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

ZA423M

Author: East Thames Group

The work reported here has been funded by the Technology Strategy Board under the Small Business Research Initiative (SBRI) under the Retrofit for the Future programme. This project is one of nearly 90 projects funded under the programme. Further information on the programme can be found at: www.innovateuk.org/retrofit

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SBRI
Government challenges.
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Project details

Project reference number: ZA423M

Location of property: Ilford, IG1Lead

participant:

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1. Project details and directory

Project Participants

Role	Organisation	Contact Details
Property Owner		
Property Owner (held in trust)	East Thames Group	Address: 4th Floor, 29-35 West Ham Lane, Stratford, London E15 4PH Tel: 0208 522 4050 Website: www.east-thames.co.uk
Design Team		
Architect	ECD Architects	Address: Studio 3 Blue Lion Place, 237 Long Lane, London, SE1 4PU Tel: 020 7939 7528 Website: : www.ecda.co.uk
Contractor		
Main contractor	Breyer Group	Address: Farringdon Avenue, Harold Hill, Romford, Essex, RM3 8ST Tel: 01708 383 500 Website: www.breyergroup.co.uk
Sub-contractor – services	Igloo Environmental Ltd	Address: 73 High Street, Great Dunmow, Essex, CM6 1AE Tel: 01371 859 004 Email: admin@igloo-eco.com Website: www.igloo-eco.com

2. Introduction

The property (TSB009) was chosen to be the subject of the retrofit as it was a particularly poor performer in terms of energy efficiency and thermal comfort. As an 'E' rated property it had the high environmental impacts associated with an energy inefficient home, namely high carbon emissions. As a common property type it reflects efficiency issues common to a number of properties across the UK, such as a significant lack of insulation, poor air tightness, and a reliance on expensive inefficient heating systems.

Beyond the 'eco' elements of the retrofit, the layout of the property also did not meet the needs of the future resident. It had been badly subdivided in previous years and therefore the project was an opportunity to address both the sustainability and layout of the property for future generations. The core aim of the retrofit was to improve energy efficiency and to reduce the associated carbon emissions by over 75%, by using a mixture of proven and new techniques, materials and technologies.

3. Occupants

The property had been vacant for some time when it was chosen to be the subject of the retrofit. The residents chosen to move into the retrofitted property were a family of four who have lived in the area for a number of years and required a larger property.

4. Dates

Event	Date
Project start date (when was the first proposal discussed or agreed)	Spring 2009
Planning application submitted (if appropriate)	08/04/10
Planning permission granted (if appropriate)	07/06/10
Building Regulations application submitted (if appropriate)	03/08/10
Building Regulations approval granted (if appropriate)	04/11/10
Contract for work let / signed	08/10/10
Occupants moved out (state if they remained or property was empty)	Property was vacant
Start on site	11/10/10
Completion of retrofit	07/04/11
Occupants moved in	11/04/11
Monitoring system commissioned and operating properly	07/04/11
Building defects corrected	07/04/11
Building services and controls operating correctly	07/04/11

5. Pre-retrofit property

TSB009 is a two storey, three bed end-terrace Victorian property which is typical of many thousands of similar properties across the UK. East Thames alone has over 2,500 similar properties in the area. The property is not in a conservation area; however, the local planning officers confirmed that any change to the external appearance of the property would require a full plans application. The property comprised of a small kitchen, living room and bathroom at ground floor with four small bedrooms at first floor. It had poor quality UPVC double glazing and very little loft insulation. The property was nevertheless robust and suitable for extensive upgrade.

The property exhibited poor levels of energy efficiency and air tightness. When the property was initially selected, it was determined to produce 72 kilograms of CO_2 per m^2, with the aim of the retrofit to reduce this by 78% to 16 kilograms of CO_2 per m^2. Unfortunately the air tightness of the existing property could not be tested due to the presence of 'sitex security' in lieu of windows. However, the final air test result of 2.71 was significantly better than current building regulations standards and lower than our target of 3.0 m3/ (h.m^2).

6. Design

Our approach to energy saving and CO_2 reduction was to follow a lean-clean-green hierarchy, focusing on low to no maintenance solutions, to:

- Minimise heat losses from the building's thermal fabric and ventilation
- Supply residual space and water heating using replicable, low carbon technology
- Minimise lighting and appliance energy load
- Use proven, renewable energy systems

The original proposal of measures sought to find an innovative way of externally insulating without alteration to the external appearance of the property, whilst simultaneously employing advanced insulation materials to address internal cold bridging at the solid floors and window reveals.

To provide heating and top-up hot water, a high efficiency Vailant Eco TEC boiler was specified, along with solar hot water panels. A whole house heat recovery mechanical ventilation system from EnviroVent would then provide pre-warmed, filtered, fresh air by recovering almost all the heat from the returned air. The main specification was as follows:

Thermal Insulation

- Existing solid ground floor to be covered with 55mm Aerogel Spacetherm C – 18mm chipboard with a Spacetherm blanket backing to achieve a U-value of **0.16 W/m²K**
- Existing suspended ground floor to be insulated using 50mm Rockfall with an o/a U-value of **0.19 W/m²K**

- Existing solid masonry walls to be insulated externally using 160mm Pavatex Diffutherm to achieve a U-value of **0.22 W/m²K**
- Loft – blown loft insulation laid at 420mm achieving a U-value of **0.1 W/m²K**

Windows and Doors

- Entrance doors: High performance: U-value of **0.75 W/m²K** (Ecopassiv by Green Building Store)
- Windows: Triple glazed U-value of **0.75 W/m²K** (Ecopassiv by Green Building Store)

Ventilation

- EnergiVent Q humidity-responsive, filterless mechanical heat recovery ventilation with a retrofit airtightness strategy

On-site renewables

- Solar thermal back-up to boiler providing hot water when possible

Lighting

- 90% efficient LED lighting throughout

Energy efficient appliances – A+ or better

- Cooker
- Washing machine
- Fridge-freezer

Monitoring and Controls

- Prototype Wattbox intelligent controls and user interface

7. Construction

Procurement – The project was tendered

Contract type – JCT 2010 (with CDP)

Contract structure – Main contract with sub-contract labour covering most trades. Sub-contractors – Single M&E sub-contractor with a number of other minor trades. Specialist installers –All installers were procured via the main contractor.

Specialist equipment suppliers – All specialist equipment was procured via named sub contractors.

Site supervision – in-house site agent

Role of architect / design team – retained to supervise / oversee construction and sign off works

ECD - This project was relatively successful with an air-tightness result of 2.71 m^3/ ($h.m^2$). Although completion was delayed by nearly six weeks, this was in part due to the requirement for additional strengthening works to the existing bay windows (partly resulting from poor quality replacement of windows in previous years). Although site issues were raised during construction, the quality of finish was generally high and there are no serious ongoing issues to be addressed. The external insulation and render finish looks good and although the insulation results in a step, the continuity with the rest of the terrace is maintained. The works were generally completed in accordance with the specification with minor changes including the removal of the existing redundant chimney; thereby improving the appearance of the existing gable wall.

8. Commissioning and occupancy

Practical completion was reached on 07 April 2011, and the tenants moved in over the following weekend. The tenants were selected at the end of the construction phase and were therefore not involved in the design process; however, the selection of finishes was agreed with them via the RLO. The only technology that the tenants come into direct contact with is the Wattbox, to control the temperature of the home. The Wattbox is simple and intuitive to use and training was provided to the tenants on how to use it by Ice Energy. A short, simple, home user guide has also been produced by ECD for the property providing simple advice, tips and facts on how to use the retrofitted home. The tenant is keen to see how energy use behaviour combined with the efficiency measures within the home will affect electricity bills, particularly in winter.

9. Costs

Item Stage>	Design stage		Post-construction			Comments
	Materials	Labour	Material	Labour	Ext	
Management and administration						
Design						
Construction overall						
- Prelims					£ 17,030.00	
- Fabric measures					£ 30,040.00	
- Building services (conventional)						
- Low /zero carbon technologies					£ 68,272.00	
- Other (add more rows and break down costs further if you wish)					£36,070.00	Variation works to contract i.e. builders works structural,
- Consequential costs						

Occupant temporary housing						
Monitoring equipment					£ 8,100.00	Meters
Monitoring and reporting service					£ 600.00	Air testing

Below are the design/feasibility stage estimates costs:

CONSULTANT SERVICES - £11,500 + VAT: We have considered the breakdown of the consultant team involvement in the next stage and envisage the following services to come from ECD and their sister company, PPCR:

- Liaison with Planning Officer and achievement of detailed planning consent
- Prepare Schedule of Works/Outline specification and detail drawings
- Site visits and inspections plus diary/blog of progress
- Final production of SAP/PHPP analysis plus EPC certificate and production of Home User Guide
- M&E co-ordination role (lighting, ventilation, heating, monitoring and PV system layouts)
- Structural evaluation of the existing structure and advice on the impact of increased loading
- Tenant consultation/interviews/report over 24 month monitoring period (in conjunction with PPCR)

CONTRACTED WORKS - £105,320 + VAT: These figures summarise a summary breakdown of the subcontract packages plus the main contractor's preliminaries, overheads and client contingency.

- Fabric insulation measures £14,012
- Replacement fenestration £22,023
- MVHR including ceiling works £5,774
- Boiler & Solar thermal £6,389
- Solar PV £9,076
- LED Lighting £1,616
- Supply of appliances £6,938
- EST monitoring/BWIC £18,355
- Additional monitoring, covers the additional cost of the TVOC monitoring £2,500

SUB-TOTAL £86,683

+ 12.5% preliminaries/overheads + 8% contingency + 17.5% VAT

FIT-OUT WORKS - £30,969 + VAT: Funded by East Thames and undertaken by Breyer Group, these are separate to the TSB funding.

10. Wash-up meeting

A formal wash-up meeting was held for the project on 8th September 2011 facilitated by UCL. All of the key project participants have remained in close contact during the period since the retrofit was completed to ensure that any issues/snags have been resolved.

11. Doing it again

Breyer Group – We have been the main contractor for four R4tF contracts, all of which have provided valuable and offered differing lessons and challenges.

- Understanding the fabric of the building is essential. Within all of our schemes, structural
- issues were uncovered which, although not part of the retrofit works, needed to be rectified to enable the Retrofit works to proceed. As these problems were identified mid- completion, there were naturally time and cost implications for us and our client.
- As these exemplar schemes used new technologies and highly specialised materials, the potential lead-in period of these items could have been better understood in order to avoid the unexpected delays to programme we subsequently experienced.
- The availability and use of subcontractors to conduct these specialised works/installations became a concern to us and, as a result of these schemes, we have created a new division within Breyer Group and obtained Microgeneration Certification Scheme (MCS) accreditation to enable our directly employed staff to conduct future works of this nature.

ECD – We have been involved in the design and management of thirteen R4tF projects and have employed a wide variety of technologies across a number of house types with nine client bodies and seven different contractors using a number of different procurement routes. Our learning from this process includes the following:

- In order to ensure best value, all projects should be tendered. The Retrofit for the Future process encouraged contractor partnering. However this proved to be of limited value as most of the specialist knowledge and support provided at design stage was sourced from specialist manufacturers and sub-contractors.
- Provide as much detailed information at tender as possible. We provided a standard specification and suite of details across all of our projects which were adapted to suit the technologies installed.
- Obtain as much relevant site/ building information as possible from the client before construction (including asbestos surveys).
- Liaise closely with the site agent as he/ she will be critical in ensuring site quality is maintained. If possible, allow input from a fully trained clerk of works on a weekly basis to ensure that site agents are following drawings and maintaining quality.
- Deal with vacant properties first so that the lessons can be learnt on each property type before tenants are exposed to potential delays.
- Ensure that where named/ nominated sub-contractors are included their performance is monitored. For example the installation of Micro-CHP units has generally been poor resulting

in delays to the main contract.

- Supply of specialist materials needs to be carefully managed and understood at the outset of the job to avoid potential delays.

ECD are involved in a number of ongoing retrofit projects and are employing the lessons learned from the R4tF programme.

12. Business benefits

ECD – This project has used a number of innovative technologies which we hope to use on more mainstream projects over the next few years. Networking with specialist suppliers has also increased our skills and understanding of the technologies involved and potential opportunities.

Breyer Group – As a result of our learnings from this and our other R4tF projects, we have obtained Microgeneration Certification Scheme (MCS) accreditation to enable our directly employed staff to conduct future works of this nature.

How many business leads and opportunities has the project helped stimulated for participants?

ECD – This has led to repeat work with clients and hopefully further opportunities for low-carbon retrofit and refurbishment.

Breyer Group – We have been able to utilise and demonstrate our experience of Retrofit schemes to assist us in bidding and planning for similar projects.

13. Additional Information

Key results from the retrofit:

	Pre retrofit	Post retrofit
SAP rating	49	88
Energy efficiency / environmental rating	E	B
Energy/fuel spend	£145	£525.54 (predicted)
CO_2 emissions (CO_2 per m^2)	72 kilograms CO_2 per m^2	16 (78% reduction)
Air changes per hour	Not tested	-
Air permeability $m^3/(h.m^2)$	Not tested	2.71