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: ZA439S
Property number: TSB060

Author: Welsh School of Architecture, Cardiff University

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

Technology Strategy Board
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Final Report

Project information

- **ZA reference number:** ZA439S
- **Location of property:** NP20, Newport
- **Lead participant details:** Charter Housing Association, Exchange House, The Old Post Office, High Street, Newport, NP20 1AA. Tel: 01633 212375.
- **Date report issued:** 16 September 2011

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1. Project details and directory

Role	Organisation	Contact Details
Project manager	Welsh School of Architecture, Cardiff University	Address: Bute Building, King Edward VII Avenue, Cardiff, CF10 3NB. Tel: 02920 874754. Website: www.cardiff.ac.uk/archi
Housing Association	Charter Housing Association	Address: Exchange House, The Old Post Office, High Street, Newport, NP20 1AA. Tel: 01633 212375. www.charterhousing.co.uk/
Architect	Welsh School of Architecture, Cardiff University	Address: Bute Building, King Edward VII Avenue, Cardiff, CF10 3NB. Tel: 02920 870415. Website: www.cardiff.ac.uk/archi
Structural Engineer	wL^2 Ltd	Address: 14 Craig yr Eos Road, Ogmore by Sea, CF32 0PG. Tel: 07595 485706
Main contractor	Charter Building Maintenance	Address: C/O Travis Perkins Site, Cwmbran, NP44 2YP. Tel: 01633 483351. www.charterhousing.co.uk/
Sub-contractor – Electric	CW Electrical	Address: 11 Malpas Road, Newport, NP20 5PA. Tel: 01633 821442 www.crimewatchalarms.co.uk/
Sub-contractor - System	Micaul Solar Limited	Address: Unit 41, Court Road Industrial Estate, Llantarnam, Cwmbran, NP44 3AS. Tel: 01633 535455 www.micaul.com/
Sub-contractor – Carpentry	Vintage Joinery	Address: Unit 9, Cwmtillery Ind Est, Cwmtillery, NP13 1LZ. Tel: 01495 214115. Email: vintagejoinery@btconnect.com www.vintagejoinery.co.uk/
Supplier of MetSIP Ltd	MetSIP Ltd	Address: Unit 3, Rhymney River Bridge Road, Cardiff CF23 9AF Tel: +44 (0)29 2047 1053 | Fax: +44 (0)29 2045 5202 | E-mail: info@mibmetsip.com www.mibmetsip.com/index.html
CDM coordinator	Davis Langdon LLP	Address: 4 Pierhead Street Capital Waterside Cardiff CF10 4QP Tel: 02920 497497

		www.davislangdon.com/EME/
Groundworks	Geotechnical Engineering	Address: Geotechnical Engineering Ltd, Centurion House, Olympus Park, Quedgeley, Gloucester, GL2 4NF. Tel: 01452 527743 Email: geotech@geoeng.co.uk Website: www.geoeng.co.uk/
Ground survey	Carbon Zero Consulting	Cedars Farm Barn Market Street Draycott Web. Derbyshire Tel. 0844 8550115 Fax. 01332 874 850 DE72 3NB E-mail. info@carbonzeroco.com www.carbonzeroco.com
Building monitoring	Welsh School of Architecture, Cardiff University	Address: Bute Building, King Edward VII Avenue, Cardiff, CF10 3NB. Tel: 02920 874437. Website: www.cardiff.ac.uk/archi
People monitoring	Welsh School of Architecture, Cardiff University	Address: Bute Building, King Edward VII Avenue, Cardiff, CF10 3NB. Tel: 02920 876207. Website: www.cardiff.ac.uk/archi

2. Introduction

This retrofit project involved an urban end of terrace social house owned by Charter Housing Association that was built in 1989. The two storey house is located within the city of Newport in South Wales and has a lounge and kitchen on the ground floor, two bedrooms and a bathroom on the first floor. A turfed garden is at the rear of the property. Three adults live in the house.

The project concept followed a meeting between the Director of Asset Management at Charter Housing Association and the Welsh School of Architecture, Cardiff University, held to discuss opportunities to identify low carbon solutions for existing social housing. The funding call from Technology Strategy Board provided an opportunity to implement some of the approaches that had been suggested. The team, including the property owner, Charter Housing Association, the Welsh School of Architecture at Cardiff University, existing collaborative framework suppliers, technology suppliers and the tenants set out to achieve a successful retrofit scheme which was innovative through providing an integrative, technologically robust, holistic, people focussed approach. The main aim was to achieve 80% long term carbon savings rather than being seduced into a technological short term 'quick fix'.

Energy efficiency measures were considered in the first instance to reduce the overall demand for energy. This was followed by appropriate renewable energy technologies whilst providing more amenity and comfort for the householder. Energy savings have been made through modifications to the building form and space, fabric and systems together with low energy appliances. The measures adopted have been agreed by all stakeholders including landlord and tenant and fit in with existing maintenance practices and tenant utility.

For replication purposes the project involved minimal disruption and decantation was avoided. Planning permission was not required and overall costs were kept realistic to give value for money. The project was based on:

- The involvement of a ‘real’ maintenance supply chain including designers, maintenance teams, liaison officers, contractors and tenants
- Value for money design interventions based on value engineering 'what-if?' solutions
- Robust long life technologies. The aim of the collaboration was to design a methodology that could be used to identify appropriate retrofit solutions for existing social housing and to test this methodology on one of Charter Housings properties.

3. Occupants

The occupants, two adults, their 21 year old son and a pet dog, have lived at the property for 20 years. They are all unemployed and therefore spend a lot of time at home.

The occupants remained in the property during the retrofit. A storage container, located at an offsite secure location, was used to store non-essential belongings during the retrofit including furniture and clothes. The tenants were happy that their home was to be included within the retrofit and were involved and very patient throughout the process. The tenants were keen to be involved and have participated wherever possible which has included taking over 1500 photographs of works in progress and entering data into a weekly diary.

Please state the make-up of occupants before and after the retrofit:

Age band	Number before retrofit	Number after retrofit
Under 5 years	0	0
5-16 years	0	0
17-21 years	1	1
22-50 years	1	1
51-65 years	1	1
Over 65 years	0	0
Please state if (yes/no):	**Before retrofit**	**After retrofit**
Married couple / partners	Yes	Yes
Couple / partners with children	Yes	Yes
Any disabled persons	No	No

4. Dates

Event	Date
Project initiation date (when the project was first discussed)	28/05/2009
Project start date (when funding had been approved and final decisions could be made)	01/03/ 2010
Planning application submitted (if appropriate)	N/A
Planning permission granted (if appropriate)	N/A
Building Regulations application submitted (if appropriate)	Not submitted
Building Regulations approval granted (if appropriate)	5/1/2011
Contract for work let / signed	05/2010
Occupants moved out	Remained at property
Start on site	14/06/2010
Majority of work complete	14/09/2010
Final completion of retrofit	12/11/2010
Occupants moved in	Remained at property
Monitoring system commissioned and operating properly	06/02/2011
Building defects corrected	12/11/2010
Building services and controls operating correctly	14/09/2010
End date for monitoring of property and tenants	09/2012

5. Pre-retrofit property

The property is an urban end of terrace two bedroom, three person house in Newport, South Wales. The property was built in 1989 and comprised 56m^2 internal floor area situated over two storeys. The house included:

Ground Floor: Small entrance hall open to kitchen, lounge with door direct to garden
First Floor: 1 double bedroom, 1 single bedroom, bathroom
Garden: A grassed area of approximately 50m^2

The construction of the house was un-insulated brick and block cavity wall, concrete slab floor, tiled timber truss roof, loft insulation in poor condition, timber double-glazed windows in poor condition and gas central heating. Gas was used for heating and cooking. Energy was being lost as a result of the building fabric and via draughty windows and doors, poor natural lighting meant that lights were used all day, appliances were not efficient and hot water was not used or heated efficiently.

The property, and others on the estate, were purchased by Charter Housing Association from a private developer during the recession of the early 1990s. The house did not meet the space standards required of new build social housing. It was lacking in living and amenity space, which presented an additional challenge to the retrofit team.

Temperature and humidity monitoring took place before the works were undertaken. The energy supplier provided the following information for the property:

21/09/07 to 14/09/08	7501 units of electricity. Cost approximately £950.00. 332 of units of gas. Cost approximately £280.00
14/09/08 to 15/09/09	5627 units of electricity. Cost approximately £848.00. 313 units of gas. Cost approximately £352.00.

A range of potential addresses were suggested by Charter Housing Association that were problematic with regards to energy and were typical of their portfolio and across the UK. The property was chosen as the tenants were supportive of the retrofit and were considered secure tenants. The property, although had been ‘looked after’ by the tenants, had received no major modifications or installation of energy efficiency measures.

6. Design

To achieve the objectives a decision making matrix was developed and used by the team to identify the optimal, practical and replicable solution for the property. Solutions were identified that would make big cuts in **carbon** emissions with realistic, whole life **costs**, **minimal disruption** to the tenants, a sensible **timescale**, a UK based **supply chain**, opportunities for large scale **roll out**, **comfort** and a practical **maintenance** regime. Relative costs and future cost savings were analysed for each option together with CO_2 savings.

Energy efficiency measures were considered in the first instance to reduce the overall demand for energy. This was followed by the application of appropriate renewable energy technologies in addition to providing more amenity and comfort for the householder. Energy savings have been made through modifications to the building form and space, fabric and systems together with the use of low energy appliances. The measures adopted were agreed by all stakeholders including landlord and tenant and fit in with existing maintenance practices and tenant utility. Modifications to the property include (Appendix 1):

Form and space
Aim: to reduce energy demand, improve daylighting and address lack of space and amenity.
Modifications:

- Inclusion of a SIP sun space with large rooflight (U-value 0.15) to act as buffer to living room
- Sun tube over stairs which previously had no source of natural light

Fabric
Aim: to reduce heat losses and draughts and to improve occupant comfort.
Modifications:

- Internal dry-lining (U-value 0.19)
- Loft insulation (U-value 0.16)
- Hardwood triple glazed windows and doors (U-value 0.90)
- Storage in bedrooms on exposed walls

Appliances
Aim: to reduce energy demand from white goods and lighting.
Modifications:

- Washing machine (CDA C1330IN Energy rating A+)
- Fridge freezer (CDA FW850 Energy rating A)
- Cooker and hob (CDA SV100 Energy rating A)

Systems (Appendix 2)
Aim: to provide energy from renewable sources.
Modifications:

- 5KW ground source heat pump 320.0%, radiators on standard tariff
- Whole house mechanical ventilation and heat recovery
- 6.3m^2 PV array (2.1kw peak)

- Solar thermal system ($2m^2$) located on extension roof
- Controls to include time and temperature control
- Low energy light bulbs

Originally it was proposed to include a living space in the roof. This was not undertaken. Following comments from the assessment and a follow up meeting with Building Regulations it was agreed that the living space in the roof of the retrofit property was not feasible. The stairs that are in the property are located within the living space on the ground floor and therefore a sprinkler system would be required to enable the design to pass Building Regulations. As this would not be replicable the tenants and the team agreed not to go ahead with this component of the works.

An amendment had to be made whilst works were ongoing relating to the PV system. An initial survey by the systems supplier had overlooked the presence of the apex on the roof space to be used for the PV. The apex had to be removed to accommodate the proposed PV. This was favourable in that the supplier was from Wales but unfavourable due to uncertainties of supply of materials within schedule. Also there was additional cost associated with removing the apex.

The original intention was to construct the sunspace to the rear of the property using traditional methods. However the structural engineer suggested, very near to the start date, that there was a lightweight panel solution available that would be suitable for the sunspace. This structure was erected quickly and easily and provides the high thermal properties required. The SIP panablok system involves a MetSIP 86mm Lite Panel Structure and was provided ‘in kind’ by the supplier, MIB MetSIP, who also supplied the brickslip facades system used on the extension to match the existing house. A flat roof made up of light gauge steel cassette was installed to allow for the inclusion of the planned solar thermal panels. Changes to the raft had to be made quickly to accommodate this change. However, this enabled costs to be reduced and to implement Modern Methods of Construction (MMC) which reduced construction times.

A suntube was installed above the stairs to provide additional natural daylight.

Airtightness at the property has improved to $2m^3/h/m^2$ through robust detailing and new triple glazing and doors.

7. Construction

Organisation and management of construction process
With regards to procurement, the project was negotiated with a framework partner.

A collaborative contract was set up with Micaul Solar, provider of the systems, under JCT.

Charter Building Maintenance were the main contractors on site, who undertook all direct labour, preparation and making good. Subcontracts were held with:

- Vintage Joinery – carpenters who supplied and fitted windows and doors
- Micaul Solar Limited – supplied and fitted systems
- TND Insulation – supplied and installed Warmcell loft insulation
- CWElectrical – (partnership agreement) supplied and fitted electrics for system, monitoring and general electrics
- Davis Langdon LLP - Regulations required that a CDM coordinator was involved throughout the project

All subcontractors were engaged via Charter Housing Association. The project team were involved in the selection process for each subcontractor. Meetings were held with potential suppliers and the team to ensure that subcontractors involved understood the holistic, low carbon approach that the retrofit was trying to achieve. A meeting with all subcontractors was held prior to works starting to highlight the key objectives of the retrofit. Micaul Solar Limited, provided additional training for any of the team and their associated staff on renewable technologies.

Other suppliers who were involved in the retrofit included:

- wL2 Ltd – structural engineers;
- Robert Price – supplied general building materials and the white goods;
- Geotechnical Engineering – ground engineers who installed the borehole for the GSHP;
- JT Landscapes – asbestos survey prior to works;
- Carbon Zero Consulting – confirm that the geology was appropriate for GSHP;
- AKW Medicare – supplier of bathroom;
- Rixonway – supplier of kitchen;
- Travis Perkins – supplier of general building materials.

Site Supervision was provided throughout the duration of the project by the foreman of Charter Building Maintenance team who was on site at all times and the planned maintenance surveyor, from Charter Housing Association who visited the site three times a day.

The architect/design team were part of the core retrofit team. They therefore visited the property frequently and were on hand to respond to enquiries.

In order for a contractor to be employed by Charter Housing Association they have to be able to demonstrate value for money to be included on an approved contractors list. As the team were using technologies that were new to Charter the majority of companies involved were required to go through the approval process. As part of the approval process, four quotes are required. As new technologies and processes were involved in the retrofit obtaining comparable quotes was often difficult and time consuming, particularly for specialist products, such as ‘spaceboard’, when speed to turn things around was required. This could be a significant problem in the procurement process.

Lessons learnt from on site

Works during the retrofit were completed on schedule within the set budget although generous contributions ‘in kind’ from partners were required to do this. The technologies installed have so far proved successful and work well together.

In general, the construction process went very well. There was a lot of flexibility and on site thinking by the whole team which was outside of usual practice including re-design of the raft, having to remove the apex on the roof at the last minute, alter the joists in the bathroom floor to accommodate the wet room and installation of a sun tube. This need for rapid response to uncertainties was primarily due to a lack of in depth knowledge of new technologies. All partners involved need to be prepared to act quickly to agree on a solution to such issues. In some cases team members were not used to reacting quickly enough to such issues, which created frustration within the team. The amendment of the sunspace design at the last minute provided some interesting discussions but on reflection, the timescale for construction on site of this structure was rapid and assisted the programme significantly.

In some situations, the need to keep costs down and turn things around quickly resulted in less favourable decisions being made, such as brick slips being included on the extension which were not considered as aesthetically pleasing or technically sound as other alternatives. As bricks had already been ordered it was felt they had to be used.

Communication and trust between the team is essential, particularly due to new technologies involved, to allow clear understanding of new technologies and how they interact. For example, windows were installed without sills which was considered unfavourable by the team. This was due to a lack of understanding about the need for a quick turnaround by the joinery supplier. If the supplier had explained the timing issue the programme could have been amended for the windows with sills to be produced correctly.

A lack of time and the need to think differently from normal practice prevented detailed documentation of progress by site workers.

8. Commissioning and occupancy

The property was inhabited during the retrofit by the tenants. They are therefore very aware of the works that have been undertaken during the retrofit. The team kept the tenants fully informed of progress of the works and of any changes that were to be made. The tenants were involved in the decision making process and wherever a decision was made they were invited to participate.

The usual commissioning checks were carried out on the systems by Micaul Solar Limited.

The tenants and staff at Charter Housing Association have received training on the technologies installed. A training manual was given to tenants (Appendix 3).

An asbestos survey was undertaken prior to works. A ground survey was undertaken to identify geology relating to the GSHP.

9. Costs

Item Stage>	Design stage		Post-construction		Comments
	Materials	Labour	Material	Labour	
Management and administration	£500 (TRAVEL)	£9,800	£765	£12,000	Additional material cost – cameras for providing visual diary. Reduced cost to accommodate loss of grants from LCBP
Design	£1000 (BUILD REGS)	£6,000	£550	£6,000	
- Structural engineer	£0	£0	£0	£176 *(£1,300 in KIND)*	The market value of the service provided would be approximately £1,500
Construction overall					
- Prelims	£0	£0	£500	£2,000	Labour provided by Charter Maintenance Team
- Fabric measures	£31,650		£9,285 windows and doors £162 Dry lining *(£9,500 Sunspace IN KIND)* £2,001 Loft Insulation	£1038 windows and doors £6,000	£4,000 deducted from original budget due to change in programme Labour provided by Charter Maintenance Team MIB MetSIP,
- Building services (conventional)	£1,000	£1,350	£3,100	£9,304	Labour provided by Charter Maintenance Team
- Low /zero carbon technologies	£21,375		£18,597 tech equip (exc vAT) £936 Electrics £300 Suntube	£4,660 tech equip (exc VAT) £962 Electrics £100	This includes PV, GSHP, MVHR and solar thermal technologies. A breakdown of the costs can be found in the appendices (Final specification of systems (Final systems spec ZA439S.pdf)
- White goods	*(£750 IN KIND)*		*(£1,200 'IN KIND')*		'In Kind' provision from ROBERT PRICE– not from budget
- Consequential costs	£5,000	£4,350			

- General redecorating costs			£1,500	£1,500	Labour provided by Charter Maintenance Team
- Replacement wetroom			*(£1,200 'IN KIND')*		AKW Medicare provided 'IN KIND' Installed by CBM
- Replacement kitchen			£1,500	£1,000	Rixonway
- General electrics	£0	£0	£1,267	£845	Related to dry lining and other making good.
- Asbestos survey	£0	£0	£0	£329	Health and safety requirement
- CDM coordinator	£0	£0	£0	£1,527	CMD regulations
- Ground survey	£0	£0	£0	£470	Necessary to identify appropriateness of ground conditions for GSHP
- Occupant temporary housing	£0	£0	£1,300	£0	Container and portable toilet
Monitoring equipment	£4,000	£0	£4,266 equipment £834 Electrics	£0 £845 Electrics	
Monitoring and reporting service	£0	£8,600	£0	£6,123	Reduced cost to cover loss in grants from LCBP
Monitoring people	*£0*	*(£8,000 IN KIND)*	*£0*	*(£8,000 IN KIND)*	
R&D costs (please detail)	£0	£0	£0	£0	
TOTAL	**£64,525**	**£30,100**	**£58,763 (including 'IN KIND' contribution)**	**£64,179**	**FINAL TOTAL £122,942**

10. Wash-up meeting

A number of post retrofit meetings have been held to review and reflect on works including looking at any issues that have arisen and what can be learnt from the project. Key meetings have taken place on 23 September 2010, 7 April 2011 and 15 April 2011. These meetings have not involved all members of the team at any one time but have involved all key members at least once. The details discussed at these meetings have been included within other sections of the report.

Issues that have arisen have been discussed at these meetings and solutions have been identified, for example, building monitoring has indicated that the GSHP is overriding the solar thermal system, with hot water generated from the solar thermal system therefore not being used. This has enabled the team to go to the renewables supplier to rectify the problem.

A number of situations have arisen post works between subcontractors where responsibility has not been accepted. This has included issues regarding installation of the systems/electrical equipment.

11. Doing it again

Charter Housing Association, the property owner, have confirmed that they would do it again. The experience has provided the organisation as a whole with more confidence to take risks with regards to low carbon technologies and property modifications beyond those traditionally used.

Definitely do again
The ground source heat pump has been effective and has performed well to date. Investigations would be made to apply the technology to a group of properties rather than just one household to reduce costs.

Retrofit projects need committed staff who believe in the project and who are prepared to be adaptable and flexible due to potential unfamiliarity with design and technologies being used.

Tenants should be involved within the decision making process which allows for design of the retrofit to suit the lifestyle.

Dry lining will have a significant impact on heat loss but has not had an impact on the perceived size of the property.

Not do again
It is felt that the project is not financially viable in the current market.

Charter Housing are not keen on installing solar thermal in the future due to the long payback period. Future market incentives may improve this.

Improvement of design process
It is felt that there is a lot of technology in a small space which could lead to confusion in future particularly with regards to future maintenance and utilisation if new tenants were to live at the property.

Improvement of construction process
Charter Housing Association has demonstrated adaptability and flexibility during working practice in order to implement technologies that were new to them. It has been found that there is a need to be able to adapt from traditional way of working to include new technologies.

A retrofit scheme involves experts from a range of different areas. It is essential that communications are clear and prompt to ensure that confusion does not arise resulting in additional, unnecessary costs or delays in the work programme.

Improvement of the commissioning and occupancy process

There were advantages in having the tenants in situ, including awareness of exactly what work was being undertaken and being able to contribute to the decision making process together with the obvious cost savings involved with decantation.

The main disadvantage of the tenants living at the property is that they made requests for additional works, such as new carpets and turfing the garden which was not in good condition prior to works and were not scheduled into the programme. Their presence slowed things down such as packing belongings to allow internal works to take place. Although decanting the tenants would substantially add to the cost of the project, the team feel that this would probably be favourable in future.

Despite lots of preplanning, the impact on the tenants lives was quite dramatic. The residents have had to change their living habits. In general they have embraced this well.

Efficiency gains from a larger programme

It would be easier to establish a procurement process and maintenance regime if a larger retrofit programme were to be adopted which would include sourcing low carbon materials within budget and skills and materials from a local market.

The replicability of the project can be assessed from 8.5% of dwellings in England and Wales were constructed between 1981 and 1990. Of this 1,997,500 dwellings, 352,500 belong to LA's or RSL's.

Work at the WSA (Srivastav, PLEA conference 2011, as described below) has compared the *estimated* cost of the retrofit with demolish and build of a new brick and block house to achieve 17kg/m^2/yr. It was found that the cost for the retrofit was £1,389/m^2. The rebuild cost would be £400/m^2 more expensive. In the current situation demolition costs are very high particularly because of transportation and landfill costs. This could be reduced with a good reclamation/ recycling strategy which would make rebuild more economical. Economies of scale of the retrofit would see a reduction of the total cost.

12. Business benefits

The programme has enabled Charter Housing Association to go through the process of evaluating and implementing solutions to achieve deep carbon cuts that they were unfamiliar with before. New products such as ground source heat pump, larchwood triple glazed windows, a suntube, MVHR and recycled insulation have been tested which would not have been done under normal circumstances. Products such as these would not have been used due to risks associated with potential failure as these are still seen within the social housing sector as not the 'norm'.

Working as a team has given confidence to those involved to make risky decisions. This project has provided confidence to use these products, and others, in the future. Charter Housing Association have begun to take the experiences gained onto other projects and have been able to make more informed decisions as a result. The scheme has demonstrated that an integrative, technologically robust, holistic people focussed approach to making deep carbon savings from social housing can be implemented in the working practices of a social housing provider, particularly when considering the supply chain and tenants. The process of holding meetings and a team of various expertise has enabled a balanced approach to selecting the most appropriate solutions available. As a result of the collaboration Charter Housing Association have more awareness of the diverse range of skills and professionals working within the university (and relationships with other professionals) which in turn has led to a wider understanding of a resource that is available. This valuable resource can bring massive benefits the Housing Association sector.

Ongoing monitoring will provide evidence on what sort of financial savings, and carbon savings will be made if we were to make similar changes to other properties within Charter Housing Associations portfolio.

New products and businesses within the local area have been used which will help to stimulate the local economy and enable us to work with suppliers for technologies to suit our needs. Product and installation knowledge developed as a result of the scheme have been used to develop a further framework agreement for the installation of renewable technologies. Suppliers engaged have assisted in training staff on overall awareness of new technologies and the finer issues of maintenance.

The scheme has improved morale as improved knowledge has been gained by staff being made aware of and viewing new technologies. It has provided a snapshot into the future of social housing and staff have an increased desire to be a part of this. Charter Housing Association have started to look to bring renewable technologies to more properties and have a number of properties within the Welsh Assembly Governments ARBED scheme where we are utilising skills and knowledge developed through the retrofit.

The property was valued at between £85,000 - £90,000 as it was before the retrofit by a local estate agent. It has been re-valued at between £110,000 - £120,000 post retrofit. The estate did suggest that this increase is mainly due to the improvement in condition and the solar extension rather than the energy efficiency measures and renewable technologies.

13. Additional Information

Social implications
The tenants of the property are generally much happier and more comfortable in their home. Their living habits have changed as a result of the work but they have embraced this. However, social impacts of the work cannot be underestimated. Responsibility and assistance from the householder is essential.

General behaviour of tenants cannot always be influenced to enable the technologies to perform most efficiently. Despite receiving training and an instruction manual on how to use the equipment, the tenants are still turning the thermostat on and off preventing the equipment from working as efficiently as possible. Follow up training will be provided.

Relationships between tenant and neighbours and householder and housing association have been damaged as a result of the works. Neighbours are envious of the works that have been undertaken as they would like the same.

Supply chain
There is a need for a broader awareness of issues associated with low carbon technologies and the range of expertise required for implementation. It can be time consuming to hold meetings to ensure all parties are involved in decision making, however, if necessary alterations to the programme are made, a lack of awareness of changes can have implications on the rest of the programme and plan. The involvement of many different areas of expertise can also lead to a lack of responsibility for technical problems that arise.

For example, the renewable technologies supplier used in the scheme usually asks the client to source a drilling company and provide a specification for the borehole. During the scheme a range of quotes and proposed methods of installation were obtained of which the renewable supplier could not advise which was the most appropriate, this created confusion and concern about the system. The choice of borehole driller and the method of installation therefore had to be made by the design and construction team who had little experience in the area.

It was found to be difficult to identify reputable suppliers, particularly of the system, due to a lack of knowledge of relatively new technologies. It was found that there needed to be a level of trust and confidence in what technologies would be the most appropriate for the type of house in question. As problems arose, such as incorrect specification for borehole installation and for PV sizing, a lack of confidence in the system and the suppliers arose. By this time works had all been programmed and the team were committed to works. It took time for confidence in the relationships to be re-established. One point of contact was designated between the team and the systems suppliers to ensure that confusion was avoided.

Funding
Low Carbon Building Programme Grants were removed following the May 2010 general election. This resulted in 50% of funding for GSHP and PV no longer being available.

Requests had been made to the renewable supplier to submit the application earlier but they had been too busy. This meant that this component of the budget had to be cut from elsewhere to allow the GSHP and PV to go ahead.

Publicity

- Paper presented at the Passive and Low Energy Architecture (PLEA) conference during July 2011 'The cost implications of refurbishment and demolish and built pathways for a dwelling energy upgrade'

- Presentation at A4B Delivering Low Carbon Buildings Cymru – from policy to practice event July 6th 2011 at National Botanic Gardens of Wales

- Masters student project at the Welsh School of Architecture, Cardiff University – 'Explorations in modelling which used the model ECOTECT as a method to design alternatives and predict the performance of a PV system for the retrofit property', May 2011. This modelling exercise has found than to maximise energy input the panels could be tilted by an additional 2˚

- Case study for South Wales Carbon Reduction Task Group, report in progress

- Article in the Chongqing Construction Commission Magazine in China

- Presentation at the Low Carbon Build Environment Conference in Cardiff in October 2011, 'Designing Low Carbon Homes: Lessons from Practice'

- Case study in the EPSRC funded Sustainable Urban Environments research project 'Retrofit 2050'