Technology Strategy Board
Driving Innovation

Retrofit for the Future

Project final report

Cover note

This report was prepared by the collaborative project team for this Retrofit for the Future project, to provide fuller context on their experiences and the particulars of their retrofit's specification, construction and occupation.

The authors were encouraged to include honest, transparent and constructive comment, garnered from multiple perspectives across their team. All views are taken to be an accurate account from the time.

There may have been further modifications to the property after this report was produced. It is therefore possible that a small minority of statements will no longer be valid.

Although minor modifications have been made to this report by the Technology Strategy Board, these were only to ensure the privacy of individuals, including the residents, and compliance with the Data Protection Act.

This report may contain links to other websites, such as for project partners or the retrofit project. The Technology Strategy Board is not responsible for the content of those websites.

This report has already proven to be a valuable source of information for the technical and cost analysis reports published by the Technology Strategy Board which are available at: www.retrofitanalysis.org

Retrofit for the Future Project Final Report

Project number: ZA157H
Property number: TSB084

Author: Sustainable Energy Academy

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Final Report

Project information

- **ZA reference number:** ZA157H

- **Location of property:** N19, London

- **Lead participant details:** Sustainable Energy Academy
  The National Energy Centre
  Davy Avenue
  Knowlhill
  Milton Keynes
  MK5 8NG

  www.superhomes.org.uk

- **Date report issued:**

1. Project directory

Role	Organisation	Contact Details
Project Director	Sustainable Energy Academy	The National Energy Centre Davy Avenue Knowlhill Milton Keynes MK5 8NG www.superhomes.org.uk
Property Owner / Project Manager	Camden Council	33 – 35 Jamestown Road London NW1 7DB www.camden.gov.uk
Energy Modelling and Monitoring	Parity Projects	Block A 230/231 Riverside Business Centre London SW18 4UQ Tel: 0208 874 6433 www.parityprojects.com
Main contractor	United House	Goldsel Road Swanley Kent BR8 8EX Tel: 01322 665522 www.unitedhouse.net
Sub-contractor – general	Masher Brothers Construction	Masher Brothers Construction 97-103 Florence Road Lewisham London SE14 6QL Office 020 8691 1632
PV/solar thermal installer	Evo Energy	27 Eldon Business Park Nottingham Nottinghamshire NG9 6DZ Office 08448 150 200
Supplier – windows	Pilkington UK Limited	Office 01227 280140

2. Introduction

The Sustainable Energy Academy, manager of the award winning Old Home SuperHome project, has extensive experience of insulation in domestic settings. However, it appears that there is no obvious procedure for doing this; indeed most homeowners appear to have to undertake their own investigations and 'reinvent' the wheel each time.

WHISCERS™ (Whole House In-Situ Carbon and Energy Reduction Solution) is a process which can be used to internally insulate a property with exceptional ease and very little mess. Because the methods used result in little or no rework on site they are a particularly suitable solution for social housing and allow for residents to remain in the property whilst the works are completed.

3. Occupants

A family of five lived in the property prior to the works. They remained in situ throughout the renovation; one of the children was not yet at school and therefore in the property for much of the time. One of the adults suffered from asthma. These were important considerations for the period of the retrofit works. The family was already reasonably environmentally aware and were enthusiastic about taking part. They were fully informed of the works to take place, any likely disruption to be caused and what results they could expect at the end of the project.

The residents have been very pleased with the results of the works. Indeed they now regularly check the temperature of the water from their solar thermal system and note down the output from the PV.

They are also very pleased with the internal wall insulation. In some rooms it has formed an internal sill which they didn't have before. In the kitchen, where the window sits closer to the external wall, they now have a window seat. The only room in which they particularly notice the insulation in is the downstairs cloakroom where the window itself is very small and again the window sits close to the outside of the wall.

It is worth noting that some of their furniture was stored off site during the works. In part this was due to the Decent Homes work and the major renovations to the kitchen.

4. Dates

Event	Date
Patent Application filed	11th May 2009
Home Energy Assessment completed	9th November 2009
Contract signed with TSB	6th February 2010
Air tightness testing and thermal imaging	6th April 2010
Project start date (when was the first proposal discussed or agreed)	22nd February 2010
JCT signed with United House and Camden Council	30th June 2010
Planning application submitted	Not required (Certificate of lawful development granted)
Planning permission granted	Not required
Building Regulations application submitted (if appropriate)	26th August 2010
Building Regulations approval granted (if appropriate)	14th June 2011
Tenants signed variation to tenancy agreement	15th June 2010
Certificate of lawful development submitted	22nd April 2010
Certificate of lawful development granted	13th July 2010
Start on site	7th June 2010
Completion of retrofit	22nd October 2010
Monitoring system commissioned and operating properly	9th February 2011
Building defects corrected	8th November 2010
Building services and controls operating correctly	10th November 2010
Grand Opening	11th November 2010

5. Pre-retrofit property

Under the rules of the competition, a complete house in social ownership had to be chosen. It was considered desirable to choose a house which was typical of Camden Council's street properties, so that the lessons learned about installing the energy saving measures and their effectiveness on this project could be transferred to other Camden properties. At least one roof aspect had to be south facing in order to maximise the solar gain possible for the solar thermal and photovoltaic panels.

Letters were sent to the tenants of all of the houses that satisfied the conditions above, explaining the project, how they would potentially benefit from the works, and asking who would be willing to take part. Fifteen tenants responded to these letters and were interviewed by phone to determine:

- The willingness of tenants to engage with the project
- How they would be affected by the disruption, noise and dust involved
- How many people would benefit from the retrofit (the more occupants the better).

From this, a shortlist of four properties was visited in September 2009 by the project partners, to determine the most suitable property to retrofit, considerations being:

- How typical the property was of Camden Council's street properties
- Whether the property would be straightforward to retrofit in particular:
    - Absence of major/recent fittings to the internal faces of external walls
    - Standard features e.g. no unusual window shapes or decorative features.

TSB084 is a typical Camden three-storey late Victorian terrace with very few fixtures to the external walls and no unorthodox features
The property dates from around 1880 and includes a kitchen/dining room, box room and Cloakroom on the ground floor. The first floor consists of the living room and bedroom one and the second floor two further bedrooms and a family bathroom.

In addition to the energy efficiency measures, the house also benefitted from a major refurbishment. This included fitting a new kitchen, WC and bathroom, paid for by Camden Council as part of their work to improve all tenants' homes.

6. Design

The original proposed works were as follows:

- Installation of 100mm XPS internal wall insulation on all external walls, using the WHISCERS™ process
- Replacement low energy lamps
- Additional roof and loft insulation
- Replacement front and rear doors
- Addition of individual MVHR (Mechanical Ventilation Heat Recovery) units in the kitchen, bathroom and cloakroom
- Installation of TRVs (Thermostatic Radiator Valves) on all radiators
- 8sqm photovoltaic panels
- 8sqm solar thermal panels
- Major renovation of sash windows including the installation of slimlite glazing
- Reduced flow shower head and low flush toilets.

These measures were finalised using Parity Projects' Home Energy Masterplan software to balance the optimised overall package.

An early survey indicated damp in front and party walls which required treatment before the insulation could be fixed. This caused a slight delay to the project, added to the costs, and involved mess on-site which we were hoping to avoid.

A number of discussions were held relating to the windows. Specifically planning issues were discussed, along with cost, delivery schedules and thermal properties. Reasonably early in the process, it was agreed to switch to vacuum glass. This also caused a delay in the project when the delivery date was put back.

Concerns were raised about the use of inter-floor insulation and whether it may contribute to cold bridging and thence rotting of the joist ends. It was agreed to use a number of different solutions and to add additional sensors to monitor the effects.

A further issue was the discovery of asbestos in the roof. This was removed by a licensed contractor.
Although neither the damp nor the asbestos resulted in changes to the retrofit design they each added to the time spent in the property, the mess caused and the cost of the project.

Development of the WHISCERS™ process also incurred problems, which is only to be expected with such an innovative solution. Analysis was undertaken to determine the best laser solution for the process and the best board cutting method; water jet and laser cutting were examined and rejected, before we eventually decided upon cutting by router. There were some errors by the board cutters and difficulties with the interface between the software and the cutting machines. The machine itself required additional tools and additional training in their use. There were also concerns about lack of sufficient Z movement on the cutter. There were issues with delivery of boards to the site and the clear labelling of the boards to note where they should be installed. The consortium also had to determine robust detailing for all eventualities, including sealing the perimeter of the IWI (Internal Wall Insulation) boards.

7. Construction

A standard JCT contract was signed between Camden Council and United House as the two parties had no existing framework agreement in place.

United House operated a materials supply only contract with labour supplied by the nominated sub-contractor Masher Brothers Construction. Masher Brothers' direct labour of multi-tradesmen (electricians, plumbers, heating engineers etc) undertook the majority of the works. A specialist sub-contractor was used for the asbestos removal within the loft.

The renewables element of work was sub-contracted to Evo Energy who had previously worked with both United House and Masher Brothers Construction.

Site works were managed by Masher Brothers foreman and daily meetings were held with United House management team. Camden Council's Project Officer made weekly site visits to inspect the works carried out and to liaise with the residents. United House also provided a Resident Liaison Officer (RLO) to oversee day-to-day activities in respect of resident questions or concerns.

There was no architect involved with the project. Design decisions were developed and carried forward by the core working group (Sustainable Energy Academy/Camden/United House/Parity Projects) with support from product specialists such as Knauf Insulation.

The bulk of the retrofit works were carried out as programmed, helped by the fact that many of the design proposals had been tried and tested on previous United House projects. The WHISCERS™ process posed the most challenging of tasks to coordinate as the intention was to operate a 'just-in-time' delivery system. Whilst the technology and process had been trialled under laboratory and then mock-site conditions, further refinement to the data processing element was required before the system could be fully implemented on site. Any errors in measurements led to incorrect board cutting and greater fitting difficulty. Unfortunately this was witnessed on site on two occasions.

8. Commissioning and occupancy

M&E systems commissioned include the PV, solar thermal and individual heat recovery ventilation fans. No problems were highlighted with the installation although minor tweaks where required on the monitoring equipment.

The handover process, as with any United House project, was handled by the site manager who carried out a full demonstration of the installed systems as well as providing an operation and maintenance (O&M) manual. As the residents were fully engaged throughout the project the handover process was merely a formality.

9. Costs

Item Stage>	Design stage		Post-construction		Comments
	Materials	Labour	Material	Labour	
Management and administration	12,000		16,000		Delivery resource requirements were higher than expected from landlord (Camden) – this was in part due to management requirements of damp/asbestos/decent homes works. Camden management costs = approx £15k, only £5K claimed from bid.
Project Management and coordination activities	15,300		19,000		Project management costs are ongoing as reporting is still under way.
Design					
Construction overall					
- Prelims	4,000		5,000		
- Fabric measures	15,300		18,600		
- Building services (conventional)	2,200		1,800		
- Low /zero carbon technologies	15,000		12,500		
- Commissioning	1,500		1,500		
- Contingencies	5,000				
- Consequential costs	3,000		2,625		
Occupant temporary housing	N/A		N/A		
Monitoring equipment	7,676	1,000			The monitoring equipment specified for this project went beyond the minimum EST requirements as we wanted to affirm key technical areas of risk, in particular the presence of moisture at intermediate floor joist ends and behind internal wall insulation.
Monitoring and reporting service	included above				Parity Projects has set up its standard website to display collected data in both graphical form and as downloadable CSV files.
R&D costs (please detail)	10,000		16,000		WHISCERS development

Decent Homes works (paid by Camden)	10,000	17,500	

10. Wash-up meeting

No specific wash-up meeting has been held as discussions have been on-going as to how we can further develop the WHISCERS™ process and roll out to more properties.

11. Doing it again

We would definitely do this again. The TSB funding enabled the R & D and project management in a way that other funding would not. Whilst the build cost was a substantial charge to the project, of equal value was the ability to test and re-test different measuring systems and to develop protocols for different design aspects.

With further development, which we are now undertaking, we expect installation times to be further reduced. The patent has been granted for the WHISCERS™ process and this will now be tested on a larger scale, funding permitting, to discern economies of scale etc. We are also hoping to be able to test on properties where Decent Homes work is not required at the same time. This will enable a testing of a pure WHISCERS™ process.

12. Business benefits

As a result of the works carried out at TSB084, United House secured the UK's first large scale IWI project in Islington known commercially as 'IssyClad'. Over the course of the project (due for completion autumn 2011), up to 100 homes shall benefit from lower fuel bills and improved thermal comfort.

R&D work has also continued on the WHISCERS™ process which has included a successful patent application which was granted in February 2011. Roll- out of the system is scheduled for August 2011 when the first mainstream project, under negotiation at the time of writing, will be for 104 one- & two-bedroom units in Dorking.

13. Additional Information

With the majority of their housing being solid-walled and lying within conservation areas, this project was a fantastic opportunity for Camden Council to work with the expertise of the project partners, building upon previous experience of retrofitting exemplar homes, and to learn about the challenges of internal solid wall insulation with residents *in situ*. With over twenty thousand homes with solid walls in Camden Council's housing stock, this approach is essential as a solution to the problems they face as a local authority in reducing the significant emissions that arise from their housing stock.

Camden are proud of the contribution and commitment of the residents and recognise that replication of these works would have been almost impossible without their buy-in to the project. This social factor is an important one to consider, despite rising energy prices, and may represent one of the major challenges to roll-out to diverse populations, where decanting is not an option.

Other challenges that were successfully overcome included asbestos and damp.

“Camden is committed to solutions to making our homes more energy efficient and this project will be pivotal in formulating our future approaches and policies.”