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: ZA522P
Property number: TSB109

Hounslow Homes
Managing quality homes for London Borough of Hounslow

bere:architects

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. Ideas from business. Innovative solutions.

Final Report

Project Information

- **ZA reference number:** ZA522P
- **Project name:** TSB109
- **Location of property:** TW3, Hounslow
- **Lead participant details:**

bere:architects

73 Poets Road
London
N5 2SH

Hounslow Homes
Managing quality homes for London Borough of Hounslow

Ashmead Road Depot
Feltham, London
TW14 9NN

- **Date report issued:** 31 October 2011

Contents

1. Project details and directory

Role	Organisation	Contact Details
Architects	bere:architects	73 Poets Road, London, N5 2SH Website: www.bere.co.uk
Property manager and contractor	Hounslow Homes	Ashmead Rd Depot, Feltham, Middlesex, TW14 9NN Website: www.hounslowhomes.org.uk
ALMO (Arms Length Management Organisation)	Hounslow Homes	Ashmead Rd Depot, Feltham, Middlesex, TW14 9NN Website: www.hounslowhomes.org.uk
Architect	bere:architects	73 Poets Road, London, N5 2SH Website: www.bere.co.uk
Architect	bere:architects	73 Poets Road, London, N5 2SH Website: www.bere.co.uk
Engineer	Galbraith Hunt Pennington	26 Station Way, Cheam, Surrey SM3 8SQ
QS		1 Spaldwick Road, Stow Longa, Cambridgeshire PE28 0TL
Main contractor	Hounslow Homes	Ashmead Rd Depot, Feltham, Middlesex, TW14 9NN Website: www.hounslowhomes.org.uk
Main contractor	Hounslow Homes	Ashmead Rd Depot, Feltham, Middlesex, TW14 9NN Website: www.hounslowhomes.org.uk
Supplier - windows	Walter Bayer	Friedhofstr. 5 79215 Elzach Germany Via. www.doublegood-windows.com

2. Introduction

ZA522P is a prototype low energy retrofit of a single social housing residence. Using the Passivhaus Planning Package, bere:architects took a Passivhaus approach to the retrofit. The project demonstrates that this approach is capable of achieving a reduction in Specific Space Heat Demand of 95% on post war building stock. The intention of the project was to produce a replicable retrofit for occupied houses characteristic of social housing stock. The project demonstrates how the use of external insulation, which is applied with minimal disruption to the tenants and enables retention of internal floor area and aesthetic improvements, is central in achieving replication.

Hounslow Homes were interested in potential means of improving energy efficiency in their housing stock and wanted to be involved with the retrofit programme. Hounslow Homes' vision is to play a key role in contributing to a vibrant, inclusive, safe, healthy and sustainable modern London borough. The socially, environmentally and financially responsible management of energy and carbon emissions from the properties it manages will be fundamental to achieving the vision of a sustainable borough. By embracing the need to undertake eco-retrofits, install renewable/ low carbon energy sources, and continuously tackle fuel poverty and deliver affordable warmth, Hounslow Homes has a clear focus to provide warm, comfortable and affordable homes. Tenants will be financially better off and have improved health, whilst the homes will be easier to let and have increased asset value and lower management and maintenance costs. Hounslow Homes has an important role; in contributing towards carbon emission reduction targets at a local level, setting an example for the community and raising awareness on issues such as climate change, and reducing energy use and carbon emissions.

3. Occupants

The tenants on this project stayed in occupation for the works. They are an elderly couple with considerable health complications, but the fact that they managed to stay in situ; and that Hounslow Homes were able to adjust the works schedule to accommodate their health requirements, is one of the significant achievements of the project.

Make-up of occupants before and after the retrofit:

Age band	Number before retrofit	Number after retrofit
Under 5 years		
5-16 years		
17-21 years		
22-50 years		
51-65 years		
Over 65 years	2	2
Please state if (yes/no):	**Before retrofit**	**After retrofit**
Married couple / partners	Yes	Yes
Couple / partners with children	No	No
Any disabled persons	One occupant has mobility problems due to ill health	One occupant has mobility problems due to ill health

Open communication channels throughout the design and construction phase of the project built trust between the tenant, the design team and the construction team; when coupled with early clarification of expectations for what was required during the monitoring and building evaluation phase, this translated into easier follow-up with the tenants. Hounslow Homes knows that involving residents in the management of their homes is vital in order to deliver better housing services and improve the quality of life. Hounslow Homes Tenant Liaison Officers dealt with the tenants on all matters concerning improvements to their home. Fostering early buy-in from the tenants to the project was fundamental, both in delivering the project without having to decant the tenants, and for facilitating latter assessment efforts.

Both the design team and contractors were thoughtful in their engagement with the tenants, sharing information, making time to answer any questions or concerns that they had, and realistically striving to communicate how the construction phase was progressing and its impact upon their daily lives during the works. Early on in the works Hounslow Homes discussed and agreed the requirements for property access post-construction, to facilitate understanding of building performance and resultant retrofit achievements. Furthermore, we provided the necessary training to allow the tenants to make use of the ventilation systems, affording them healthier living, further maximising energy savings and optimising the use of their home.

The tenants, an elderly couple in poor health, were excited at the prospect of participating in this project and were exceptionally cooperative and accommodating, and Hounslow Homes honoured this with a award at their tenants' awards ceremony. The tenants understood that a post-occupancy monitoring period was essential to record the impact of the retrofit, and to develop a full cost/benefit analysis with a view to clarifying the optimum expenditure. They have communicated to us that they are willing to oblige the ongoing recording of information and any necessary 'intrusions', as they would like the experience from this property to contribute to learning for the greater good; in turn, they look forward to benefitting from greater thermal comfort and enhanced quality of life. They have also agreed to participate in post-occupancy evaluation interviews, which should provide valuable feedback on tenant comfort and satisfaction.

4. Dates

Event	Date
Project start date (when was the first proposal discussed or agreed)	01/06/2009
Planning agreed to be permitted development	20/11/2009
Building Regulations - Building notice application submitted	05/02/2011
Contract for work let / signed	10/01/11
Occupants remained in property	-
Preliminary Thermal imaging and air testing	03/06/2010
Start on site	07/02/2010
First construction phase airtest	05/06/2011
Final construction phase airtest	04/10/2011
Completion of retrofit	30/07/2011
Monitoring system commissioned and operating properly	28/08/2011
Building defects corrected	On going
Building services and controls operating correctly	28/08/2011

5. Pre-retrofit property

The house is a 3-bedroom, semi-detached, single-family dwelling built in the early 1950s. The property is located in Hounslow, close to Heathrow airport, and is not located within a conservation area. It is of solid masonry construction, and is currently occupied by an elderly couple.

The selecting of this property came down to many factors. Firstly, the property selected for retrofit is representative of a large percentage of housing types and situations present in the UK housing market. Semi-detached dwellings comprise 13% of the UK housing stock; 22% of the stock was built in the era between 1945-1964. In the House of Commons report entitled, 'A Century of Change: Trends in UK statistics since 1900', semi-detached homes built between 1945-1964 are shown to be the second most prolific housing type, with 1.7m homes falling in this category. This is a comon housing type amongst the stock that Hounslow Homes manages. Another reason for choosing this property was that it was of solid wall construction. Local Authorities recently received large amounts of funding to install cavity wall insulation (CERT and SHESP), but little so far had been provided on the more expensive option of external wall insulation. Further selection criteria included the requirement for: new windows, loft insulation top up, heating upgrade, re-wiring upgrade, and a new kitchen and bathroom, amongst other things.

It was the intention of the project that the retrofit measures proposed will not only apply to this dwelling, but that, in principle, they can be applied to a large percentage of the stock that Hounslow Homes manages, as well as the overall UK stock. For aspects such as external insulation and mechanical ventilation systems to become more commonplace however, it is important that early exemplar projects are done to a high standard.

BSRIA conducted an airtest prior to work commencing on the retrofit. This showed the property to have an Air Permeability of 6.2m^3/hr/m^2 @ 50 Pa. An additional airtest of the building was also performed, to give an air change rate result of 6.3ach^{-1}

The house was also assessed prior to the retrofit works using the Passivhaus Planning Package to determine the specific heat demand requirements of the existing construction; this assessment showed that the house would require 442kWh/(m^2a) to maintain internal temperatures of 21°C. It is unlikely that the house was ever heated to these levels however. The residents complained in particular that the front hallway was particularly draughty, and that there were cold spots around their front bay window as a result of poorly fitting UPVC double glazing.

6. Design

bere:architects employed a whole house retrofit solution at TSB109. They used a cost-effective collection of improvements to make the home more comfortable, healthier and cheaper to run.

The retrofit works comprised:

- Passivhaus levels of insulation:
  - 240mm EPS external insulation to north, west and south sides of property. East wall employs 240mm of EPS insulation to first floor. (240mm extended one meter below ground creating a thermal bubble beneath the building)
  - The neighbour's single story extension abuts the property's east elevation. It was therefore only possible to extend the 240mm insulation to the first floor of the east elevation. Wood fibre insulation was applied internally to the walls of the ground floor to mitigate cold bridging in this area.
  - 300mm of cellulose insulation, on top of 105mm of mineral wool insulation was laid in the attic.

- Continuous airtightness membrane installed in attic and sealed to cementitious parge coat to walls. Continuous airtight seal from parge coat to airtightness membranes in extension. Windows sealed to parge coat with continuous tapes. Airtightness grommets fitted to all service penetrations.

- Passivhaus certified triple glazed windows and doors achieve 0.8 W/(m2K).

- Heat Recovery Ventilation system (HRV) with an operating efficiency of 92%.

- Elimination of cold bridges with internal wood fibre insulation.

- 150mm mineral wool insulation laid between floor joists to ground floor.

- High performance insulation (0.038 W/mK at 40°C) to hot water pipes.

- Improved airtightness from 6.3ach^{-1} to 1.65 ach^{-1} at 50 Pascals as verified by the BRE.

- Roof-mounted solar thermal array with solar cylinder with new combi boiler.

The original proposal included replacing the existing roof with a new roof incorporating 400mm of insulation, but this was changed as it would not have been possible to do the works without displacing the residents. The final design utilised mineral wool insulation laid between the roof joists with OSB boards on top. The original design proposals included a flexible air tightness membrane but this had proved difficult to work with on bere:architects Tower Hamlets retrofit

scheme, and so it was decided to substitute the OSB boards for the membrane. The OSB boards provided a working platform for the works to the roof. The board joints could then be taped to provide a continuous airtightness barrier. Duct and cable penetrations could also be sealed to the boards. Cellulose insulation was then blown in to the attic space on top of the chipboard.

The roof eaves were also extended to accommodate the additional thickness of the wall insulation. This was achieved through the addition of additional timbers to extend the rafters, requiring the removal of the lowest five courses of tiles. In order to improve thermal bridging at this point a high performance PUR insulation board was fitted between the rafters to provide a continuous insulated envelope over the top of the external walls.

The original proposals had included replacing the suspended timber floor with a super insulated ground slab. After consultation with Hounslow Homes, and a review of a number of options, the decision was made to replace the proposed below slab insulation with 150mm mineral wool insulation laid between the floor joists to ground floor, supported on geo-textile membrane. This was done so that the floors could be insulated on a room by room basis, and to ensure that the residents would be able to remain in the building during the construction process.

A number of small changes were made to the design during the course of construction:

- The existing foul drain was too close to the side wall of the house on the west elevation to accommodate the below ground insulation. A new drain run was therefore dug to enable the continuous application of external insulation. A new soak-away was also created as it was suspected that the existing soak away was silted up.

- It was necessary to re-wire the entire property due to the bad condition of the existing fuse board and wiring.

- It was advantageous to relocate the duct work for the heat recovery system on the first floor south east bedroom to avoid cupboards doors.

- The RSL also took the opportunity to carry out a number of improvements to the property including refurbishment of the existing kitchen and the provision of an accessible bathroom with a walk-in bath**.**

Using the Passivhaus Planning Package to model expected energy demands established that the proposals should result in a reduced specific heat demand of 28kWh/(m^2a). This represents a reduction of 95%.

7. Construction

bere:architects (working in conjunction with Hounslow Homes) submitted the application for this competition to the TSB, and were therefore allocated the money for this project.

There was extended dialogue between bere:architects and Hounslow Homes even before the building work started, as there were several issues in the practicality of delivering a Passivhaus retrofit. For example, there was extended deliberation over the roof detail; how it was going to be insulated and accommodate the external insulation. bere:architects originally proposed raising the whole roof, but Hounslow homes saw this as too costly, time consuming and also impractical, considering the possibility of undertaking this on a much wider scale if it was required for a roll out across its stock. Eventually both parties came to an agreement and ultimately delivered a successful alternate roof detail.

The team's cost consultant, e-Griffin Cost Consultancy, undertook a detailed cost analysis of the project and a schedule of works for delivery. Hounslow Homes' internal Contracts Team was then asked to put a price against the schedule of works using as much internal resource / in-house skills as possible. This was a fundamentally important part of this project as it was envisaged that this project would provide great opportunities for the in-house contractors to up skill and deliver an exemplar whole house retrofit.

Once Hounslow Homes had submitted a price against the schedule of works, the cost consultant evaluated this against private sector contractor prices and judged it to be a competitive price offering, and agreed that the work could proceed. Due to this arrangement there was no procurement or specialised contract required; the initial agreement stood, whereby Hounslow Homes could be paid by bere:architects (who were allocated the competition funds). Both parties were comfortable with this arrangement and in retrospect it enabled as much of the £150,000 to be utilised on the actual property as possible.

The only subcontractors used were those brought in to apply the external wall insulation, commission the heat recovery unit and to undertake air tests. As much of the work as possible was kept in-house by Hounslow Homes Contracts Team.

bere:achitects (design team) were in constant dialogue with Hounslow Homes (contractor) throughout the build and regularly attended site. bere:architects co-ordinated the delivery of toolbox talks to the contractor on new equipment/ installation practices, consultation with the tenants, and obtaining information to upload on to the retrofit diary website.

ZA522P started on site in early February, by which time bere:architects' other Retrofit for the Future scheme in Tower Hamlets had already been on site for over three months. As a result, many of the early lessons learnt from that project could be applied to the works on site in Hounslow. On the Tower Hamlet's scheme below ground insulation works had delayed the

erection of scaffolding and subsequent high level works. Hounslow's team therefore proposed to erect scaffolding first, and then carry out the below ground insulation once the scaffold had been struck. The amendments to the below ground drainage runs were carried out first however, in order to allow external soil vent pipework to be repositioned. Unfortunately a dispute between the tenants and the owners of the neighbouring building led to protracted negotiations for scaffolding access, resulting in an overall delay to the works on site.

As noted above, the experience of using a flexible airtightness membrane on the Tower Hamlets retrofit scheme resulted in the use of OSB board in the loft space. Although this allowed work to proceed quickly in the roof, after the boards had been fixed down the decision was taken to rewire the house. A number of additional penetrations therefore needed to be made through the OSB boards, each of which required sealing to maintain the airtightness barrier. The OSB board still needed to be sealed to the external walls, resulting in difficult taping and membrane details at the eaves. Upon completion the Hounslow site foreman suggested that on future schemes it would be more straightforward to lift the roof timbers individually to allow a continuous airtightness membrane to be installed between the wall plate and joists, avoiding the need for taping.

Experience of poor external wall insulation subcontractors on the Tower Hamlets retrofit highlighted that the Hounslow Homes team would need to monitor the application of this material carefully. Early toolbox talks were carried out with the installers to show how the proposed details differed from the standard details installers were familiar with, and to explain the levels of performance expected of the product. As a result the installation of the insulation at TSB109 was significantly better.

Following the resolution of the scaffolding issues, work generally progressed well on site in spite of the continual occupancy of the house. At times Hounslow's team recognised that the tenants were becoming slightly overwhelmed by the works and scaled back their site presence. The site team, and particularly the Hounslow site foreman, had an excellent relationship with the residents. The additional upgrade works to the kitchen and bathrooms provided the residents with an immediate benefit early in the construction process.

Hounslow Homes also kept a log of the build process.

8. Commissioning and occupancy

Open communication channels through the design and construction phase of the project built trust between the tenant and the design and construction team, and when coupled with early clarification of expectations for what was required during the monitoring and building evaluation phase, this translated into easier follow-up with the tenants. Both the design team and contractors were thoughtful in their engagement with the tenants, sharing information, making time to answer any questions or concerns that they had, and realistically striving to communicate how the construction phase was progressing, and its impact upon their daily lives during the works. Early on in the works we discussed and agreed our requirements for property access post-construction, to facilitate understanding of building performance and resultant retrofit achievements. Furthermore, we provided the necessary training to allow the tenants to make use of the ventilation system, further maximising energy savings and optimising the use of their home.

Throughout the build process, Hounslow Homes ensured that the residents had the various aspects of the project explained to them. Upon completion of the project, bere:architects recapped on this and showed the residents how the building would now operate. Throughout the build, Hounslow Homes were quick to observe occupant use of the building, and in minor cases where issues could have arisen they were able to fine-tune systems where necessary. bere:architects proposed to conduct a formal handover to the residents with representatives from Hounslow Homes, but unfortunately due to the recent ill-health of the tenants the formal handover has been postponed. For this handover a simple A1 poster will be presented, identifying, with drawings and photographs, the various equipment and systems installed in the house. The poster includes a brief description of the retrofit measures and the installed systems, to provide an overview of their operation, referencing the operation and maintenance manuals if further information is required. The poster is designed to be mounted within the boiler cupboard so that it does not leave the house if the occupants change. Hounslow Homes will also have a digital copy of the poster should they need to provide a replacement. During the handover meeting bere:architects will give a practical demonstration of the controls for the boiler, and solar thermal controls. Replacement of filters in the heat recovery ventilation system will also be demonstrated to the maintenance team from Hounslow Homes, as it is understood that they will initially be taking responsibility for this.

As part of the Retrofit for the Future competition requirements, monitoring data is being collected over a two year period in order to verify the energy savings made. The initial readings from this data indicate that the building is warmer than in previous years. More conclusive results will be possible once the property has been monitored throughout a heating season. This increased thermal comfort has been verified by anecdotal evidence from the residents, who have stated that the house feels considerably warmer in cold periods. Hounslow Homes are aware that they may have to fine tune the building and its engineering services if noticeable problems are identified in the data analysis.

9. Costs

From the total project funding a nominal budget was set for the construction works, to allow sufficient funding for design and management fees and VAT. Working with e-Griffin Cost Consultants, bere:architects produced a costed schedule of works. Hounslow reviewed the specification and drawings provided by bere:architects, and provided standard day rates for their labour force to complete the cost information. The final construction budget sum allowed for a small contingency of approximately 10%.

The final contract sum also included additional work which was to be funded directly by Hounslow Homes, either to bring the house up to the Decent Homes standard or pre-empt future scheduled maintenance works. This included upgrades of the mains water supply and replacement of kitchen and bathroom fittings. Hounslow also agreed to bring forward rotational decoration works to minimise future disruptions.

Item Stage>	Design stage		Post-construction		Comments
	Materials	Labour	Material	Labour	
Management and administration		£13,319		£13,319	
Design		£17,743		£17,743	
Construction overall		£104,621		£126,768	
- Prelims		£5,980		£5,980	
- Site clearance		£10,739		£10,739	
- Fabric measures		£61,227		£83,375	Increased due to cost increase on windows
- Building services (conventional)					Included in fabric improvements
- Low /zero carbon technologies		£13,272		£17,854	No split between materials and labour provided
- Other		£1,071		£1,071	Builders' work in connection with services
- Consequential costs				£22,148	Upgrades to bathrooms kitchen and drainage
Occupant temporary housing		N/A		N/A	
Monitoring equipment		£4,582		£4,582	Includes solar thermal monitoring
Monitoring and reporting service					
R&D costs (please detail)					
Contingency		£7,750			Contingency expended to cover additional window costs

10. Wash-up meeting

A wash – up meeting was held on the 17th of October 2011. The meeting has influenced this report.

11. Doing it again

Hounslow Homes

If the £150,000 funding and the opportunity to work closely with bere:architects came up again, we would definitely undertake another whole house retrofit project. The whole aim of this project was to develop and demonstrate a whole house solution for a refurbishment that delivers deep cuts in energy use and carbon emissions, high levels of comfort, and attractive costs. Heavy scrutiny of the design by bere:architects ensured that we only installed those measures that were strictly necessary. This approach maximized the use of the £150,000 budget, and created an integrated whole dwelling solution which addressed all the aspects of the home that can be used to cut carbon emissions, including insulation, heating systems, ventilation, white goods and control systems. Much of the work that Hounslow Homes has done to date on its housing stock has entailed the installation of isolated measures to improve the 'energy efficiency' in buildings. These measures have been traditionally straightforward and simple/small, but have delivered effective carbon savings in high volume. TSB funding has enabled us to undertake a 'radical refurbishment' and tested our capacity to deliver deep interventions which currently require high spend. In the long term – and looking at the fact that we will ultimately need to retrofit 16,500 homes - it's now up to us to use this retrofit experience to develop sensible proposals in the middle ground. This polarization, on how much to spend on measures to save carbon, might end up leaving us in a difficult position however when trying to find the most cost effective and efficient mechanisms for change, as part of delivering the forthcoming 'Green Deal' measures. Unfortunately we simply cannot afford to retrofit all our properties to this exemplar standard, and it would also take far too long to achieve. bere:architects designed this build for us in such a way that we were able to get a better understanding of what measures were synergistic, certainly in terms of capital costs, and doing them at the same time on a wider roll-out scale would offer significant cost savings. For example, the costs of applying external wall insulation drops significantly if done at the same time as re-roofing, and results in a much more technically sound outcome.

bere:architects

bere:architects are currently working on a number of low-energy retrofit schemes using a whole house Passivhaus approach, and would definitely use the same approach to retrofitting social housing again. The opportunity to demonstrate this approach at a larger scale, on a greater number of properties, would however be of significantly more interest.

By increasing the scale of the retrofit programme it should be possible to reduce the need for works inside the house, and further limit disruption for tenants, e.g. if neighbouring buildings are also retrofitted then internal insulation would not be required on the party walls. Increased scale would also allow for the use of centralised or shared Heat Recovery Ventilation which would reduce the need for internal ductwork and the associated loss of space. We understand from the wash-up meeting that the Hounslow Homes implementation team believe that they would be able to reduce the labour costs for a single house by 20% as a result of the knowledge gained.

The design process for future retrofits will also benefit from the experiences of working with an occupied property, i.e. disruptive internal works would be designed out earlier on future projects.

The purpose of this retrofit project was to demonstrate a method of achieving big improvements in energy efficiency in such a way that they could be realistically reproduced across the country, in large numbers and with minimal disturbance to the occupants of the houses. The key to achieving this was using insulation externally rather than internally. bere:architects believe that planners and communities across the country need to accept that there is no alternative other than external insulation except in rare circumstances. This should be viewed positively – it gives a wonderful opportunity to freshen up our streetscapes at the same time as making a public statement about the commitment of an individual or community to address the serious problems of fuel poverty, and health problems from damp homes.

The levels of airtightness achieved at TSB109 were not as low as required for Passivhaus EnerPHit certification of the house. The occupied nature of the house restricted the amount of airtightness improvements that could be made internally; potential air paths within intermediate floors could not be dealt with. The updated PHPP assessment of the energy consumption of the house suggests that it should still operate at close to EnerPHit levels, which we expect to see confirmed by the ongoing monitoring. bere:architects are still investigating ways to further improve the airtightness in order to obtain certification.

12. Business benefits

There are numerous benefits arising from having completed this project:

Hounslow Homes as the ALMO:
Benefits come from improving the thermal insulation and energy efficiency of the house. The level of heating that the tenants can afford directly affects the organisation's maintenance bill, other costs arising from complaints, repairs, voids and even legal action. In extreme cases, an energy inefficient home may affect the tenant's ability to pay their rent. It is also worth noting that the energy efficiency improvements should have increased the asset value of the stock, and a good reputation can be attained from being able to demonstrate that the organisation provides good quality homes that are affordable to heat and embody eco-retrofit installations.

Hounslow Homes as the Contractor:
Prior to undertaking this project, Hounslow Homes had never undertaken an innovative whole house retrofit like this, primarily due to lack of ability to invest; gaps in design and energy performance of buildings (largely due to occupants not using buildings in the way intended); insufficient capability and skills in the supply chain; risk aversion to new products, processes and services, and the pressure of delivering an integrated systems approach for homes and communities. Having now completed this project, the key benefits that have been realised are: a) Demonstration - working on a project of this scale has provided us with a holistic approach to a whole house retrofit. We are looking forward to working with the design team to capture and assess outcomes and provide independent results; b) Collaboration - the competition has provided us with opportunities for collaboration and cross-sector learning; c) Better awareness of the 'true' costs involved. We have also become aware of the ever increasing need to align public and private funding to maximise impact of interventions; d) Confidence building - we are hoping that the evidence base from this project will provide us with some confidence and help us to plan accordingly the retrofit measures we will look to deliver across the properties we manage.

The Residents:
Benefits will emerge as the tenants begin to realise that the energy efficiency of their home has been vastly improved. The tenants (particularly as they are elderly and increasingly susceptible to fuel poverty) benefit as much from being able to afford more warmth in their home as from reduced fuel costs. This leads to the creation of a more comfortable and healthier home environment. With the mechanical ventilation system installed as part of the retrofit, the property is now receiving a plentiful supply of fresh air internally. After only one month into the completion of the project, the tenant noted a perceived improvement in his breathing – which was important as he suffered from ongoing health problems. Prior to the retrofit work commencing the residents had complained that it had felt like a gale blew through the hallway in winter, and that the bathroom was significantly colder than the rest of the house. Now they are able to move from room to room comfortably without needing to put on additional clothes or turn on or adjust the heating.

bere:architects:

By far the greatest benefit to bere:architects from the retrofit projects has been the opportunity to prove the applicability of Passivhaus retrofit measures at a domestic scale. The programme has shown that even in occupied buildings it is possible to achieve Passivhaus EnerPHit levels of energy efficiency. This will be enormously beneficial in convincing more RSLs that these levels of energy efficiency can be achieved with their existing stock. bere:architects also hope to continue their working relationship with Hounslow Homes, particularly investigating the potential opportunities for scaling up the retrofit approach. Early discussions regarding suitable potential sites and funding sources have already begun.

bere:architects have recently established a working group to accumulate cost information from Passivhaus architects and housing associations, to determine the real additional costs of Passivhaus construction compared to new build housing. The results from this retrofit will be used to contribute to the data available to the group. This will enable a review the costs of seasonal maintenance and the potential additional cost of implementing Passivhaus retrofits to reduce these maintenance costs.

13. Additional Information

The role of property management organisations, such as Hounslow Homes (ALMO), in influencing emission levels in their stock, largely relates to their responsibilities to carry out maintenance and improvements to homes so that the homes continue to meet the needs of tenants. Refurbishment to reduce carbon emissions has to date been largely restricted to relatively low cost measures (loft insulation, draught-proofing, etc). The installation of more costly low carbon / micro-generation technologies and, indeed, whole house solutions by Hounslow Homes (and other ALMOs, social landlords, etc) is still quite rare, and is typically reliant on large amounts of grant funding support, (such as the new feed in tariff initiative). High costs are still identified as being the main barrier to their take-up.