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:
ZA389
Property number:
TSB055 / TSB056

Author: Asra Housing Group

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

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Driving Innovation

SBRI Government challenges. Ideas from business. Innovative solutions.

Final Report

Project information

- **ZA reference number:** ZA389
- **Location of property:** NG20 Warsop, NG20 Meden Vale
- **Lead participant details:** ASRA Housing Group, 3 Bede Island Road, Leicester, LE2 7EA
- **Date report issued:** 11 June 2012

Contents

1. Project Details and Directory 4
2. Introduction 5
3. Occupants 5
4. Dates 7
5. Pre- Retrofit Property Details 8
6. Design 10
7. Construction 12
8. Commissioning and Occupancy 16
9. Costs 17
10. Wash-up meeting 18
11. Doing it Again 19
12. Business Benefits 20

1. Project Details and Directory

Retrofit Property 1: TSB055, Meden Vale, NG20
Retrofit Property 2: TSB056, Warsop, NG20
Control Property 1: Meden Vale NG20
Control Property 2: Meden Vale, NG20 (system removed)
Control Property 3: Warsop, NG20

Role	Organisation	Contact Details
Housing Association	LHA – now part of asra Housing Group	Address: 3 Bede Island Road, Leicester, LE2 7EA Tel: 0116 2576752 Website: www.asra.org.uk
HA	As above	
Architect	Marsh Grochowski	Address: 16 Commerce Square, The Lace Market, Nottingham, NG1 1HS Tel: 0115 9411761 Website: www.marsh-grochowski.com
Engineer	Tunstall Partnership	Unit D2 Enterprise Park, Wigwam Lane, Hucknall, NG15 7SZ
Employers Agent / QS / Contract Administrator	Focus Consultants	101 Princess Road East, Leicester, LE1 7LA 0116 2758315 www.focus-consultants.co.uk
Main contractor	Newlife Regeneration Construction Ltd	Ford Dairy, Rear of 26 High Street, Warsop, NG20 0AG 01623 847122 www.newlife-build.co.uk
PV installer	SIG supplier and provided training course for Newlife, so installed by main contractor	www.sigplc.co.uk 0845 873 8612
Supplier - windows	Am Profiles	Hardwick View Road, Holmewood Industrial Estate Holmewood, Chesterfield Derbyshire S42 5SA 01246 856000 www.amprofiles.com
Sub-contractor Insulation	Domestic and General Insulation Ltd	Units 1 – 2, Shipston Close, Blackpole, Worcester, WR4 9XN 01905 342955 www.dgi.org.uk

2. Introduction

To achieve the 80% carbon emissions reduction target in the UK by 2050, we felt a solution needed to be found which could be rolled out along streets, without requiring the property to be empty. The solution needed to be replicable and able to be scaled up. This meant it had to be applicable to different house types, and had to be focussed on measures which would reduce in cost through scale. Therefore our aim was to achieve the savings using the lightest touch possible, and primarily working on the outside of the property.

The properties chosen were a mid-terrace and a semi-detached, in the North Nottinghamshire coalfields region, in order to show how the solution worked on each of these house types.

The project came about from a partnership between the University of Nottingham, Miicrowatt, BASF, DGI, SIG and LHA, formed through a day held at the University of Nottingham. A major part of our project was to prove the Microwatt equipment, and to evidence how much reduction in emissions this could achieve through behavioural savings. So our intention was to install the Microwatt equipment in 2 – 4 additional test houses which would not have measures installed, but after an initial period of monitoring to set a benchmark, these residents would be given the opportunity to use not only the monitoring, but also the energy lock and the iTRVs. This would help property owners LHA assess how much resource to put into changing tenant behaviour in tackling fuel poverty, as well as understanding more about improving the fabric and performance of the homes.

3. Occupants

The occupants were the same before and after retrofit, and lived in the property throughout the retrofit. Due to the requirement for some test properties, we needed to choose an area where we owned a large number of the same or similar archetypes, therefore selected the North Nottinghamshire coalfields area. This area has also suffered with lack of inward investment generally, so we felt the project was an opportunity to raise interest in a potentially valuable new industry.

To select the tenants, we sent out a letter to all suitable properties within the vicinity, and visited all respondents. Setting the selection criteria was difficult, as a number of tenants were keen to be involved. There was a feeling from some of our tenants that maximum investment always went to properties where people did not take as much pride, for example decent homes funding for new kitchens. Also, we wanted to assess whether the works carried out could be done without need for redecoration. Therefore we tried to select homes where the tenants had looked after their properties, and where they were in a generally good condition. The final decision as to which properties

had the works carried out, was down to the length of tenancies. The tenants in TSB055 had lived in the property for 9 years, and the tenants in TSB056 for 22 years.

We also tried to find household profiles which were similar for both properties and the control homes as we felt this would give more scope for comparison. We had also intended that the results of the monitoring would be used for engagement with the local school, which meant we needed to select properties with children in the home.

All of the properties selected had one parent who was at home during the day but one parent out at work. In the terraced property, one of the residents was at home during the day due to a disability, which also meant she lead a fairly sedentary lifestyle, and therefore required her home to be warm.

TSB055

Age band	Number before retrofit	Number after retrofit
Under 5 years	0	0
5-16 years	2	2
17-21 years	0	0
22-50 years	2	2
51-65 years	0	0
Over 65 years	0	0
Please state if (yes/no):	Before retrofit	After retrofit
Married couple / partners	Yes	Yes
Couple with children	Yes	Yes
Any disabled persons		No

TSB056

Age band	Number before retrofit	Number after retrofit
Under 5 years	0	0
5-16 years	1	1
17-21 years	1	1
22-50 years	1	1
51-65 years	1	1
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		Yes

4. Dates

Event	TSB055	TSB056
Project start date (when was the first proposal discussed or agreed)		
Planning application submitted (if appropriate)	-	-
Planning permission granted (if appropriate)	-	-
Building Regulations application submitted (if appropriate)		
Building Regulations approval granted (if appropriate)		
Contract for work let / signed	13 June 2010	13 June 2010
Occupants moved out (state if they remained or property was empty)	-	-
Contract start on site	7 June 2010	7 June 2010
Contract Practical Completion Date	17 December 2010	17 December 2010
Occupants moved in	-	-
Monitoring system commissioned and operating properly	Still not operating properly	Still not operating properly
Building defects corrected	Ongoing	Ongoing
Building services and controls operating correctly	Ongoing	Ongoing

5. Pre- Retrofit Property Details

TSB055

This is a semi-detached property, built in approximately 1920 of brick built cavity wall construction, with cavity of around 50mm and therefore classed as hard to fill. The wall had been rendered previously in a non-insulating render. The cavity wall had been filled, but this appeared to not be very effective, perhaps as it had not been fully filled due to the lack of clear cavity. We found cavity wall insulation in a number of test holes, but not in all.

The property has 3 bedrooms, two reception rooms, and a good sized kitchen, with a floor area of 86.04. There is a small utility area at the front of the property, which sits outside the main structural wall and is accessed through the porch, although this does appear to have been built at the same time as the rest of the property. There was a lean-to porch on the back of the property which was a timber structure with single glazed panes. The rear of the property faces south. The house is surrounded by private garden area. The windows were primarily single glazed.

This property had solid concrete floor in most areas of the ground floor, however in the dining room at the front of the house it had a suspended timber floor with a small void beneath. The house was heated by a gas fired central heating system, but the boiler is a back boiler, likely to be over 20 years old. The radiators were all single panel.

Due to the nature of our project, which was aimed at being able to deliver the same solution to any property, we focussed more on the tenants than the property itself. However we were looking at a specific type of property, of which we own large numbers and which are seen as hard to treat. Therefore the criteria for the houses were that they were brick construction, built between 1900 and 1920 with solid wall or hard to fill cavity. We also required that they had a majority of single glazing, as we didn't want to replace windows which had been installed recently. It was also useful that this property had a south facing aspect.

LHA did not own the adjoining property.

TSB056

This is a mid-terraced property. It has a narrow cavity construction on the ground floor, with no cavity on the first floor. The cavity had not been filled. The property has 3 bedrooms, and two reception rooms, with a downstairs bathroom. The floor area of this property is 77.64 which meant this would be particularly difficult to insulate internally without affecting the lifestyle of the occupiers.

This property sits directly onto the pavement at the front, but has a small private yard at the rear of the property. To the rear of the kitchen and

bathroom is a small lean-to shed. The property has concrete floors to the lounge, kitchen and bathroom, but has a suspended timber floor at the front with a void beneath. This property also had a full gas central heating system, again with an aged back boiler.

As above, once we had established the property construction type and age which we were looking for, the final decision on which property to retrofit was dependant on the tenant, rather than the individual home.

6. Design

Our philosophy was light touch. We intended to insulate the walls externally, using a new system which was to be developed as part of Phase 1 of our project. This product was BASF Neopor graphite beads being incorporated into a render, and then applied over BASF boards. The intention for the external system was that it would also help with air tightness, and issues of thermal bridging. A local architect was used to develop a pattern book of details intended to avoid thermal bridging.

Due to the light touch, and needing to address the floors, we intended to dig down and insulate around the external perimeter of each property, using BASF Styrodur C. We were not sure what the condition of the foundations / footings would be on these properties so could not assess the potential for this until invasive surveys in Phase 2. In TSB056, where the property sits directly on the pavement, there was a suspended timber floor with a void beneath. This is intended to provide ventilation, however with a concrete floor at the rear of the property the ventilation strategy is fairly limited anyway, so we decided to trial filling this with the Neopor bead.

The loft was to be filled with 400mm of mineral wool.

In terms of energy supply, both properties were to be fitted with PV panels and solar hot water systems, and new boilers. As both properties already had cylinders, the new pressurised cylinder would go in the same position as the previous one. Due to the intended air tightness, we also designed in a whole house mechanical ventilation system. The initial intention was for this to go through the chimney voids, which would be redundant, due to the back boilers being removed.

The windows were to be triple glazed windows, manufactured locally.

<u>Changes from initial design</u>

Sticking with the light touch, we found brand new, high efficiency back boilers, so used these, rather than having to change location of the boiler. This helped as space was limited in the kitchens, particularly for TSB056. However this meant that one of the chimney voids was no longer redundant. The contractors also felt that installing the MVHR ducts through the chimneys would cause a massive amount of disruption and re-plastering, which we were trying to avoid, so early on the decision was made to install ducts down the side of the chimney breasts.

Due to the different sections of roof in TSB055, it was very difficult to get ducting into the necessary parts of the roof void, in particular the bathroom. The bathroom is in a section of the property which is outside of the rectangular footprint, and the roof extends down from the eaves to cover this. Therefore the contractor fitting the ducting was required to be a contortionist in order to feed this through to the bathroom void!

In terms of the insulation, Neopor board was not used as as it was found that Neopor had lesser thermal benefits than other existing phenolic boards made by Kingspan, and therefore 200mm would have been required as standard, whereas we were able to use 150mm as standard, and 100mm on the front of TSB056 and still achieve the same designed U value.

7. Construction

The procurement was incredibly difficult due to the way the project came about. The day at the University of Nottingham was intended to put partners together, including contractors and suppliers, with landlords, and innovations. Therefore the project team consisted of two organisations which fitted insulation, and also supplied PV panels. One was primarily an insulation contractor – DGI, the other, SIG, primarily a PV installer. This meant it was not possible to tender for the main packages of work, and therefore to secure potentially reduced costs in these areas.

Going into Phase 2, we had already identified a local supplier of high performance windows, an installer for the bulk of the work, being insulation, and a supplier for the PV solar. Therefore the main contractor's role would be to oversee all of these nominated sub-contractors, and to install any other parts of the work. We selected a local contractor off our framework. We had experience of using them for new build, as well as decent homes and void works, and they knew our properties well. They are also part of the TREES group which is a social enterprise that employs local people and offers training. In an area such as North Nottingham, we felt it really important to ensure that it was local people carrying out the work and benefiting from the project.

The contract was a JCT minor works. We ended up appointing the insulation contractor directly, because their work was such a large chunk of the cost, once we added on profit and prelims for a main contractor to manage them, this became too expensive within the contract sum. Due to the experimental nature of the materials being used, the insulation contractor had high costs, and as detailed above, it was not possible to tender this package of work to reduce this cost. Therefore to reduce costs we took certain elements of the work away from them and gave these to the main contractor. These included excavating for the below ground insulation, below ground drainage, and paving. Although these were specific tasks, this lead to some confusion between the main contractor and the insulation contractor, as the insulation contractor initially left works such as replacing satellite dishes and guttering, and it was challenging to get these completed. There were also difficulties with the treatment of the roof due to the depth of insulation. The eaves had to be extended, which had not been priced in the initial costing of the project, so this was carried out by the main contractor. DGI had initially suggested using flashings to overcome the issue on the gable, but then they expected the main contractor to deal with this, so again difficult discussions were needed to get the work carried out within the budget.

The window supply and install was sub contracted by the main contractor, as was the PV installation. The main contractor was trained to install PV by SIG and went through the MCS accreditation process. They also fitted the solar hot water systems, boilers and cylinders, although the plumbing works were subcontracted to another local plumber.

- Windows: AM Profiles sub-contracted to Newlife Regeneration
- MVHR Installation: Newlife Regeneration
- Boiler Replacements: Newlife Regeneration with M & T plumbers
- Solar Hot Water: Newlife Regeneration with M & T plumbers
- PV Installation: Newlife Regeneration with SIG overseeing
- Insulation: DGI – directly contracted by client
  (Cavity Removal and Re-fill, External Walls, Perimeter, Below Ground Beads, Loft)
- Preparation and incidentals: Newlife direct labour
  (Excavation for below ground insulation, lintels, drainage, paving, fencing, loft hatch and ladders, builder's work to eaves, plastering, scaffolding).
- Finishing works: Newlife Regeneration

The technologies were procured due to their performance and / or previous experience of the product by the client / contractors. The solar panels used were GBSOL, and these were procured by SIG, for Newlife to install. There were issues with this contractual relationship, as although initial costs looked comparable, SIG didn't provide all of the equipment required for fitting, and therefore their costs were higher than other similar products which Newlife could have procured directly.

The PV panels were Schuko, again procured by SIG. The MVHR was used due to its performance on SAP Appendix Q, and cost. The main contractor used ITHO for training, but installed the product themselves. Most MVHR systems are not intended for retrofitting, and once on site the contractor found that the planned route for installing ducting was not possible, therefore they had to be creative using flexible ducting. ITHO commissioned the system and this was working as expected at practical completion.

Ventilation system ducting in roof space

Site supervision was primarily by the managing contractor however the client appointed an Employer's Agent / Contract Administrator. From the client's perspective, it would have been better to appoint a clerk of works or an architect with more experience of the issues surrounding thermal bridging and air tightness, and it would certainly have been useful to have an air tightness champion on site, as the air tightness has only very marginally improved, which is really disappointing.

There were also gaps in the project, which were not allocated to any party in terms of responsibility, and this has also caused the project to not perform as well. These include changing light bulbs. It was really disappointing on a recent visit to the properties, to see that the light bulbs in the properties were

not energy efficient and that this had not been picked up by any party previously. Therefore this still needs to be addressed.

Specific issues arising which we would now treat differently:

Issue	**Potential Solutions**
Loft - realised that due to the need for access and storage, there was a requirement for boarding in the loft, rather than just mineral wool, and DGI were unable to suggest a suitable board, therefore Knauf insulation were contacted directly and supplied space board, at no cost. Also flexible ducting in the loft has separated at joints since commissioning, meaning the MVHR is not working. This is due to tenants accessing the loft and standing on ductwork.	Storage platforms secured from rafters and / or rigid ductwork throughout the loft space.
MVHR - incredibly difficult to get duct work into bathroom due to roof structure. Contortionist was required to get into the eaves to pass duct through. Also very disruptive in terms of decoration works, removing and cutting down shelves on each side of chimneys etc.	Use single room ventilation systems
Boiler Condensate Pipe – this runs across the alcove next to the chimney breast, and then out through the wall. The pipe was not insulated enough and did not have enough of a fall. Therefore both residents have had continuing problems with their condensing pipes freezing in winter.	New boiler to go in kitchen on outside wall, and condensate pipe to be better insulated with vertical drop.
Beads for insulation – these caused a real mess and blew everywhere. Neighbours complained of beads in fish ponds etc.	Would not use these again. Don't feel the benefit outweighs the cost and difficulty of these being used.
Neopor beads blown into floor void – these have not filled the floor void. The method of blowing them into the void has an automatic stop when it thinks the void is full. However checks since prove that the void is approximately 50% full and therefore ineffective.	Would use a net containing insulation quilt and thread this through from one side to the next. The beads were used as this was a trial project, but they were expensive, and have now proved to be ineffective.
The cylinder was too large for the space at TSB056. Due to the fact we were installing solar, we also took out	In TSB056, we would have installed a combination boiler, due to the lack of space. The cupboard which held

the electric shower and installed a shower running off the cylinder. However this means that the tenants have to have the gas boiler on to heat water in the winter, when in the past they would not have needed to.	the former tank was also used for storage, but once the tank was changed, the storage area was no longer useable.
Air tightness levels	These are disappointing, as very little change has been seen, although the major areas shown from the pre-contract test were all addressed, including letterboxes and gaps around windows. We intend to commission a further smoke test to assess whether the work in these areas was not as successful, or whether carrying out the work has caused other problems.
Cost	There was a real need for a contingency sum within the budget and asra Housing (LHA) would not attempt this type of project again without a contingency sum.

8. Commissioning and Occupancy

As residents were living in the property and engaged in the process from the beginning, there has been a level of assumption which is probably unrealistic, that the residents understood the technologies. The information provided has been disjointed and not formalised into a resident pack, which allows for confusion and conflicting information from different parties. This is something which we aim to address, once we have resolved the issues with the monitoring equipment. There was not a formal handover due to the tenants living in the property. The works were treated as work under our stock investment programme would be, partly due to the 'light touch' philosophy.

In several post completion visits, it was found that the tenants in TSB056 were leaving their upstairs bedroom and downstairs bathrooms windows open during the day. Prior to the work, the tenants' had an issue with condensation in their bathroom, and fear of this coming back is resulting in them opening their windows. This is causing the MVHR system not to run correctly.

The MVHR ducting in the loft space was flexible, and sealed by the contractors prior to commissioning which showed that it was working. However on subsequent visits, there has been a lot of dirt around the MVHR output vents, and on further investigation, some of the joins in the ducting in the loft had separated. The tenant said they thought this was due to them using the loft for storage and therefore having to access it. The pipes run through the insulation and therefore are likely to be knocked. Rigid ducting would have worked better in this situation.

The tenants in TSB056 are seeing less benefit than those in TSB055, mainly due to the issues above. However air tests on both properties have also shown that they are less air tight than expected, and therefore the MVHR systems are not actually necessary at the moment.

There is a need to go back in and do more work, and asra is hoping to fund this work. However it is unable to do so until payment has been received for the contract, which was already overspent.

9. Costs

Item Stage>	Design stage		Post-construction		Comments
	Materials	Labour	Material	Labour	
Management and administration		3525		3525	This cost is for CDM / / QS / CA. The main project management was by the client and this was provided FOC to the project. In reality much more time was spent than expected by both client and CDM / EA.
Design		11456.50		11456.50	Includes architect and engineer.
Construction overall					
- Prelims		9450		9450	
- Fabric measures	65179.38		70021.41	Inc	
- Building services (conventional)	9983.40		12784.53	Inc	Increased cost of fires
- Low /zero carbon technologies	24845.49		24852.85	Inc	Reduced electrician cost by £1000.
- Training (MCS)		881		881.25	
- Appliances	4000		0		Realised we couldn't afford these when VAT issue arose.
- University of Nottingham		5850		0	Decided they were not required if EST were – however since realised they should have been involved to co-ordinate monitoring.
- Consequential costs		1762.50		7619.33	Included externals and paving which hadn't been factored in by insulation contractor, plus increased scaffolding costs.
Occupant temporary housing					
Monitoring equipment		9,000		15854.50	As detailed, expected EST to pay for standard monitoring costs.

10. Wash-up meeting

No formal wash-up meeting was held. However, through discussions and the later site meetings, the following points were raised.

The amount of money requested should have been enough for the works required, however due to the experimental nature of the project, we should have allowed for more, which would have made the project run more smoothly, and probably would have allowed all of the involved parties to get more from the project.

There were two other major issues with costs. These were VAT and monitoring. As we were not aware that VAT had to be included at the bid stage, we had to try and do the same amount of work, but for around 10% less (10% as much of the work could be charged at 5%, however consultants' fees were still at full rate of VAT). We also had allowed for the EST to pay £3k per property retrofitted for the monitoring equipment, as we misunderstood the initial documentation. This meant finding an extra £6k within the budget.

It was particularly difficult that in both DGI and SIG the main contact who had been instrumental in setting up and costing the project, as an experimental project, left during the project. Unfortunately discussions had not all been minuted fully and even those which had, had not been passed to other staff in those organisations, so they did not understand the potential value of this project for their own learning and future work streams, and it became a challenge for them to complete the works within the budget, rather than a learning opportunity.

The tenants have not seen the significant benefit which we all expected. This is partly due to the lack of air tightness, but also due to some of the equipment not working as expected, in particular the Microwatt monitoring equipment. Without this working properly, it is very difficult to assess why the tenants are not achieving benefits. This should have allowed us to go back in after completion and to give tenants advice on why they were not getting the best possible benefit from their solar hot water for example.

The initial property, TSB055, also took much longer than expected, due to organising the programme and contractors, getting the supplies delivered at the right time, and the degree of learning on the job which was required. This caused a great deal of stress for the residents, as they had scaffolding around their property for a number of months, and workmen around for almost 6 months. On the second property, TSB056, this process was improved significantly. Due to the tenant's disability, the family were very specific about working times, and the contractor was very clear about the programme. Therefore I have no doubt that the process and timescale would continue to improve, once a team was working together repeatedly on a number of properties.

11. Doing it Again

The scheme has been a great learning exercise from the client perspective. We definitely would not do the same project in the same way again. The procurement issues and therefore value secured is the thing which we would change first, however a number of specific works and technologies would also be changed as detailed earlier in the report.

Some of the issues came about from the fact that we installed to singular properties. For example, the letter of complaint from the neighbour at TSB055, and concern over down-valuation of her property, would not have happened if this work was being carried out under Green Deal perhaps, or CESP and therefore being offered to all residents in an area. This would also bring costs down significantly.

As a client, we are fitting external solid wall insulation to properties and will continue to do so. This is already much cheaper than the insulation work which was carried out on the retrofit. We expect this to become cheaper in future, although that will depend on availability of labour. In terms of materials, we are working with Efficiency East Midlands on regional procurement, which will develop a framework of suppliers for materials, as well as contractors. This process is also looking at forecasting demand, to allow manufacturers to reduce costs. Fitting to whole terraces and pairs of semis would be the aim, but this will depend on whether sources of funding are available under Green Deal, as most private sector occupiers in areas where social housing providers own stock, would not be able to fund this.

We are also fitting mechanical ventilation systems to other existing properties where there are issues with condensation. However we are trialling a range of different solutions to try and find the most cost effective and efficient.

In terms of the below ground perimeter insulation, it is difficult to know yet whether this has achieved any benefit. We need to establish a method of monitoring this, now that Microwatt are not involved in our project. Holes with temperature sensors inside and out, on both the control and retrofitted properties has been proposed as one solution, so we are exploring the costs for this. For this measure some reductions in cost could be gained in materials, and speed of fitting due to training. On semi detached properties, the marginal cost of doing two rather than one would be much less, as the equipment is already on site.

Unfortunately with Microwatt going out of business, we have not been able to really test that part of our solution, which we had really high expectations of using again. The cost for this would come down, as early on in the project we looked at schemes with Microwatt. This is due to an area based pick up being used for the radio signals, rather than an individual one in each loft.

12. Business Benefits

Due to the issues experienced with this project and explained above, my expectation is that none of the project partners would expect to see more work directly from this project. The project lost momentum due to the timescales involved and the key personnel changing. Although the main contractor did a great job of bringing the job in as near to the budget as possible, this meant it was incredibly challenging, and unnecessarily so. Much of the innovation was innovation for innovation's sake, for example the neopor beads in the render insulation, which was something which came about purely from BASF's involvement in Phase 1. This did not significantly improve the performance of the property, but meant the insulation cost significantly increased.

The main organisation which would have achieved more business from this project was Microwatt, who declared themselves insolvent before they had delivered on their contracted items. Their products were our main innovation and they were a small SME which could really have benefited from this project. Due to their poor performance prior to them declaring insolvency they would not have received any further business from us, even if they had continued to trade under the same name.

Although involved parties may not have generated business directly from this project I do believe that most, if not all, of them will have learnt from the project, and that this learning will be applied in future jobs, making them more successful. So, although they may not have generated business directly off the back of this project, I would suggest there are business benefits for all involved.