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

BioRegional
solutions for sustainability

Retrofit for the Future Project Final Report

Project number: ZA122S
Property number: TSB119 & TSB117 (reference

Author: BioRegional

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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SBRI Government challenges. Ideas from business. Innovative solutions.

Final Report

Project information

- **ZA reference number:** ZA122S
- **Location of property:** Sutton, SM5
- **Lead participant details:** BioRegional, BedZED Centre, 24 Helios Road, Wallington, SM6 7BZ

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- **Date report issued:** 11th November 2011

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1. Project details and directory

There are three properties in the project, two of these are comparison properties and as such have been covered in this report. The properties are all located in Sutton, Surrey.

Role	Organisation	Contact Details
Property Owner		
Property Owner (Arms Length Management Organisation for London Borough of Sutton's Housing Stock)	Sutton Housing Partnership	Address: SHP, Sutton Gate, 1 Carshalton Road, Sutton, Surrey, SM1 4LE Email: Tel: 020 8915 2413 Website: www.suttonhousingpartnership.org.uk
Design Team		
Project Management	BioRegional	Address: BioRegional, BedZED Centre, 24 Helios Road, Wallington, SM6 7BZ. Tel: 020 8404 4889 Website: www.bioregional.com
Technical Advisor and Quality Assurance	Parity Projects	Address: Parity Projects Limited, Block A 230/231, Riverside Business Centre, London, SW18 4UQ Tel: 020 8874 6433 Website: www.parityprojects.com
Contractor		
Main contractor	Lakehouse	Address: Lakehouse, South East Regional Office , Unit 17, Bourne Enterprise Centre, Borough Green, Kent, TN15 8DG Tel: 07917 260 890 http://www.lakehouse.uk.com
Sub-contractor – electric	P.T Building Services	Address: 11 Glencairne Close, London. E16 3SW
Sub-contractor – heating (Internal heating installation)	P.T Building Services	Address: 11 Glencairne Close, London. E16 3SW
PV & SWH system installer	Carbon Energy Solutions	Address: Unit 6, Twisleton Court, Priory Hill, Dartford, Kent, DA1 2EN Tel: 01322 271932
Sub-contractor – External solid wall insulation installer	Drens Ltd.	Unit 17 Access House, 30 Rugby Road, Twickenham, Middlesex, TW1 1DG Tel: 0208 744 9666 info@drens.co.uk
Supplier - windows	Howarth Timber (Windows & Doors) Ltd	Address: The Dock, New Holland, North Lincolnshire DN19 7RT. Email: windowsanddoors@howarth-timber.co.uk www.howarth-timber.co.uk

2. Introduction

BioRegional in conjunction with WWF developed the idea of One Planet Living. One Planet Living is a holistic approach to sustainability looking at waste, materials, ecology as well as energy use (more information can be seen in 13 about the One Planet Living Principles. The aim of our Retrofit for the Future project was to apply the One Planet Living principles to the retrofit of social housing. We therefore looked at not only the end product (a low energy home) but also the means of getting there, e.g. the embodied energy of the materials used and the other interventions that should be retrofitted in order to help residents lead a sustainable lifestyle. In addition, we wanted to use the project to help train the contractors working on the property about the best retrofit techniques.

We have two control houses, one that will be retrofitted with those measures required to meet Decent Homes Standards and loft insulation (funded through the CERT scheme); the other will have no work done to it. However, all the tenants in the three houses are taking part in a behaviour change programme. The idea of the control houses is to show:

- What carbon savings could be achieved by just doing simple low cost measures, such as the new windows, boiler and loft insulation in the Decent Homes house.
- What carbon savings are achieved just by undertaking a behaviour change programme with the residents.

The project should therefore provide some steer as to what is the most cost effective way of saving carbon: is it deep retrofit, light retrofit or behaviour change?

3. Occupants

For the project we were not only relying on physical retrofit measures to save energy but also on changing occupant behaviour. Therefore the same tenants occupy the property as prior to the works being carried out. The residents were in situ for the entire duration of the project.

All the properties have at least one occupant who is in the house between 9-5. Occupancy ranges from 3 to 5 people per property and include school-age children in all cases.

4. Dates

The dates for the project apply to both the properties that had work done (the One Planet House and the Decent Homes House). The behaviour change only house only had monitoring installed and this was commissioned in August 2011.

Event	Date
Project start date (when was the first proposal discussed or agreed)	February 2010
Planning application submitted (if appropriate)	June 2010 & September 2010
Planning permission granted (if appropriate)	September 2010 & November 2010
Building Regulations application submitted (if appropriate)	N/A
Building Regulations approval granted (if appropriate)	N/A
Contract for work let / signed	September 2010
Occupants moved out (state if they remained or property was empty)	Tenants remained in-situ
Start on site	October 2010
Completion of retrofit	March 2011
Occupants moved in	N/A
Monitoring system commissioned and operating properly	March 2011
Building defects corrected	April 2011
Building services and controls operating correctly	March 2011
Behaviour change programme	November 2010-March 2013

5. Pre-retrofit property

All three properties are from the same estate and all are mid-terrace with a south facing front façade. Berfore the retrofit they had single glazed windows and a limited amount of loft insulation (less than 70mm). The 3-bedroom terraced houses are typical of 12,000 ex London County Council low-rise, cavity walled houses built between 1928 and 1936 on the St Helier Estate, spanning the boroughs of Sutton and Merton. The properties have a gross internal area of around 75m^2.

The English House Condition Survey 2006 estimated that within the social housing sector there are 496,000 homes of the same age (1919-44) as the properties that we used in the project. The survey also showed that there are over 700,000 mid-terraced houses, over 1.1m terraced houses and over 2.1m low-rise houses in the social housing portfolio. These figures suggest that between 0.5 and 2m houses could be retrofitted using the proposed measures. In addition it is considered that these measures could readily be applied to social housing's purpose-built, low-rise flats, as well as being applicable to much of the 15m private housing stock built between 1919 and 1990.

Having decided on the type of social housing property, we then aimed to find another 2 identical properties that could be used as comparators. Sutton Housing Partnership sent out a letter to all of their tenants on the estate asking if they would like to take part in the project. The three households were selected from the list of responders on the basis that they all had similar family sizes and had very similar properties (same age, orientation and built form).

Parity Projects performed an energy assessment of the Decent Homes House and the One Planet House to identify the most appropriate and cost effective measures for reducing energy consumption. These reports were used as the basis for selecting the retrofitting measures.
The picture below shows one of the properties prior to retrofit; all three properties look very similar:

Energy bill data has been obtained for all properties for a period of one year prior to the retrofit taking place. The data from these bills can be seen in the table below:

Home	Electricity (kWh)	Gas (kWh)	Total (kWh)
One Planet House	3,948	12,908	16,856
Decent Homes House	3,640	17,099	20,739
Behaviour Change House	6,917	27,341	34,258

6. Design

This project was designed to examine and compare the energy performance of three similar houses:

- Behaviour change house: Changed occupant behaviour and lifestyle in an unimproved house.
- Decent Homes house: Changed occupant behaviour and lifestyle in an improved, 'Decent Homes' plus CERT funded loft insulation house.
- One Planet House: Changed occupant behaviour and lifestyle in a house retrofitted to very high energy efficiency standards with additional features installed to aid low environmental impact lifestyles.

The renovation of the One Planet House was designed to use the holistic 10 One Planet Living principles framework which covers everything from zero carbon, low embodied energy materials and zero waste to sustainable food and transport. The key energy saving features were:

- Under-floor insulation using woodfibre boards
- Internal wall insulation using woodfibre boards
- Loft insulation using recycled newspaper
- Installation of new energy efficient white goods
- Thermostatic radiator valves
- High performance timber framed double glazed windows instead of standard uPVC double glazed windows, with trickle vents for background ventilation
- Replacement of fans in the kitchen and bathroom with heat recovery extractor fans (closing-off of passive vents)
- Sealing up main air leakage routes to achieve 0.5 air changes/hour
- Insulated loft hatch
- Solar thermal system
- Solar photovoltaic panels for electricity generation
- Careful installation of all features to reduce thermal bridging
- Changing the existing electric hob to a gas hob as CO_2 emissions from gas cooking are much lower than electric cooking
- Low energy light bulbs
- Thick lined curtains
- As part of Decent Homes work being carried out in the property the existing bathroom pod, which is a pre-fabricated extension housing the bathroom, was replaced and a new kitchen was installed.

In addition, to help the resident live a One Planet Lifestyle the following features were also planned:

- Low flow tap restrictors
- Low flow showerhead and mains shower
- Clothes horse and line
- Full recycling provision throughout the house

- Garden composter
- Water butt
- Cycle storage
- Fruit tree
- Herb Garden

Solid wall insulation
The original plan was to install internal wall insulation to both facades of the terraced property. However, further discussions between the design team and the property owner led us to favouring external insulation for the property as this would prevent a loss of floor space and would cause less disruption to the occupants (who were to be in-situ during the works). Both of these factors meant that the project would be more easily replicable. However, initial discussions with the London Borough of Sutton indicated that planning permission for external render to the front of the property would not be likely, but that external render to the rear of the property would not need planning permission. Unfortunately, when asked for a lawful development certificate, they reconsidered their position and required us to seek planning permission, which was then approved.

We had planned to use the Pavatherm wood-fibre board for the external wall insulation at the back of the house as well as internally. However, we were unable to find a system (render + insulation +fixing) that was guaranteed. The property owner was worried about using an un-guaranteed system. We therefore decided to use a more tried and tested system using 70mm of PIR (poly isocyuranate) insulation with a coloured render for the external insulation at the back of the property. At the front of the property we stuck to the original plan of using internal wood fibre board insulation.

Windows for the bathroom pod
The manufacture of the timber frame windows was delayed due to the heavy snow in Yorkshire (where the supplier's manufacturing plant was located). This meant that they were not delivered in time to go into the bathroom pod during manufacture. Because the delivery of the bathroom pod could not be postponed (road closures were required in order to crane it into place which have to be booked in months in advance), it was decided to leave the PVCu windows in the bathroom pod. Replacing the windows on site with the timber ones would have led to some very high embodied energy windows and potentially a worse seal.

No under-floor insulation in corridor
Under-floor insulation had been planned in the corridor downstairs. However, the way the floorboards were laid out meant that a cupboard would need to be deconstructed in order to lift them and thereby install the insulation. Further investigation as to the energy savings from this measure revealed it would only save 5 pence per year on energy bills. We therefore decided not to do this measure. The use of cavity wall beads was investigated, but there were lots of problems with these including the potential for there to be holes in the floor void which would mean filling the neighbouring properties with these beads.

Chimney not blocked up
The final work on the house was to seal up the chimney and to install mechanical extract fans into the kitchen. The original plan was to insert a chimney balloon into the chimney to

prevent draughts coming into the house. However, in order to do this a cap was needed for the chimney to prevent things falling onto the balloon. Although we still had the scaffolding up, access to the chimney from the roof was impossible due to the position of the solar panels on the roof. The solution we decided upon was to brick up the chimney and install a "hit and miss vent" to provide ventilation.

7. Construction

- **Procurement:** The project was negotiated by Sutton Housing Partnership with one of their framework contractors (Lakehouse).
- **Contract type:** Sutton Housing Partnership is in a NEC partnering contract with Lakehouse.
- **Contract structure:** Lakehouse were the main management contractor and all trades were subcontracted to local contractors. There was one General Sub Contractor for general building works, insulation, electrical works and plumbing.
- **Specialist installers**: There was a specialist installer for the solar thermal and solar photovoltaic systems; these were procured by the Main Contractor via a competitive and qualitative tender process.
  The timber frame window supplier was nominated by BioRegional based on a competitive and qualitative tender process.
- **Site supervision**: The main contractor had a dedicated full-time Site Manager.
- **Monitoring**: The monitoring installation and commissioning was carried out by Parity Projects who are part of the project team.
- **Role of architect/design team** – BioRegional provided project management for the retrofit work as well as weekly site visits during construction and tenant liaison. Parity Projects provided technical advice for the contractors, as well as sign-off for certain elements of the work, e.g. solid wall insulation. They also participated in weekly site visits.

Problems encountered:

Internal insulation with wood-fibre board and lime plaster: A number of problems came from this: there were delays in the supplier providing training to the contractor installing the insulation and items needed for the work were not all provided as expected (e.g. blades to cut the insulation which were not available from other building suppliers). These issues delayed the internal wall insulation by about 4 weeks.

There were then a number of issues with the installation including:

- Cutting up the wood-fibre board to fit the wall produced a lot of dust and took a long time.
- Applying the lime plaster was a difficult skill to learn and, because each coat needed to dry to a certain extent before it could be smoothed over, it was a very long process. The contractor did all the rooms simultaneously to overcome this problem to a certain extent. See picture below of the lime plaster being applied.
- The corner beading (which goes on the edge of the window reveal) was also very tricky to make good with the lime plaster.
- Breathable paint was also required to go on the walls to maintain their breathability.

This is more expensive than standard paint which therefore impacted on the budget.

Loft Hatch: The loft hatch was smaller than normal; it was difficult to source a loft hatch of the right size.

Asbestos: An asbestos survey was carried out on both the properties and the asbestos that was found by the survey was removed. However, when the kitchen was removed in the "One Planet House" as part of Decent Homes work, further asbestos was found hidden behind a panel, which required notification to the Health and Safety Executive. This delayed the project by 6 weeks whilst we waited for appropriate personnel to remove it.

Snow: Just as both tenants' kitchens had been removed, there was very heavy snowfall which prevented anyone from getting to site up until Christmas. In addition, the window manufacturer (based in Yorkshire) had their production line delayed by a month. This led to keeping the existing PVCu windows in the box bathroom, as detailed above.

Windows: When they did arrive, the windows were not the right size for the window spaces (the manufacturers made a mistake). The windows were sent back. The manufacturer sent new ones but one was still wrong. Further checking of the measurements by the project team ensured that the same mistake did not happen again.

Training: Despite running two training sessions with the contractors and sub-contractors about retrofit, thermal bridging and air tightness, there was a lot of misunderstanding about the specification, which needed to be ironed out as we went along.

Position of extract fans: The layout of the kitchen was such that there was no room in the wall for the extract fan. Usually in similar houses, the fan would be placed in the window. However, breaking the seal on the glass to install a fan would have had a very detrimental impact on the air tightness of the house. We therefore had to put the extract fan in the ceiling and run pipework to the outside.

Existing flooring in the home: The tenant had installed laminate flooring in the lounge. In order to install the under-floor insulation and the internal wall insulation, this had to be taken up. There was a high risk that the laminate flooring couldn't be removed without damage. Careful removing of this flooring added costs to the measure.

What went well:

External insulation: This was a very easy procedure and only took two days. It also vastly improves the external appearance of the property.

Cavity walls: The contractor used the left over insulation to plug up any gaps in the cavity wall insulation.

Solar thermal and solar photovoltaic systems: These were installed without any problems.

New appliances: The tenants' existing appliances were re-used through an appliance re-use centre.

Under-floor insulation: Once the laminate flooring had been taken up, installing the under-floor insulation (wood-fibre boards) was relatively easy.

Loft insulation: Installation of the loft insulation (recycled newspaper) was simple.

8. Commissioning and occupancy

On completion of the works, a member of the team from BioRegional visited both the houses to show the tenants how to use their new heating system and, for the One Planet House, the solar thermal and solar photovoltaic panels. This revealed that the residents had not changed the boiler programmer from the factory settings. BioRegional helped the residents programme the heating and hot water (previously the tenants did not have a programmable heating system). This visit also revealed that, at the One Planet House, the resident had turned off the solar thermal system because it was plugged into the same socket as the immersion heater had been previously.

The solar thermal system had been installed in March. In September, by looking at the monitoring data, Parity Projects noticed that there was no heat coming out of the solar thermal system. The solar thermal providers went to diagnose the problem with the system and found that the system had de-pressurised. Whilst looking at the system, they noticed that the tenant had changed the hot water programmer to come on in the morning and the evening thereby using the gas boiler to provide hot water instead of the solar thermal system. BioRegional have since spoken to the tenant about this and she has changed her programmer.

We are also running a series of four workshops with the tenants. These cover all aspects of One Planet Living with a focus on energy, water and food. The tenants of all three houses have already attended one workshop, with the others planned over the coming six months. The idea of the workshops is that the tenants identify actions that they can take to reduce their energy consumption; they then pledge to do these actions in front of the other residents. In addition, there is a competition between the tenants to see who can use the least energy. There will be a prize for the winner. A member of the team from BioRegional also visited each resident at home to show them simple actions that lead to a more sustainable lifestyle.

The workshops are designed to be interactive and fun; they last about two hours and include a number of games to break up the session. The format of the workshops is:

- 1st workshop: Introduction to One Planet Living, residents work out their ecological footprint using the BioRegional calculator, residents think of ideas that would help them be more sustainable.
- 2nd workshop: This workshop is energy focussed, the need to reduce energy consumption is discussed and residents think of five actions they will take to reduce their energy consumption. They consider the barriers to these actions and how they could overcome them. Start of the competition to see which house can keep their thermostat down to 19 degrees and who uses the least electricity.
- 3rd workshop: Residents discuss how they got on with their energy saving pledges. Results of the competition are announced. Residents sign up to slightly harder pledges to save energy and water.4th workshop: Celebration and residents consider how they will maintain their good energy behaviour over the longer term.

9. Costs

The overall costs for the project were high because the contractor's team had not undertaken a retrofit project previously. This led to a number of items needing to be re-done in a different way. The need to incorporate the monitoring also significantly increased the cost of the electrical works to the property which would not be the case for a standard retrofit project. The re-decorating costs were much higher than expected due to the large amount of furniture that needed to be moved around in the house. Had internal insulation not been installed, the re-decoration would not have been required. The management of the project cost significantly more than originally thought; this was also due to the fact that the contractor had not undertaken a retrofit project before and therefore needed more hand-holding than expected. By doing external and internal insulation this added to costs, as an additional sub-contractor was required.

Item Stage	Design stage expectations		Post-construction costs		Comments
	Materials	Labour	Material	Labour	
Management and administration		£9,250	£13	£16,032	
Design		£5,600		£8,511	
Construction overall	£40,471	£23,968	£21,654	£31,779	
Prelims		£2,258		£3,177	This includes the profit and fees from the main contractor.
Fabric measures	£22,641	£8,610	£6,833	£4,763	
Building services (conventional)	£2,110	£1,100	£3,235	£2,349	This includes a new boiler, a new cylinder for the solar thermal system and new radiators as well as moving radiators because of the internal wall insulation.
Low /zero carbon technologies	£12,350	£300	£7,231	£4,549	Solar thermal collectors (70% of hot water demand). Solar PV (1.08kWp)
New appliances	£1,170		£1,265	£20	Fridge/freezer, washing machine, oven, hob and microwave.
Training		£3,000	£400	£2,200	2 training sessions for the contractors. One general session and one on thermal bridging and air-tightness.
One Planet Living Measures	£800	£3,100	£900	£3,250	Low flow tap restrictors, Low flow showerhead and mains shower, Clothes horse and line, full recycling provision throughout the house, garden composter, water butt, cycle storage, fruit tree and herb garden.
Behaviour change programme	£900	£4,400	£800	£8,111	Preparation and delivery of four workshops with residents as well as follow up work between workshops.
Consequential costs	£500	£1,200	£990	£3,360	Re-decorating – mostly needed due to the internal wall insulation.
Occupant temporary		£2,000			

housing					
Monitoring equipment	£11,065		£17,896	£6,141	
Decent Homes house			£4,175	£3,919	
Monitoring and reporting service				£384	

10. Wash-up meeting

A wash-up meeting was held on the 16th June 2011, attended by BioRegional, Lakehouse, Parity Projects, Sutton Housing Partnership and residents of the two properties that had been retrofitted.

From the wash-up meeting the following resident feedback was obtained:

- It's very warm
- "I already notice a big difference in how much I pay for electricity: I was paying £30 per week, now I'm only paying £10."
- It looks even better than they were expecting.
- They can feel the temperature difference between the pre-retrofit property and the post-retrofit property (especially upstairs).
- It is actually a bit too hot in the bedrooms
- They don't mind the monitoring equipment, but they haven't been looking at it.
- It would be better if you could put the extract fan on without having the light on it.
- Seemed like things were left half finished, whilst contractors worked on the other property.
- They didn't notice the loss in space from the internal wall insulation.
- If they had fully understood what was going to be involved in the work, they might not have gone ahead with it, but they were happy that they did. However, they would have preferred to be decanted during the works.
- The water saving bath is too shallow.

11. Doing it again

Definitely do again

- The recycled newspaper loft insulation was easy to install and relatively good value given its low embodied energy.
- The external wall insulation was fitted by a local company. This only took two days including putting on the render, which was significantly faster and less trouble than the internal wall insulation. It also caused less disruption to the tenant and didn't incur the consequential costs of redecorating. Before and after photos of the wall that had the external insulation can be seen below:

- **Definitely not do again** Retrofitting with the residents in-situ if installing internal wall insulation or under-floor insulation. The contractors needed significantly more time at the end of each day to make the house liveable for the tenants again when doing these works, which added to the cost and resulted in a longer period for the works.
- Internal wall insulation using lime plaster and wood-fibre board. This created a lot of dust (which was unpleasant for the tenants), took a long time to install and required redecoration of all of the rooms that it was installed in to ensure that the wall matched the rest of the room. Although the cost of installing the internal wall insulation was only £2,541, the redecorating costs that it resulted in were around £3,000.

Reduction of costs

- Working simultaneously on a large number of properties would significantly reduce costs as contractors would always be able to do a full day's work. This would particularly apply to the internal wall insulation using the lime plaster. This is because the lime plaster needs to dry between applications.
- To reduce costs, we would use external wall insulation instead of internal wall insulation as, although it is slightly more expensive, there are no consequential decorating costs.
- A better understanding of all the works that were to take place by the contractor would have allowed a more logical critical path to be established. This would have significantly reduced costs as in quite a few cases things needed to be re-done to accommodate something that had been misunderstood from the specification.
- Although the under-floor insulation wasn't particularly problematic, it did have quite a high cost (£992 just for the lounge) which when compared to the energy that it saved was probably not worthwhile.

Improvement of the design process

As the project went along, the specification was refined instead of it being complete from the beginning; this led to a number of inefficiencies. For example, the full extent of the work needed to install the monitoring was not included at the beginning.

Improvement of the construction process

- Originally the Retrofit for the Future project was not under the same contract as the

Decent Homes contract with Sutton Housing Partnership. This prevented some of the work for Decent Homes being considered alongside the retrofit, which was very inefficient. This was rectified, but it would have been better if they had been under the same contract from the beginning.

- Better communication was needed between the design team, the contractor and the tenants. In particular, a meeting at the beginning with everyone including the tenants and half way through the project would have improved communications.
- The contractor should have been led through the specification more than was done to ensure that they understood everything that was required.

Improvement of the commissioning and occupancy process
Having understood the common pitfalls associated with the tenants using the equipment, the initial meeting with the tenant to show them how to use the retrofitted home would be refined.

Replication at scale
The key to replication at scale would be that:

- Only *external* solid wall insulation is used.
- Under-floor insulation is not installed.
- A large number of properties would be available for retrofitting in a particular area
- The work is combined with other work to upgrade the existing stock, e.g. the Decent Homes programme or its replacement.
- A very thorough training programme with all those involved in the project is undertaken

With a larger programme of retrofits in a similar area, all the different contractors could be working at the same time.

12. Business benefits

Lessons learnt: The retrofit project has given BioRegional a much better insight into actually how to retrofit a project with on the ground experience rather than just theory. This is really useful when designing retrofit programmes for other clients. This also enables us to provide training to other RSLs and Local Authorities about how to go about retrofitting their existing stock. Finally, we have been developing our thinking about behaviour change for some time; this project allowed us to test out some of the ideas to see what worked and what didn't. We are currently looking for funding from other social housing providers to develop a toolkit about behaviour change with their tenants.

BioRegional estimate that 5 of our current business leads and opportunities have been a direct result of the retrofit for the future project.

This year BioRegional have generated around £75,000 of work as a result of the Retrofit for the Future project. We would expect to generate this much work or more every year for the next five years. In total this would amount to £375,000.

13. Additional Information

An introduction to One Planet Living

In 2001, BioRegional came up with a way of describing sustainability which has caught on around the world - “One Planet Living”. Globally we are consuming 50 per cent more renewable resources every year than the planet can regenerate, with carbon emissions forming the largest component of this. If everyone on earth consumed as much as we do in Europe we would need three planets to support us. To be environmentally sustainable, we need to develop lifestyles that are consistent with ‘one planet’ ways of living. To ensure that our programmes and partners address all aspects of sustainability, we have created the ten One Planet Living principles as a mechanism for developing and presenting solutions for sustainability.

Zero carbon	making buildings more energy efficient and delivering all energy with renewable technologies
Zero waste	reducing waste, reusing where possible, and ultimately sending zero waste to landfill
Sustainable transport	encouraging low carbon modes of transport to reduce emissions, reducing the need to travel
Sustainable materials	using sustainable and healthy products, such as those with low embodied energy, sourced locally, made from renewable or waste resources
Local and sustainable food	choosing low impact, local, seasonal and organic diets and reducing food waste
Sustainable water	using water more efficiently in buildings and in the products we buy, tackling local flooding and water course pollution
Land use and wildlife	protecting and restoring existing biodiversity and natural habitats through appropriate land use and integration into the built environment
Culture and community	nurturing a culture of sustainability, community and sense of place
Equity and fair trade	creating bioregional economies that support fair employment, inclusive communities and international fair trade
Health and happiness	encouraging active, sociable, meaningful lives to promote good health and wellbeing

The ten One Planet Principles