The Parity Projects' rehabilitation programme:

The rehabilitation programme set up by Parity Projects included conventional renovation work along with specific eco-measures.

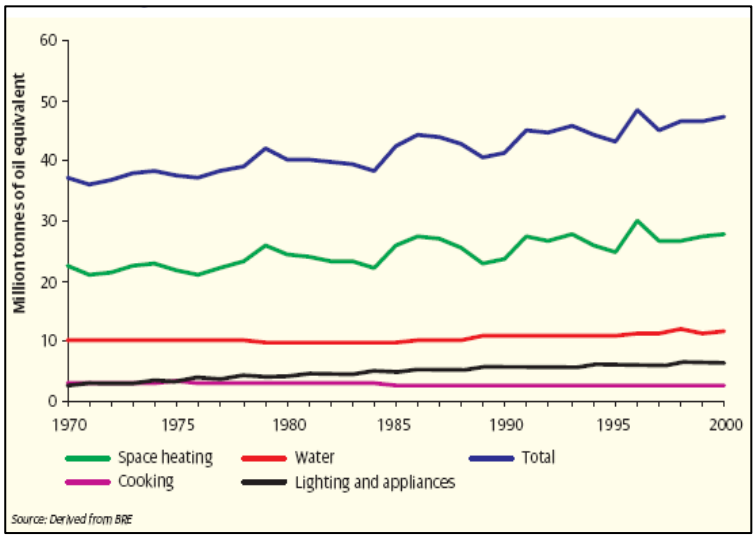
Conventional renovation work:

- Roof strengthening
- Loft conversion
- Re-wiring
- Redecorating
- Damp proofing work

Specific eco-measures:

- Beyond best-practice insulation
- Very efficient heating system through gas condensing boiler and underfloor heating
- New double or triple glazed windows
- Air-tightness improvement and ventilation control
- Rain water recycling

Domestic final energy consumption by end use, 1970 to 2000
http://www.berr.gov.uk/files/file11250.pdf



Carshalton Grove efficiency measures by end use

End Use	Carshalton Grove measures
Space Heating	*Int. Wall and floor insulation*
	Draught exclusion
	New windows
	Underfloor heating
	Replacement boiler
Water	*Solar thermal water heating*
	Highly insulated thermal store
	Pipe lagging
Lighting	*Low energy design*
Cold appliances	*Careful selection of equipment*
Cons. Electronics	
Cooking	
Wet appliances	
Miscellaneous	

Wall insulation:

Throughout the house, insulation has been provided using **different combinations**, while a **timber studwork** is always supporting the installation:

The walls of the **ground floor living room**, have been insulated using a **3 layers combination of solid panels of mineral fibre** (1). Although those walls –that are the front walls of the property- were discovered to be cavity wall during the replacement of a window, the rehabilitation proceeded with solid wall rather than cavity wall insulation as it is a continuous cavity with the neighbouring property.

The property is prone to water penetration, largely because of the build up of garden material against the front walls, and the solid wall option seemed to be the best in this regard too. In view of the dampness, it was also decided to **leave a small void between the internal surface of the wall and the installed insulation material.**

- the **spare bedroom's** walls have been insulated with a **single panel** of Celotex (2)
- the **dining room's** walls have been insulated using **sheep's wool** (3)
- the **bathroom's** walls have been insulated with **recycled cotton and hemp** (4)
- the **study room's** walls have been insulated with **recycled-newspaper blown pulp** (5)
- and the walls of the **loft**, that hosts the main bedroom, have been insulated using **multi-layered foil materials** (6)

1): 2): 3): 4): 5): 6):





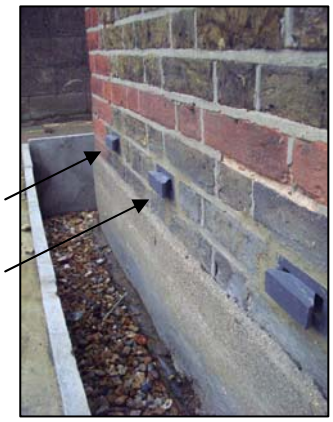

Parity Projects is thus gradually gathering an **extensive database** of most insulation products associated with their average purchase costs, installation costs and measured thermal performance.

Airtightness, draught-proofing and damp-proofing

Airtightness and draught-proofing: A test carried out by BSRIA to establish the existing airflows through the building fabric before the rehabilitation showed a **leakage rate of 15 $m^3/m^2/h$**, 50% above the limit fixed by the 2006 Building Regulation Part L for new homes.

Those draughts have been addressed during the construction work as in the long term they could have undermined all the efforts made to insulate the home. In spite of its environmental shortcomings, **expanding foam** was used to seal the gaps around the air brick as no viable alternative was available.

Damp proofing of the front wall: For a long time before the house was bought, the high external ground level had allowed settled rain water to seep horizontally into the front wall lower parts, causing damp problems. Moreover, internal skirting of the ground floor were above the floor line, therefore covering the air bricks and adding to the problem by preventing proper ventilation below the floorboards.



During the rehabilitation, the external ground level adjacent to the house has been lowered by digging a **gravel-filled drainage ditch** deeper than the damp proof course. Rainwater is now diverted in the trench and soaks away via **tubes** pushed deep into the ground below, avoiding the vulnerable wall face.

To **speed up the natural drying process** of the front wall in an environmentally harmless way, a **specific air flow system** – based on specific brick's air chambers and temperature variations- has been installed and has already helped in measurably reducing the wall moisture levels[1].

Windows:

Replacement windows represented an important investment and were chosen according to their lasting combination of **better performing glass and highly insulating frames** in order to provide the most satisfying improvement in U-Values. Attention was also paid to the use of materials that are **environment-friendly** in manufacture and disposal.

Although the procurement process had been particularly difficult and had known some delays, **hardwood timber frames** instead of PVC ones were finally installed, remaining true to the original design of the house. All windows on the ground and first floor have **double glazing**, and the loft main window is **an extremely efficient triple glazed** unit.

A redundant external door and a north facing window have also been bricked up as they would provide neither solar gain nor sufficient resistance to heat loss.

Heating system and floor insulation:

A **water-based underfloor heating system**, fuelled by the **central high-efficiency gas-condensing boiler**, has been installed throughout the house as it

[1] www.parityprojects.com

is **more energy efficient** and **less space consuming** than a radiator-based heating system. The system offers both room heating at much lower system temperatures, and additional gain in term of space, which was important since the internal insulation would partly reduced available space in the rooms.

The fixing of the heating pipes required the replacement of both ground and upper floors, and the installation of insulating materials. Different materials have been used for the different floors:

For the **living room** on the ground floor, **concrete** had been used in spite of its high carbon footprint because this dense floor material can act as a secondary **thermal store** for the system and is more resistant to the continued risk of damp that affects the lower parts of the front wall. After removing rotting timber, a layer of sand was laid before placing an Eco Damp Proof Membrane made of recycled polythene. The underfloor heating system was positioned and further edge insulation was then installed, followed by the concrete floor.

In the **dining room** and on the **first floor** however, the **existing wooden floor boards** have been retained above the Celotex insulation panels, heating pipes and sand screed, on the basis that those old dry boards would not warp as might newer boards with higher moisture content.

As the suspended timber floor in the dining room must remain fully ventilated, the external outlet of the existing vents on the front wall were connected to plastic ducting that connects it into drainage pipes. Those drainage pipes continue under the living room concrete ground floor and through the dining room, providing it with adequate under floor ventilation.

Water:

Solar water heating: The house has no south facing sloping roof that would make it suitable for solar energy harvesting, but **especially designed solar water heating panels** have been installed on the new flat roof of the loft extension to the rear of the property. With a pay-back period of 7-8 years, they are very cost-effective and will provide around **60% of the house hot water needs**.

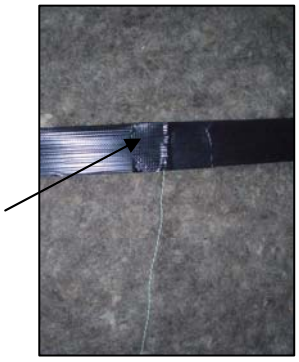
Rainwater harvesting: Several points of capture from rooftop drainage allow extensive rainwater harvesting. The house's **different tanks** are **piped into each other** so that overflow from the first storage tank situated in the eaves of the loft extension is captured in a second large tank in a roof space above the property's entrance. The disposition of the tanks allows gravity to deliver rainwater to outlets using conventional plumbing system.

This water is **used to supply the low volume dual flush (2/4 litre) toilets and the washing machine**. Ultimately, the surplus is collected in an **outdoor rainwater butt** that is used to irrigate the garden.

Water efficient appliances: A range of appliances such as **aerated taps** and **shower nozzles** have also been installed to further reduce water consumption without impairing the residents' comfort. They are predicted to offer a **15% reduction in the overall need for water**. A meter has been installed in the home by Sutton and East Surrey Water Plc for the residents to be able to follow the evolution of their water consumption and to be charged for the volume used only. The filters and cleansing systems needed for the proper re-use of grey water were considered too complex and expensive and no such system has been adopted at Carshalton Grove.

Accounting for the expected average rainfalls and the efficiency savings, **a family of four** living in the rehabilitated home may reasonably expect to require **110/l/h/d** only.
At current rates, it translate into a £50 reduction on water bills per annum, a benefit that does not allow for major expenses on such a system and explains why relatively simple but effective fixings have been preferred to more expensive off-the-shelf grey water recycling systems.

Monitoring:



Thermal sensors have been installed within the walls throughout the property to monitor the performance of the various insulation materials in use. Thermocouples were also put in the living room's concrete slab to monitor its in-use performance.
Temperature readings are taken **at 5 minutes intervals** and stored using a **data logging system designed in-house**, potentially replicable for other homes. Once the project is completed the data collected will be available from the **Parity Project website.**

The different invoices and contractor references have also been kept to be able to compare the cost of what was deemed to be conventional refurbishment with the built cost and long term savings derived from eco refurbishment.

Contractors:

- Sheffield Insulation	Insulation materials
- Ecomerchant	Natural materials
- Cavity Trays Ltd	Plastic ducting
- Invisible Heating Systems Ltd	Underfloor heating equipment
- Schrijver Systeem® UK Ltd	Wall aeration system
- British Polythene Industries PLC	Visqueen eco-membrane
- Bereco	Hardwood timber framed windows
- One Stop Building Materials Ltd	General
- KRS Designs of Crowborough	Design of the loft