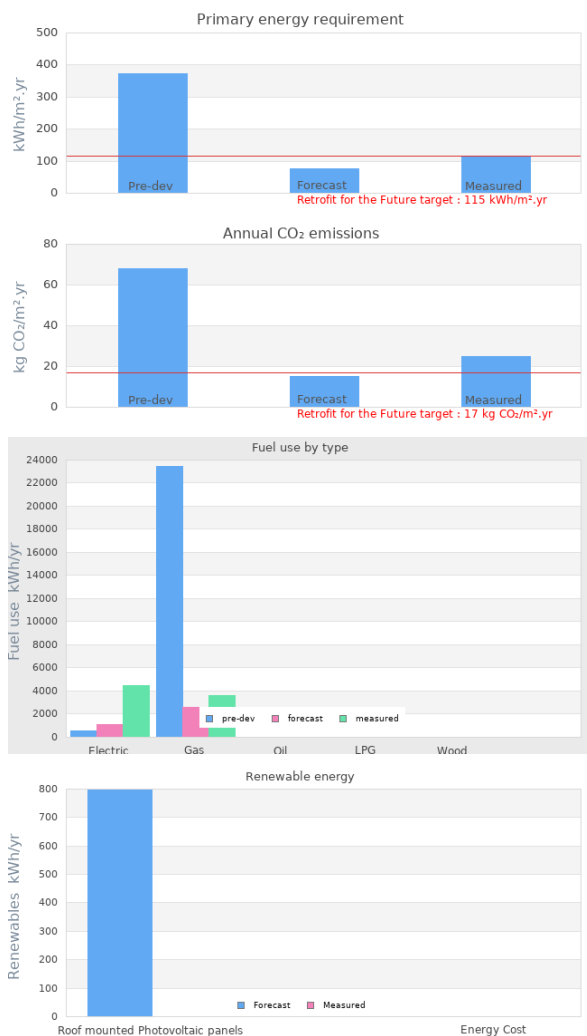


Project name Peterborough EnviroCluster Retrofit Project

Project summary The comprehensive upgrade of the fabric and services of a 1970s, masonry construction, two storey, three bedroom, semi-detached house to effect an 87% reduction in its overall energy consumption. Including: fully insulating the building and installing super-high performance windows and doors, making the fabric air and wind-tight; installing a sun-space and wind lobby, Installing solar thermal water heating; installing pv micro generation (incorporating battery storage and export to grid facilities); installing heat exchange technology into the fresh air input, together with pre-heated air from the sun-space and roof labyrinth.



Project Description

| | |
|------------------------------|---------------------------------------|
| Projected build start date | 03 May 2010 |
| Projected date of occupation | 30 Oct 2010 |
| Project stage | Under construction |
| Project location | Peterborough, Cambridgeshire, England |
| Energy target | Retrofit for the Future |
| Build type | Refurbishment |
| Building sector | Public Residential |
| Property type | Semi-Detached |

| | |
|---|--|
| Existing external wall construction | Masonry Cavity |
| Existing external wall additional information | 280mm o/a brick, uninsulated cavity, blockwork, plaster |
| Existing party wall construction | 220mm (approx) block, uninsulated cavity, blockwork, plaster |
| Floor area | 76.25 m ² |
| Floor area calculation method | PHPP |

Project team

| | |
|---------------------------------------|---|
| Organisation | UK Centre for Economic and Environmental Development |
| Project lead | UK Centre for Economic and Environmental Development (UKCEED) |
| Client | Axiom Housing Association |
| Architect | Waterland Associates |
| Mechanical & electrical consultant(s) | Cunnington Clarke |
| Energy consultant(s) | Cambridge Centre for Energy Studies (Cambridge University) |
| Structural engineer | Stanza Consulting |
| Quantity surveyor | Davis Langdon (Peterborough) |
| Other consultant | Moixa Energy |
| Contractor | Larkfleet Homes |

Design strategies

| | |
|--------------------------------------|--|
| Planned occupancy | The property is a family home, with the principal tenants being a late middle aged couple, with adult children and grand children. Some of the adult children reside sporadically with the principal residents and the grand children regularly spend the night at the premises. |
| Space heating strategy | Heating from existing (SEDBUK 'A' Rated) gas fired combination boiler, through existing radiators. Solar thermal system feeds into the boiler. |
| Water heating strategy | Existing gas fired combination boiler with feed-in water from solar panels and thermal store. No electric back-up. |
| Fuel strategy | Mains Gas, Mains Electricity |
| Renewable energy generation strategy | 1kWp photovoltaic panel array on the roof. |

| | |
|---|---|
| Passive solar strategy | Solar collection provision in new roof structure (thermal labyrinth) and in exterior thermal cladding (glazed, solar capture elements). Solar heated (tempered) air feeds into Whole House Heat Recovery Ventilation System. |
| Space cooling strategy | Natural ventilation and shading incorporated into exterior cladding. Summer bypass and night purging using Whole House Ventilation system. |
| Daylighting strategy | Daylighting provision remains as is, with glazing interventions maintaining average 2% daylight factor in kitchen and 1.5% in living spaces. |
| Ventilation strategy | Whole House Heat Recovery Ventilation with summer bypass. |
| Airtightness strategy | It is proposed to fully insulate the building externally (on the exterior of the existing fabric), effectively wrapping the entire building envelope in, between 200mm & 400mm of, insulation. Into this insulation zone it is proposed to install a wind and air tightness membrane so that the entire house is fully wind and air-tight. Special measures will be incorporated at the existing openings (windows, doors, service penetrations etc) to ensure the minimum air infiltration at these points. The existing air tightness is 10.82 m ³ /hr.m sq The proposed air tightness will be 0.6 m ³ /hr.m sq |
| Strategy for minimising thermal bridges | It is proposed to fully insulate the building externally (on the exterior of the existing fabric), effectively wrapping the entire building envelope in, between 200mm & 400mm of, insulation. As a result of this strategy for the insulation, the existing fabric of the building is isolated from the external environment, thus eliminating almost all potential thermal bridges. It will be necessary as part of the construction works to investigate the situation at the current points of cavity closure (around windows doors etc) and if necessary take remedial action; allowance has been made for this. |
| Modelling strategy | SAP (2005) with Extension for Whole House v1.6. |

Insulation strategy

It is proposed to fully insulate the building externally (on the exterior of the existing fabric), effectively wrapping the entire building envelope in, between 200mm(walls) & 400mm(roof) of, insulation. In addition to this it is proposed to insulate above the existing floor using 20mm of vacuum insulated panels and the doors and windows are all to be replaced with super-high performance alternatives. U-Values W/(mK) Existing Roof 2.0; First Floor Ceiling n/a; Walls 1.80; Ground Floor 0.52; Windows 2.80; Doors 3.00. Proposed Roof 0.10; First Floor Ceiling 0.22; Walls 0.16; Ground Floor 0.31; Windows 0.80; Doors 0.65.

Other relevant retrofit strategies

We are planning to carry out our package of retrofit measures with tenants remaining, as far as possible, in the dwelling during the proposed works. We intend to demonstrate our approach can be undertaken with minimal disruption to the tenants and with no associated temporary re-housing costs

Other information (constraints or opportunities influencing project design or outcomes)

Peterborough is flat and low lying on the edge of the Fens and subject to S-W prevailing winds. Bretton was built on a II World War airfield and is flat and exposed. Extensive, mature (25-30 yrs.) tree planting offers protection. Mid-density 3 and 2 storey housing provides a dense housing area with intermittent open space and access corridors. The site is surrounded with similar 1970s buildings, which the Local Authority Development Control Department do not consider to be of architectural significance. Advice has been sought from the Senior Development Control Officer and he has confirmed that the proposed development would be welcomed as an improvement on the existing local architectural style.

Energy use

Fuel use by type (kWh/yr)

| Fuel | previous | forecast | measured |
|-----------------|----------|----------|----------|
| Electric | 547 | 1097 | 2253 |
| Gas | 23490 | 2569 | 2665 |
| Oil | | | |
| LPG | | | |
| Wood | | | |

| Fuel | previous | forecast | measured |
|------|----------|----------|----------|
| | | | |

Primary energy requirement & CO2 emissions

| | previous | forecast | measured |
|---|----------|----------|----------|
| Annual CO2 emissions (kg CO2/m ² .yr) | 68 | 15 | 25 |
| Primary energy requirement (kWh/m ² .yr) | 372 | 75 | 114 |

Renewable energy (kWh/yr)

| Renewables technology | forecast | measured |
|---|----------|----------|
| Roof mounted Photovoltaic panels | 798 | |
| - | | |
| Energy consumed by generation | | |

Airtightness (m³/m².hr @ 50 Pascals)

| | Date of test | Test result |
|------------------------------|--------------|-------------|
| Pre-development airtightness | - | 10.05 |
| Final airtightness | - | 3.33 |

Annual space heat demand (kWh/m².yr)

| | Pre-development | forecast | measured |
|--------------------------|-----------------|----------|----------|
| Space heat demand | - | 28 | - |

Whole house energy calculation method

SAP Extension for Whole House

Other energy calculation method

Predicted heating load

16.5 W/m² (demand)

Other energy target(s)

Building services

| | |
|---|------|
| Occupancy | NULL |
| Space heating | NULL |
| Hot water | NULL |
| Ventilation | NULL |
| Controls | NULL |
| Cooking | NULL |
| Lighting | NULL |
| Appliances | NULL |
| Renewables | NULL |
| Strategy for minimising thermal bridges | NULL |

Building construction

Storeys

Volume

Thermal fabric area

Roof description

NULL

Roof U-value

0.00W/m² K

Walls description

NULL

Walls U-value

0.00W/m² K

Party walls description

NULL

Party walls U-value

0.00W/m² K

Floor description

NULL

Floor U-value

0.00W/m² K

Glazed doors description

NULL

Glazed doors U-value

0.00W/m² K

Opaque doors description

NULL

Opaque doors U-value

0.00W/m² K

Windows description

NULL

Windows U-value

0.00W/m² K

Windows energy transmittance
(G-value)

Windows light transmittance

Rooflights description

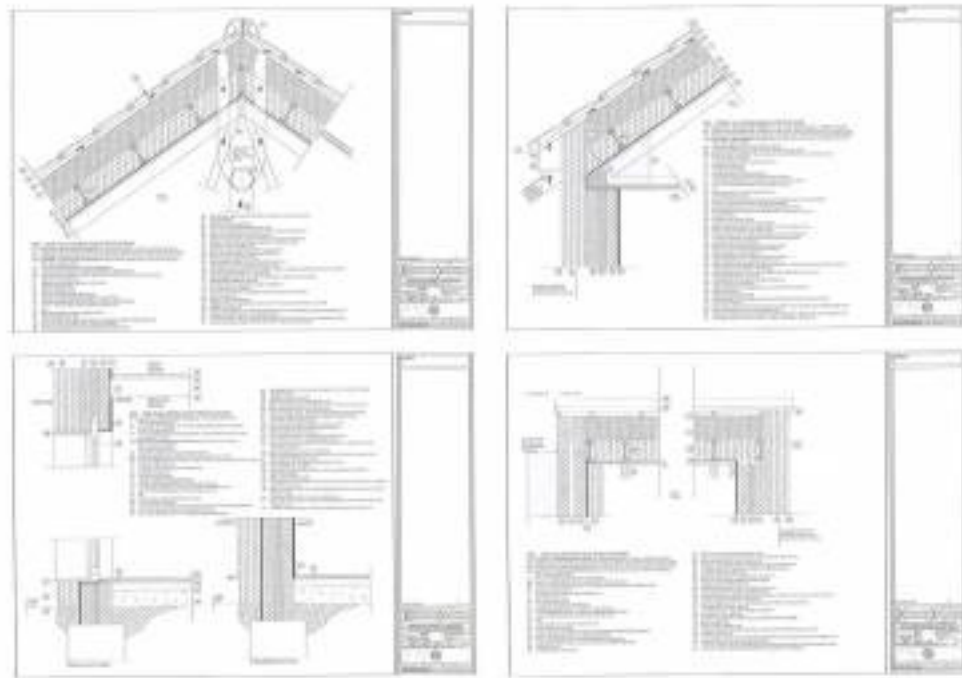
NULL

Rooflights light transmittance

Rooflights U-value

0.00W/m² K

Project images

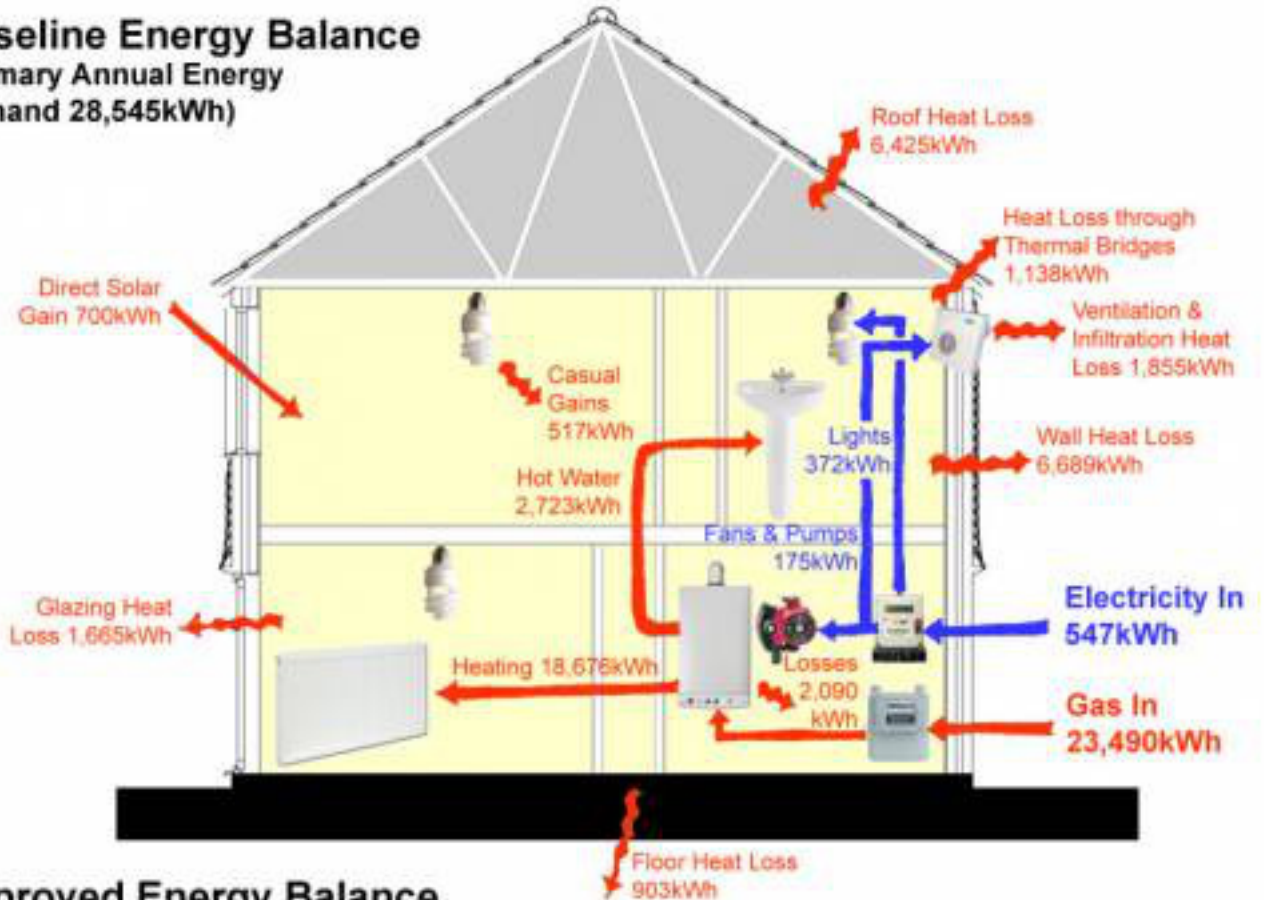


Peterborough – Carbon Retrofit Project

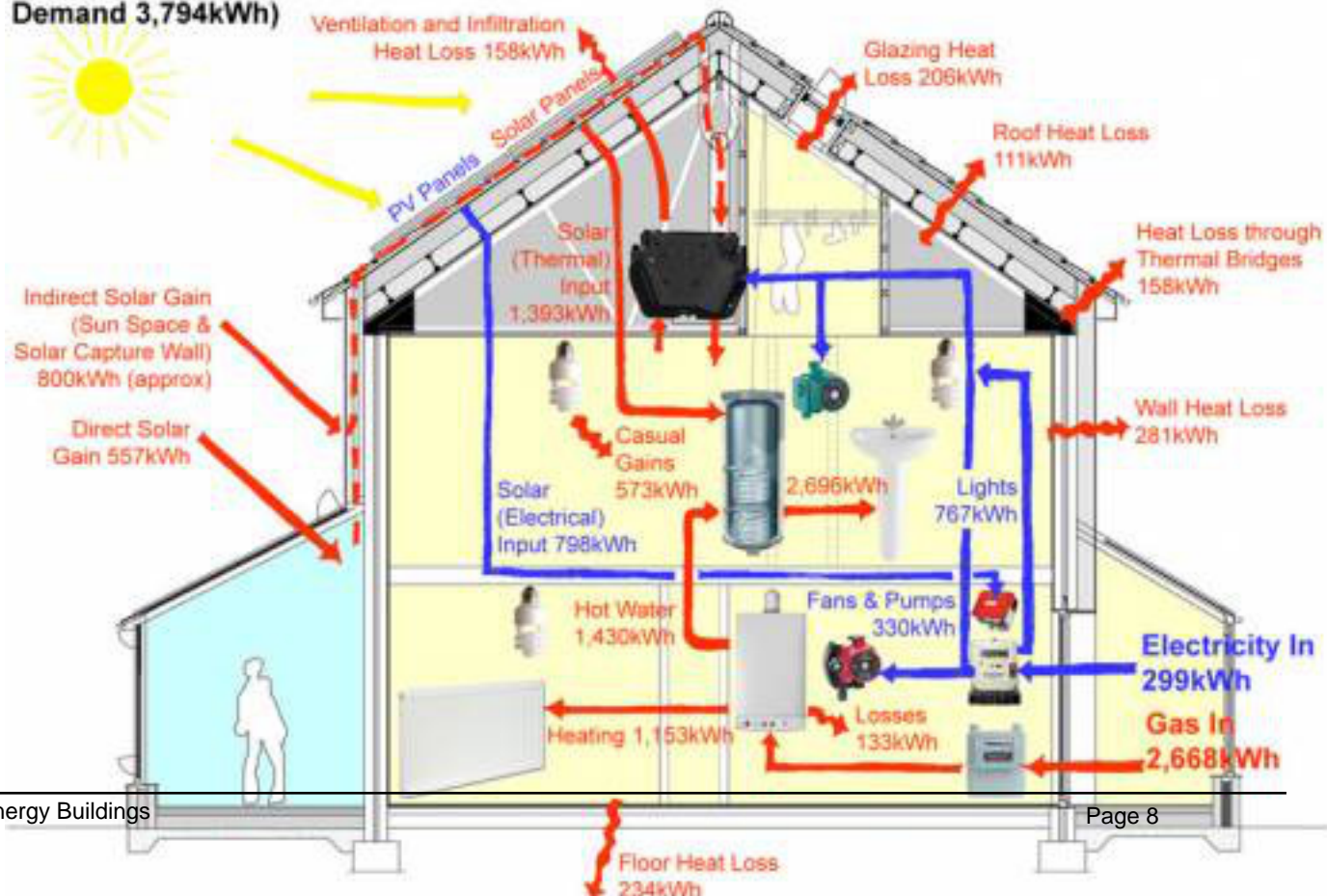


Peterborough

Baseline Energy Balance (Primary Annual Energy Demand 28,545kWh)



Improved Energy Balance (Primary Annual Energy Demand 3,794kWh)

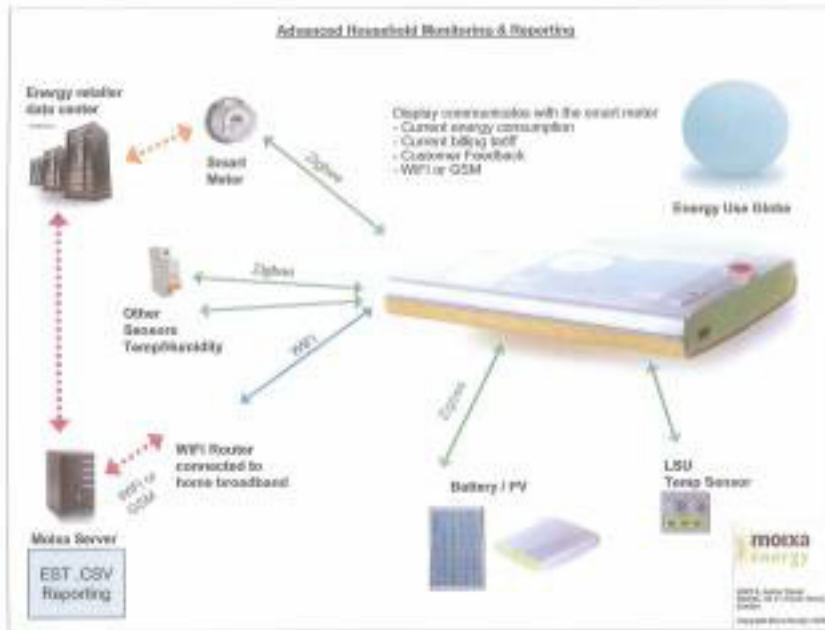




| ITEM | WORK SECTION | QTY | COMMENTS |
|----------------|----------------|------------|----------|
| SUBSTRUCTURE | FOUNDATIONS | 24,150.00 | |
| | FOUNDATIONS | 784.00 | |
| | FOUNDATIONS | 1,004.00 | |
| | FOUNDATIONS | 11,778.00 | |
| | FOUNDATIONS | 488.00 | |
| | FOUNDATIONS | 2,242.00 | |
| | FOUNDATIONS | 2,258.00 | |
| EXTERNAL WALLS | EXTERNAL WALLS | 793.00 | |
| | EXTERNAL WALLS | 8,747.50 | |
| | EXTERNAL WALLS | 2,242.00 | |
| | EXTERNAL WALLS | 881.00 | |
| | EXTERNAL WALLS | 1,386.00 | |
| | EXTERNAL WALLS | 8,430.00 | |
| | EXTERNAL WALLS | 207.00 | |
| | EXTERNAL WALLS | 13,758.00 | |
| | EXTERNAL WALLS | 1,745.00 | |
| | EXTERNAL WALLS | 1,079.00 | |
| | EXTERNAL WALLS | 275.00 | |
| INTERNAL WALLS | INTERNAL WALLS | 275.00 | |
| | INTERNAL WALLS | 1,760.00 | |
| | INTERNAL WALLS | 602.00 | |
| | INTERNAL WALLS | 404.00 | |
| | INTERNAL WALLS | 1,500.00 | |
| ROOFING | ROOFING | 4,800.00 | |
| | ROOFING | 2,260.00 | |
| MECHANICAL | MECHANICAL | 1,500.00 | |
| | MECHANICAL | 1,500.00 | |
| ELECTRICAL | ELECTRICAL | 1,500.00 | |
| | ELECTRICAL | 1,500.00 | |
| PAINTING | PAINTING | 1,500.00 | |
| | PAINTING | 1,500.00 | |
| FINISHES | FINISHES | 1,500.00 | |
| | FINISHES | 1,500.00 | |
| TOTAL | TOTAL | 212,000.00 | |
| | TOTAL | 212,000.00 | |

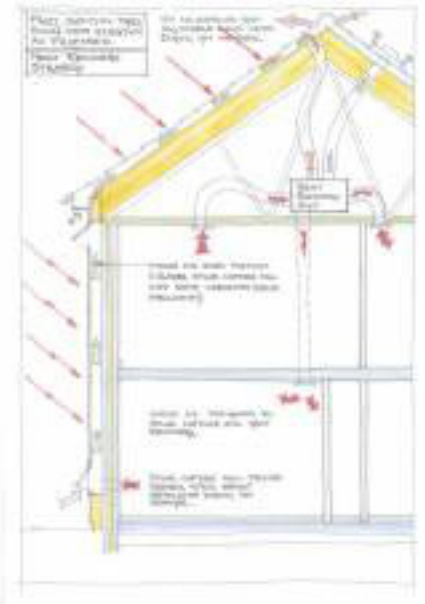
NOTES
 1. ALL MATERIALS TO BE INSTALLED IN ACCORDANCE WITH THE SPECIFICATIONS AND NOTES OF THE CONTRACT DOCUMENTS.
 2. ALL COSTS FOR LABOR, MATERIALS, EQUIPMENT, TRANSPORTATION AND HOUSING COSTS ARE INCLUDED IN THE UNIT PRICE.
 3. PRICES FOR ALL MATERIALS TO BE SUPPLIED BY THE CONTRACTOR SHALL BE SUBJECT TO THE MARKET RATE AT THE TIME OF ORDERING.





Peterborough – Carbon Retrofit Project



Peterborough – Carbon Retrofit Project






Peterborough – Carbon Retrofit Project



Measure analysis - one by one

| Measure | Savings | | Capital cost & Life | | 80 year cost | | | Cost effectiveness analysis | | Excluded | |
|---------|--|----------------------------------|----------------------|--|---------------------------------|---------------------------------|---|--|-------------------------------|----------|---|
| | Annual CO ₂ emission savings from measure | Annual Fuel savings from measure | Measure Life (years) | Capital cost to include (before maintenance cost if significant) | Fuel cost savings over 80 years | Capital costs over 80 year life | Net cost of measure over its lifetime (Capital less fuel savings) | CO ₂ saved from measure over 80 years | €/tonne CO ₂ saved | | |
| | kg/yr | £/yr | years | £ | £ | £ | £ | tonne CO ₂ saved | £/tonne CO ₂ saved | | |
| 1 | Roof insulation | 1184 | 91.76 | 60 | 31,426 | 4,800 | 27,306 | 10,400 | 12 | 228 | ✓ |
| 2 | Wall insulation | 1249 | 98.94 | 60 | 13,205 | 4,800 | 15,205 | 6,400 | 35 | 66 | ✓ |
| 3 | Ground Floor insulation | 31 | 2.32 | 60 | 3,507 | 400 | 3,807 | 2,000 | 8 | 74 | ✓ |
| 4 | New windows and doors | 151 | 14.78 | 30 | 3,807 | 807 | 2,370 | 22,300 | 11 | 2,120 | ✓ |
| 5 | Solar Heating | 287 | 21.92 | 30 | 3,400 | 1,400 | 7,200 | 3,000 | 18 | 37 | ✓ |
| 6 | Photovoltaic panels | 437 | 31.12 | 30 | 3,000 | 3,000 | 4,800 | 3,000 | 27 | 108 | ✓ |
| 7 | Heat Recovery Ventilation + increased Airflows | 228 | 15.7 | 30 | 3,110 | 840 | 10,200 | 10,000 | 14 | 106 | ✓ |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |
| 11 | | | | | | | | | | | |
| 12 | | | | | | | | | | | |
| 13 | | | | | | | | | | | |
| 14 | | | | | | | | | | | |
| 15 | | | | | | | | | | | |
| 16 | | | | | | | | | | | |
| 17 | | | | | | | | | | | |
| 18 | | | | | | | | | | | |
| 19 | | | | | | | | | | | |
| 20 | | | | | | | | | | | |
| | Package(s) | 3000 | £ 140 | | £ 62,649 | £ 8,400 | £ 56,220 | £ 66,820 | 183 | £ 474 | |

