

New Barracks Estate Retrofit

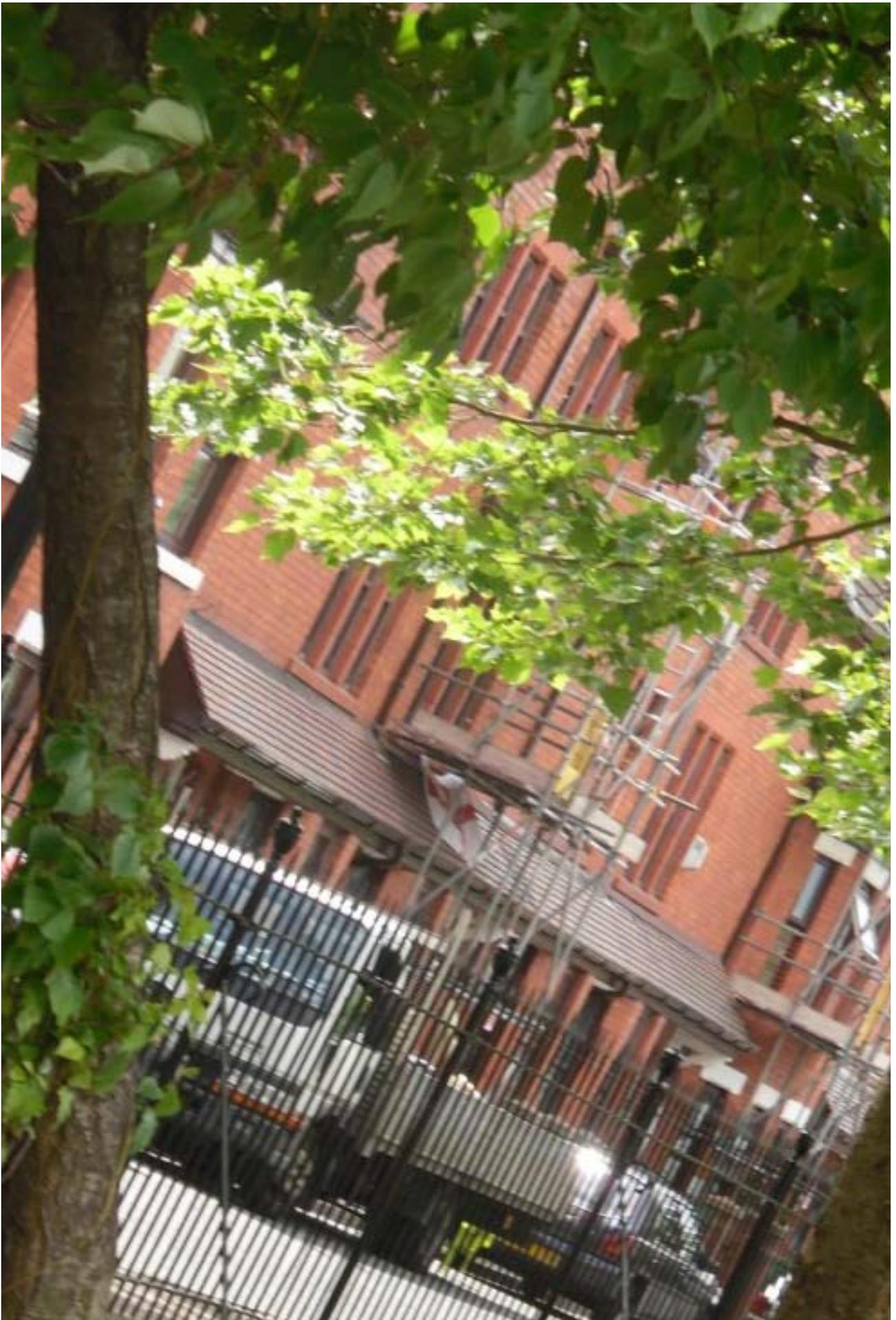
Measuring Change Post Retrofit





Contents

Executive Summary	1	6/ Discussion and conclusions	26
1/ Introduction	4	6.1 Change in survey response rates	26
1.1 Measuring Change post retrofit	4	6.2 Comfort and living conditions	26
1.2 Study context	4	6.3 Energy use and expenditure	27
1.3 Pre retrofit studies	4	6.4 Conclusion	27
2/ Methodology	7	7/ References	29
2.1 Introduction	7	Appendix A	30
2.2 The questionnaire	7	The Post Retrofit Measuring Change Questionnaire	30
2.3 Bill data collection and analysis	7		
3/ Questionnaire return rates	9		
4/ Perceptions on comfort and living conditions post retrofit	11		
4.1 Comfort	11		
4.2 Living conditions	12		
4.3 Tenant comments on comfort and living conditions	14		
5/ Tenant bills and energy use	16		
5.1 Heating behaviours	16		
5.2 Paying energy bills	16		
5.3 Paying gas bills: finding it easier?	17		
5.4 Gas bill data by house size and type	18		
5.5 Household gas expenditure	18		
5.6 Household gas usage	19		
5.7 Gas cost changes as a result of retrofit improvements	20		
5.8 Paying electricity bills: finding it easier?	21		
5.9 Electricity bill data make up	22		
5.10 Household expenditure on electricity	22		
5.11 Household electricity usage	23		
5.12 Electricity cost changes as a result of the retrofit	24		



Executive Summary

ARUP



In 2010, Salix Homes retrofitted all of its properties on the Barracks Estate, Ordsall, Salford in a programme to bring all households on the estate to up to Decent Homes Plus Standard. The intended outcomes of the programme were the creation of better homes for tenants in terms of comfort as well as a reduction in tenant expenditure and energy use and carbon emissions.

Salix Homes was keen, where possible, to identify and measure the impacts of the retrofit programme with regard to social, environmental and economic benefits. Therefore, ahead of the retrofit project in late 2009, Arup was appointed to run Salix Homes' Measuring Change programme to establish the energy use (gas and electricity) levels, expenditure, energy use behaviours and home temperature/comfort levels amongst Barracks Estate tenants before the retrofit took place.

In October 2011, to measure the extent of the impacts that had occurred as a result of the retrofit Arup launched the Measuring Change programme again.

This report details the findings of estate wide research carried out twelve months after the implementation of a low carbon retrofit programme across the 78 properties of the New Barracks housing estate in Salford. The research:

- involved questionnaires, gas and electricity bill analysis and interviews
- sought to ascertain information on changes on energy use, comfort levels and living conditions
- followed on from pre retrofit research carried out in March 2010
- experienced a significant fall in return rates, compared with the pre retrofit survey.

The findings of the research also underpin a separate evaluative Social Return on Investment report (Arup, 2012).

The findings show that for the most part the retrofit has been a success across a number of crucial areas likely to improve the lives of tenants. Household bill data analysis carried out shows a significant fall in gas use and expenditure a significant fall. A fall of 8,435 kWh in average annual gas use and a fall in annual expenditure of £353 per year (after accounting for inflation).

Annual household electricity use has increased on average, by 599 kWh, and similarly annual electricity expenditure has increased by £76 (after accounting for inflation). This rise in electricity usage could also be explained by the electricity consumption of the MVHR unit (thought to be offset by the savings on gas bills) and/or an increase in tenants' disposable income due to the significant decrease in gas expenditure. It was estimated that MVHR units could cost up to £30

per annum depending on the size of the house¹, thus accounting for 40% of the increase in average electricity expenditure.

When asked directly whether pre retrofit the tenants tended to find it difficult to pay bills, over 50% said they did either *always* or *sometimes* struggled with both gas and electricity bills. When asked if they now found it easier, most said they did, although some maintained that they still found it difficult.

Comfort levels for whole house and living room as recorded on the pre retrofit survey, were neutral; 3.5 out of 7 as scored by tenants (on a scale of 1-7 where 1 is uncomfortable and 7 is comfortable). These have improved in the post retrofit survey, being scored by tenants at 5.5 for both whole house and living room, using the same scale.

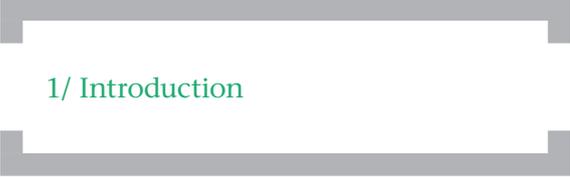
Tenants were asked about a number of areas relating to living conditions in their homes. There were reported success supported by survey data in improved draughtiness, damp, incidences of mould and ventilation. Tenants also pointed to improvements in *cosiness, night chills, health and happiness and noise reduction*. Some however maintained that problems persisted in some areas of the house, particularly with regard to kitchens and bathrooms which still remained cold.

Conclusions drawn from the research stress:

- the changes from the retrofit which have positively affected a number of areas of the tenants' lives
- the importance of whole house retrofit
- engaging with and gathering information from the affected tenants before and after retrofit to get a true understanding of change
- the importance of advice and guidance on both behaviours and new technology
- the commitment of Salix Homes' and the New Barracks Estate's measuring the impact of the retrofit.



¹ Based on information shown on the Envirovent website for the model of MVHR unit installed, typical l/s/m² assumptions and the ground floor areas of the houses on the New Barracks Estate (see http://www.envirovent.co.nz/pages/product_sub.asp?page=energiVent)



1/ Introduction

1/ Introduction

1.1 Measuring Change post retrofit

This report details the findings of estate wide research conducted in late 2011, 12 months after a low carbon retrofit programme was implemented across the New Barracks Estate, Salford. The research sought to establish changes in:

- tenant's energy use behaviours
- perceptions of household comfort
- living conditions.

The research methodology included a questionnaire survey of tenant's perceptions, collation of 12 months energy data and in depth interviews. This report details and discusses the data collected post retrofit and is set out as follows:

- Section 2: methodology
- Section 3: questionnaire return rates
- Section 4: changes in living conditions
- Section 5: changes in energy use and expenditure
- Section 6: discussion and conclusions.

As well as forming the basis of this report, the data gathered has been used in an additional report; an evaluative Social Return on Investment (SROI) assessment which sets out how change has occurred by mapping the social and environmental outcomes (by stakeholder group) resulting from the investment in retrofit.

1.2 Study context

Salix Homes is an Arms Length Management Organisation (ALMO), based in Salford. In 2010 Salix Homes implemented a low carbon retrofit programme across the New Barracks Estate, Ordsall, Salford. Salix Homes saw this programme as an opportunity to engage with tenants, assess energy use/behaviours pre and post retrofit and to articulate and (where possible) monetise the wider social impact.

Housing on the New Barracks Estate comprises 78 early Edwardian properties. Household make-up across the estate is varied in terms of numbers of residents and age profile. Properties on the estate are managed by the New Barracks Co-operative Tenant Management Organisation (TMO).

In 2009, 54% of the people in this area were suffering from income deprivation; 28% were dependent on benefits and the average annual household income was approximately £20,000². People living in this area also suffered from significant health problems with only approximately 55% considering themselves "In Good Health" and just over 15% of the people claiming incapacity benefit or disability living allowance.

Prior to the retrofit works properties generally had inadequate heating systems poor or inoperable controls and limited insulation. Evidence of mould growth was apparent in bathrooms, kitchens and end terrace walls due to surface condensation. Windows were generally single glazed and ventilation to the bathrooms and kitchens was through wall mounted extractor fans, many of which were inoperable.

The low carbon retrofit programme included boiler replacement, double glazing installation, internal insulation of external walls, installation of mechanical ventilation system, new bathrooms, new kitchens, property re-wiring and new front doors.

1.3 Pre retrofit studies

To date, Arup, on behalf of Salix Homes, has conducted a number of studies on the New Barracks Estate. Specifically these previous studies were:

- a low carbon Retrofit Options Appraisal study (Arup, 2009)
- pre retrofit Measuring Change (Arup, 2010)
- pre retrofit forecast Social Return on Investment (SROI) report (Arup 2011).

The Retrofit Options Appraisal produced Standard Assessment Procedure (SAP) calculations for combinations of retrofit interventions in terms of energy saving potential, capital cost and carbon savings. Recommendations were then made relating to types of retrofit interventions most suited to the aims of the New Barracks Estate retrofit programme.

The pre retrofit Measuring Change study was carried out to determine tenant perceptions of living conditions and comfort levels pre retrofit and average energy consumption across the estate pre retrofit. Data was collected in March 2010 via an incentivised estate wide tenant questionnaire which was mailed directly to tenants. A high return rate of 68% was achieved for this survey. Further data was gathered through in-depth interviews with tenants

² Salix Homes. 2009. Ordsall and Islington Neighbourhood Profile. Available at: <http://www.salixhomes.org/2445.htm> [accessed June 2010].

1/ Introduction

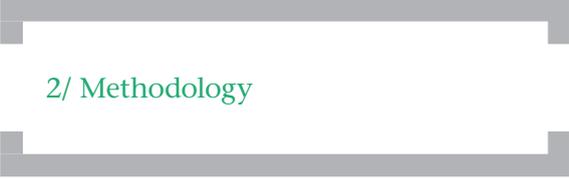
from a cross section of the estate's households and an interview with the Head Administrator of the New Barrack's Estate Co-operative. Key findings from the Measuring Change research included pre retrofit household energy use and expenditure averages of:

- 17,668 kWh of gas used per year
- £624 spent on gas per year
- 3,145 kWh of electricity used per year
- £408 spent on electricity per year

Tenant perceptions of comfort in living rooms and the whole house averaged at a neutral score of 3.5 on a scale of 1-7, where 1 was uncomfortable and 7 comfortable.

The SROI analysis gave a greater understanding of the value created by investment in the improvement works. The extensive SROI impacts map established a range of stakeholders. Impacts were identified and mapped including: reduced bills for tenants, improved comfort levels, and increased environmental awareness for the tenants, fewer complaints for the TMO, increased value of housing stock for the Council, increased expenditure in the wider economy and reduced CO2 emissions in the environment. Some dis-benefits were also identified, like temporary disturbance from the works to the tenants. Where appropriate, financial proxies were used to quantify the outcomes and any assumptions were also detailed. These were used to calculate the SROI ratio which was estimated to be 1.6:1, ie. for every £1 invested in the New Barracks Estate retrofit project there was £1.60 of social value created.





2/ Methodology

2/ Methodology

2.1 Introduction

In October 2011, 12 months on from the completion of the retrofit programme, all (78) householders across the New Barracks Estate were re-contacted and asked to complete a questionnaire and send copies of gas and electricity bills for 1st August 2010 to 31st July 2011. A covering letter explaining the purpose of the research, and guidance on contacting gas and electricity providers (including utility companies contact details) was provided to assist tenants, if necessary to obtain duplicate bill data. All tenants were given approximately six weeks to return the information.

Questionnaire completion and bill return was incentivised with entry into a prize draw funded by Salix Homes and the New Barracks Co-operative, with the draw taking place at an estate-wide meeting organised by the Co-operative in October 2011.

2.2 The questionnaire

The tenant questionnaire (sample shown in Appendix A) sought to establish post retrofit:

- changes perceived by tenants in energy use and expenditure
- tenant heating use behaviours and understanding of the heating system
- comfort levels (whole house and living room)
- changes in living conditions.

Data collected via the questionnaires was inputted into a spreadsheet for analysis to ascertain and

graphically represent how much change had occurred since the retrofit. The questionnaire also gathered comments and opinions on various aspects relating to energy use, comfort and living conditions. Furthermore, where comparable data on comfort and living conditions was available from the pre retrofit survey, comparisons were made with post retrofit data and changes documented.

2.3 Bill data collection and analysis

Tenant bills varied in quantity and quality with 365 days of data being returned in only a few instances. As such, where a threshold of 300 days of expenditure and usage data was available the data was deemed “usable” and taken forward for use in the analysis. These figures were extrapolated to give annual results and inputted into a spreadsheet for analysis.

Where comparable (pre and post retrofit) data was available from households, direct comparisons for gas and electricity use and expenditure were made to illustrate the change in energy consumption and expenditure for individual households. No correction for energy price inflation was carried out on these individual household results. However, a correction for inflation was carried out by multiplying pre retrofit usage figures by the post retrofit £/kWh rate for comparison. The results of this are shown in sections 5.7 and 5.12 for gas and electricity respectively.





3/ Questionnaire return rates

3/ Questionnaire return rates

In October 2011 the return rate for the post retrofit survey was 33% which equated to 26 completed questionnaires. This was a much lower return rate than the pre retrofit questionnaire of March 2010. The rates of returns are shown in Table 1 below.

	Completed questionnaires	Useful dataset: gas	Useful dataset: electricity
Pre retrofit questionnaire March 2010	68%	27%	27%
Post retrofit questionnaire October 2011	33%	21%	17%

Table 1 Return rates from pre and post retrofit questionnaires

4/ Perceptions on comfort and living conditions post retrofit

4/ Perceptions on comfort and living conditions post retrofit

4.1 Comfort

Via the questionnaire tenants were asked to score comfort levels in their living room and across their whole house on a scale from 1-7, where 1 was uncomfortable and 7 was comfortable. The results showed that in both cases the average score for whole house comfort and living room comfort was 5.5. This shows a significant two point improvement when compared to pre retrofit scores which were previously at 3.5 for both the whole house and the living room.

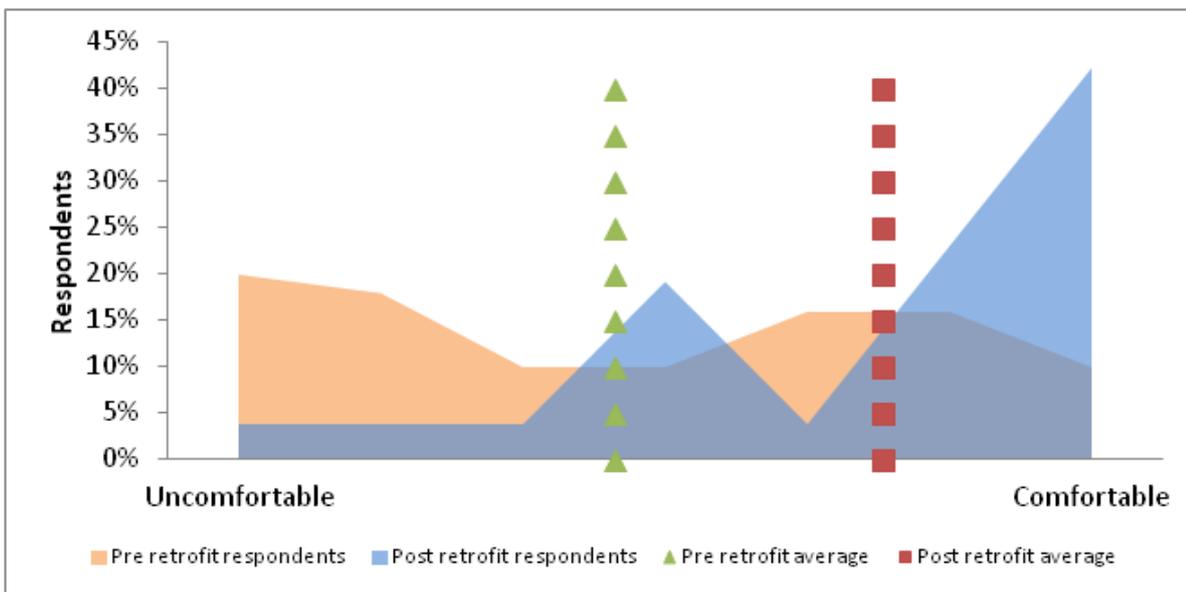


Figure 1 Individual respondents and average pre and post retrofit living rooms comfort levels

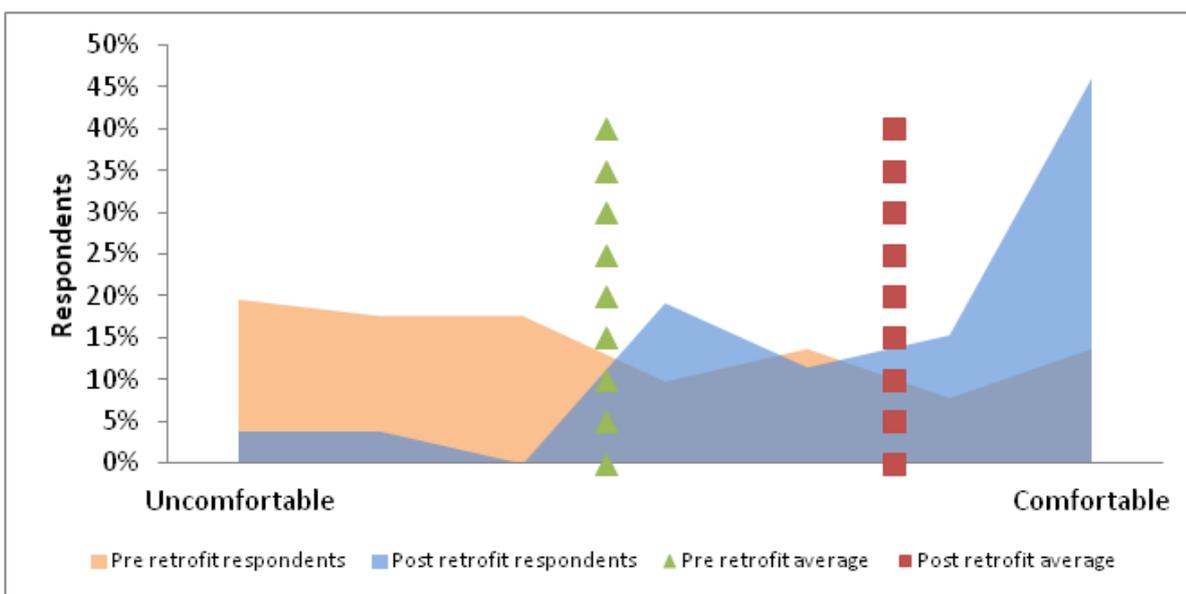


Figure 2: Individual respondents and average pre and post retrofit whole house comfort levels

4/ Perceptions on comfort and living conditions post retrofit

4.2 Living conditions

The questionnaire asked tenants how they felt that ventilation, damp, mould, draughts and respiratory problems had changed in their homes since the retrofit. The survey questions are shown in Figure 3 below (with response options ranging from *big improvement* to *got a lot worse*). Tenants could also comment on any other changes noted since the retrofit works were completed.

	Big improvement	Some improvement	no change / not noticed	got a bit worse	got a lot worse
Ventilation	<input type="checkbox"/>				
Damp	<input type="checkbox"/>				
Mould	<input type="checkbox"/>				
Respiratory Problems	<input type="checkbox"/>				
Draughts	<input type="checkbox"/>				
Other 1 (Please state)	<input type="checkbox"/>				
Other 2 (Please state)	<input type="checkbox"/>				
Other 3 (Please state)	<input type="checkbox"/>				

Figure 3 Survey questions regarding living conditions improvements (taken from questionnaire)

The results are shown in Figure 4 to 9 overleaf. Positive changes outweigh neutral and worsened changes for most of the different aspects of living conditions. The exception is respiratory problems, which show a majority of *no change* answers.

In relation to draughts, 65% of respondents reported *big improvements* and 31% reported *some improvement*. Changes in damp and mould both showed similar patterns with 50% of respondents noticing a *big improvement*. Similarly, for ventilation the majority of tenants reported a *big* or *some improvement* (32% and 40% respectively), rather than *no change* (24%).

Only small numbers of people reported aspects getting worse. Five households (19% of respondents) in total reported problems (ie. *bit worse* or a *lot worse*). These related to ventilation (one household, 4%), damp (one household, 4%), mould (two households, 8%) and draughts (one household, 4%).

Other positive improvements reported explicitly by tenants on the questionnaire (within the “other” sections shown in Figure 3) were unique ie. only reported by one respondent. Specific improvements highlighted by tenants included the following (exact quotes given):

- “windows” – big improvement
- “warmth” – big improvement
- “doors” – big improvement
- “night chills” – big improvement
- “vents” – no change.

These additional changes are included on the *all changes* graph shown in Figure 9.

4/ Perceptions on comfort and living conditions post retrofit

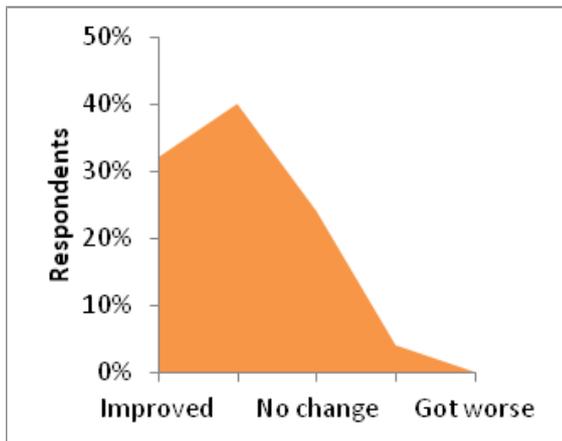


Figure 4 Ventilation improvements

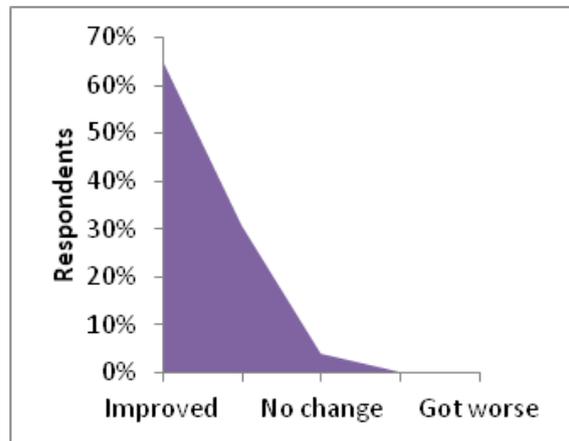


Figure 7 Draught improvements

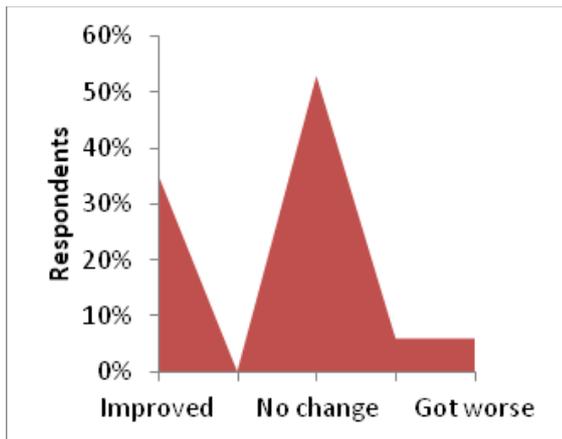


Figure 5 Respiratory problem improvements

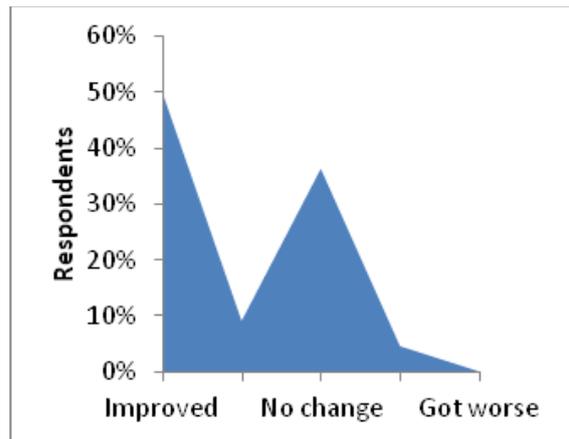


Figure 8 Mould improvements

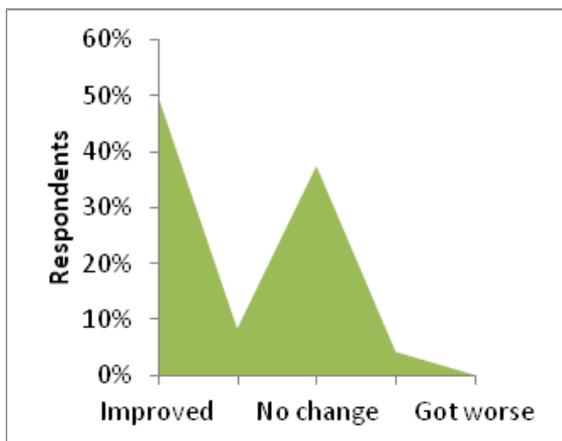


Figure 6 Damp improvements

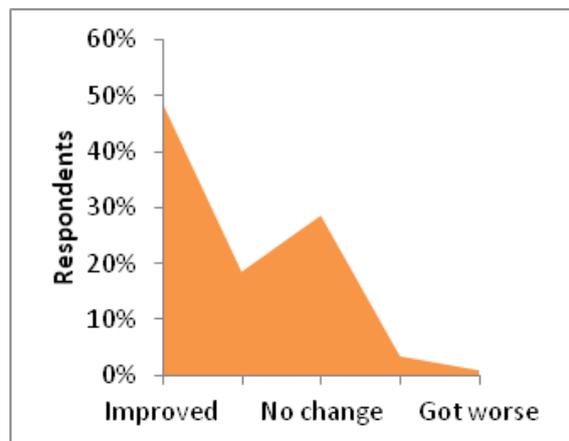


Figure 9 All changes

4/ Perceptions on comfort and living conditions post retrofit

4.3 Tenant comments on comfort and living conditions

Tenants were invited to give detailed comments about how the retrofit works had impacted on their properties, their living conditions and their wellbeing. Table 2 below represents a selection of positive and negative comments made by tenants. Positive comments were made about the general feeling of “happiness” created from having a warmer home, free of draughts. Further, tenants were happy with not having to heat their homes as often, or for shorter periods of time. Negative comments were made about the mechanical ventilation equipment being noisy or not working as it should. Several other negative comments related to kitchens and bathrooms remaining cold despite the retrofit works, these are discussed further in section 6 of this report.

Positive	Negative
I think the insulation and gas boiler have made most difference	<u>Adjoining houses</u> both sides are not insulated nor have received decent homes
~	~
I believe I am <u>healthier and happier</u>	Envirovent <u>hard to monitor</u> some noise now and again
~	~
It has not changed the way I live but has made me feel <u>more secure and comfortable</u> and think more about the energy use than I did before	The ventilation is terrible when we a shower the <u>condensation runs down the walls</u> and the kitchen windows steam up when cooking
~	~
We are now <u>draught free!</u> The <u>noise outside is less</u> with the new windows and it <u>feels a lot warmer.</u>	Bathroom has not been insulated. Bathrooms were to be insulated as always cold even in summer, <u>freezing in winter pipes freeze up</u> every year so no improvement at all in bathroom worse if anything
~	~
The house is <u>much warmer</u> and draft free	Hasn't really changed the <u>coldest room is the bathroom</u> - it's always freezing
~	~
<u>No more draughts</u> coming from the windows or doors - <u>no icy cold kitchen or bathroom</u> either	Nothing has changed in the <u>kitchen still have got the damp</u>
~	~
Whole house has lost its chilly feel. I'm <u>not having to put the heating on as much</u> and doesn't take as long to warm up when I do	
~	
The house is <u>still as warm</u> when I don't have the heating on	
~	
I have found a <u>big improvement</u> in all the work that has been done in particular the doors and windows.	
~	
House <u>much warmer</u> apart from bathroom	
~	
There is no change in the way <u>I live a bit more cosy</u>	

Table 2 Tenant comments on comfort and living conditions



5/ Tenant bills and energy use

5/ Tenant bills and energy use

5.1 Heating behaviours

Results show that since the retrofit tenants have been setting their thermostats to a lower average temperature, 21°C compared to a pre retrofit average of 24°C, representing a fall on average of 3°C.

Tenants were asked whether or not their new heating system and the controls were easy to understand. Only 8% (2 out of 26) of the respondents reported difficulties in understanding and using their heating controls and the heating system.

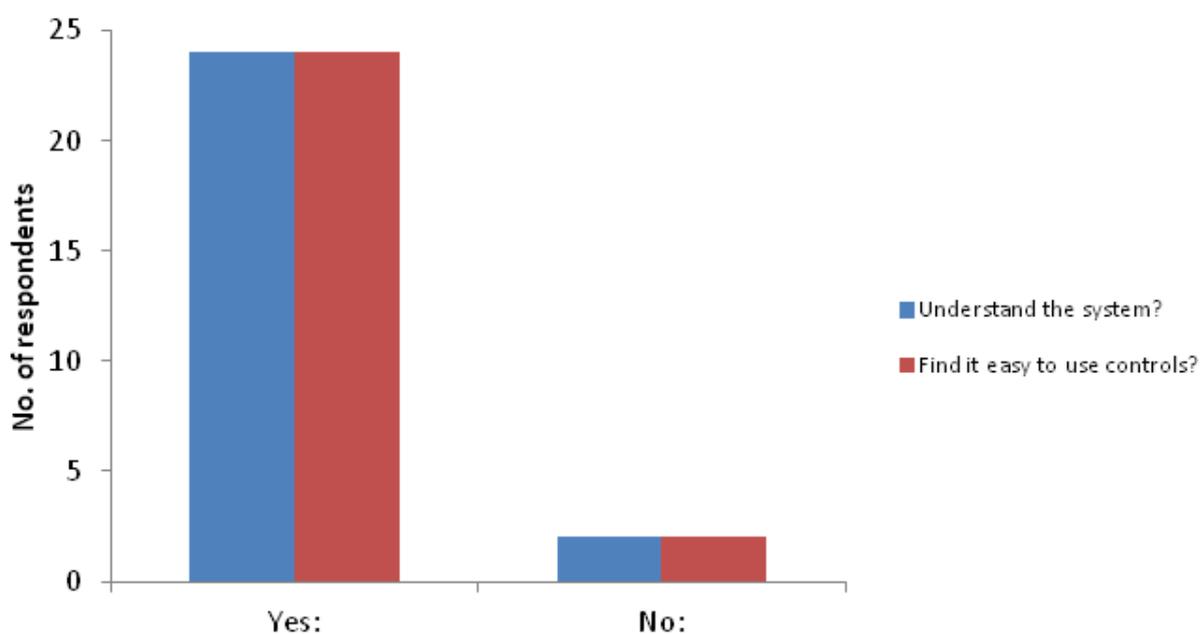


Figure 10: Tenants' understanding of post retrofit heating system and the controls

5.2 Paying energy bills

Tenants were asked if they had struggled to pay bills pre retrofit. The answers to this question are shown in Figure 11. Tenants were also asked whether bills had become easier to pay since the retrofit. The tenants' responses are discussed in sections 5.3 and 5.8 for gas and electricity respectively.

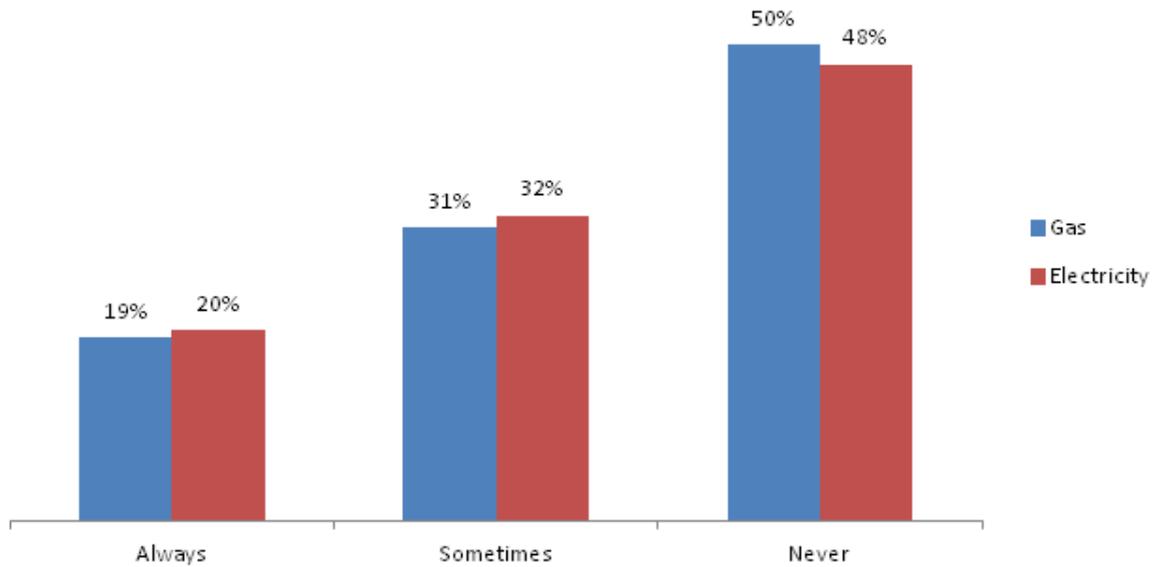


Figure 11: Before the improvements did you struggle to pay gas/electricity bills?

The results show that pre retrofit, around 52% of households *always* or *sometimes* struggled to pay electricity bills (20% and 32% respectively) and 50% of tenants *always* or *sometimes* struggled to pay gas bills (19% and 31% respectively). These respondents were considered the most vulnerable in terms of fuel poverty risk, whether or not this situation has improved for these tenants is discussed further in sections 5.3 and 5.8.

5.3 Paying gas bills: finding it easier?

Tenants were asked whether they now found it easier to pay gas bills since the retrofit. The results are shown in Figure 12.

Do you find it easier to pay gas bills since the retrofit works?

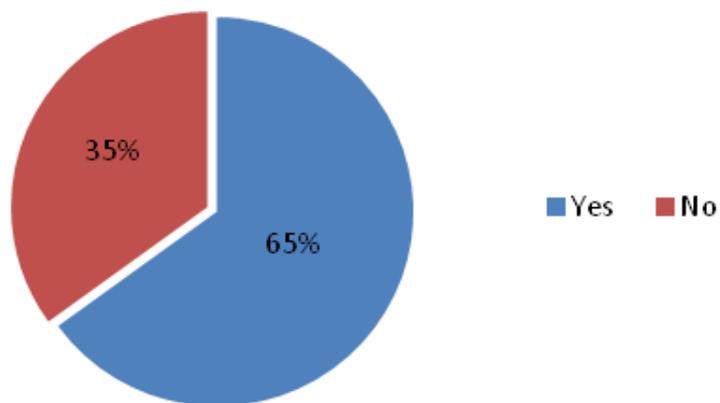


Figure 12: Change in ease of paying gas bills after the retrofit works

5/ Tenant bills and energy use

The evidence in Figure 12 suggests that 65% of tenants are now finding it easier to pay gas bills post retrofit. This will be particularly important for the 19% of respondents who, pre retrofit stated that they *always* struggled to pay gas bills.

Of those who stated that they either *always* or *sometimes* struggled to pay gas bills most claimed to now find it easier. Table 3 summarises how tenants in these two sub-groups have been affected in terms of their ability to pay gas bills.

	Pre retrofit	Post retrofit do find easier
<i>Always</i> struggled	19% of all respondents	40% of those who <i>always</i> struggled pre retrofit now find it easier
<i>Sometimes</i> struggled	31% of all respondents	75% of those who <i>sometimes</i> struggled pre retrofit now find it easier

Table 3: Change in circumstance, those who *always* or *sometimes* struggled to pay gas bills pre retrofit

Logically, it follows that a larger proportion (75%) of those who *sometimes* struggled to pay gas bills are now finding it easier, whereas less than half (40%) of those who previously *always* struggled to pay gas bills are now finding it easier.

5.4 Gas bill data by house size and type

There were 16 usable sets of gas bills returned as part of the post retrofit survey, equating to 21% of the

estate. The returns were made up of responses from tenants living in different house types and sizes. This mix of houses is a significant factor in determining the averages for energy use. For comparison, the table below shows the house-type profile for the pre and post retrofit gas bill datasets returned.

House type and size	Pre retrofit returns	Post retrofit returns
Large three bed	53%	44%
Small three bed	16%	25%
Two bed	31%	31%

Table 4: Make-up of gas bill data returned (pre and post retrofit questionnaires)

The proportion of the returns from tenants in large three bed houses was higher in the pre retrofit survey suggesting that observed averages for gas use and expenditure post retrofit, may be higher as large three bed houses take more energy to heat. As such observed changes for individual households for gas expenditure (not corrected for inflation) and use follow in sections 5.5 and 5.6.

5.5 Household gas expenditure

Annual gas expenditure for the respondents is shown in Figure 13. These are observed figures which have not been corrected for inflation (see section 5.7 for corrected values). A large range is observed between the lowest annual household expenditure at £128 and the highest at £825 for the observed year.

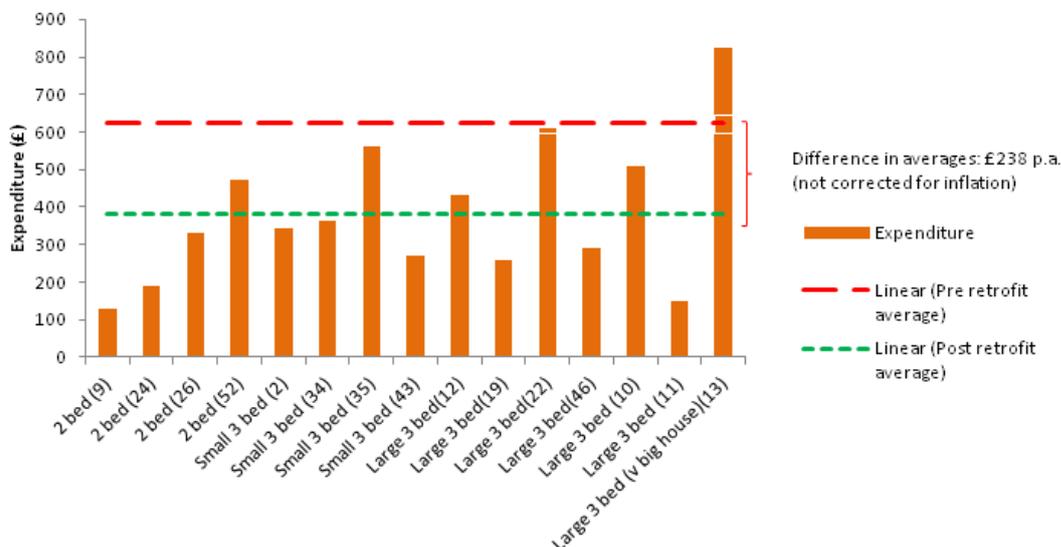


Figure 13: Annual household expenditure on gas for individual households, and average annual spend on gas pre and post retrofit (figures not adjusted for inflation)

5/ Tenant bills and energy use

The benefits of the retrofit works become apparent when comparing the pre retrofit average with post retrofit observed average. These levels are plotted in Figure 13. The difference between them is shown at £238³ over one year, not corrected for inflation.

Some of the tenants that supplied gas bill data for the post retrofit survey also sent in usable bill data as part of the pre retrofit survey. Where this occurred direct comparisons were made. Table 5 shows the difference in gas expenditure (refer to section 5.7 for inflation adjusted difference in expenditure). The highest annual saving was £436 compared with the only one increase in expenditure of £69 across the two datasets.

House type and Tenant ID	Pre retrofit annual spend (£)	Post retrofit annual spend (£)	Difference
2 bed (9)	£159	£129	-£30
Small 3 bed (2)	£276	£344	£69
Small 3 bed (34)	£736	£362	-£374
Large 3 bed(12)	£868	£432	-£436
Large 3 bed(19)	£680	£258	-£422
Large 3 bed (10)	£832	£510	-£322
Large 3 bed (v big house) (13)	£834	£825	-£9

Table 5 Comparable annual gas expenditure for individual households pre and post retrofit

5.6 Household gas usage

Individual household gas usage figures are shown in Figure 14. Average annual household use across the estate has fallen significantly when compared to pre retrofit gas use figures. Usage has fallen on average by 8,435 kWh per year.

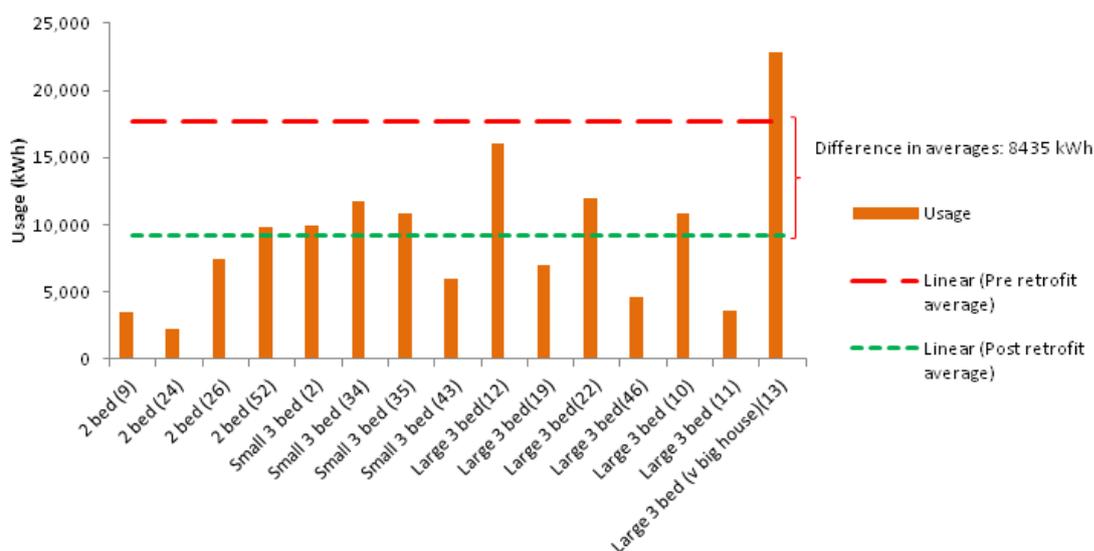


Figure 14: Annual household gas usage for individual households, and average annual gas usage pre and post retrofit

³ Pre retrofit year's average was based on 21 observations.

5/ Tenant bills and energy use

Table 6 below shows the change in gas use pre and post retrofit for properties where comparable data was available from both surveys. The results confirm that gas use has fallen across the estate with the majority of households experiencing a fall in use and two tenants seeing an increase. The figures show a range of 16,623 kWh for the highest saving, to the highest increase of 1,958 kWh.

House Type and Tenant ID	Post retrofit use (kWh)	Pre retrofit use (kWh)	Change kWh %
2 bed (9)	3,543	2,497	1,046 (42%)
Small 3 bed (2)	9,990	8,032	1,958 (24%)
Small 3 bed (34)	11,769	19,334	-7,564 (39%)
Large 3 bed (12)	16,027	22,800	-6,773 (30%)
Large 3 bed (19)	7,038	18,155	-11,116 (61%)
Large 3 bed (10)	10,864	23,276	-12,412 (53%)
Large 3 bed (v big house) (13)	22,832	39,455	-16,623 (42%)

Table 6: Comparable annual gas usage results pre and post retrofit

5.7 Gas cost changes as a result of retrofit improvements

To determine the saving in annual gas expenditure relating to the retrofit improvements average annual pre retrofit and post retrofit gas use was multiplied by the post retrofit average unit gas cost⁴. The results are shown below in Table 7.

	Average use (kWh)	Average spend (£)	Average gas cost £/kWh (3dp)	Annual average cost at current survey prices (£)	Difference at current rate (£)
Pre retrofit	17,668	624	0.035	740	353
Post retrofit	9,234	387	0.042	387	

Table 7 Change in gas expenditure when expressed using a common rate

The results in Table 7 illustrate that the difference between non-adjusted expenditure levels outlined in section 5.5 do not reveal the full extent of the gas bill savings resulting from the retrofit works. Using the post retrofit annual unit gas cost and therefore accounting for gas price inflation reveals a saving which is £120 per annum more than the observed average change.

⁴ The average annual current spend was divided by the average annual current use to give a £/kWh rate (average). The pre retrofit use was then multiplied by this average £/kWh rate and compared with the current level of expenditure. This allowed both pre and post retrofit levels of usage to be compared using a current £/kWh rate.

5.8 Paying electricity bills: finding it easier?

Tenants were asked whether they found it easier to pay electricity bills since the retrofit works. The results are shown in Figure 15.

Do you find it easier to pay electricity bills since the retrofit works?

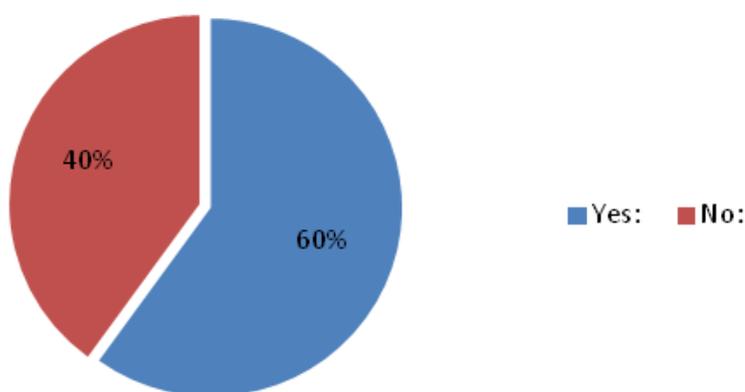


Figure 15: Change in ease of paying electricity bills post retrofit works

The evidence suggests that tenants on the estate are noticing savings on their electricity bills with 60% stating that they now find it easier to pay bills. The same tenants who reported *no change* when asked if it has become easier to pay their gas bills, reported *no change* in ease of paying electricity bills.

Of those who stated that they either *always* or *sometimes* struggled to pay electricity bills, most now found it easier. Table 8 summarises how tenants in these two sub-groups of the total respondents have been affected in terms of their ability to pay electricity bills.

	Pre retrofit	Post retrofit do find easier
<i>Always</i> struggled	20% of all respondents	40% of those who always struggled pre retrofit now find it easier
<i>Sometimes</i> struggled	32% of all respondents	62% of those who sometimes struggled pre retrofit now find it easier

Table 8: Change in circumstance, those who *always* or *sometimes* struggled to pay electricity bills pre retrofit

As with gas bills, under half (40%) of those who *always* struggled now found it easier to pay electricity bills. Of those who previously *sometimes* struggled to pay gas bills, 62% now found it easier.

5.9 Electricity bill data make up

In total, there were 13 usable sets of electricity bills returned equating to 17% of the estate. The returns were from tenants living in different house types and sizes. For comparison, the table below shows the house-type profile of the pre and post retrofit electricity bill data returned.

House type and size	Pre retrofit returns	Post retrofit returns
Large three bed	50%	38%
Small three bed	17%	31%
Two bed	33%	31%

Table 9 Make-up of electricity bill data returned during the tenant questionnaires (pre and post retrofit shown)

The proportion of returns from tenants in large three bed houses was higher pre retrofit. This suggests that the pre retrofit averages for usage and expenditure may be higher than those observed in the post retrofit questionnaire, as the large three bed houses have the potential for more occupants. Sections 5.10 and 5.11 illustrate these averages and individual household results.

5.10 Household expenditure on electricity

Figure 16 shows the annual expenditure on electricity by the respondents. These figures have not been corrected for inflation (refer to section 5.12 for corrected values). The range in expenditure figures is significant with £195 being the lowest observed expenditure, and £805 being the highest; an expenditure range of £610 a year.

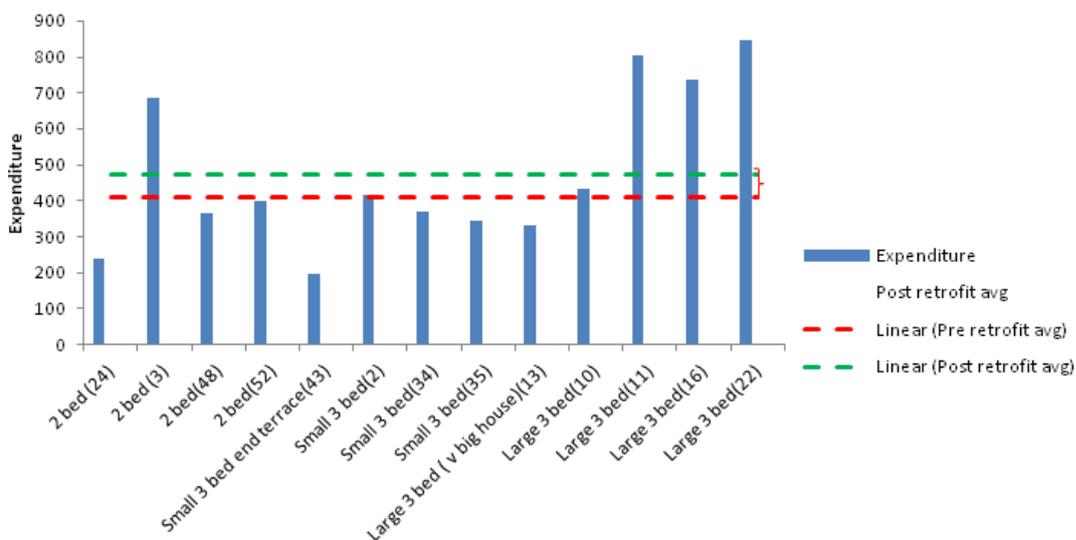


Figure 16 Annual household spend on electricity for individual households, and average annual spend on electricity pre and post retrofit

5/ Tenant bills and energy use

The change in average annual observed expenditure on electricity was an increase of £65. Table 10 shows results from the pre and post retrofit datasets, where these were available. All but one of those respondents with comparable datasets spent more on electricity post retrofit. The largest observed increase was £192 for the year and the only observed decrease was £145 for the year. Refer to section 5.12 for inflation adjusted difference in expenditure.

	Post retrofit expenditure	Pre retrofit expenditure	Change
2 bed(48)	£366	£355	£11
Small 3 bed end terrace (43)	£195	£167	£27
Small 3 bed (2)	£417	£383	£35
Small 3 bed (34)	£367	£275	£92
Large 3 bed (v big house) (13)	£330	£265	£65
Large 3 bed (10)	£431	£577	-£145
Large 3 bed (11)	£805	£680	£126
Large 3 bed (16)	£736	£544	£192

Table 10: Comparable annual electricity expenditure results pre and post retrofit

5.11 Household electricity usage

Post retrofit electricity usage figures are shown below in Figure 17. The averages from the pre and post retrofit datasets are plotted for comparison. An average increase in electricity use of 599 kWh is shown.

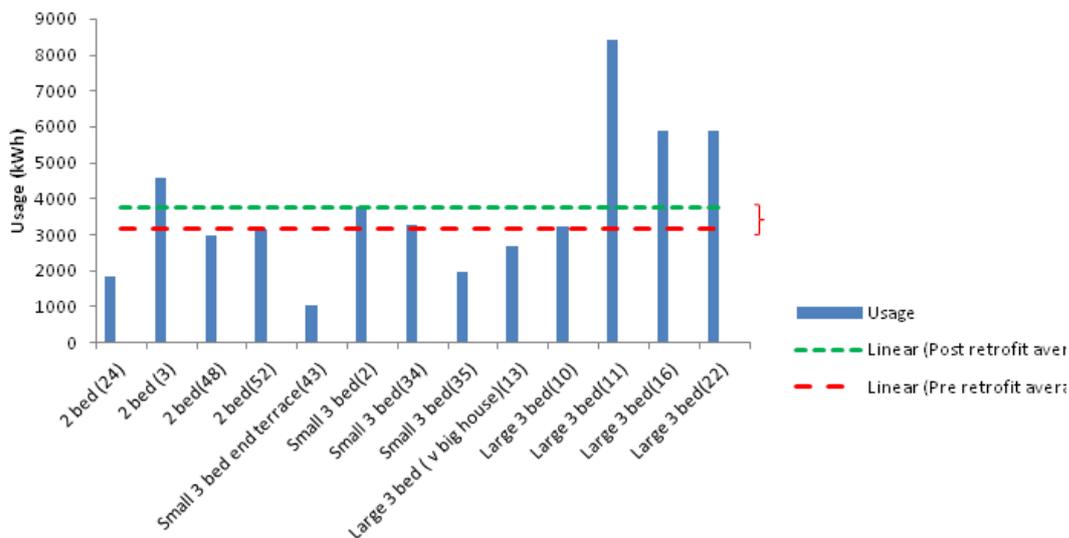


Figure 17 Annual household electricity usage for individual households, and average annual electricity usage pre and post retrofit

5/ Tenant bills and energy use

Table 11 shows data for individual households from the pre and post retrofit datasets. As with expenditure, where comparable data was available an increase in use is shown across most of the households. The highest increase was 2,650 kWh. This is compared with the most significant observed saving of 1,142 kWh for the year.

	Post retrofit (kWh)	Pre retrofit (kWh)	Annual Change (kWh)
2 bed (48)	2,959	2,928	32 (1%)
Small 3 bed end terrace (43)	1,037	889	149 (17%)
Small 3 bed (2)	3,768	3,531	237 (7%)
Small 3 bed (34)	3,281	2,572	709 (28%)
Large 3 bed (very big house) (13)	2,670	3,280	-610 (19%)
Large 3 bed (10)	3,234	4,376	-1,142 (26%)
Large 3 bed (11)	8,411	6,895	1,516 (22%)
Large 3 bed (16)	5,882	3,232	2,650 (82%)

Table 11 Comparable electricity usage results pre and post retrofit

5.12 Electricity cost changes as a result of the retrofit

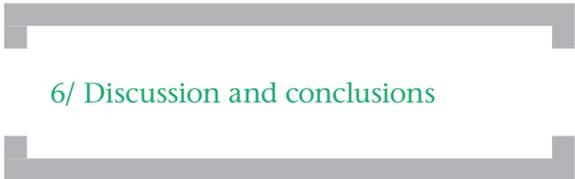
To determine the change in annual electricity expenditure relating to the retrofit improvements, average annual pre retrofit and post retrofit electricity use was multiplied by the post retrofit average electricity unit cost⁵. The results are shown below in Table 12.

	Average use	Average spend (£)	Average electricity cost £/kWh (3dp)	Annual average cost at current survey prices (£)	Difference at current rate (£)
Pre retrofit survey	3,146	408	0.130	398	76
Post retrofit survey	3,744	474	0.127	474	

Table 12 Change in electricity expenditure when expressed using similar rates

The results show that the post retrofit average unit cost of electricity has decreased compared to the pre retrofit questionnaire. Therefore due to the increase in electrical consumption, the adjusted change in electrical expenditure is £76 per annum.

⁵ The average annual current spend was divided by the average annual current use to give a £/kWh rate (average). The pre retrofit use was then multiplied by this £/kWh rate and compared with the current level of expenditure. This allowed both pre and post retrofit levels of usage to be compared using a current £/kWh rate.



6/ Discussion and conclusions

6/ Discussion and conclusions

6.1 Change in survey response rates

Despite identical incentives for returning both questionnaires there were much fewer returns for the post retrofit Measuring Change questionnaire compared with the pre retrofit questionnaire (33% and 68% respectively).

During an interview with the Head Administrator of the New Barracks Co-operative carried out for the SROI analysis (Arup, 2012) this reduction in response rate was explained by a “degree of fatigue” amongst the tenants regarding the retrofit programme. The retrofit works were a major part of estate life for over a year and were a period of significant upheaval for some tenants which was now behind them. Many may have wished to move on from this period and as such declined to engage in the post retrofit Measuring Change process. This suggests that engagement and buy-in on such projects can be limited and perhaps drops off, once the works are complete. This could have implications for other longer term projects such as the estate’s plans for installing renewable energy on the estate.

Other likely reasons for the reduced tenant response rate may have been the increased tenant comfort achieved as a result of the retrofit. This might have meant tenants are now more content in their home and were less motivated to respond to the questionnaire to register any complaints or highlight individual issues.

A further reason may have been the disassociation between the survey and a future change in housing quality. Through the pre retrofit survey tenants may have seen completing the survey as a way of ensuring that problems in their home would be addressed in the forthcoming works. With the works complete, this association was no longer assumed.

6.2 Comfort and living conditions

A major impact of the retrofit works has been the change in tenant perceptions of household comfort. This is illustrated by the change in average comfort score from pre retrofit to post retrofit of 3.5 to 5.5 on a scale of 1-7 (where 1 was uncomfortable and 7 was comfortable – see section 4.1). Tenants made specific comments relating to *health* and *happiness* resulting from improvements in living conditions. Other comments related to *cosiness* and the housing no longer having a *chill* or being *icy*.

The largely positive improvements in living conditions (relating to the different aspects covered in section 4.2) have implications for physical and mental health and wellbeing for all tenants. The

reduction in damp and mould are correlated in the data with almost 60% of respondents reporting an improvement. These reductions are likely to help towards the reduction of asthma related problems and some household pests such as mites. At least one tenant is still reporting damp in their kitchen, which is likely due to the kitchen, like the bathroom, not being additionally insulated (see final paragraph in this section). This same tenant reported *no change* in damp and mould on the survey; this could be representative of the 36% who stated that damp and mould had *no change* since the retrofit. Alternatively however there may be instances where *no change* was reported as there was no problem with damp or mould pre retrofit.

Tenants also reported ventilation improvements with 72% reported some improvement. However there were a number of complaints made about the MVHRs. This apparent contradiction may be explained by some confusion between ventilation and draughtiness in the houses. The issues raised throughout the survey about the MVHR related to tenants stating that the MVHR units had not been working properly or were noisy. This has subsequently been resolved through the installation of an LED to allow tenants to tell when the MVHR units are switched on or not. This confusion around MVHR use could go some way to explaining the occurrence of damp and mould, as the more air-tight homes (through improved insulation) may have been retaining moist air with MVHR not being used effectively. This demonstrates the importance of appropriate education on new installed technologies for the users (in this case, the tenants).

Other negative comments were made by tenants regarding cold bathrooms and kitchens. These rooms did not receive further insulation as part of the retrofit works and as such they are likely to be colder, compared with the insulated areas of the house. Furthermore the bathrooms and kitchens are within an outrigger which extend beyond the rest of the house with at least two external walls. These outriggers have cavity walls which already contain some insulation within the cavity. These rooms were not insulated as part of the retrofit works as they were deemed non-habitable, intermittently used rooms. There was also uncertainty around whether or not the bathrooms could still contain a bath with the loss of space associated with internal wall insulation.

6.3 Energy use and expenditure

Post retrofit, on average, tenants now set their thermostat at 21oC compared to a pre retrofit temperature of 24oC. This fall in thermostat setting is in the context of rising average comfort levels across the estate. This fall is likely to be due to:

- the fabric improvements and the new heating systems improving the effectiveness and responsiveness of heating the houses
- the heating system prior to the retrofit not being capable of achieving comfortable conditions.

Perceptions and observed changes in energy use and expenditure correlated in the questionnaire and the energy use data respectively. The bill data analysis showed a significant fall in gas use and expenditure. A fall of 8,435 kWh for average annual gas use and an a fall in average gas expenditure of £353 per year (after accounting for inflation). Annual electricity use has increased 599 kWh on average and electricity expenditure has increased annually by £76 (after accounting for inflation).

Reasons put forward by tenants relating to change in energy use refer to not needing to use heating as frequently and only needing to use it for shorter periods during the day. Some tenants also stated that the improved controls on the heating system made it easier to operate.

There were two tenants that still found gas and electricity bills difficult to pay post retrofit. One tenant stated in a telephone interview that this was due to increased consumption arising from increased dependents living in the house, recently becoming unemployed and the installation of a new energy intensive appliance (a kiln) used for a home-based business.

Of the questionnaire respondents 60% considered their electricity bill easier to pay post retrofit. This is unlikely to be due to a fall in electricity use, as the average observed electricity use for the average tenant has increased post retrofit. One tenant did remark that it *is hard to save any money on gas and electricity due to large rises from the big 6 companies who supply*, whereas others could not explain why they were using more, they just noted that they were. The point on energy supplier price rises does not explain the increased expenditure alone, as there were average increases in electricity usage and expenditure.

This rise in electricity usage could also be explained by the electricity consumption of the MVHR unit (thought to be offset by the savings on gas bills) and/or an increase in tenants' disposable income due to

the significant decrease in gas expenditure. It was estimated that MVHR units could cost up to £30 per annum depending on the size of the house⁶, thus accounting for 40% of the increase in average electricity expenditure.

Learning from the project has shown the need to ensure advice and guidance are available post retrofit to ensure tenants understand the need to change behaviours and effectively use the new technologies to reduce gas and electricity consumption. Salix Homes is committed to providing ongoing energy advice so that tenants are informed on how best to reduce gas and electricity use in their homes, and how to bring about further bill savings where possible.

6.4 Conclusion

The findings show that for the most part the retrofit has been a success across a number of crucial areas likely to improve the lives of tenants. The improvement in living conditions and tenant comfort levels across the estate will have positive implications for health and wellbeing, whilst the significant savings in expenditure on gas bills will increase disposable income and reduce the risk of at-risk tenants falling into fuel poverty. Furthermore the reduction in gas usage will reduce the impact of future rises in gas cost. These impacts, combined with the likely carbon savings from reduced gas usage are the key success of the retrofit works.

Issues still remain around the temperatures in the bathrooms and kitchens, ie. the areas of the houses which did not receive additional insulation as part of the retrofit programme (see section 6.2). This has resulted in some tenant discomfort and a continued damp problem in the kitchen of at least one tenant. This illustrates the importance of whole house retrofit for future projects, but also the need for continued advice and education. Further energy audits and assessments are now offered by Salix Homes as it is felt these will be imperative to the continued success of this retrofit programme.

By commissioning this study the commitment of Salix Homes and the New Barracks Estate towards measuring the impact of the retrofit has been demonstrated.

⁶ Based on information shown on the Envirovent website for the model of MVHR unit installed, typical l/s/m2 assumptions and the ground floor areas of the houses on the New Barracks Estate (see http://www.envirovent.co.nz/pages/product_sub.asp?page=energiVent)



7/ References



7/ References

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Appendix A

The Post Retrofit Measuring Change
Questionnaire



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