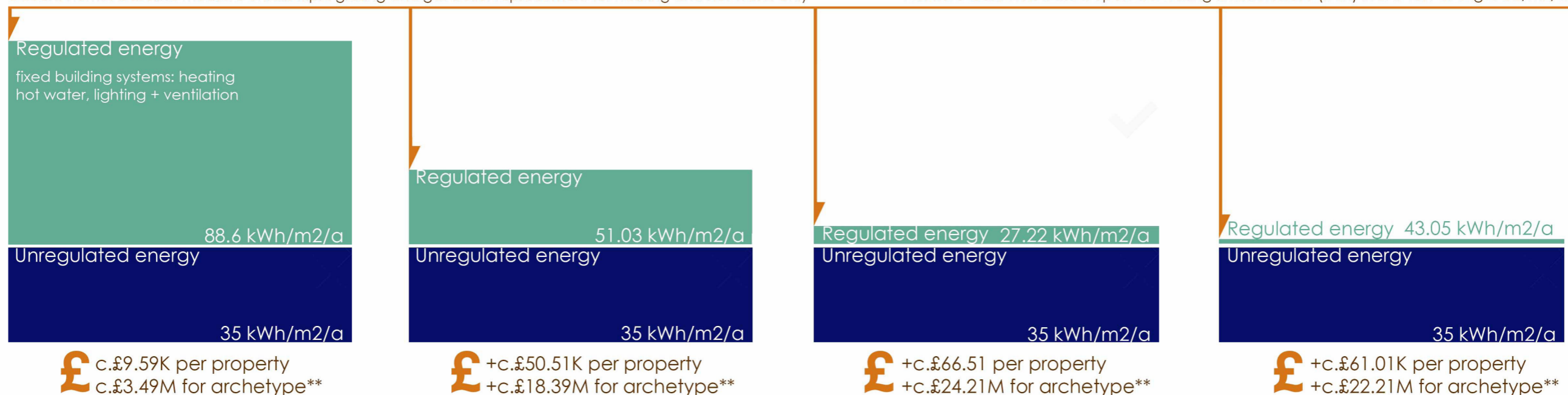
Dwelling Emission Rate in kgCO₂/m²/a = **22.7**
Capital Cost Uplift beyond base = **526.69%**
Typical annual maintenance cost = **£210/a**
Typical annual replacement cost = **£530/a**
Resident typical annual energy cost = **£648.80/a**

Dwelling Emission Rate in kgCO₂/m²/a = **-2.1**
Capital Cost Uplift beyond base = **693.53%**
Typical annual maintenance cost = **£460/a**
Typical annual replacement cost = **£610/a**
Resident typical annual energy cost = **£530.94/a**

Dwelling Emission Rate in kgCO₂/m²/a = **0.06**
Capital Cost Uplift beyond base = **636.18%**
Typical annual maintenance cost = **£460/a**
Typical annual replacement cost = **£490/a**
Resident typical annual energy cost = **£669.84/a**

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

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

Archetype 2 - 1B low rise flat

Based on modelling of 155 Ditton Fields

49m²

Non-Decant

2180 units across housing stock in broad category

- High levels of fabric performance
- Gas fuelled heating and hot water

- High levels of fabric performance
- Heat pumps for heating + hot water
- Solar Technology for energy generation
- Continuous Mechanical Extract

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

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

Decent Homes

CCC Retrofit Plus

EnerPHit

Net Zero Carbon*

Carbon reduction Part L 2013 = **-102%**
Carbon reduction SAP 10.1 = **-230.55%**
SAP rating = **72C**

Dwelling Emission Rate in kgCO₂/m²/a = **TBC**
Capital Cost Uplift beyond base = **n/a**
Typical annual maintenance cost = **£110/a**
Typical annual replacement cost = **£375/a**

Resident typical annual energy cost = **£845.28/a**

Carbon reduction Part L 2013 = **32.4%**
Carbon reduction SAP 10.1 = **59.39%**
SAP rating = **79C**

Dwelling Emission Rate in kgCO₂/m²/a = **5.82**
Capital Cost Uplift beyond base = **595.92%**
Typical annual maintenance cost = **£210/a**
Typical annual replacement cost = **£530/a**

Resident typical annual energy cost = **£613.49/a**

Carbon reduction Part L 2013 = **77.6%**
Carbon reduction SAP 10.1 = **89.04%**
SAP rating = **90B**

Dwelling Emission Rate in kgCO₂/m²/a = **1.57**
Capital Cost Uplift beyond base = **812.24%**
Typical annual maintenance cost = **£410/a**
Typical annual replacement cost = **£610/a**

Resident typical annual energy cost = **£440.58/a**

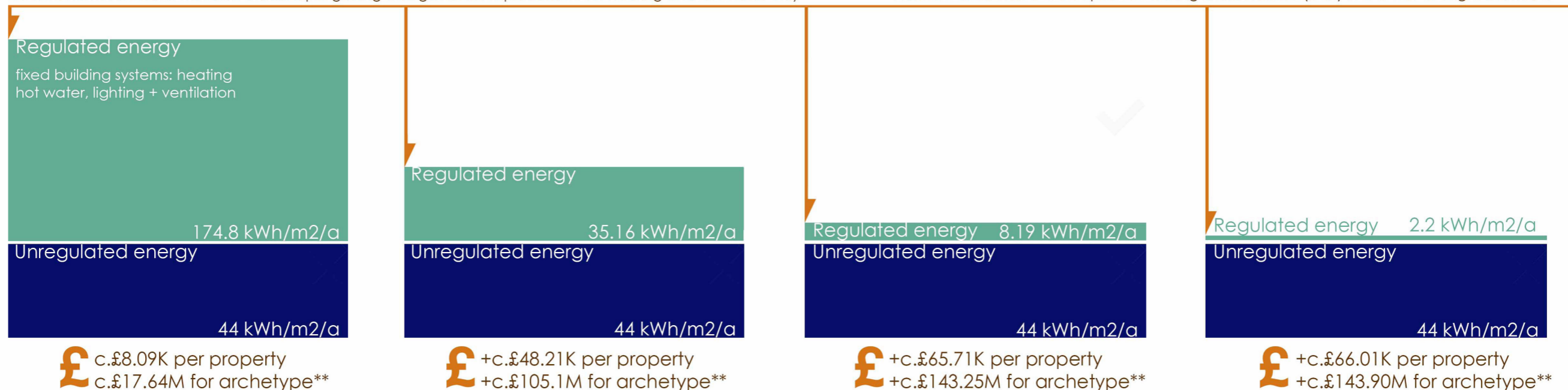
Carbon reduction Part L 2013 = **88%**
Carbon reduction SAP 10.1 = **94.7%**
SAP rating = **92A**

Dwelling Emission Rate in kgCO₂/m²/a = **0.76**
Capital Cost Uplift beyond base = **815.95%**
Typical annual maintenance cost = **£410/a**
Typical annual replacement cost = **£640/a**

Resident typical annual energy cost = **£402.26/a**

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

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

Archetype 3 - 1B medium rise flat

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

50m²

Non-Decant

1030 units across housing stock in broad category

- High levels of fabric performance
- Gas fuelled heating and hot water

- High levels of fabric performance
- Gas fuelled heating and hot water
- Solar Technology for energy generation
- Continuous Mechanical Extract

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

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

Decent Homes

CCC Retrofit Plus

EnerPHit

Net Zero Carbon*

Carbon reduction Part L 2013 = **-49.4%**
Carbon reduction SAP 10.1 = **-129.84%**
SAP rating = **77C**

Carbon reduction Part L 2013 = **37.1%**
Carbon reduction SAP 10.1 = **-23.84%**
SAP rating = **85B**

Carbon reduction Part L 2013 = **131.6%**
Carbon reduction SAP 10.1 = **112.80%**
SAP rating = **99A**

Carbon reduction Part L 2013 = **77%**
Carbon reduction SAP 10.1 = **99.53%**
SAP rating = **95A**

Dwelling Emission Rate in kgCO₂/m²/a = **33.74**
Capital Cost Uplift beyond base = **n/a**
Typical annual maintenance cost = **£1110/a**
Typical annual replacement cost = **£375/a**
Resident typical annual energy cost = **£681.55/a**

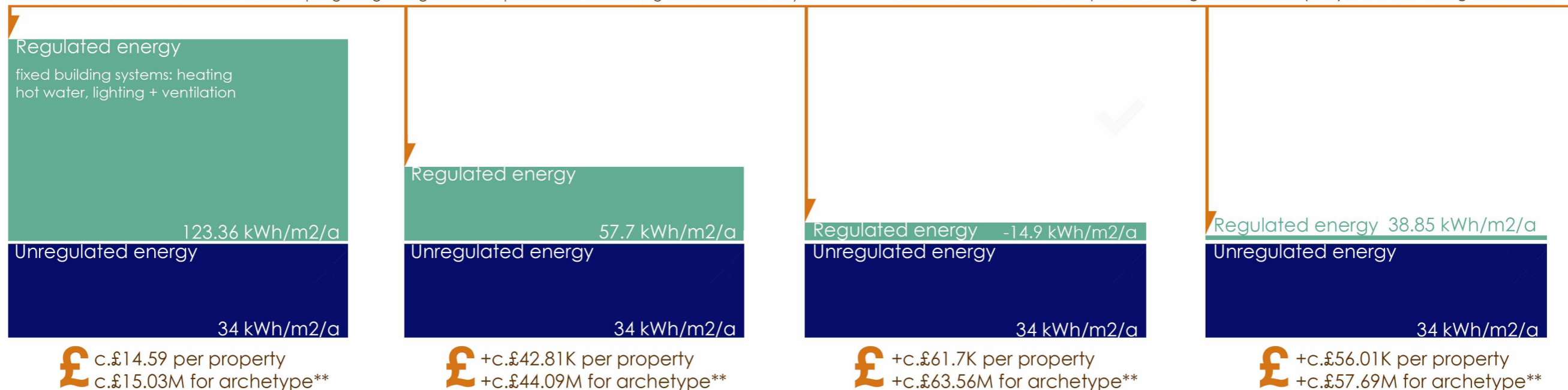
Dwelling Emission Rate in kgCO₂/m²/a = **18.18**
Capital Cost Uplift beyond base = **293.42%**
Typical annual maintenance cost = **£210/a**
Typical annual replacement cost = **£530/a**
Resident typical annual energy cost = **£502.79/a**

Dwelling Emission Rate in kgCO₂/m²/a = **-2.73**
Capital Cost Uplift beyond base = **422.96%**
Typical annual maintenance cost = **£460/a**
Typical annual replacement cost = **£610/a**
Resident typical annual energy cost = **£302.24/a**

Dwelling Emission Rate in kgCO₂/m²/a = **0.1**
Capital 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**

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

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

Archetype 4 - 1B post war bungalow

Based on modelling of 83 Ekin Road

43m²

Non-Decant

208 units across housing stock in broad category

- High levels of fabric performance
- Gas fuelled heating and hot water

- High levels of fabric performance
- Heat pumps for heating + hot water
- Solar Technology for energy generation
- Continuous Mechanical Extract

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

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

Decent Homes

CCC Retrofit Plus

EnerPHit

Net Zero Carbon*

Carbon reduction Part L 2013 = **-52.1%**
Carbon reduction SAP 10.1 = **-210.67%**
SAP rating = **73C**

Carbon reduction Part L 2013 = **33.7%**
Carbon reduction SAP 10.1 = **42.97%**
SAP rating = **76C**

Carbon reduction Part L 2013 = **80.6%**
Carbon reduction SAP 10.1 = **86.32%**
SAP rating = **90B**

Carbon reduction Part L 2013 = **88.4%**
Carbon reduction SAP 10.1 = **92.81%**
SAP rating = **91B**

Dwelling Emission Rate in kgCO₂/m²/a = **40.76**
Capital Cost Uplift beyond base = **n/a**
Typical annual maintenance cost = **£110/a**
Typical annual replacement cost = **£375/a**
Resident typical annual energy cost = **£722.96/a**

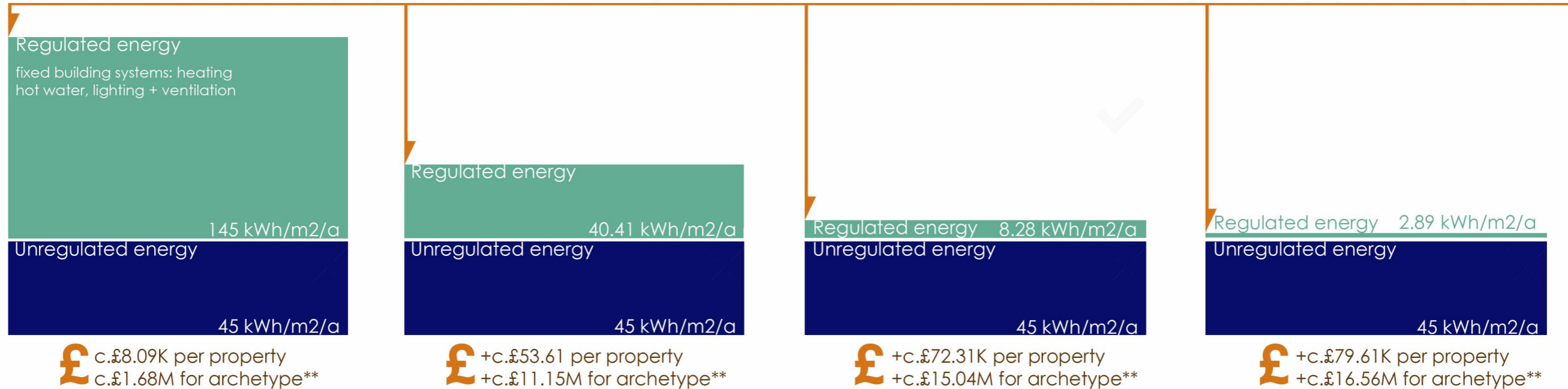
Dwelling Emission Rate in kgCO₂/m²/a = **7.38**
Capital Cost Uplift beyond base = **662.67%**
Typical annual maintenance cost = **£210/a**
Typical annual replacement cost = **£530/a**
Dwelling typical annual energy cost = **£576.69/a**

Dwelling Emission Rate in kgCO₂/m²/a = **1.67**
Capital Cost Uplift beyond base = **893.82%**
Typical annual maintenance cost = **£410/a**
Typical annual replacement cost = **£610/a**
Dwelling typical annual energy cost = **£356.58/a**

Dwelling Emission Rate in kgCO₂/m²/a = **0.92**
Capital Cost Uplift beyond base = **984.05%**
Typical annual maintenance cost = **£410/a**
Typical annual replacement cost = **£830/a**
Dwelling typical annual energy cost = **£364.62/a**

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

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

Archetype 5 - 2B pre-1945 semi

Based on modelling of 38 Akeman Street

106m²

Non-Decant

990 units across housing stock in broad category

- High levels of fabric performance
- Gas fuelled heating and hot water

- High levels of fabric performance
- Heat pumps for heating + hot water
- Solar Technology for energy generation
- Continuous Mechanical Extract

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

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

Decent Homes

Carbon reduction Part L 2013 = **-77.2%**
 Carbon reduction SAP 10.1 = **-252.66%**
 SAP rating = **68D**

Dwelling Emission Rate in kgCO₂/m²/a = **41.12**
 Capital Cost Uplift beyond base = **n/a**
 Typical annual maintenance cost = **£110/a**
 Typical annual replacement cost = **£375/a**

Resident typical annual energy cost = **£1164.42/a**

CCC Retrofit Plus

Carbon reduction Part L 2013 = **44.1%**
 Carbon reduction SAP 10.1 = **53.21%**
 SAP rating = **77C**

Dwelling Emission Rate in kgCO₂/m²/a = **5.24**
 Capital Cost Uplift beyond base = **548.13%**
 Typical annual maintenance cost = **£210/a**
 Typical annual replacement cost = **£530/a**

Resident typical annual energy cost = **£880.90/a**

EnerPHit

Carbon reduction Part L 2013 = **66%**
 Carbon reduction SAP 10.1 = **80%**
 SAP rating = **88B**

Dwelling Emission Rate in kgCO₂/m²/a = **2.24**
 Capital Cost Uplift beyond base = **775.30%**
 Typical annual maintenance cost = **£410/a**
 Typical annual replacement cost = **£610/a**

Resident typical annual energy cost = **£751.83/a**

Net Zero Carbon*

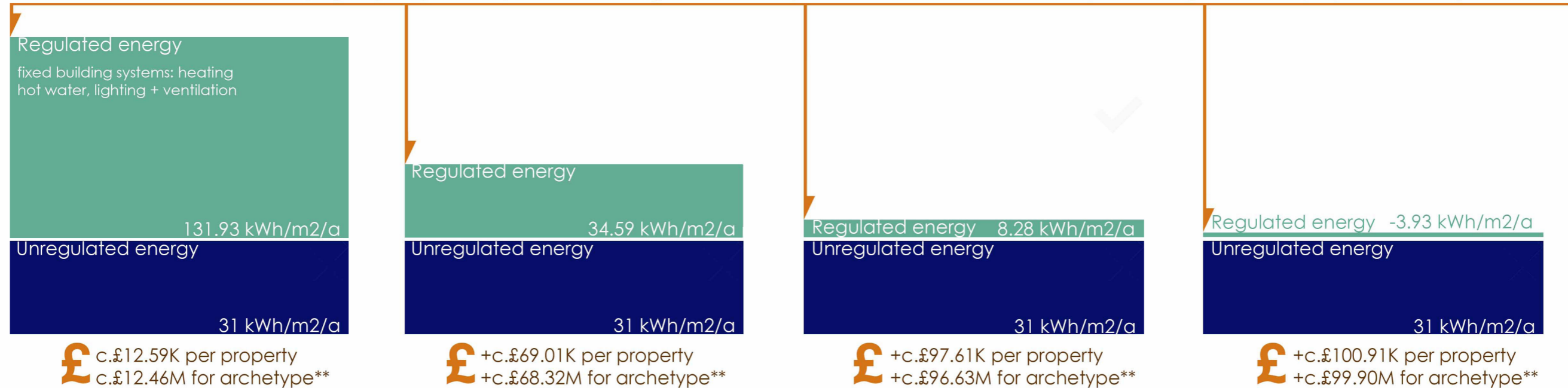
Carbon reduction Part L 2013 = **93.2%**
 Carbon reduction SAP 10.1 = **94.11%**
 SAP rating = **92A**

Dwelling Emission Rate in kgCO₂/m²/a = **0.66**
 Capital Cost Uplift beyond base = **801.51%**
 Typical annual maintenance cost = **£410/a**
 Typical annual replacement cost = **£720/a**

Resident typical annual energy cost = **£611.12/a**

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

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

Archetype 6 - 2B post-1945 semi

Based on modelling of 3 Neptune Close

65m²

Non-Decant

1717 units across housing stock in broad category

- High levels of fabric performance
- Gas fuelled heating and hot water

- High levels of fabric performance
- Heat pumps for heating + hot water
- Solar Technology for energy generation
- Continuous Mechanical Extract

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

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

Decent Homes

CCC Retrofit Plus

EnerPHit

Net Zero Carbon*

Carbon reduction Part L 2013 = **-40.9%**
Carbon reduction SAP 10.1 = **-93.64%**
SAP rating = **79C**

Carbon reduction Part L 2013 = **45%**
Carbon reduction SAP 10.1 = **65.45%**
SAP rating = **83B**

Carbon reduction Part L 2013 = **85.1%**
Carbon reduction SAP 10.1 = **92.93%**
SAP rating = **93A**

Carbon reduction Part L 2013 = **89.2%**
Carbon reduction SAP 10.1 = **94.72%**
SAP rating = **94A**

Dwelling Emission Rate in kgCO₂/m²/a = **24.65**
Capital Cost Uplift beyond base = **n/a**
Typical annual maintenance cost = **£110/a**
Typical annual replacement cost = **£375/a**
Resident typical annual energy cost = **£781.01/a**

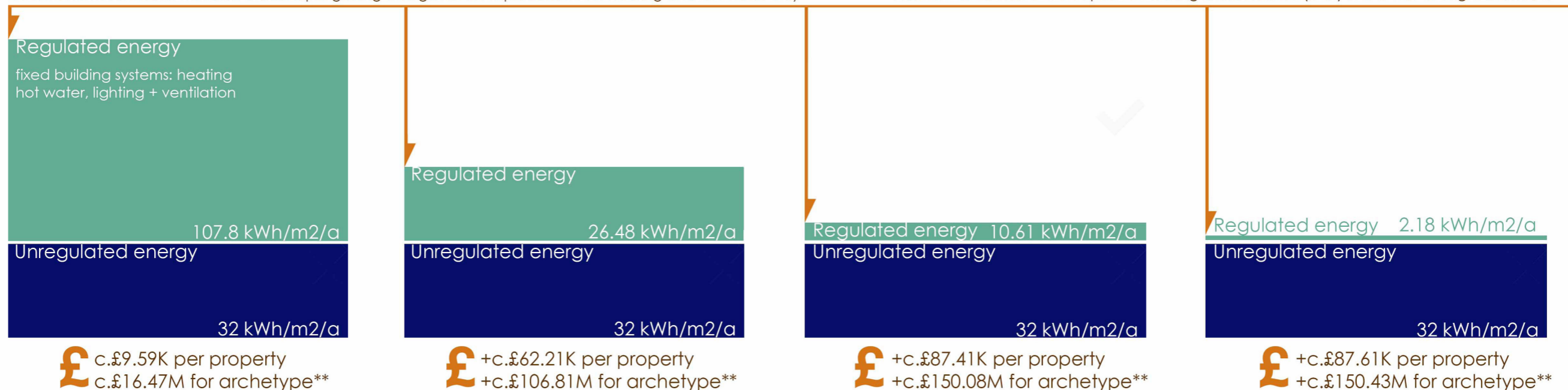
Dwelling Emission Rate in kgCO₂/m²/a = **4.25**
Capital Cost Uplift beyond base = **648.7%**
Typical annual maintenance cost = **£210/a**
Typical annual replacement cost = **£530/a**
Resident typical annual energy cost = **£599.92/a**

Dwelling Emission Rate in kgCO₂/m²/a = **0.87**
Capital Cost Uplift beyond base = **911.47%**
Typical annual maintenance cost = **£410/a**
Typical annual replacement cost = **£610/a**
Resident typical annual energy cost = **£419.59/a**

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 = **£640/a**
Resident typical annual energy cost = **£393.07/a**

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

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

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

Based on modelling of 38 Abbey Road

126m²

***Decant

164 units across housing stock in broad category

- High levels of fabric performance
- Gas fuelled heating and hot water

- High levels of fabric performance
- Heat pumps for heating + hot water
- Solar Technology for energy generation
- Continuous Mechanical Extract

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

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

Decent Homes

Carbon reduction Part L 2013 = **-79.5%**
Carbon reduction SAP 10.1 = **-230.53%**
SAP rating = **76C**

Dwelling Emission Rate in kgCO₂/m²/a = **26.96**
Capital Cost Uplift beyond base = **n/a**
Typical annual maintenance cost = **£110/a**
Typical annual replacement cost = **£375/a**

Resident typical annual energy cost = **£1336.19/a**

CCC Retrofit Plus

Carbon reduction Part L 2013 = **39.9%**
Carbon reduction SAP 10.1 = **50.56%**
SAP rating = **80C**

Dwelling Emission Rate in kgCO₂/m²/a = **5.24**
Capital Cost Uplift beyond base = **378.41%**
Typical annual maintenance cost = **£210/a**
Typical annual replacement cost = **£530/a**

Resident typical annual energy cost = **£1024.55/a**

EnerPHit

Carbon reduction Part L 2013 = **59.6%**
Carbon reduction SAP 10.1 = **72.16%**
SAP rating = **88B**

Dwelling Emission Rate in kgCO₂/m²/a = **2.24**
Capital Cost Uplift beyond base = **503.15%**
Typical annual maintenance cost = **£410/a**
Typical annual replacement cost = **£610/a**

Resident typical annual energy cost = **£874.44/a**

Net Zero Carbon*

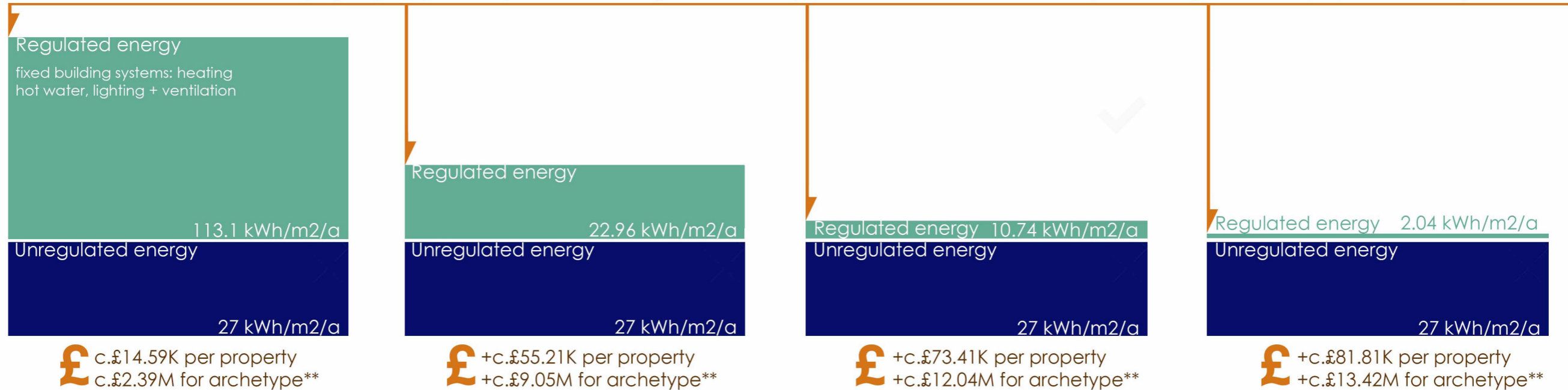
Carbon reduction Part L 2013 = **88.9%**
Carbon reduction SAP 10.1 = **93.63%**
SAP rating = **92A**

Dwelling Emission Rate in kgCO₂/m²/a = **0.66**
Capital Cost Uplift beyond base = **560.73%**
Typical annual maintenance cost = **£410/a**
Typical annual replacement cost = **£780/a**

Resident typical annual energy cost = **£648.95/a**

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

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
*** 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

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 qualifications 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 521 no. 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-glazed⁴ windows / doors [u -value of $0.12W/m^2K$] (with trickle vents);
 - Gas combi-boiler replacement;
 - Assumed airtightness of $8m^3/hr/m^2@50Pa$

- 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 = $0.22W/m^2K$];
 - 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 $5m^3/hr/m^2@50Pa$
- 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 120mm [u -value = $0.15W/m^2K$];
 - 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 $1m^3/hr/m^2@50Pa$ 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 expensive 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;

- 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 role⁵;
 - 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;
 - 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;

⁴ 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 is decarbonised.

⁵ 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 kgCO₂/m²/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 50m² flat or in a 500m² 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/m²/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.

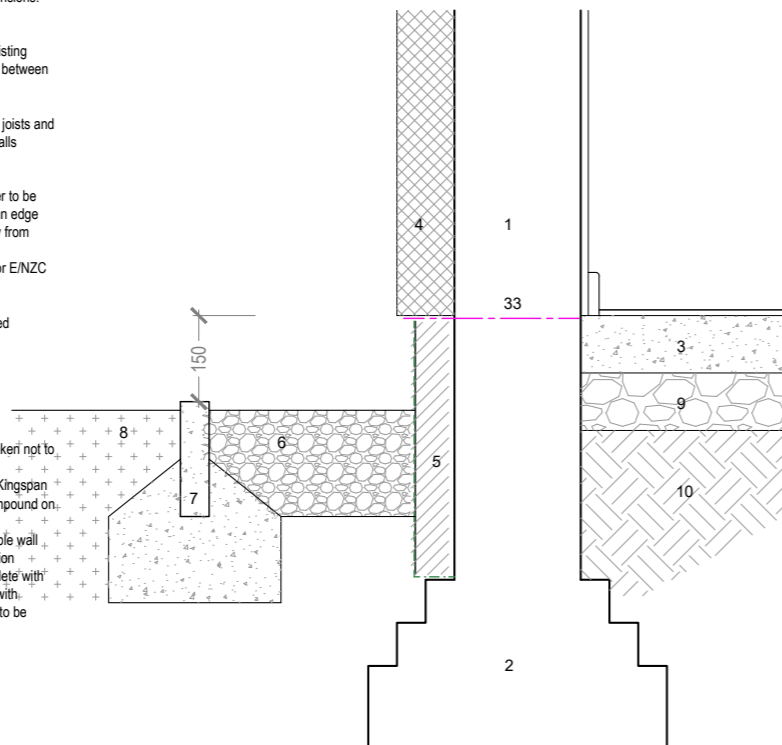
Considerations for future detail retrofit / pilot schemes

- 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-by-dwelling 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

1. Existing solid brick wall
2. Indicative existing foundations
3. Existing solid concrete floor
4. 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)
5. New XPS insulation Greenguard GG300 board suitable for under ground situations, 70mm CCC Retrofit+ and 120mm E/NZC option o/a thick.
6. New French drain filled with pea shingle.
7. New 200 x50mm pre cast concrete kerb edging set in concrete foundation
8. Top soil
9. Assumed existing compacted hardcore base
10. Assumed sub-soil
11. New floor finish
12. New MDF skirting - decorated with flexible sealant below
13. New wet plaster - decorated
14. New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m² - to give 60min FR
15. New 100mm sound deadening mineral wool laid between joists
16. Existing floor structure
17. 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 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
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
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
33. Injected chemical damp proof course
34. Proprietary air sealing tape
35. 80mm woodfibre insulation
36. Existing roof truss
37. Existing 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 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 made good.
- 42.

42. Existing wall finish
43. 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
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 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 of insulation
48. Existing window
49. Sand/cement render to extg substrate to provide airtightness barrier



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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DRAWING
 Solid Wall / Floor
 Option 1 CCC Retrofit +
 (Non-Decant)

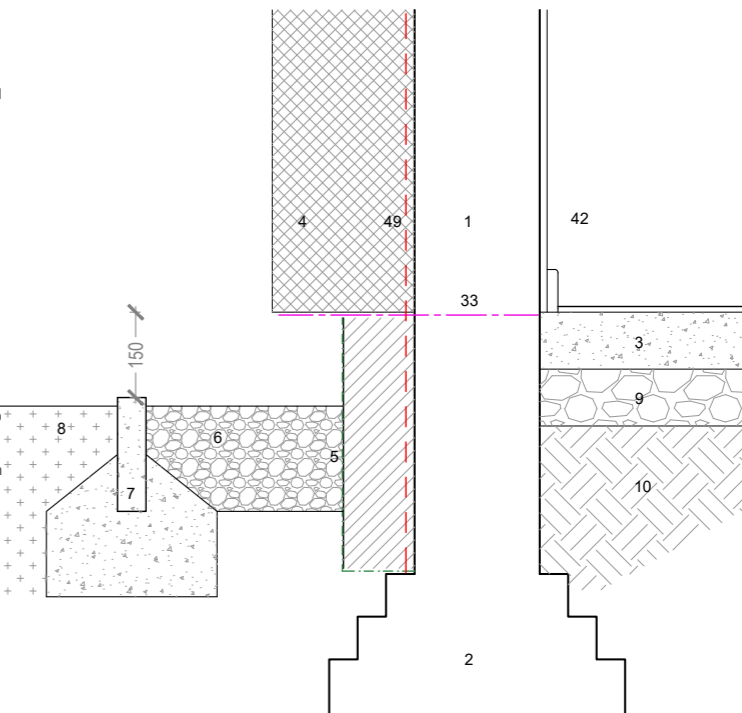
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JOB	9419	DWG	125	REV	A03

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11. New floor finish
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13. New wet plaster - decorated
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21. Existing brick sleeper walls, ensure walls are sound and free of damaged, broken bricks etc and replace where necessary
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DRAWING
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 Option 2 EnerPHit / Net Zero Carbon
 (Non-Decant)

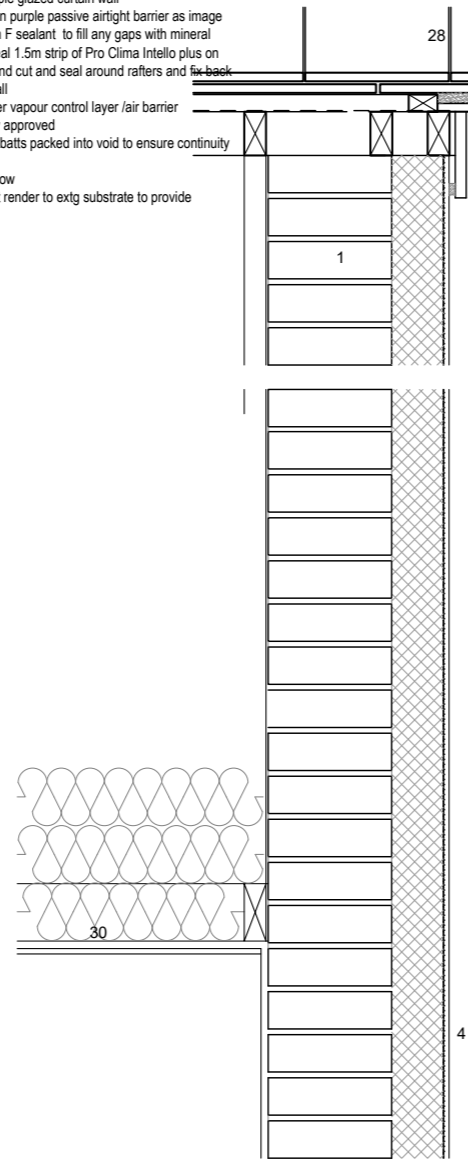
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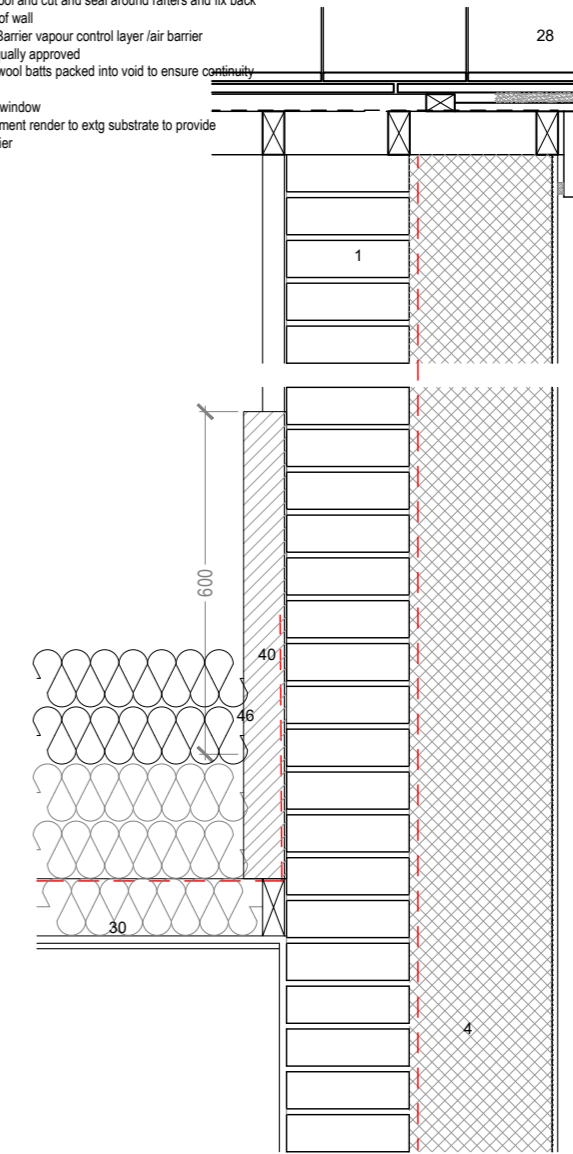
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43. 200mm Kingspan ThermoPitch TP10 infill insulation to be cut for a tight fit and extend into eaves (E/ NZE level only) with trays as appropriate to ensure clear 50mm air path
44. Full height triple glazed curtain wall
45. Apply paint on purple passive 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 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 of insulation
48. Existing window
49. Sand/cement render to extg substrate to provide airtightness barrier



1. Existing solid brick wall
2. Indicative existing foundations
3. Existing solid concrete floor
4. 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)
5. New XPS insulation Greenguard GG300 board suitable for under ground situations, 70mm CCC Retrofit+ and 120mm ENZC option o/a thick.
6. New French drain filled with pea shingle.
7. New 200 x50mm pre cast concrete kerb edging set in concrete foundation
8. Top soil
9. Assumed existing compacted hardcore base
10. Assumed sub-soil
11. New floor finish
12. New MDF skirting - decorated with flexible sealant below
13. New wet plaster - decorated
14. New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m² - to give 60min FR
15. New 100mm sound deadening mineral wool laid between joists
16. Existing floor structure
17. 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 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
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
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 ENZC option)
31. Existing brick cavity wall with insulation
32. 2no coats of liquid tanking membrane to lap with injected chemical damp proof course
33. Injected chemical damp proof course
34. Proprietary air sealing tape
35. 80mm woodfibre insulation
36. Existing roof truss
37. Existing 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 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 made good.
- 42.

42. Existing wall finish
43. 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
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 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 of insulation
48. Existing window
49. Sand/cement render to extg substrate to provide airtightness barrier



--- Representative of air tightness

Revision Schedule				
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Feilden+Mawson

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 1 Fenny Road Norwich NR1 1SU
 6 Colton Court Cambridge CB1 7BN
 email: info@feildenmawson.com www.feildenmawson.com

DRAWING
 Solid Wall, Gable / Verge Detail
 Option 1 - Retrofit +
 Non-Decant

CLIENT Cambridge City Council

JOB Achieving Zero Carbon

RIBA Stage 2 - WIP Issue for Information

SCALE	1:10	PAPER	A4	DATE	18.03.2021
JOB	9419	DWG	131a	REV	A03

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DRAWING
 Solid Wall, Gable / Verge Detail
 Option 2 - EnerPHit / Net Zero Carbon
 Non-Decant

CLIENT Cambridge City Council

JOB Achieving Zero Carbon

RIBA Stage 2 - WIP Issue for Information

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JOB	9419	DWG	131b	REV	A03

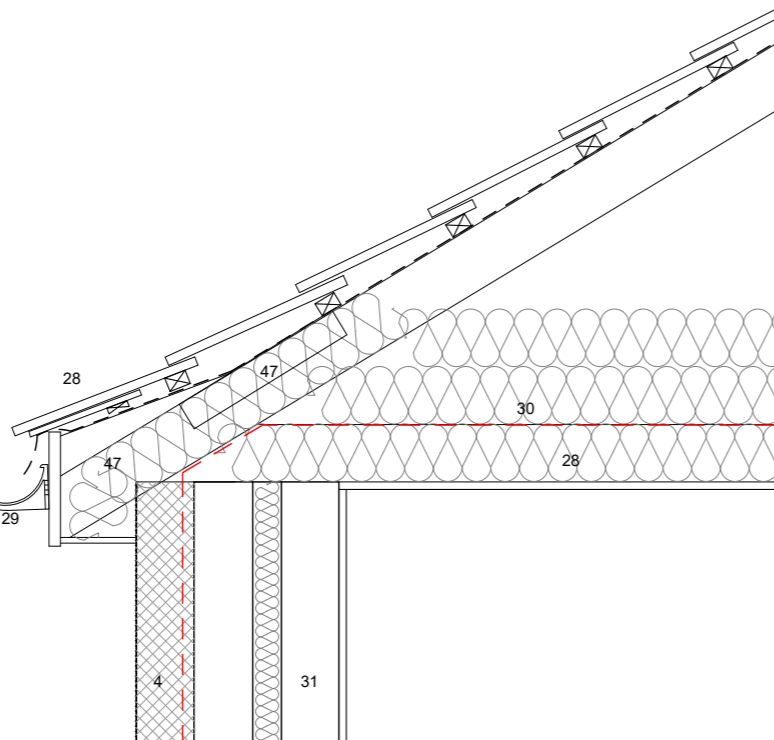
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6. New French drain filled with pea shingle.
7. New 200 x50mm pre cast concrete kerb edging set in concrete foundation
8. Top soil
9. Assumed existing compacted hardcore base
10. Assumed sub-soil
11. New floor finish
12. New MDF skirting - decorated with flexible sealant below
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27. New Lime plaster
28. Existing truss - extended as required
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
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33. Injected chemical damp proof course
34. Proprietary air sealing tape
35. 80mm woodfibre insulation
36. Existing roof truss
37. Existing 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 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 made good.
- 42.

42. Existing wall finish
43. 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
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 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 of insulation
48. Existing window
49. Sand/cement render to extg substrate to provide airtightness barrier

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



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CLIENT Cambridge City Council

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RIBA Stage 2 - WIP Issue for Information

SCALE	1:10	PAPER	A4	DATE	18.03.2021
JOB	9419	DWG	133	REV	A03

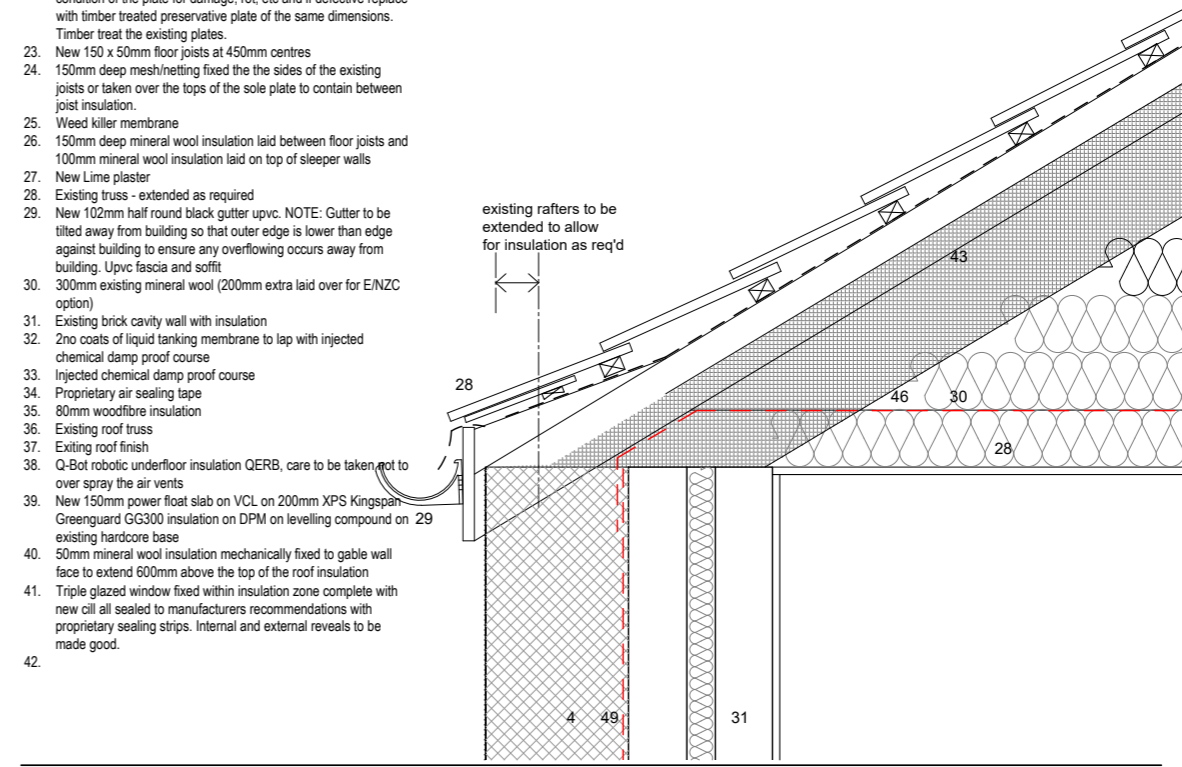
DRAWING
Cavity Wall and Pitched Roof
Option 1 - CCC Retrofit +
Non-Decant

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

1. Existing solid brick wall
2. Indicative existing foundations
3. Existing solid concrete floor
4. 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)
5. New XPS insulation Greenguard GG300 board suitable for under ground situations, 70mm CCC Retrofit+ and 120mm E/NZC option o/a thick.
6. New French drain filled with pea shingle.
7. New 200 x50mm pre cast concrete kerb edging set in concrete foundation
8. Top soil
9. Assumed existing compacted hardcore base
10. Assumed sub-soil
11. New floor finish
12. New MDF skirting - decorated with flexible sealant below
13. New wet plaster - decorated
14. New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m² - to give 60min FR
15. New 100mm sound deadening mineral wool laid between joists
16. Existing floor structure
17. 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 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
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
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
33. Injected chemical damp proof course
34. Proprietary air sealing tape
35. 80mm woodfibre insulation
36. Existing roof truss
37. Existing 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 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 made good.
- 42.

42. Existing wall finish
43. 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
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 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 of insulation
48. Existing window
49. Sand/cement render to extg substrate to provide airtightness barrier

Notes:
Assume eaves insulation upgrade and additional roof insulation can all be accessed from external scaffold
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 structure the newly extended roof projection may clash with window head - potential for lowering of window heads.



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RIBA Stage 2 - WIP Issue for Information

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JOB	9419	DWG	134	REV	A03

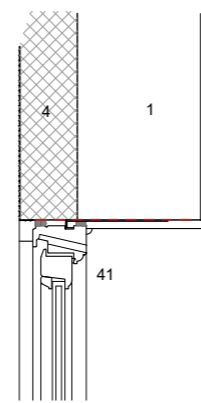
DRAWING
Cavity Wall and Pitched Roof
Option 2 - EnerPHit / Net Zero Carbon
Non-Decant

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

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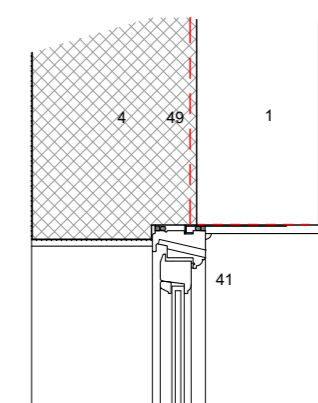
1. Existing solid brick wall
2. Indicative existing foundations
3. Existing solid concrete floor
4. New K-Rend 260mm o/a K-Systems M External Wall Mineral Wool Rendered System - 250mm insulation EnerPHit / Net Zero Carbon option. (100mm o/a with 90 insulation for CCC Retrofit+ Option)
5. New XPS insulation Greenguard GG300 board suitable for under ground situations, 70mm CCC Retrofit+ and 120mm ENZC option o/a thick.
6. New French drain filled with pea shingle.
7. New 200 x50mm pre cast concrete kerb edging set in concrete foundation
8. Top soil
9. Assumed existing compacted hardcore base
10. Assumed sub-soil
11. New floor finish
12. New MDF skirting - decorated with flexible sealant below
13. New wet plaster - decorated
14. New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m² - to give 60min FR
15. New 100mm sound deadening mineral wool laid between joists
16. Existing floor structure
17. 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 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
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
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 ENZC option)
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32. 2no coats of liquid tanking membrane to lap with injected chemical damp proof course
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- 42.

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RIBA Stage 2 - WIP Issue for Information

SCALE	1:10	PAPER	A4	DATE	18.03.2021
JOB	9419	DWG	135	REV	A03

DRAWING
 Window Head / Jamb Solid Wall
 Option 1 - CCC Retrofit +
 Non-Decant

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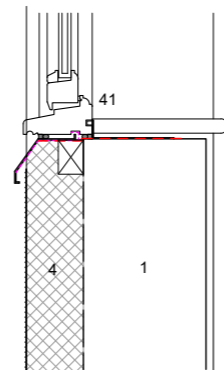
SCALE	1:10	PAPER	A4	DATE	18.03.2021
JOB	9419	DWG	136	REV	A03

DRAWING
 Window Head / Jamb Solid Wall
 Option 2 - EnerPHit / Net Zero Carbon

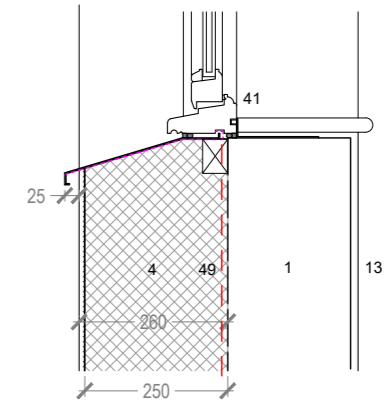
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11. New floor finish
12. New MDF skirting - decorated with flexible sealant below
13. New wet plaster - decorated
14. New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m² - to give 60min FR
15. New 100mm sound deadening mineral wool laid between joists
16. Existing floor structure
17. Existing floor deck
18. New indicative air tightness line - Protect Barrier vapour control layer/air barrier membrane or equal and approved
19. Ryttons 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. Timber treat the existing plates.
23. 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
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
33. Injected chemical damp proof course
34. Proprietary air sealing tape
35. 80mm woodfibre insulation
36. Existing roof truss
37. Existing 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 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 made good.
- 42.



1. Existing solid brick wall
2. Indicative existing foundations
3. 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)
5. New XPS insulation Greenguard GG300 board suitable for under ground situations, 70mm CCC Retrofit+ and 120mm E/NZC option o/a thick.
6. New French drain filled with pea shingle.
7. New 200 x50mm pre cast concrete kerb edging set in concrete foundation
8. Top soil
9. Assumed existing compacted hardcore base
10. Assumed sub-soil
11. New floor finish
12. New MDF skirting - decorated with flexible sealant below
13. New wet plaster - decorated
14. New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m² - to give 60min FR
15. New 100mm sound deadening mineral wool laid between joists
16. Existing floor structure
17. Existing floor deck
18. New indicative air tightness line - Protect Barrier vapour control layer/air barrier membrane or equal and approved
19. Ryttons 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
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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.



— Representative of air tightness

Revision 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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RIBA Stage 2 - WIP Issue for Information

SCALE	1:10	PAPER	A4	DATE	18.03.2021
JOB	9419	DWG	137	REV	A03

DRAWING Window Cill Solid Wall Option 1- Retrofit + Non-Decant

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Revision Schedule				
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RIBA Stage 2 - WIP Issue for Information

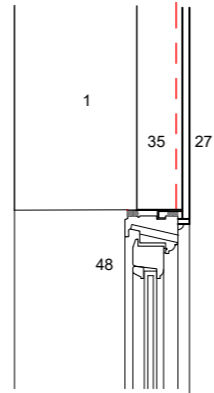
SCALE	1:10	PAPER	A4	DATE	18.03.2021
JOB	9419	DWG	138	REV	A03

DRAWING Window Cill Solid Wall Option 2- EnerPHit / Net Zero Carbon Non-Decant

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1. Existing solid brick wall
2. Indicative existing foundations
3. Existing solid concrete floor
4. 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)
5. New XPS insulation Greenguard GG300 board suitable for ground situations, 70mm CCC Retrofit+ and 120mm E/NZC option o/a thick.
6. New French drain filled with pea shingle.
7. New 200 x50mm pre cast concrete kerb edging set in concrete foundation
8. Top soil
9. Assumed existing compacted hardcore base
10. Assumed sub-soil
11. New floor finish
12. New MDF skirting - decorated with flexible sealant below
13. New wet plaster - decorated
14. New 2no layers 12.5mm British Gypsum Fireline plasterboard, tape and joint with 3mm skim coat finish, nominal 11.7kg/m² - to give 60min FR
15. New 100mm sound deadening mineral wool laid between joists
16. Existing floor structure
17. 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 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
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
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
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34. Proprietary air sealing tape
35. 80mm woodfibre insulation
36. Existing roof truss
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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
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.
42. Existing wall finish
43. 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
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 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 of insulation
48. Existing window
49. Sand/cement render to extg substrate to provide airtightness barrier



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DRAWING
 Window Head / Jamb Solid Wall
 IWI Detail. Option 1/2- CCC Retrofit Plus
 / EnerPHit + Net Zero Carbon
 Decant

CLIENT Cambridge City Council

JOB Achieving Zero Carbon

RIBA Stage 2 - WIP Issue for Information

SCALE	1:10	PAPER	A4	DATE	18.03.2021
JOB	9419	DIWG	141	REV	A02

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11 Wheaton House Gnd Floor

Zero Carbon Communal ASHP					
Floor	Gnd	31m2	External	W/m2K	5 m2
Walls	Cavity Walls**		0.15	W/m2K	36.37 m2
Roof				W/m2K	31 m2
Triple Glazing			0.8	W/m2K	14.13 m2
Heating	Communal ASHP				
Ventilation	Zehnder Comfoair 200	MVHR			
Airtightness	membrane in loft etc		1	m3@50Pa	
Renewables	PV West		0.55	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 will need some works doing to them, either removal or mitigation					
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.					
U-value done on EWI of CWI wall, this needs mentioning in the report.					
Modelled 190mm mineral wool conductivity 0.032W/mK					
Carbon Reduction Part L 2013		66.20%	with PV		53.80% without PV
Carbon Reduction SAP 10.1		99.59%	with PV		92.26% without PV
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 +					
Floor	Left untouched		0.6	W/m2K	m2
Walls	Cavity Walls**		0.22	W/m2K	36.37 m2
Roof				W/m2K	31 m2
Triple Glazing			0.8	W/m2K	14.13 m2
Heating	Keep gas boiler				
Ventilation	Aereco	MEV			allow £2000 for install
Airtightness	membrane in loft etc		5	m3@50Pa	
Renewables	PV West		1	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 will need some works doing to them, either removal or mitigation					
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.					
U-value done on EWI of CWI wall, this needs mentioning in the report.					
Modelled 90mm mineral wool conductivity 0.032W/mK					
Carbon Reduction Part L 2013		23.60%	with PV		-8.79% without PV
Carbon Reduction SAP 10.1		-90.60%	with PV		-96.81% without PV
Total Energy Cost		£233.00			13.38 DER
Regulated Energy		51.03	kWh/m2/yr		22.7 DER
Unregulated Energy		35	kWh/m2/yr		82B SAP
Enerphit ASHP Communal ASHP					
Floor	Left untouched		0.6	W/m2K	m2
Walls	Cavity Walls**		0.15	W/m2K	31 m2
Roof				W/m2K	31 m2
Triple Glazing			0.8	W/m2K	14.13 m2
Heating	ASHP				
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 will need some works doing to them, either removal or mitigation					
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.					
U-value done on EWI of CWI wall, this needs mentioning in the report.					
Modelled 190mm mineral wool conductivity 0.032W/mK					
Carbon Reduction Part L 2013		99.00%	with PV		53.80% without PV
Carbon Reduction SAP 10.1		112.41%	with PV		94.86% without PV
Total Energy Cost		£115.14			0.25 DER

Regulated Energy		27.22	kWh/m2/yr		-2.1 DER
Unregulated Energy		35	kWh/m2/yr		100A SAP
Base Case					
Floor	Left untouched		0.6	W/m2K	m2
Walls	Cavity Walls**		0.55	W/m2K	0 m2
Roof				W/m2K	31 m2
Triple Glazing			0.8	W/m2K	14.13 m2
Heating	Keep gas boiler				
Ventilation	untouched	Extract			
Airtightness	membrane in loft etc		8	m3@50Pa	
Renewables	PV		0	kWp	
Thermal Bridges	Canopy			m	
	Gutter Eaves			m	
	Window Sills		8.4	m	
	Gable			m	
	Party Gable			m	
	Gnd Floor Perimeter		8.84	m	
Cavity Walls filled assumed					
Carbon Reduction Part L 2013		-26.70%	without PV		22.2 DER
Carbon Reduction SAP 10.1		-125.17%	without PV		26.74 DER
Total Energy Cost		£357.02			78C SAP
Regulated Energy		88.6	kWh/m2/yr		
Unregulated Energy		35	kWh/m2/yr		

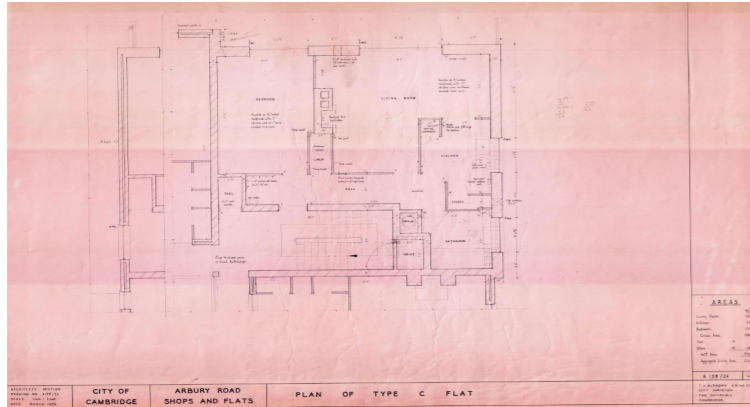


155 Ditton Fields

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 Perimeter	28 m	
Thermal Bridges will need some works doing to them, either removal or mitigation			
Headers and stretchers, presumed to be solid walls			
Modelled 190mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013		88% with PV	27.10% without PV
Carbon Reduction SAP 10.1		94.70% with PV	60.64% without PV
Total Energy Cost	£14.18	3.77	DER
Regulated Energy	2.2 kWh/m2/yr	0.76	DER
Unregulated Energy	44 kWh/m2/yr	92A	SAP

Local Plan + ASHP			
Floor	Left untouched	0.6 W/m2K	48.6 m2
Walls	Solid Walls	0.22 W/m2K	49 m2
Roof		0 W/m2K	0 m2
Triple Glazing		0.8 W/m2K	7.29 m2
Heating	ASHP		
Ventilation	Aereco MEV		allow £1000 for install
Airtightness	membrane in loft etc	5 m3@50Pa	
Renewables	PV West	1 kWp	
Thermal Bridges	Canopy	1 m	
	Gutter Eaves	0 m	
	Window Sills	4.8 m	
	Gable	0 m	
	Party Perimeter	28 m	
	Gnd Floor Perimeter	28 m	
Thermal Bridges will need some works doing to them, either removal or mitigation			
Headers and stretchers, presumed to be solid walls			
Modelled EWI 90mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013		32.40% with PV	7.20% without PV
Carbon Reduction SAP 10.1		59.39% with PV	45.15% without PV
Total Energy Cost	£225.41	20.76	DER
Regulated Energy	35.16 kWh/m2/yr	5.82	DER
Unregulated Energy	44 kWh/m2/yr	79C	SAP
Enerphit ASHP			
Floor	Left untouched	0.6 W/m2K	48.6 m2
Walls	Solid Walls	0.15 W/m2K	49 m2
Roof	400mm mineral wool	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 kWp	
Thermal Bridges	Canopy	1 m	
	Gutter Eaves	0 m	
	Window Sills	4.8 m	
	Gable	0 m	
	Party Perimeter	28 m	
	Gnd Floor Perimeter	28 m	
Thermal Bridges will need some works doing to them, either removal or mitigation			
Headers and stretchers, presumed to be solid walls			
Carbon Reduction Part L 2013		77.60% with PV	27.10% without PV
Carbon Reduction SAP 10.1		89.04% with PV	60.64% without PV
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

Walls	Solid Walls	1.5 W/m2K	49 m2
Roof		0 W/m2K	0 m2
Triple Glazing		0.8 W/m2K	7.29 m2
Heating	Keep gas boiler		
Ventilation	untouched extract		
Airtightness	membrane in loft etc	8 m3@50Pa	
Renewables	PV	0 kWp	
Thermal Bridges	Canopy	1 m	
	Gutter Eaves	0 m	
	Window Sills	4.8 m	
	Gable	0 m	
	Party Perimeter	28 m	
	Gnd Floor Perimeter	28 m	
Headers and stretchers, presumed to be solid walls			
Carbon Reduction Part L 2013		-102.00% without PV	42.86 DER
Carbon Reduction SAP 10.1		-230.55% without PV	48.36 DER
Total Energy Cost	£457.20	72C	SAP
Regulated Energy	174.8 kWh/m2/yr		
Unregulated Energy	44 kWh/m2/yr		



Arbury Road 1 Bed

Net Zero Carbon Communal ASHP			
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		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 will need some works doing to them, either removal or mitigation			
Modelled 190mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013	77.00% with PV	64.70% without PV	
Carbon Reduction SAP 10.1	99.53% with PV	94.89% without PV	
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
Roof	Party Floor	0 W/m2K	50 m2

Triple Glazing		0.8 W/m2K	9.8 m2
Heating	Keep gas boiler		
Ventilation	Aereco MEV		allow £1000 for install
Airtightness	membrane in loft etc	5 m3@50Pa	
Renewables	PV West	1 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 will need some works doing to them, either removal or mitigation			
Modelled EWI 90mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013	37.10% with PV	1.50% without PV	
Carbon Reduction SAP 10.1	-23.84% with PV	-30.59% without PV	
Total Energy Cost	£196.79	13.34	DER
Regulated Energy	57.7 kWh/m2/yr	18.18	DER
Unregulated Energy	34 kWh/m2/yr	85B	SAP
Enerphit Communal ASHP			
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		0.8 W/m2K	9.8 m2
Heating	Communal ASHP		
Ventilation	MVHR		
Airtightness	membrane in loft etc	1 m3@50Pa	
Renewables	PV West	2 kWp	
Thermal Bridges	Canopy	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 will need some works doing to them, either removal or mitigation			
Bear in mind that a small flat with ASHP would need HWC and also outside space for ASHP unit probably not practical and therefore some form of community heating required at a guess.			
Carbon Reduction Part L 2013	131.6% SAP 100A with PV	82.60% without PV	
Carbon Reduction SAP 10.1	112.80% SAP 94A with PV	94.32% without PV	
Total Energy Cost	-£3.76	-9.72	DER
Regulated Energy	-14.90 kWh/m2/yr	-2.73	DER
Unregulated Energy	34 kWh/m2/yr	99A	SAP
Base Case Gas			
Floor	First Floor	0 W/m2K	50 m2
Walls	Solid Walls	1.5 W/m2K	39 m2
Roof	Party Floor	0 W/m2K	50 m2
Triple Glazing		0.8 W/m2K	9.8 m2
Heating	Keep gas boiler		
Ventilation	untouched	extract	

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 Part L 2013	-49.40% without PV	31.68	DER
Carbon Reduction 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 will need some works doing to them, either removal or mitigation			
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.			
U-value done on EWI of CWI wall, this needs mentioning in the report.			
Modelled 190mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013	88.40% with PV	31.30% without PV	
Carbon Reduction SAP 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
Local Plan +	ASHP		
Floor	Left untouched	0.6 W/m2K	42.85 m2
Walls	Cavity Walls**	0.22 W/m2K	51.76 m2
Roof	300mm mineral wool	0.15 W/m2K	42.85 m2
Triple Glazing		0.8 W/m2K	9.27 m2
Heating	ASHP		
Ventilation	Aereco	MEV	allow £2000 for install
Airtightness	membrane in loft etc	5 m3@50Pa	
Renewables	PV West	1 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 will need some works doing to them, either removal or mitigation			
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.			
U-value done on EWI of CWI wall, this needs mentioning in the report.			
Modelled EWI 90mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013	33.70% with PV	10.30% without PV	
Carbon Reduction SAP 10.1	42.97% with PV	34.08% without PV	
Total Energy Cost	£228.39	23.48	DER
Regulated Energy	40.41 kWh/m2/yr	7.38	DER
Unregulated Energy	45 kWh/m2/yr	76C	SAP
Enerphit 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 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 will need some works doing to them, either removal or mitigation			
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.			
U-value done on EWI of CWI wall, this needs mentioning in the report.			
Modelled 190mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013	80.60% with PV	30.90% without PV	
Carbon Reduction SAP 10.1	86.32% with PV	50.70% without PV	

Total Energy Cost	£46.88	6.88	DER
Regulated Energy	8.28 kWh/m2/yr	1.67	DER
Unregulated Energy	45 kWh/m2/yr	90B	SAP
Base Case Gas			
Floor	Left untouched	0.6 W/m2K	42.85 m2
Walls	Cavity Walls	0.55 W/m2K	51.76 m2
Roof	300mm mineral wool	0.15 W/m2K	42.85 m2
Triple Glazing		0.8 W/m2K	9.27 m2
Heating	Keep gas boiler		
Ventilation	untouched	Extract	
Airtightness	membrane in loft etc	8 m3@50Pa	
Renewables	PV	0 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	
Cavity Walls filled assumed			
Carbon Reduction Part L 2013	-52.10% without PV	36.66	DER
Carbon Reduction SAP 10.1	-210.67% without PV	40.76	DER
Total Energy Cost	£374.66	73C	SAP
Regulated Energy	145.0 kWh/m2/yr		
Unregulated Energy	45 kWh/m2/yr		



38 Akeman Street

Zero Carbon 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	10.1
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	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 Gable	11 m			
	Gnd Floor Perimeter	20.8 m			
Thermal Bridges will need some works doing to them, either removal or mitigation					
Modelled 190mm mineral wool conductivity 0.032W/mK					
Carbon Reduction Part L 2013		93.20% with PV	34.3% without PV		
Carbon Reduction SAP 10.1		94.11% with PV	59.82% without PV		
Total Energy Cost		£19.64		2.6	DER
Regulated Energy		-3.93 kWh/m2/yr		0.66	DER
Unregulated Energy		31 kWh/m2/yr		92A	SAP
Local Plan +	ASHP				

Floor	Left untouched	0.6 W/m2K	44 m2		
Walls	Solid Walls EWI	0.3 W/m2K	80.19 m2		
Roof	300mm mineral wool	0.15 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	Aereco	MEV		allow £2000 for install	
Airtightness	membrane in loft etc	5 m3@50Pa			
Renewables	PV West	1 kWp			
Thermal Bridges	Canopy	0 m			
	Gutter Eaves	19 m			
	Window Sills	10.6 m			
	Gable	4 m			
	Party Gable	11 m			
	Gnd Floor Perimeter	20.8 m			
Thermal Bridges will need some works doing to them, either removal or mitigation					
Modelled EWI 90mm mineral wool conductivity 0.032W/mK					
Carbon Reduction Part L 2013		44.10% with PV	27.70% without PV		
Carbon Reduction SAP 10.1		53.21% with PV	43.13% without PV		
Total Energy Cost		£289.42		14.69	DER
Regulated Energy		34.59 kWh/m2/yr		5.24	DER
Unregulated Energy		31 kWh/m2/yr		77C	SAP

Enerphit 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	10.1
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	Canopy	0 m			
	Gutter Eaves	19 m			
	Window Sills	10.6 m			
	Gable	4 m			
	Party Gable	11 m			
	Gnd Floor Perimeter	20.8 m			
Thermal Bridges will need some works doing to them, either removal or mitigation					
Modelled 190mm mineral wool conductivity 0.032W/mK					
Carbon Reduction Part L 2013		66.00% with PV	33.2% without PV		
Carbon Reduction SAP 10.1		80% with PV	59.82% without PV		
Total Energy Cost		£160.35		8.93	DER
Regulated Energy		8.28 kWh/m2/yr		2.24	DER
Unregulated Energy		31 kWh/m2/yr		88B	SAP

Base Case Gas					
Floor	Left untouched	0.6 W/m2K	44 m2		
Walls	Solid Walls	1.5 W/m2K	80.19 m2		
Roof	300mm mineral wool	0.15 W/m2K	36 m2	Sloping/Flat	10.1
Triple Glazing		0.8 W/m2K	19.81 m2	u-values	0.18W/m2K

Heating	Keep gas boiler				
Ventilation	untouched	extract			
Airtightness	membrane in loft etc	8 m3@50Pa			
Renewables	PV	0 kWp			
Thermal Bridges	Canopy	0 m			
	Gutter Eaves	19 m			
	Window Sills	10.6 m			
	Gable	4 m			
	Party Gable	11 m			
	Gnd Floor Perimeter	20.8 m			
Carbon Reduction Part L 2013		-77.20% without PV	32.47	DER	
Carbon Reduction SAP 10.1		-252.66% without PV	41.12	DER	
Total Energy Cost		£572.94	68D	SAP	
Regulated Energy		131.93 kWh/m2/yr			
Unregulated Energy		31 kWh/m2/yr			



3 Neptune Close

Zero Carbon ASHP			
Floor	Left untouched	0.6 W/m2K	32.3 m2
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	2.4 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	
	Gnd Floor Perimeter	16.3 m	
Thermal Bridges will need some works doing to them, either removal or mitigation			
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.			
U-value done on EWI of CWI wall, this needs mentioning in the report.			
Modelled 190mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013	89.20% with PV	43.90% without PV	
Carbon Reduction SAP 10.1	94.72% with PV	67.40% without PV	
Total Energy Cost	£18.67	3.05	DER
Regulated Energy	2.18 kWh/m2/yr	0.65	DER

Unregulated Energy			
		32 kWh/m2/yr	94A SAP
Local Plan + ASHP			
Floor	Left untouched	0.6 W/m2K	32.3 m2
Walls	Cavity Walls**	0.22 W/m2K	82.61 m2
Roof	300mm mineral wool	0.15 W/m2K	32.3 m2
Triple Glazing		0.8 W/m2K	15.03 m2
Heating	ASHP		
Ventilation	Aereco	MEV	allow £1000 for install
Airtightness	membrane in loft etc	5 m3@50Pa	
Renewables	PV West	1 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	
	Gnd Floor Perimeter	16.3 m	
Thermal Bridges will need some works doing to them, either removal or mitigation			
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.			
U-value done on EWI of CWI wall, this needs mentioning in the report.			
Modelled EWI 90mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013	45.00% with PV	24.40% without PV	
Carbon Reduction 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
Unregulated Energy	32 kWh/m2/yr	83B	SAP
Enerphit ASHP			
Floor	Left untouched	0.6 W/m2K	32.3 m2
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	
	Gnd Floor Perimeter	16.3 m	
Thermal Bridges will need some works doing to them, either removal or mitigation			
Cavity Walls if filled, might allow EWI if they have been done to a good standard, otherwise IWI which becomes invasive and expensive.			
U-value done on EWI of CWI wall, this needs mentioning in the report.			
Modelled 190mm mineral wool conductivity 0.032W/mK			
Carbon Reduction Part L 2013	85.10% with PV	42.60% without PV	

Carbon Reduction SAP 10.1			
		92.93% with PV	68.05% without PV
Total Energy Cost		£45.19	4.22 DER
Regulated Energy		10.61 kWh/m2/yr	0.87 DER
Unregulated Energy		32 kWh/m2/yr	93A SAP
Base Case Gas			
Floor	Left untouched	0.6 W/m2K	32.3 m2
Walls	Cavity Walls**	0.55 W/m2K	82.61 m2
Roof	300mm mineral wool	0.15 W/m2K	32.3 m2
Triple Glazing		0.8 W/m2K	15.03 m2
Heating	Keep gas boiler		
Ventilation	untouched	extract	
Airtightness	membrane in loft etc	8 m3@50Pa	
Renewables	PV	0 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	
	Gnd Floor Perimeter	16.3 m	
Cavity Walls filled assumed			
Carbon Reduction Part L 2013			
		-40.90% without PV	27.65 DER
Carbon Reduction SAP 10.1			
		-93.64% without PV	24.65 DER
Total Energy Cost		£406.61	79C SAP
Regulated Energy		107.8 kWh/m2/yr	
Unregulated Energy		32 kWh/m2/yr	



38 Abbey Road

Zero Carbon				
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/m2K
Triple Glazing		0.8 W/m2K	11.81 m2	500mm mineral wool
Heating	ASHP			33m2
Ventilation	Zehnder Q350	MVHR		
Airtightness	membrane in loft etc		1 m3@50Pa	
Renewables	PV West		4.15 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 will need some works doing to them, either removal or mitigation				
IWI to be deployed, 80mm woodfibre and lime plasters				
Carbon Reduction Part L 2013		88.90% with PV	37.30% without PV	
Carbon Reduction SAP 10.1		93.63% with PV	54.31% without PV	
Total Energy Cost		£36.59	2.47	DER
Regulated Energy		2.04 kWh/m2/yr	0.66	DER
Unregulated Energy		27 kWh/m2/yr	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 mineral wool
Heating	ASHP			33m2
Ventilation	Aereco	MEV		allow £2000 for install
Airtightness	membrane in loft etc		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 will need some works doing to them, either removal or mitigation				
Carbon Reduction Part L 2013		39.90% with PV	27.50% without PV	
Carbon Reduction 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 Energy		27 kWh/m2/yr	80C	SAP
Enerphit SAP 10 ASHP				
Floor	Q Bot	0.35 W/m2K	50 m2	
Walls	Solid Walls IWI	0.55 W/m2K	83.85 m2	
Roof	Sloping Roof	0.15 W/m2K	35 m2	Flat Ceiling 0.09W/m2K
Triple Glazing		0.8 W/m2K	11.81 m2	500mm mineral 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 will need some works doing to them, either removal or mitigation				
Carbon Reduction Part L 2013		59.60% with PV	35% without PV	
Carbon Reduction SAP 10.1		72.16% with PV	54.31% without PV	
Total Energy Cost		£262.08	8.99	DER
Regulated Energy		10.74 kWh/m2/yr	2.24	DER
Unregulated Energy		27 kWh/m2/yr	88B	SAP
Base Case				
Floor	Untouched	0.7 W/m2K	50 m2	
Walls	Solid Walls	1.5 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 mineral wool

Heating	Keep gas boiler		33m2
Ventilation	untouched	extract	
Airtightness	membrane in loft etc	8 m3@50Pa	
Renewables	PV	0 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	
Carbon Reduction Part L 2013	-79.50% without PV	27.85	DER
Carbon Reduction SAP 10.1	-230.53% without PV	27.5	DER
Total Energy Cost	£723.83	76C	SAP
Regulated Energy	113.10 kWh/m2/yr		
Unregulated Energy	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 ²	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	
					<hr/>	
					1,671,000	
					<hr/>	

Version: C

No.	Description	Quantity	Unit	Rate	Amount	Notes
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	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				60,080	
	Total				60,080	

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	

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	47. Mineral wool batts packed into void to ensure continuity of insulation	35	m2	95.00	3,325	
	Total				4,225	

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.	14	m2	500.00	7,000	
	Total				7,000	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	Item	2,000.00	2,000	
	Total				2,000	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				56,330	
	Total				56,330	

Version: C

Archetype 2

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	

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	47. Mineral wool batts packed into void to ensure continuity of insulation	39	m2	95.00	3,705	
	Total				4,605	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	2,000.00	2,000	
	Total				2,000	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				57,430	
	Total				57,430	

Version: C

Archetype 3

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (90mm insulation)	39	m2	200.00	7,800	
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	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					
	Total				11,540	

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	47. Mineral wool batts packed into void to ensure continuity of insulation	39	m2	95.00	3,705	
	Total				4,605	

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.	10	m2	500.00	5,000	
	Total				5,000	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	2,000.00	2,000	
	Total				2,000	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				61,660	
	Total				61,660	

Version: C

Archetype 4

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	

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	47. Mineral wool batts packed into void to ensure continuity of insulation	43	m2	95.00	4,085	
	Total				4,985	

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.	9	m2	500.00	4,500	
	Total				4,500	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	2,000.00	2,000	
	Total				2,000	

No.	Description	Quantity	Unit	Rate	Amount	Notes
1	Archetype 5					
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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				81,570	
	Total				81,570	

Version: C

Archetype 5

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (90mm insulation)	80	m2	200.00	16,000	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. 70mm thickness.	32	m3	125.00	4,000	
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					
	Total				22,900	

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	47. Mineral wool batts packed into void to ensure continuity of insulation	36	m2	95.00	3,420	
	Total				4,320	

Version: C

Archetype 5

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	2,000.00	2,000	
	Total				2,000	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				71,850	
	Total				71,850	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	4. External wall mineral wool rendered system (90mm insulation)	68	m2	200.00	13,600	
3	5. XPS insulation greenguard GG300 board suitable for under ground situations. 70mm thickness.	27	m3	125.00	3,375	
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	
	Total				19,295	

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	47. Mineral wool batts packed into void to ensure continuity of insulation	32	m2	95.00	3,040	
	Total				3,940	

Version: C

Archetype 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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	2,000.00	2,000	
	Total				2,000	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				69,800	
	Total				69,800	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	Internal wall insulation (no detail available)	90	m2	150.00	13,500	
	Total				13,500	

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	47. Mineral wool batts packed into void to ensure continuity of insulation	35	m2	95.00	3,325	
	Total				4,225	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	2,000.00	2,000	
	Total				2,000	

Version: C

No.	Description	Quantity	Unit	Rate	Amount	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	

Version: C

Archetype 1

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	

Version: C

Archetype 1

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				75,490	
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				76,100	

Version: C

Archetype 1

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	

Version: C

Archetype 1

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	

Version: C

Archetype 1

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.	14	m2	500.00	7,000	
	Total				7,000	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	

Version: C

Archetype 2

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 Total				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				73,260	

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	

Version: C

Archetype 2

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	

Version: C

Archetype 2

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	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	

Version: C

Archetype 3

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				75,660	
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				76,270	

Version: C

Archetype 3

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	

Version: C

Archetype 3

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				<u>7,725</u>	

Version: C

Archetype 3

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. <div style="text-align: right;">Total</div>	10	m2	500.00	5,000 <hr/> 5,000	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	

Version: C

Archetype 4

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				79,800	
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				80,410	

Version: C

Archetype 4

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	

Version: C

Archetype 4

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)	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	

Version: C

Archetype 4

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.	9	m2	500.00	4,500	
	Total				4,500	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	

Version: C

Archetype 5

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				109,580	
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				110,190	

Version: C

Archetype 5

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	

Version: C

Archetype 5

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	

Version: C

Archetype 5

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	

Version: C

Archetype 6

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				96,340	
20	Typical annual replacement costs - PV, MVHR & Heating	1	No	610.00	610	
	Total				96,950	

Version: C

Archetype 6

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	

Version: C

Archetype 6

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	

Version: C

Archetype 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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	

Version: C

Archetype 7

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	Qbot to ground floor	47	m2	100.00	4,700	
	Total				4,700	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	Internal wall insulation (no detail available)	90	m2	150.00	13,500	
	Total				13,500	

Version: C

Archetype 7

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	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				4,575	

Version: C

Archetype 7

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,000.00	4,000	
	Total				4,000	

Version: C

No.	Description	Quantity	Unit	Rate	Amount	Notes
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	

Version: C

Archetype 1

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				70,620	
	Total				70,620	

Version: C

Archetype 1

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	

Version: C

Archetype 1

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	

Version: C

Archetype 1

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.	14	m2	500.00	7,000	
	Total				7,000	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	1,100.00	1,100	
	Total				1,100	

Version: C

Archetype 2

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	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	40	m2	60.00	2,400	
10	Sub Total				47,440	
11	Location factor uplift			3.00	1,420	
12	Preliminaries			17.00	8,310	
13	Oh&p			8.00	4,570	
14	Consultancy fees			5.00	3,090	
15	Contingency			10.00	6,480	
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				74,090	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				74,090	
	Total				74,090	

Version: C

Archetype 2

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	

Version: C

Archetype 2

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	

Version: C

Archetype 2

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,800.00	4,800	
	Total				4,800	

Version: C

Archetype 3

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	0.5kWp PV array to west facing roof				1,000	
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				45,240	
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	490.00	490	
	Carry Forward				70,630	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				70,630	
	Total				70,630	

Version: C

Archetype 3

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	

Version: C

Archetype 3

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	

Version: C

Archetype 3

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.	10	m2	500.00	5,000	
	Total				5,000	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	1,000.00	1,000	
	Total				1,000	

Version: C

Archetype 4

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				87,740	
	Total				87,740	

Version: C

Archetype 4

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	

Version: C

Archetype 4

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	

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.	9	m2	500.00	4,500	
	Total				4,500	

Version: C

Archetype 4

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	9,400.00	9,400	
	Total				9,400	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				113,510	
	Total				113,510	

Version: C

Archetype 5

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	

Version: C

Archetype 5

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	

Version: C

Archetype 5

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	

Version: C

Archetype 5

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	6,800.00	6,800	
	Total				6,800	

Version: C

Archetype 6

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				97,180	
	Total				97,180	

Version: C

Archetype 6

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	

Version: C

Archetype 6

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	

Version: C

Archetype 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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £2,000 per KW	1	No	4,800.00	4,800	
	Total				4,800	

Version: C

Archetype 7

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	

Version: C

Archetype 7

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Brought Forward				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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	Qbot to ground floor	47	m2	100.00	4,700	
	Total				4,700	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	Internal wall insulation (no detail available)	90	m2	150.00	13,500	
	Total				13,500	

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	

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	

No.	Description	Quantity	Unit	Rate	Amount	Notes
2	PV @ £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 two-horse 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 out 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.

