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Retrofit for the Future

Project Final Report

Revision 23, July 2012

Includes Monitored Data Analysis

Southern Housing Retrofit

Southern Housing Group

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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Retrofit for the Future, Final Report, Rev 1

Project Information

- **ZA reference number** = ZA521E
- **Project name** = Southern Housing Retrofit
- **Location of property** = Tower Hamlets
- **Lead participant details** =

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- **Date report issued** = July 23th, 2012
- **Website links** = www.towerhamletspassivhausretrofit.retrofitdiaries.org

Contents

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Introduction

The case study is a prototype deep energy-saving retrofit of a single house owned by a social housing provider. It is occupied by three generations of a single family.

Using the Passivhaus Planning Package, bere:architects took a fabric-first approach to the retrofit. The monitored data (appendix 6 and 7) confirms that this approach has worked very well in delivering significantly better winter and summer thermal comfort and indoor air quality, at the same time achieving a massive reduction in overall energy consumption. This was mainly achieved by means of reducing the Specific Space Heating Demand of the house, thus making it more affordable to live in and protecting the occupants from fuel poverty.

The intention of this project was to produce an easily replicable retrofit. It demonstrates how new windows can be installed and external insulation applied, with little disruption to the occupants of the house and without reducing the size of rooms.

It is thought that this approach is applicable to most of the UK's post-war building stock. If widely replicated, these benefits have the potential to be extended to the national economy, the environment and even national security.

Southern Housing is enthusiastic partner in this project and is keen to see the approach described in this report replicated across their housing stock, if future funding permits this. The social, environmental and financial benefits resulting from reduced energy consumption, carbon emissions and improved health and comfort will help achieve the vision of developing a vibrant, inclusive, safe, healthy and sustainable modern London borough.

Occupants

The occupant is the Muhammad family. The family spans three generations and includes 4 young children. The family had moved to the house only recently before the retrofit programme began.

It should be noted that although the occupants were generally happy with the retrofit process, there were times when the temporary loss of space on the ground floor due to floor insulation and alterations to the rear leant-to as well as the delays to the programme created difficulties. As a result, for a brief period, three of the residents moved out of the house to avoid the construction work and the noise and dirt associated with it. However, most of the family stayed in occupation throughout the retrofit works which is still regarded to be considerable achievement of the project.

The residents cook very frequently which, before retrofit, resulted in high humidity levels within the house and build-up of condensation on the glazing and walls.

Occupant profiles before and after the retrofit:

Age band	Number before retrofit	Number after retrofit
Under 5 years	1	1
5-16 years	3	3
17-21 years	2	2
22-50 years	2	2
51-65 years		
Over 65 years		
Please state if (yes/no):	**Before retrofit**	**After retrofit**
Married couple / partners	Yes	Yes
Couple / partners with children	Yes	Yes
Any disabled persons		No

Open communication channels through the design and construction phases 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. Both the Design Team and Contractors were thoughtful in their engagement with the family; sharing information, answering any questions or concerns, discussing how the construction phase was progressing and its impact upon their daily lives during the works.

The Muhammad family understands that a post-occupancy monitoring is essential to record the impact of the retrofit and to develop a cost/benefit analysis with a view to advising on future retrofits. They are keen to allow the ongoing recording of information, as they would like the knowledge gained from this retrofit to contribute to learning for the greater good. They have also agreed to participate in post-occupancy evaluation interviews, which should provide valuable feedback on tenant comfort and satisfaction.

Dates

Event	Date
Project start date (when was the first proposal discussed or agreed)	01/06/2009
Planning agreed to be permitted development	30/11/2009
Building Regulations - Building notice application submitted	04/10/2010
Contract for work let / signed	14/01/2011
Occupants remained in property	-
Preliminary Thermal imaging and air testing	03/06/2010
Start on site	18/10/2010
First construction phase airtest	08/03/2011
Final construction phase airtest	11/5/2011
Completion of retrofit	12/7/2011
Monitoring system commissioned and operating properly	21/06/2011
Building defects corrected	ongoing
Building services and controls operating correctly	28/06/2011

Pre-retrofit property

bere:architects approached Southern Housing to put forward suitable buildings for retrofitting. A number of other houses were also proposed, but these were not selected by the Technology Strategy Board for phase 2 funding.

Whilst there has been funding to install cavity wall insulation for some years, (CERT and SHESP), little has been provided so far for deep retrofits incorporating external wall insulation. External insulation would allow residents to remain in full occupation of the house, which is essential for wider applicability of retrofit to majority of housing stock. Consequently, the house was selected for the retrofit works for the following reasons:

- The house is not listed and is not located within a conservation area
- The house has solid wall construction which would facilitate the application of external insulation without the complications of a cavity
- The house was already partially rendered and so externally insulating it was unlikely to present a problem with the planning authorities
- The hosue was occupied during the retrofit works and was thus representative of Southern Housing stock; this would enable finding ways around the problems of retrofitting an occupied house
- The strong support of the occupants was present

The house is a 1960s brick terrace house with design typical of mid century social housing stock in the Borough. The footprint of the building is approximately 43.22m^2 and it has a total internal floor area of 96m^2. The house is a 3 bedroom mid terrace single family residence. It has ground floor solid concrete slab and solid brick construction, finished with pebble-dash render on the first and second floors. The house still had its original metal-framed single-glazing and had not been previously insulated, except in the loft, where it had 90mm of insultation. 200mm of insulation was added to the loft space prior to the start of the retrofit works and following the initial assessment of the house. The original external WC, common to all houses on the street, had in the past been connected to the main house by means of a single glazed corridor and a simple flat roof.

BSRIA conducted an air test prior to commencement of the retrofit. The air permeability of the house was measured to be 6.0m3/hr/m2 @ 50 Pa. An additional air test was also performed by Paul Jennings which gave an air change rate result of 5.6ach^{-1} (using the Passivhaus units of measurement).

The house was also assessed prior to the retrofit works using the Passivhaus Planning Package in order to determine the specific heat demand requirements of the existing building. This assessment showed that the house would require 315kWh/m^2a to maintain internal temperatures of 21°C (Appendix 4). However, it is unlikely that the house was ever heated to this level.

Design

bere:architects employed a whole house retrofit solution based on Passivhaus principles. A cost-effective suite of improvements was selected to make the home more comfortable, healthy and cheaper to run.

The original Stage 1 proposal employed passive ventilation in the form of specialist heat recovery air-supply windows to preheat fresh air coupled with a passive stack ventilator. However in the early stages of the design process bere:architects found that the technology was not commercially available and a working prototype was not ready for use. The final project therefore employs a Heat Recovery Ventilation system (HRV). A Photovoltaic array was also included in the original proposal to provide power to the stack ventilator. This was omitted from the designs following the switch to the HRV system so that the budget could be used for further fabric improvements.

The original proposal also included the replacement of the existing concrete ground slab with a super insulated ground slab. After conversations with the RSL the decision was made to substitute the proposed below slab insulation with vacuum insulation on top of the slab. This minimised the disruption of removing the ground floor slab and ensured that the insulation could be laid room by room enabling the residents to remain in the building during the construction process.

The retrofit works comprised:

- Passivhaus levels of insulation:
  - 200mm and 250mm EPS insulated render system to front and rear walls.
  - The external insulation was extended one meter below ground to foundation level, creating a thermal bubble beneath the building to limit the heat losses through the ground slab.
  - 490mm mineral wool insulation to attic.
  - High performance vacuum insulation panels above the floor slab.
  - Internal wood fibre insulation for elimination of cold bridges from neighbouring facades and party walls

- Continuous airtightness membrane installed in attic, 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 new and existing service penetrations.

- Passivhaus, draught-free certified triple glazed windows and doors with U-value of 0.8 W/(m^2K).

- New timber framed rear extension insulated with 375mm wood fibre insulation to walls and 225mm mineral wool and 150mm wood fibre insulation to roof.

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

- Improved airtightness from 5. 6ach^{-1} to 1.9ach^{-1} @ 50 Pa as verified by ALDAS and BSRIA.

- Roof-mounted solar thermal array with solar cylinder and a re-configured conventional boiler.

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

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

- After discovering a drain and inspection chamber that had not been picked up in the original survey, it was necessary to adjust the design of foundations to the extension. One wall of the inspection chamber was removed and the foundations were poured in place of this wall.

- In breaking out the slab of the existing extension it was discovered that the neighbour's floor slab would need to be under pinned.

- During construction the residents expressed concern over loosing space to internal insulation and to the duct routes for the HRV system. The routes of the HRV ducts were subsequently adjusted slightly and a compromise was made which allowed for reduction of wood fibre insulation. This did not affect thermal bridge mitigation.

Using the Passivhaus Planning Package to model the improved building and expected energy demands, reduced specific heat demand was estimated to be 25kWh/m^2a which is 92% reduction compared to a pre-retrofit house heated to the same temperature.

Construction

Summary

- Procurement – the contract was negotiated between Southern Housing (SH) and AD Enviro, a contractor who had already worked with SH on decorating contracts and decent homes upgrades.
- Contract type – JCT Intermediate Form
- Contract structure – the main contract with direct or semi-direct labour covering most trades plus some sub-contractors
- Sub-contractors – sub-contractors were employed for external insulation, heat recovery ventilation and waterproof roof membranes for the rear extension
- Specialist installers – the main contractor used their own labour or regular subcontractors for all other installations
- Specialist equipment suppliers – included Passivhaus window manufacturers, vacuum insulation suppliers, wood fibre insulation for the extension and party walls and the heat recovery system and ductwork
- Site supervision – AD employed a full time site foreman. No clerk of works was employed.
- Role of architect/design team – bere:architects were retained as contract administrators and visited site on a regular basis to check compliance with the contract drawings and specification

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- Construction started in early November and was initially expected to be completed in late February although there were a number of factors affecting the programme over the course of the works.
- The application of external insulation required the relocation of a gas meter mounted on the front façade of the house. AD found it very difficult to obtain commitment from TRANSCO to relocate the service resulting in a delay to the erection of scaffolding at the front preventing works to the windows and roof.
- Following demolition of the rear WC it was established that the main drain for the street ran beneath the proposed site of the new extension. As a result the foundation design for the extension had to be revised to include additional underpinning. By the time the foundation works were completed, bad weather had created waterlogged ground conditions, delaying the erection of rear scaffolding.
- A section of wall due to be demolished in the original designs was discovered to be structural and therefore needed to be retained. As a result the vacuum insulation to the floors, which was made to site dimensions, had to be re-measured and the delivery dates delayed.
- Following the installation of external insulation it was discovered that a number of design requirements had been ignored. Render stops had been omitted from the window surrounds and the adhesive used to fix the boards had been poorly applied at the top of the facades, resulting in potential thermal bypass behind the insulation material. bere:architects therefore required that the render stops were fitted and that additional expanded foam was installed to seal the insulation at the eaves.
- The airtightness strategy for the scheme relied upon the use of a flexible membrane in the loft spaces connected to the parge coat on the external walls. The construction sequence required that the membrane had to be installed in sections and taped to provide a continuous seal across the

roof space. Sealing of this membrane to the heat recovery ductwork and around roof timbers also proved difficult and required considerable rectification work.

AD Enviro

- The design was changed on site only when unforeseen problems occurred. These included the below ground drainage, tenant requesting changes to internal layouts and different insulation solutions.
- There were a number of challenges that AD experienced, although most of them had been expected issues. The property had a large occupancy for a relatively small space and AD needed to constantly relocate and move items to accommodate their work. Had it been possible to get a container sited in close proximity to the property, it would have provided some storage facilities for the residents. However, the project location didn't allow for it as there was no space in the front or rear garden. AD had to use another local authority's land for their containers which was not ideal and would not be recommended for future works.
- The residents were very helpful and were keen to understand why and what was going on. They were helpful with access arrangements and were flexible on dates when AD could not be 100% accurate with the timings.
- The biggest problem for a main contractor was managing specialist sub contractors. On a regular, standard refurbishment, AD normally works with contractors with whom they have been collaborating for many years without problems. However, for this low-energy retrofit options were limited, which resulted in collaboration with previously unknown companies and people.
- The materials were harder to obtain than AD had anticipated and some items took weeks rather than days to source. AD's contracts manger, James Ellis expected that contractors would feel privileged to be working on a contract like this and provide greater support, but if anything the opposite was true.
- The first external insulation contractor went into administration. The next sub-contractor, recommended by the manufacturer of the proposed materials, did not provide the service it promised and in AD's opinion should be removed from the approved list. The service and reliability was non-existent.
- The other major issue AD experienced was time tasks took to complete. The amount of detail involved in ensuring the building was air tight and fully insulated was immense. The labour force needed to be fully skilled and aware of what and why they were doing (e.g. 'rabbit ears' window taping and maintaining air tight barriers in the loft space).

Commissioning and occupancy

All specialist equipment installed was commissioned upon completion. The heat recovery ventilation system was commission by the suppliers, The Green Building Store, with the assistance of Brian Moggs, the installer. AD Enviro's plumbing sub-contractors commissioned the solar-thermal system after receiving training from Vailant.

From the contractor's point of view the main commissioning was done correctly. However, following the installation of the monitoring equipment a number of issues were identified and some monitors were found to be faulty. AD initially struggled to get a definitive answer from the monitoring company to make sure that the equipment had been installed correctly. AD noted that they found it difficult to find assistance within the supplying organisation and no one seemed to take responsibility for assisting them with the new technology.

AD's carried out an informal handover whenever new equipment was completed which generally went well. The equipment was explained to the residents, including exactly how things work and how to handle minor maintenance repairs. The residents were issued with a copy of the health and safety file which had all of the operation manuals inside for any troubleshooting.

Furthermore, bere:architects conducted a formal handover to the residents with representatives from AD Enviro and Southern Housing. A simple A1 poster was produced identifying, with drawings and photographs, various equipment and systems installed. The poster includes a brief description of the retrofit measures and the installed systems with an overview of their operation; referencing the operation and maintenance manuals if further information is required. It was designed to be mounted within the boiler cupboard so that it does not leave the house if the occupants change. SH also have a digital copy of the poster should they need to provide a replacement. During the handover meeting bere:architects gave a practical demonstration of the controls for the boiler and solar thermal controls. Replacing of filters in the heat recovery ventilation system was also demonstrated to the residents, although Southern Housing will initially take responsibility for this.

As part of the retrofit for the future competition requirements, monitored data is being collected over a two year period. This will give more conclusive results about occupant comfort, building performance and the energy savings made compared to original building. So far, the feedback from the residents has been positive. Despite the disruption of the works they consider that the process has been worthwhile. The residents have yet to experience a full heating season but they have already noted that the internal humidity levels are reduced, there is no sign of condensation build up and temperatures are more comfortable.

Costs

A nominal budget was set for the construction works from the total project funding, to allow sufficient funding for design and management fees and VAT. AD Enviro produced a tender sum from the schedule of works, specification and comprehensive tender drawings provided by bere:architects. It allowed for a small contingency sum of approximately 10%.

The final contract sum also included additional work which was to be funded directly by Southern Housing in order to bring the house up to the Decent Homes standard. This included upgrades of the mains water supply and replacement of kitchen and bathroom fittings. SH also agreed to include additional decoration works.

During the works on site additional costs arose from:

- The discovery of the main sewer that had not been identified in the original survey, making it necessary to adjust the designs of foundations to the extension.
- Unexpected need to underpin neighbour's floor slab due to breaking out of extension floor slab.
- Relocation of HRV ducts routes.

The original budget and costs forecast, like with any project, changed during the construction process with the introduction of new works by Southern Housing, such as kitchens & bathroom renovation works. This made costing the final sum difficult.

AD tried to assist with the budget constraints at the beginning of the project as best as they could. A big learning curve for AD was the cost of the alternative materials specified compared to the materials they would normally use. AD noted that it seemed that if a supplier added the words 'enviro fixing' or 'eco board', it pushed the prices up considerably. Furthermore, due to the delays and other factors that were partially out of their control, higher and unaccounted costs for preliminary works and supervision were encountered. AD also didn't anticipate how much time and money was involved in relocating tenants furniture and catering for there daily requirements. AD's initial understanding was that the majority of the residents' belongings would be housed off site which wasn't the case. AD were asked to carry out a lot of works outside of the original specification, such as redecorating areas were work had been carried out but decorations hadn't been allowed for. Nevertheless, these works were essential to keep the resident happy and in future should ideally be in the specification from the beginning.

The full final account figures are included in Appendix 5.

Item Stage>	Design stage		Post-construction		Comments
	Materials	Labour	Material	Labour	
Management and administration					SH's management and administration fees were not included in the main project budget. b:a project management fees included below
Design		£25,534		£27,262	Additional design fees were required to cover CDM co-ordinators fees as these could not be provided in house.
Construction overall	£89,618		115,957		
- Prelims	£12,000	N/A	£13,000	N/A	Contract over ran considerably due to many factors which incurred more costs for supervision, welfare etc
- Fabric measures	£56,978	N/A	£65,624	N/A	costs for this item aren't split between labour & materials. Some works tasks took longer than expected due to sub contract issues, program & material delays & a greater attention to detail than expected.
- Building services (conventional)	£3,290	N/A	£12,233	N/A	As above. Cost increases were as a result of upgrading mains water supply and additional drainage works
- Low /zero carbon technologies	£13,700	N/A	£14,330	N/A	Slight increase in cost of HRV system
- Other				£760	Asbestos survey
- Other		£1200		£1200	Air testing
- Consequential costs			£6,000		Kitchen and bathroom upgrade work
Occupant temporary housing	N/A	N/A	N/A	N/A	N/A
Monitoring equipment	£2,450		£2,810 plus solar thermal		
Monitoring and reporting service					N/A
R&D costs (please detail)	N/A	N/A	N/A	N/A	N/A

Wash-up meeting

A ‘wash-up’ meeting was held on the 29th of July 2011.

The purpose of the wash-up meeting was to capture useful lessons learnt from the procurement stage of the works across a small selection of projects. Topics of particular interest were those that would benefit the design of future projects and that would also be of use to policy makers. Of particular interest to policy makers are the opportunities for increasing efficiency and reducing costs.

Supply chain issues featured as topics of discussion; both in terms of supply of materials and in terms of the opportunities for increased expertise and efficiency amongst some specialist subcontracting techniques, such as external wall insulation. However while current planning policy effectively continues to obstruct the business opportunity around external insulation, it seems unlikely that anyone will be willing to put in the kind of effort that is needed to transform the vitally important external wall insulation sector, regardless of the urgency of the problem.

The ‘wash-up’ meeting has influenced this report and the minutes from the meeting have been included in Appendix 3 to this report.

Doing it again

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bere:architects are currently working on a number of low-energy retrofit schemes using a whole house Passivhaus approach, without planning restrictions against the use of external insulation.

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, 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 – external insulation gives an opportunity to freshen up the streetscapes while at the same time addressing the serious issues of fuel poverty, and health problems from damp homes.

It is considered that it would be adequate to use the same approach again for retrofitting social housing or any other form of housing. The opportunity to actually demonstrate this approach at a larger scale, on a greater number of properties, would be of great interest and importance. It is considered that by increasing the scale of the retrofit project the investment costs could be significantly lowered. The lessons learnt on the first one or two projects would enable future ones to be completed more quickly by a practiced team. Reliable, quick-response supply chains could be established to help keep costs and wastage to a minimum. Further significant cost savings could be achieved by eliminating the need for some of the specialist subcontractors. Moreover, by increasing the scale of the retrofits it should be possible to reduce the need for works inside the house and further limit disruption for tenants, i.e. if the rest of a terrace was retrofitted internal insulation would not be required on the party walls. Increased scale would also allow for the use of centralised Heat Recovery Ventilation which would reduce the need for internal ductwork and the associated loss of space.

The levels of airtightness achieved 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, where joists penetrate the party walls could not be dealt with. After airtightness had significantly been improved and cold draughts eliminated, heat recovery ventilation was installed to provide ample fresh air and help reduce ventilative heat losses and thus heating demand.

The PHPP assessment of the energy consumption of the house suggests that it should still operate with a specific heat demand equivalent to Passivhaus EnerPHit levels. bere:architects are monitoring the thermal bubble benefit of the foundation insulation which may show that the application of the expensive vacuum insulation panels can be avoided on future schemes. bere:architects are also investigating ways to further improve the airtightness in order to obtain certification.

Southern Housing

Southern Housing expressed keen interest in future involvement with other Retrofit for the Future projects. However, there are certain aspects of this project that would not be repeated and where other ways of incorporating certain technology would be considered. For example, space for SH's residents is a big issue, particularly in cases of high occupant density. Fitting internal insulation and ducting for the Heat Recovery

unit proved to be quite an unpopular option as it meant that shelves and other furnishings could not to be placed back into their original position, causing problems for the residents. If absolutely necessary, this could be resolved by fixing the ducting externally.

Since neither client nor contractor had experience with this type of project, the process proved to have a steep learning curve. However, experience and knowledge gained and lessons learned would next time allow for better planning and more forward thinking which would cut down the construction process substantially.

It is considered that there are multiple advantages of repeating this type of retrofit on a large scale. Manufacturers are more likely to respond quicker to much larger orders. In regards to maintenance it would be easier to set up a service agreement to service more units rather than one, thus reducing the speed of deterioration of components and ensuring that all the new technologies last the full length of their life expectancy. Furthermore, doing this on a massive scale would reduce the element of envy, increasing cooperation and minimising disruption from neighbours, compared to what was experienced with Southern Housing Retrofit. Additionally, with just one unit there is the risk of the current resident moving out and the new residents not having the knowledge of what has been installed and how it works, therefore not having the basic knowledge to maintain the technologies. Furthermore, in case of retrofitting a terrace of about 6 properties, it would be worth fitting external insulation around the whole terrace and an HR unit at each end, ducted externally into each property. Southern Housing would then possibly fit lower specification windows, rather than the Passivhaus certified triple-glazed windows, to reduce the costs. Most importantly, the benefit in carbon reduction and the impact on fuel poverty would be greater if the project were repeated on a larger scale.

Although there is a tendency of investors to try and reduce the cost of retrofit, believing that similar energy savings can be achieved with less effort and lower cost implication, it needs to be stressed that for significant energy consumption reductions and deep retrofits such as this one, similar, integral approach which addresses multiple issues at the same time is the only way. Experience shows that more selective approach which concentrates only on particular, localised issues fails to give significant results and is thus considered unacceptable for the necessary retrofit of the old housing stock.

Business benefits

Southern Housing

The Technology Strategy Board the Future project has demonstrated to Southern Housing some of the innovative Passivhaus techniques that can be effectively employed to achieve deep cuts in domestic heat load and carbon emissions. The project has also highlighted the implementation efficiency challenges presented by the need to develop improvements in specialist product supply chain, specialist skills availability and product procurement at larger volumes. The learning processes achieved during the course of the project have created opportunities for the appraisal of larger scale projects by demonstrating the challenges that can only be understood by practical implementation of prescribed carbon reduction measures. In addition, our appreciation of resident liaison issues during works has been enhanced by lessons learned during the project.

Furthermore, fuel poverty and the difficulty that some tenants have in meeting their bills is increasingly becoming a significant worry for social housing providers. The level of heating that tenants can afford, directly affects their ability to pay rent. A tenant will almost always pay a utility company before they pay their housing provider. Moreover, the organisation's costs arising from complaints, repairs, voids and even legal action can be reduced when tenants are content and can pay their bills. It is also worth noting that energy efficiency improvements are likely to improve the asset value of a house. Additionally, a good reputation can be attained from being able to demonstrate that the organisation provides good quality homes that are affordable to heat. Consequently, benefits for the property owner are multiple.

bere:architects

By far the greatest benefit to bere:architects has been the opportunity to prove the applicability of Passivhaus retrofit measures at a domestic scale. The programme has shown that even on 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 Southern Housing, particularly investigating the potential opportunities for scaling up the retrofit approach. Early discussions have already begun regarding suitable potential sites and funding sources.

bere:architects have recently established a working group to accumulate cost information from Passivhaus architects and housing associations in order 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 of the costs of seasonal maintenance and the potential additional cost of implementing Passivhaus retrofits to reduce these maintenance costs.

AD Enviro

The project has not helped AD to gain leads or business opportunities directly. It has however given AD significant experience and the skills which enables them to offer prospective clients a service tailored to there specific needs and requirements.

AD is keen to get involved on a much larger scale with local authorities and housing associations. A lot depends on the decisions made with regards to the Green Deal and other potential schemes. However, AD have already invested heavily in this market and have built up a team that is suitably skilled and has the knowledge to cover a wide range of tasks and can deliver a successful project that will achieve its key objectives.

The Technology Strategy Board is a business-led executive non-departmental public body, established by the Government. Its role is to promote and support research into, and development and exploitation of, technology and innovation for the benefit of UK business, in order to increase economic growth and improve the quality of life. It is sponsored by the Department for Business, Innovation and Skills (BIS).
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