



Ricardo
Energy & Environment



Final Report

Report for Welsh Government



Customer:**Welsh Government****Customer reference:**

Welsh Government Warm Homes
Arbed EU, Final Report

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Executive summary

The Welsh Government Arbed EU project consisted of a portfolio of area-based schemes to install a range of fully funded energy efficiency measures in privately-owned and rented homes in areas of multiple deprivation in Wales.

The project had cross-cutting environmental, social and economic aims to increase the energy efficiency of existing homes in Wales – particularly the most energy inefficient homes, to reduce the impact of fuel poverty on people in Wales, and to create jobs for Welsh residents and economic opportunities for Welsh businesses. The three key objectives of the project were to:

- Improve the energy efficiency of a minimum of 4,800 existing homes in Wales by the end of 2015.
- Save at least 3.17ktp (kilo tons of carbon) of annual greenhouse gas emissions by the end of 2015.
- Create 283 gross jobs.

The project commenced in 2012 and installations were completed in 2016. In total 7,286 dwellings were assessed and measures of varying types were installed at 6,535 dwellings. The total value of the project was £45million. The project was partly funded by the European Regional Development Fund (£33million) and partly by Welsh Government (£12m). In 2014/15 Welsh Government invested an extra £22m alongside the EU scheme.

Ricardo Energy & Environment were commissioned by Welsh Government to undertake an evaluation of the environmental, social and economic impacts of the project.

Surveys were carried out at 10% of properties where measures were installed under the Arbed project:

1. A household survey aimed at evaluating householder satisfaction with the measures, impacts on the household, the process by which they were installed, and the overall project.
2. A technical survey to evaluate the quality of the installation and appropriateness of the measures installed.
3. A follow-up survey to evaluate the impact of the measure on the household over a period of time.

Evaluation results

Householder satisfaction

The overall householder satisfaction rate was very high.

	South Wales schemes	North Wales Schemes
Initial Surveying	81% - Excellent/Good	72% - Excellent/Good
Installation	71% - Excellent/Good	63% - Excellent/Good
Scheme Managers	63% - Excellent/Good	63% - Excellent/Good
Overall project	84% - Excellent/Good	71% - Excellent/Good

Whilst a high proportion (74%) of households reported that they had experienced an issue of some kind during the installation, this did not generally impact on their overall satisfaction of the scheme and of the measures installed. Where issues were reported, these were mainly concerned with reinstatement of services (where EWI was installed), clean-up, communications with site managers or misunderstanding of what measures they would receive, or disappointment that they had not received the same measures as other households.

The majority of householders surveyed were very satisfied with the scheme and many of those surveyed have reported warmer houses and reductions in fuel bills.

Community Benefits

Residents surveyed were quick to tell us about the positive impacts that they felt the scheme had had on their communities, in addition to the benefits they received as individual households. Householders were particularly appreciative of the improved visual appearance which was an added benefit in some schemes and other community benefits such as the creation of local jobs.

It is difficult to quantify the additional benefits that these visual improvements have delivered, however the feedback from householders underlined the importance of this to the community, with one resident claiming that the Arbed project had been a 'once in a lifetime' opportunity for his community.

Scheme managers were required to encourage the participation of Welsh SME's when procuring site contractors and other suppliers. This approach resulted in the creation of over 498 jobs and in many cases local people were employed to work on local schemes. The schemes delivered training including 2842 apprenticeship weeks and further training opportunities through graduate placements and work experience.

The Welsh Government Warm Homes Arbed EU scheme is the first programme to have achieved a Welsh Local Multiplier of £2.

Energy use and fuel poverty

Our evaluation was tasked with estimating changes in energy bills and the perceived impact on fuel poverty when comparing before and after the measures were installed.

Householder's self-reported income and their estimated expenditure on energy was used as a means of estimating if a household was in fuel poverty. However, this approach has a number of limitations, as it is dependent on the ability and willingness of householders to provide accurate income/energy expenditure information. Therefore from the very limited data collated, it has not been possible to conclude whether the scheme has had a significant impact on fuel poverty. However, given that many houses were potentially under-heated prior to the Arbed measures being introduced and that this phenomenon has been sharply reduced, there is likely to have been a significant reduction in the number of houses who have difficulty maintaining their homes at an acceptable level of thermal comfort, so there will have been a net reduction in fuel poverty.

In order to determine the effect of energy efficiency measures on energy use, it is necessary to have a full year's energy use data both before and after the measures are installed. No energy use data was available from scheme managers for the period leading up to the installation, so our assessment is based on qualitative data gathered during the householder surveys, and on predicted changes to EPC ratings.

The Welsh Government has advised that EPC data provided by the scheme managers estimates that the average pre installation SAP was 51, an EPC rating of E, increasing to an average of 61 post installation, an EPC rating of D¹.

Impact on households

Where pre-existing health issues were experienced by members of households, there was some evidence of the measures installed having a positive impact. Some householders made positive comments about the impact on their properties, including a householder who reported that their damp problem had disappeared. For example, one elderly lady was delighted that she could now keep warm and wash with hot water.

	South Wales	North Wales
Householders reporting house is warmer following installation of measures	87%	81%
Householders reporting increased levels of comfort following the measures	66%	81%

¹ A: 92-100 SAP points (most efficient)

B: 81-91 SAP points

C: 69-80 SAP points

D: 55-68 SAP points

E: 39-54 SAP points

F: 21-38 SAP points

G: 1-20 SAP points (least efficient)

EPC data has been provided by the Welsh Government

38% of householders surveyed in South Wales and 42% of householders surveyed in North Wales reported a reduction in energy bills.

Technical assessment

Our technical assessment did not identify large numbers of faults, and those that were identified were more usually related to minor snagging issues, as opposed to major faults. The majority of observations – and householder complaints – were related to External Wall Installation (EWI). Many of these were related to the reinstatement of services, for example, outside taps not being correctly refitted, satellite dishes not being secure and the re-fixing of cables on the exterior skin of the EWI. There were also many instances of minor irregularities in the finish, and damaged or missing render at the base of the insulation, particularly at door reveals. Where EWI was installed, there were no instances reported of increased damp, but it may be too early to tell whether the detailing has been successful – if there is any ingress of water behind a new finished external surface it will take time for symptoms to appear internally.

Scheme selection and appropriateness of measures

Our evaluation considered the suitability of the schemes selected. Schemes proposed by local authorities were evaluated by Welsh Government against the percentage of low-income households in the area, the percentage of private sector households, i.e. owner occupied or privately rented, the percentage of hard-to-treat homes, and alignment with strategic areas. The schemes selected were almost all in the lowest 10-30% most deprived areas in Wales according to the Welsh Index of Multiple Deprivation (WIMD). In addition to the schemes being located in areas of low income, the housing stock in each scheme typically contained a very high proportion of houses which are 'hard-to-treat'.

We therefore conclude that the right areas were targeted in schemes which included the correct selection of house types, and households and where social benefits and energy efficiency improvements could be maximised.

The approach taken to determine which measures are to be implemented at an individual household consisted of several stages. Each house was visited by a qualified energy assessor and a Standard Assessment Procedure (SAP) assessment made. A further technical assessment was then made of each property to look at the practicalities of installing specific measures, and ensuring there were no constraints which would mean a particular measure would not be viable or cost effective.

The scheme design and due diligence undertaken by both the scheme managers and Welsh Government have ensured that only the most appropriate measures have been installed both at each scheme and at each individual household. We conclude that measures were selected and applied appropriately across all schemes, and are in line with the priority measures and technologies set by Welsh Government.

Recommendations

The key lessons to be learned for future domestic energy efficiency schemes in Wales may be summarised as follows:

Strategy for future domestic energy efficiency schemes

- The strategic aims of future domestic energy efficiency scheme should continue to be focused on social, economic, and environmental cross cutting themes.
- Future domestic energy efficiency schemes should continue with a whole house approach in order to achieve the strategic aims of the project and to reduce the risk of unintended consequences.
- The focus on areas of multiple deprivation is successful and should be maintained.
- There are great opportunities to use retrofit to regenerate communities, and future schemes could do even more to stimulate local economies, but a different procurement route may be needed.

External Wall Insulation

- External Wall Insulation has a huge impact in improving the lives of residents, not only reducing energy use and improving comfort levels but also in improving the appearance of previously run-down areas. This is greatly appreciated by the residents.
- EWI is a relatively new technology and there have been instances of poor quality installation. Best practice guidance is emerging and we recommend that all specifiers and installers should be trained on courses recognised by key industry, heritage and sustainability bodies.
- A selection of properties which have had thermal bridging need to be reviewed at regular intervals to ensure there has been no condensation or mould growth.
- A feedback loop and 5-yearly follow-up survey are required so that the long term effects of EWI on moisture levels and indoor air quality can be monitored, good practice shared and poor practice avoided in future.
- EWI was avoided on houses of traditional construction so the impact on heritage has been minimal. This approach should clearly be retained in future schemes.

Impact on householders and fuel poverty

- It is very difficult to measure energy savings from specific measures as there are many variables and historical consumption data is required. The advent of smart metering will make this process easier, but if clarity is required earlier then it will be necessary to gather data for a full year before measures are installed.
- Savings in metered energy use do not reveal the extent of the previous potential under-heating due to fuel poverty.
- The challenges in collecting accurate data on income and fuel bills from a sufficient number of households in order to make a robust assessment of fuel poverty is one that should be considered in future programmes where an assessment of fuel poverty is required.

Procurement and scheme management

- Flexibility is required in procurement, to enable necessary repairs to be undertaken by contractors prior to the retrofit to maximise the advantages of the measures installed.
- The quality of scheme management is critical. Where communication was good, householders had fewer complaints, and the initial engagement is important to ensure that expectations are managed correctly.
- Future schemes should consider whether the stimulation of the local economy could be given greater weight in future procurements for new domestic energy efficiency schemes

Communications

- The issue of rogue traders and the way in which they may target vulnerable households remains one that will need to be considered and addressed in future schemes.
- Clearer communications with households in order to manage customer expectations and so each household is clear of the measures being installed at the property will help to reduce complaints.
- There is a need to provide simplified information to householders on the role of the voltage optimiser if these are installed in future schemes.
- On site staff need to spend more time explaining heater controls and thermostat controls to ensure both are operated effectively and will bring about reductions in energy bills.
- Whilst there is a need to give detailed information, in order to increase the chances of it being both read and understood, it may help if the most important information could be summarised using simple, non-technical language.
- Householders packs needs to be issued to householders more speedily by scheme managers in future domestic energy efficiency schemes.

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1 Introduction

1.1 Context

Welsh Government Warm Homes Arbed EU project was an area-based scheme to install energy efficiency measures and renewable energy technologies in existing domestic properties.

Under this project, a range of fully funded energy efficiency measures were installed in privately-owned and rented homes in areas of multiple deprivation in North and South Wales. The project consisted of a portfolio of area-based schemes which were proposed by local authorities to Welsh Government.

Welsh Government managed the overall project whilst the delivery of individual schemes was managed by two scheme managers – Willmott Dixon in North Wales and Melin Homes in South Wales.

The total value of the project was £45million. The project was partly funded by the European Regional Development Fund (£33million) and partly by Welsh Government (£12m). In 2014/15 Welsh Government invested an extra £22m alongside the EU scheme

The project commenced in 2012 and installations were completed in 2016. In total 7,286 dwellings were assessed and measures of varying types were installed at 6,535 dwellings.

The project had three cross-cutting aims:

- Environmental: To increase the energy efficiency of existing homes in Wales – particularly the most energy inefficient homes – and reduce carbon dioxide emissions;
- Social: To reduce the impact of fuel poverty on people in Wales; and
- Economic: To create jobs for Welsh residents and economic opportunities for Welsh businesses in the design, manufacture, distribution, installation and maintenance of domestic energy efficiency measures and renewable energy technologies.

The project aimed to make a significant contribution to economic development in Wales, using local businesses to manufacture, supply and install as many of the measures as possible, providing training and jobs for local workers, thereby delivering a range of community benefits. These aims represent a significant departure from previous energy efficiency programmes in Wales

The design of the project represents a shift towards:

- a 'whole-house' or 'consider-all-options' approach to home energy efficiency to tackle harder-to-treat homes where the impact of fuel poverty tends to be most severe;
- a community or street-by-street approach, to support social cohesion and achieve economies of scale wherever possible.

The area-based schemes were proposed by local authorities to Welsh Government, and are characterised by a concentration of low-income households and housing stock which is energy inefficient. As the schemes are area-based, they will consist of a mix of hard-to-treat and hard-to-heat homes, low-income households, and private-sector households. The mix of measures and technologies in each scheme will depend on the nature of the area's housing stock, the needs of households in the area, the appropriateness of different measures and technologies to the housing stock, value for money, sustainability and other considerations. Measures installed include external wall insulation, boiler upgrades, heating controls, draught proofing, voltage optimisers and solar water heating.

1.2 Scheme selection and design

For each year of the project, Welsh Government invited the local authorities in Wales to submit up to 2 applications each for approval. These applications were assessed against 6 key criteria:

- The schemes ranking on the income table in the Welsh Index for Multiple Deprivation, or the percentage of households on a means tested benefit.
- The percentage of privately owned homes in the scheme

- The percentage of homes that are not connected to mains gas
- The percentage of homes that are of a solid wall or hard to treat cavity construction
- The scheme being located in a regeneration area
- The scheme being located in a “Communities First” area

Each scheme and the remedial measures installed varied due to the nature of the area’s housing stock and the needs of households in the area. This was developed by carrying out a ‘whole-house’ assessment of each property that included a technical assessment utilising RdSAP software that identified a potential mix of measures alongside value for money consideration and appropriateness of measures for a particular household.

Ricardo Energy & Environment were engaged by Welsh Government to carry out an evaluation of the effectiveness of the scheme in meeting its aims and objectives, to identify any other benefits achieved and to highlight any issues with the operation of the scheme.

1.3 Evaluation approach

Environmental, social and economic factors are all equally important in measuring outcomes. The methodology used for evaluation of the scheme was designed to assess the impact on energy use and energy bills, but also to engage with householders to understand the impact that the measures installed have had on their wellbeing, finances and comfort in their home.

The evaluation undertaken had 3 key elements:

1. **Householder Survey:** a survey aimed at capturing information relating to the experience of a sample of householders, and to measure their satisfaction of the measures installed.
2. **Technical Survey:** to review the quality and appropriateness of the measures installed into a sample of properties.
3. **Follow-up survey:** to obtain further information relating both to the energy use and householders’ experiences and perception of using and living with installed measures after 12 months of use, and how they may have benefitted from the measures installed.

1.4 Scheme details

Over the three years of the project, there were 32 schemes approved and completed. Details of each scheme are summarised in Table 1.

Table 1: Details of type of measures installed and main property type in each scheme

	Local Authority	Scheme Name	LSOA	Main property type	Main measures
Year 1	Caerphilly	Fochriw	Darren Valley 2	Circa 1940's solid wall, 1900's stone	EWI/ boiler
	Swansea	Morrison	Morrison 7	Pre 1900's solid wall	heating
	Torfaen	Blaenavon	Blaenavon 2	Circa 1930-1949, cavity & solid wall, pre 1900's	EWI/boiler
	Merthyr Tydfil	Shingrig Estate /Garden Village	Bedlinog 2	Circa 1950's traditional construction	EWI/boiler/fuel switch
	RCT	Penywaun	Penywaun 2	Circa 1950's non-traditional	EWI/boiler
	Vale of Glam	Castleland 1	Castleland 1	1900's solid wall	Heating
			Castleland 2		
	Newport	Malpas	Malpas 2	Circa 1950's BISF	EWI/boiler
	Gwynedd	Nantlle	Llanllyfni & Clynnog	Pre 1900's off-gas	Loft insulation/boiler/fuel switch
	Conwy	Colwyn bay	Glyn (Conwy) 2	Pre-1900's and 1900's solid wall	Loft insulation/boiler
	Denbighshire	Rhyl	Rhyl West 1	Pre- 1900's and 1900-1939, solid wall	Loft insulation/heating
	Flintshire	Holywell	Holywell Central	1930-1949 cavity wall	Loft insulation/EWI/ heating
Year 2	Anglesey	Holyhead	Porthyfelin 1, Porthyfelin 2 and Maeshyfyd	1900-1949 solid wall	EWI/loft insulation
	Cardiff	Caerau	Caerau 7	1950-66 solid wall, 1930-49 BISF	EWI, boiler
	Vale of Glam	Castleland 2	Castleland 2	Pre 1900, 1900-29, stone	Boiler
	Merthyr Tydfil	Penydarren	Penydarren 1 Penydarren 2	1950-66, solid wall, 1930-49 BISF	EWI, boiler
	Caerphilly	Hollybush	Argoed 2	Pre 1900, 1900-1929, stone. 1983-2007, cavity wall.	Boiler
	Bridgend	Caerau	Caerau 1 Caerau 2	1900-29, stone	Boiler and EWI

	Blaenau Gwent	Six Bells	Six Bells 1 Six Bells 2	1900-29, cavity wall. 1900-29, stone.	EWI, boiler
	RCT	Maerdy	Maerdy 1	1900-2, stone	Boiler
	Carmarthenshire	Upper Brynamman	Quarterbach 1 Quarterbach 2	Pre-1900, 1900-29, 1930-49, stone	Boiler/fuel switch
	Ceredigion	Llandysul	Llandysul Town	1950-82, cavity wall.	EWI
	Denbighshire	Rhyl 2	Rhyl West 3	1900-1960, solid wall	EWI, boiler
	Gwynedd	Fron & Carmel	Talysarn	Pre 1900, 1900-29, solid wall	EWI, boiler
	Wrexham	Llay 1-3	Llay 3	1939-49, solid wall	EWI, boiler
Year 3	Caerphilly	Phillipstown	New Tredegar 3	1900-29, stone	EWI
	Swansea	Castle	Castle 1	1967-75, cavity wall. 1930-49 cavity wall/solid wall. Pre 1900, 1900-29, stone.	EWI
	Carmarthenshire	Llanelli	Tyisha 2	Pre 1900, 1900-29, stone.	EWI
	Vale of Glam	Castleland 3	Castleland 1 Castleland 2	Pre 1900, 1900-29, stone/solid wall.	EWI, boiler
	Gwynedd	Deiniolen	Deiniolen	Pre 1900, 1900-29, solid wall	EWI, boiler
	Denbighshire	Prestatyn	Prestatyn Central 2	1930-45, solid wall/cavity wall	EWI, boiler
	Flintshire	Oakenholt	Oakenholt 2	1900-29, solid wall. 1930-50, cavity wall.	EWI, boiler
	Wrexham	Llay 4	Llay 1, Llay 2	1900-29, solid wall. Post 1946, BISF	EWI, boiler

1.5 Sampling methodology

The evaluation assessed 10% of houses which had received measures in each scheme. Householders were required to provide permission to the scheme managers in order that they were willing to be contacted by Ricardo Energy & Environment to participate in the evaluation. Due to data protection, only a sample of householder contact details was provided to Ricardo Energy & Environment for each scheme.

Data provided by the scheme managers included:

- Name of householder
- Contact details
- Measures installed
- Property type and estimated year of construction
- Meter reading (where available)

Households were selected for survey by Welsh Government, prior to the household details being sent to Ricardo Energy & Environment in password protected files. Initially, data was provided for 12% of the households in each scheme. However, due to challenges in securing appointments with the required number of households to reach the 10% target, this was subsequently increased to 15%, and then to 25%. This was due to some householders not being available during the surveyors scheduled times at each scheme, or an unwillingness to participate.

The households were selected for survey to ensure that the sample for each scheme reflected the mix of measures installed and property type within each scheme.

The actual sample of houses surveyed was also impacted on by householder availability and willingness to answer questions/answer door. Even where appointments had been made in advance, householders were not always at home or willing to participate. In this case, alternative houses were selected by the surveyor from the list of 25% of households, to ensure sufficient houses were surveyed.

1.6 Householder survey

A series of questions were developed to determine householder satisfaction with the measures installed and the project in general, and householder perceptions of savings in terms of energy use and bills and improvements to comfort and health. Householders were asked about any problems or complaints about the scheme and if they had any problems with the new measures. Questions were also asked on household income and energy bills to enable the impact of energy efficiency improvements on household energy use and energy bills to be measured. A requirement of the evaluation was also to estimate the householders' perceived impact of the measures on energy bills, in order that an estimation of the number of households in fuel poverty could be made. The survey was approved by Welsh Government Knowledge and Analytical Service, and others with an interest including Planning, Housing & Regeneration and Historical Environment Services (Cadw).

In order to help evaluate the impact of the Welsh Government Warm Homes Arbed EU measures installed, householders were also asked which additional heat sources they had available, and how often they used these in summer and winter. Householders were also asked if (prior to the installation of the measure) the warmth of their home impacted on the way in which they used their home. For example, only heating a certain number of rooms, wearing extra layers of clothing rather than putting the heating on, or going out to avoid spending time at home.

Gas meter readings were taken during the household visits where applicable, or an estimation of oil or solid fuel use made, with the aim of comparing fuel consumption pre and post installation. Attempts were also made to obtain meter readings during the follow-up telephone surveys. However, it became apparent that the meter readings taken during the household visits – and a second reading taken during the follow up telephone survey – were of little use in comparing energy use pre and post installation of measures. This was due to a number of reasons:

- Lack of consistent meter data available from scheme managers prior to the installation of measures (it had been indicated at the beginning of the project that this data would be available);
- Even where available, energy use data did not match the dates of installation and take into account the variations in heat demand over a year, or changes in occupation.
- A low percentage of households were willing or able to provide meter readings during the follow-up telephone surveys.

Ultimately what is required to make this evaluation is a full year's energy use data prior to installation of measures and a full year's data after installation, for a large sample size of properties where no other changes are taking place (e.g. in ownership or patterns of occupation). The data would then need to be corrected to reflect the variations in heat demand due to varying external temperatures. This reflects a wider issue with the evaluation of energy efficiency schemes, not just the Arbed project.

The householder survey questionnaire is reproduced in full in Appendix 1.

1.7 Technical survey

The aim of the technical survey was to determine:

- The appropriateness of measures installed to the property/area;
- The quality of work completed;
- Whether the measures are working correctly; and
- Any problems/complaints with the measures installed

A series of technical checks and questions were developed in relation to each type of measure.

The technical survey is included in Appendix 2.

1.8 Follow-up householder survey

Follow-up telephone calls were made to all households that were visited during the Year 1 schemes on-site householder satisfaction and technical surveys. Telephone calls were made approximately one year after the initial householder survey was carried out so that the impact of the measures on a whole heating season could be assessed. It should be noted that, because the household surveys were not conducted immediately after the measure were installed,² some households reported that they had already seen an impact on their energy bills and comfort levels at the time of the household survey. This may result in some householders reporting no further impacts during the follow-up surveys as any 'benefits' had already been perceived by the householder at the time of the initial survey.

The aims of the follow-up householder survey were to establish the impact of the measures installed, including changes in energy usage, behavioural changes and additional work to the property or changes to energy supplier that could have impacted on energy usage/bills. The survey also aimed to assess the householder's perception on comfort levels, potential health improvements, damp/condensation issues and the impact on the local community. As with the initial householder survey, the follow-up survey gathered information on householders' annual net income and annual energy expenditure to calculate any changes to the estimated fuel poverty status of households since the measures were installed.

When the Year 1 surveys took place, householders were informed that we would be contacting them again approximately 12 months later by telephone to ask the follow-up questions. Householders were asked to provide an email address in order that they could be notified in advance to expect a telephone call. The correct telephone number was also checked, and a mobile number obtained where possible. During the follow-up calls, calls to each householder were attempted up to 5 times in order to maximise the number of follow-up surveys completed. Where householders provided email addresses during the householder survey, introductory emails were sent to households in advance of

² Due to some schemes taking up to a year to complete

calling. Despite this, the response rate for the follow-up telephone surveys was very poor – less than 35%.

Due to these data collection issues, the follow-up surveys for Year 2 and Year 3 schemes were carried out at the same time as the householder and technical surveys. This ensured a much higher rate of data collection.

The questions asked in the follow-up survey are included in Appendix 3.

2 Properties surveyed

2.1 Householder and technical surveys

Householders were contacted in advance to arrange convenient appointments for the householder survey and technical survey to take place.

The householder survey, technical survey and follow-up householder survey were undertaken at the same properties.

Due to data collection issues, the follow-up surveys for year 2 and year 3 schemes were carried out at the same time as the householder and technical surveys which ensured a much higher rate of completion.

The total number of households that received Welsh Government Warm Homes Arbed EU measures and the percentage of those surveyed are presented in Table 2 and Table 3 for South Wales and North Wales respectively.

Table 2: Welsh Government Warm Homes Arbed EU South Wales– households surveyed

	Scheme	No. of households surveyed	Proportion %
Year 1	Fochriw, Caerphilly	48	12%
	Penywaun, Rhondda Cynon Taf	9	9%
	Blaenavon, Torfaen	19	14%
	Malpas, Newport	14	9%
	Shingrig, Merthyr Tydfil	15	9%
	Barry Phase 1, Vale of Glamorgan	10	12%
	Morrison, Swansea	4	8%
	Garden Village, Merthyr Tydfil	15	13%
Year 2	Caerau, Cardiff	23	8%
	Castleland 2, Vale of Glam	15	7%
	Penydarren, Merthyr Tydfil	27	14%
	Hollybush, Caerphilly	12	10%
	Caerau, Bridgend	19	12%
	Six Bells, Blaenau Gwent	35	6%
	Maerdy, RCT	37	9%
	Upper Brynamman, Carmarthenshire	23	10%
Year 3	Phillipstown, Caerphilly	24	9%

	Castle, Swansea	29	20%
	Llanelli, Carmarthenshire	21	12%
	Castleland 3, Vale of Glam	29	11%
	TOTAL	428	10%

Table 3: Welsh Government Warm Homes Arbed EU North Wales – households surveyed

	Scheme	No. of households surveyed	Proportion %
Year 1	Holywell, Flintshire	12	10%
	Colwyn Bay, Conwy	19	10%
	Rhyl, Denbighshire	10	10%
	Holyhead, Anglesey	8	12%
	Nantlle, Gwynedd	9	11%
Year 2	Llandysul, Ceredigion	20	19%
	Rhyl 2, Denbighshire	20	15%
	Fron & Carmel, Gwynedd	31	11%
	Llay 1-3, Wrexham	60	16%
Year 3	Deiniolen, Gwynedd	17	5%
	Prestatyn, Denbighshire	18	12%
	Oakenholt, Flintshire	32	8%
	Llay 4, Wrexham	23	18%
	TOTAL	279	11%

Table 4 and Table 5 summarise the measures installed (and subsequently surveyed) within each scheme. In some cases households received multiple measures.

Table 4: Summary of measures surveyed in South Wales schemes

Scheme	Houses surveyed	EWI	Boiler replacement	Boiler + fuel switch	Heating controls	Draught proofing	Voltage optimiser	Solar thermal
Fochriw	48	35	32	2	2		40	
Penywaun	9	7	8	3			6	1
Blaenavon	19	14	12	1	15	4	16	
Malpas	14	13	8	1	1		12	
Shingrig	15	15	6	1	1		13	
Barry Phase 1	10		9				10	
Morrison	4	1	3	1			4	
Garden Village	15			15			11	1
Caerau, Cardiff	23	19	12		1		10	
Castleland 2	15		15		1		12	
Penydarren	27	23	6	1	2		19	
Hollybush	12		12				9	
Caerau, Bridgend	19	12	9				16	
Six Bells	35	27	14		3		19	
Maerdy	37		37		2		16	
Upper Brynamman	23			23			15	
Phillipstown	24	24						
Castle	29	29	2				14	
Llanelli	21	19	3					
Castleland 3	29	23	8					
TOTAL	428	261	196	48	28	4	242	2

Table 5: Summary of measures surveyed in North Wales schemes

Scheme	Houses surveyed	EWI	Boiler replacement	Boiler + fuel switch	Heating controls	Draught proofing	Voltage optimiser	Solar thermal
Holywell	12	9	7		4			2
Colwyn Bay	19		11		2	8	19	11
Rhyl	10		8		9	5	7	3
Holyhead	8	8	4			7		8
Nantlle	9	4	9	9	9	4		7
Llandysul	20	20	3		3			
Rhyl 2	20	17	9					
Fron & Carmel	31	25	29		5	2		
Llay 1-3	60	60	14	2				
Deiniolen	17	15			8			
Prestatyn	18	13	5		5			
Oakenholt	32	16	9		6	3		
Llay 4	23	23	10					
TOTAL	279	210	118	11	51	29	26	31

3 Community Benefits

3.1 Background

The Welsh Government Warm Homes Arbed EU project was delivered under the European convergence and competitiveness programmes in Wales, which are overseen by WEFO, and had therefore to be focused on creating sustainable jobs and growth in line with the European Union's Lisbon and Gothenburg agendas, and the policies and strategies of the Welsh Government.

The project was designed with a clear focus on the delivery of community benefits alongside economic and environmental impacts. Improving the energy efficiency of homes in deprived areas of Wales, and creating jobs and training were included as programme objectives in the Welsh Government Warm Homes Arbed EU project business plans. It was recognised that tackling fuel poverty would be a consequence of these activities. The role of the contracted Scheme Managers included a mandatory requirement to participate actively in the economic and social regeneration of the locality, and the surrounding area of each scheme. The Scheme Managers were required to submit proposals on how their delivery of the schemes would contribute to Welsh economic development and regeneration in the form of sustainable jobs, supply-chain development, skills and training. Detailed community benefits to be achieved by Scheme Managers were clearly specified at the outset as follows:

- a mix of Project-wide and scheme-specific activities;
- a minimum of 52 person-weeks of employment to be provided for a new entrant trainee recruited from a source agreed by the Client for each £1m in contract value where:
 - a person-week is the equivalent to one person being employed for five days either on the development site or on other sites (with the agreement of the Client);
 - a new entrant trainee is a school or college leaver, or an adult that has not been employed in the construction industry during the previous six months, and who is undertaking training towards a construction industry or a Client-recognised qualification.
- every vacancy on site to be notified to agencies agreed by the Client and candidates identified by these agencies are to have equality of opportunity in the selection process;
- evidence that the Contractor has a process in place to recruit people who are disadvantaged in the labour market, is considering opportunities to recruit and train economically inactive persons as part of the workforce delivering this Contract, both directly and indirectly i.e. through installers, and is making reasonable efforts to retain persons that have been notified to the Client as a new entrant trainee or as previously inactive;
- working with the Client to open up opportunities for SMEs, including social enterprises, to bid for supply chain opportunities arising from this contract, including:
 - advertising opportunities on Sell2Wales;
 - using the Welsh Government's Supplier Development Service to hold 'Meet the Buyer' events in Wales; and
 - involving the Client in the procurement process for materials and installers, i.e. sitting on any procurement and/or evaluation board;
- ways in which other positive community benefit outcomes can be secured, e.g. working with local schools and colleges to offer work experience and work placements and with local communities to contribute to community regeneration schemes.

Data on Community Benefits was collected by the scheme managers using the Value Wales Community Benefit Tool. Value Wales worked closely with the scheme managers throughout this process, and the results were audited by European Funds Audit Team, Project Inspection and Verification team and Wales Audit Office.

In order to claim jobs created, the scheme managers have to produce two forms of evidence, for example, a copy of the job offer, employment contract or letter of confirmation. To be counted, jobs needed to be continued for a minimum of 52 weeks.

3.2 Community benefits reported by householders

In addition to evaluating householder satisfaction and undertaking a technical survey, this evaluation also sought to identify additional benefits to the participating communities. Visiting each scheme and undertaking householder surveys provided us with the opportunity to capture anecdotal evidence and first-hand experience of community benefits as perceived by those living within the community itself.

During the surveys of Year 1 scheme households, surveyors reported householders often commented on the positive impacts that they felt the scheme had had on their communities. For this reason, a specific question was added to the householder survey to formally capture this information for Year 2 and Year 3 household surveys.

Across schemes where households had received EWI, householders commented on the significant visual improvements that EWI has made to many streets throughout the schemes. One resident stating that *'it is a pleasure to walk around the village since the work has been completed'*. Many residents spoke about how the area had been given a facelift, and that they took more pride in their 'spruced up' homes. Whilst difficult to quantify, it was clear that residents appreciated the additional benefits that the visual improvements delivered.

One resident in Fochriw stated that he thought Welsh Government Warm Homes Arbed EU had been a *'Once in a lifetime opportunity for the community'*.

Some residents spoke of the sense of community, and that they felt privileged that their community had been 'chosen' to receive the investment, and that they had not been forgotten.

Impacts were particularly significant in schemes which had received new gas lines to replace oil heating, for example, Nantlle in North Wales and Garden Village in South Wales. Householders in Garden Village reported the whole community now benefited financially as gas is a cheaper heating fuel than oil, so people could manage their finances better. There was also a further benefit through a reduction in the issues around arranging oil deliveries in winter months, and this meant there was 'less hassle' for householders, particularly the elderly. In one scheme a householder stated that 'gas is hotter and more comfortable than oil'.

This was also evident in Nantlle, where one elderly householder was so pleased she composed an 'Arbed rap' to thank the workmen for their efforts in her home which was now much warmer.

'Who needs the sun, if you've got central heating?

Beating the cold is a thrill no competing

The warmth in your heart and the heat in your bones

Wins hands down to the cold in the stones'

Schemes provided a common focus for residents, and therefore schemes were successful in bringing the community together, reviving communication where it had previously been lacking and improving interaction between householders participating in the scheme.

Householders were aware of the local job opportunities that the schemes had created, and as a result they knew members of the work force undertaking the installations. This was a highly visible and tangible community benefit which many householders commented on.

The only potentially negative impact on communities reported were that some householders were aggrieved that they had not been able to receive the same measures as others.

Comments received from householders in the South Wales schemes were:

- Houses look much better and people are taking more pride and care (removing rubbish, planting flowers);
- Don't need to paint the house anymore, area looks like 'Balamory' because of nice bright colours;
- Area looks tidier and houses look cleaner;
- Friends and neighbours are very happy and comfortable;

- No need to order oil with delivery trucks blocking roads and access; and
- Cleaner and easier to use (gas rather than coal).

Comments received from householders in the North Wales schemes were:

- Brightened the look of the area;
- Neighbours are very happy, and have saved money too;
- There was a lot of investment but a lot of people are happy and more comfortable;
- It was a lot of stress to get here but looks much better;
- No longer have to keep an eye on the oil;
- More convenient to have gas in the village now; and
- The work has enriched our lives.

It is clear that the schemes have had a positive impact on the communities in both North and South Wales, in addition to the impact on individual households.

3.3 Community benefits reported in South Wales

The South Wales schemes represented a contract value of approximately £27 million, including goods and services, and staff and labour.

3.3.1 Jobs and training

Melin Homes reported the creation of 323 new jobs, of which 100 were previously unemployed. Further to this, 198 jobs were retained, with employers confirming that they would otherwise have been made redundant. As part of the project, Melin Homes created a skills database to capture skills and knowledge gaps across the workforce. Melin Homes have regular engagement with a wide range of training providers, Business Growth Agencies, Government Employment Agencies, Construction Industry Training Board, Development Trust Agencies and the Construction Youth Trust.

The scheme resulted in 716 accredited training weeks and a total of 34 apprenticeships completed, with a total of 2076 apprentice training weeks. Further training was delivered in the form of 37 graduate placements and 3 voluntary work opportunities.

3.3.2 Enterprise and SMEs

As part of the delivery of the programme, Welsh Government required the scheme managers to tender the Welsh Government Warm Homes Arbed EU framework in two lots – separating the installation work from the supply of materials. This was successful in enabling SME's to bid for work, unimpeded by cash flow implications which would have meant they were unable to bid for contracts involving large expenditure on materials. This not only expanded the number of opportunities open to SME's but has also encouraged long term collaboration of SME's to work together. SME's combined their knowledge and skills to submit successful bids and work together to deliver the schemes which they may not have been able to complete on their own. The tender included a significant focus on the delivery of community benefits, to encourage the generation of local and sustainable job opportunities by local Welsh SME's.

This approach was demonstrated in the delivery of the Fochriw scheme, which saw two SME's (Gibson Specialist Technical Services and Thomas CMS Holdings Limited) who would normally be competitors, joining forces to win and deliver the Fochriw contract, whilst exceeding all community benefit targets. This approach was recognised in a Procurement Collaboration Award won by Melin Homes at the Welsh Procurement Awards in 2014³.

3.3.3 Community

Framework suppliers are also committed to the delivery of community benefits, and contributed support to specific community projects which are aimed at leaving a lasting legacy from the project. For example in Year 1, Melin Homes provided a solar PV system at Fochriw Community Centre. The system was installed by a framework contractor as a donation of labour in kind. The system was sold to the local community group for £1, thus enabling them to claim a renewable electricity feed in tariff for 25 years.

³ <http://www.welshprocurementawards.org.uk/featured.html>

The wider community was also able to benefit by schemes which provided access to mains gas. This is estimated to allow an additional 1,450 houses to access a gas supply, in addition to those in receipt of Welsh Government Warm Homes Arbed EU measures.

Other examples of contributions to community benefits included work with local schools on 'green champion' activities, donations and repairs to a youth club in Caerau, Cardiff, and improvements to a scout hut and community hall in the Castleland scheme in Barry.

3.4 Community benefits reported in North Wales

The North Wales schemes represented a contract value of approximately £25 million, including goods and services, and staff and labour.

3.4.1 Jobs and training

Willmott Dixon reported the creation of 175 permanent jobs of which 17 were taken by those previously unemployed. A total of 766 apprenticeship weeks were completed, with a further 32 work experience opportunities.

3.4.2 Enterprise and SMEs

As with the scheme managers in South Wales, Welsh Government contractually required Willmott Dixon to tender the Welsh Government Warm Homes Arbed EU framework in two lots – separating the installation work from the supply of materials. Willmott Dixon specified that their supply chain were required to engage with local resources by employment or subcontracting with businesses based in Wales where at all possible. To support this, Willmott Dixon organised a 'Contractor Day' for the Y Fron & Carmel sites (Year 2 schemes), aimed at providing better opportunities for the local supply chain. In recognition that there was a shortfall in some parts of North Wales of suitably qualified contractors, Willmott Dixon launched a Constructing Skills Certification Scheme card (CSCS) initiative, to work with local training providers to support local people in achieving this accreditation, through which 12 people were trained.

3.4.3 Community

The Community Benefits Fund was used to fund a number of measures such as the installation of an Eco-garden at Ysgol Y Fron, Holywell, enabling the school to achieve their Green Flag award. A new heating system was installed at the Nantlle Community Centre, with time donated in kind for the surveying, project management and installation as well as the funding of a new boiler and radiators. Willmott Dixon and their supply chain responded to the needs of those affected by the St Asaph's floods in 2012, by coordinating the installation of loft insulation in the temporary accommodation used to house those who had been made homeless, including the elderly and families with young children.

Further examples of community activities supported by the fund include work with Techniquet Glyndwr on a numeracy development programme, hosting of community events, and a donation towards a new boat for the Holyhead Sea Cadets.

3.5 Overall summary of community benefits

Table 6 summarises the overall community benefits delivered by the Welsh Government Warm Homes Arbed EU schemes. The benefit was measured using the Value Wales Community Benefit Measurement Tool. The Welsh Local Multiplier shows the relative impact of this contract in Wales, i.e. for every £1 spent on this contract, the corresponding amount of money was reinvested in the Welsh economy. The Welsh Government Warm Homes Arbed EU scheme is the first programme to have achieved a Welsh Local Multiplier of £2.

Table 6: Summary of reported community benefits

Benefit	South Wales	North Wales	Combined
Contract Value	£27,103,251	£24,814,092	£51,917,343
Welsh Local Multiplier	£2.00	£1.90	-

Direct investment	£27,103,251	£24,814,092	£51,917,343
Revenue to businesses based in Wales	£10,906,732	£10,364,580	£21,271,312
Income to people living in Wales	£16,196,419	£10,482,949	£26,679,368
Savings to HM Treasury	£256,401	£56,775	£313,176
Landfill fees saved	£12,642	£110,300	£122,942
Water reduction savings	£186	£726	£912
Cash donations	£53,868	£30,865	£84,733
In-kind donations of labour, goods and services	£93,078	£92,873	£185,951
Overall investment in the Welsh and UK economy	£54,622,577	£45,952,581	£100,575,059

4 Approach to householder engagement and communications

As part of the evaluation of the scheme, we were required to assess the effectiveness of the scheme managers in engaging householders and communicating with them during the pre-installation and installation phases.

4.1 Initial engagement

Following the provisional approval of schemes by Welsh Government, scheme details were passed to the scheme managers for verification, which involved desktop and drive-by street surveys. In order to manage expectations, residents were not engaged at this point. Following verification the schemes were approved for engagement.

The scheme managers were then responsible for the promotion of the schemes and engagement with householders. The householder engagement was planned in detail to ensure maximum participation in each scheme. For example, Willmott Dixon maintained a Customer Engagement Diary to keep track of each round of communications from initial leafleting to final sweeps of households prior to the scheme closure.

Both scheme managers followed a similar process to engage with householders to encourage participation in each scheme.

- The first engagement with householders was usually a letter introducing the scheme and inviting householders to attend a community event.
- There was always at least one event, and sometimes multiple community events and open days in each scheme, aimed at introducing the project and providing information on the types of measures which may be included.
- The scheme managers also held 'Meet the Contractor' events, either in conjunction with the initial open day, or as a stand-alone event.

Feedback from scheme managers was that perseverance and persistence was needed to recruit householders, particularly at the beginning of schemes. Where take up was initially slow, there were multiple events - at least 3 events throughout the scheme, resulting in the schemes being kept open for longer. These events allowed householders to meet the contractors who would be carrying out the work, see sample products and obtain technical advice, and view samples of the colours available for external wall insulation. Where appropriate, the 'Meet the Contractor' events also enabled local residents to talk to the contractors about employment, training and work experience opportunities.

Householders could sign up at the community events if they were interested in participating, and appointments for individual home assessments could be made. Scheme managers reported that attendance at community events in some schemes was low as 10% of households in the scheme, but that they felt they were essential in kick-starting overall awareness of the scheme within the local area. Further leaflets were delivered following the community event, letting householders know when the scheme managers were due to be in the area. Door-to-door calls were made to householders yet to sign up.

Word of mouth was also found to be an effective way of engaging householders, with many householders agreeing to participate having seen the work being done in neighbouring properties. For this reason, the scheme managers endeavoured to keep the schemes open for as long as possible to ensure householders did not miss out. Signs and posters promoting the scheme were placed on scaffolding and lampposts in the scheme locations, displaying contact telephone numbers. The co-ordinated and sustained communication approach adopted by scheme managers ensured that there was ample opportunity for householders to get information and learn about the scheme.

4.2 Survey and sign up

The next stage for each interested household was to receive a visit by a qualified energy assessor. The energy assessor undertook an Energy Performance Certificate (EPC) assessment for each household, to give an overview of the current energy performance of each property and identify which

measures could be used to improve it. A further technical visit was then made to assess each property in more detail, to confirm the practicalities of each measure, and identify any reasons why the appropriate measure should not be installed, for example if the complexity of an elevation would mean EWI was not suitable. Each householder then received a visit from the scheme manager during which it was explained which measures had been deemed appropriate, and the options available to the householder (such as the choice of finish on EWI). This did sometimes result in householders being told that they would not receive a measure that other properties in the area were receiving. The scheme managers managed this process by explaining why certain measures are not appropriate in specific cases.

The householder was then provided with a customer agreement, which outlined the work to be undertaken. Once the householder returned a signed copy, the agreed works were built into the overall scheme programme.

Whilst every property that signed up for the scheme received an EPC assessment, there were some cases where no measures were installed if the EPC assessment did not identify any appropriate measures. In these cases, the householder would still have received bespoke energy efficiency advice from the technical advisor.

4.3 Ongoing communications

After the householder returned the signed customer agreement, the main contact with the householder is then principally through the site contractor, who would inform the householder when work will commence. However, the scheme managers maintained a high level of visibility throughout the project, providing ongoing communications to householders. Householders were able to liaise with either the site contractor or the scheme manager. For example, on the majority of schemes, Willmott Dixon had a permanent member of staff at the site. Both scheme managers employed dedicated customer liaison staff to keep in touch with householders whilst the schemes were in progress. Scheme managers kept a complaint register, and householders were provided with details for whom to contact with regard to any issues experienced during the installation.

In addition to information specific to the scheme, scheme managers also took several opportunities to deliver energy efficiency advice to householders, including at the open days, energy assessments and technical visits.

Other means of communication with householders including the 'Arbed Life' newsletters produced by Melin Homes⁴ and the Arbed website developed by Willmott Dixon⁵. Both of these explained what could be expected by householders participating in the scheme, as well as including case studies and news on current schemes.

In some schemes, there was a misconception among householders surveyed about the type of measures that they would receive and many householders felt that they had not received what they had been promised. As is clear from the results of the householder satisfaction survey, this was often the most common cause of complaint. However, these complaints need to be put in to context as it is clear that householders often find it difficult to distinguish between other energy efficiency schemes that may have been going on in the same area. These might include ECO, local authority or housing association improvements and private sector works. Whilst the initial information provided to householders is aimed at making it clear from the outset that not all measures are included in the Arbed EU scheme, it is easy to appreciate how this may be confusing to some householders. Furthermore, each home receives a detailed 'whole-house' assessment, with the decision of which measures to be installed in each house depending on a wide range of factors, which means that the measures installed may differ across different houses within each scheme.

Whilst households are assessed individually, the perception of some householders is that they will receive the same measures as their neighbours, whereas they are actually receiving the measures that are suitable for their property. Scheme managers are required to manage these expectations.

Of greater concern is the increase in unscrupulous private companies offering similar energy efficiency improvements. For example, there are instances reported where householders have been duped in to paying a fee for an EPC assessment, having been told it would qualify them for free

⁴ <http://www.melinhomes.co.uk/sites/default/files/Arbed%20life%20Feb14.pdf>

⁵ <http://arbed.org/en/home>

measures, and that they have mistakenly understood this to be linked with the Arbed EU schemes. Any confusion of householders is not through lack of effort by the scheme managers to clearly identify themselves and the project as being Arbed EU. All communication throughout the delivery of the schemes are clearly branded as 'the Welsh Government and ERDF scheme'.

4.4 Handover information

On completion of the work, householders should be provided with a handover pack but in some cases these had not been provided at the time of our audit. Depending on the measures installed, the handover pack includes information factsheets specific to each measure and 25 guarantees for materials and workmanship where External wall insulation has been installed. The information sheets explain what the measure is, the impact of the measure on energy efficiency and how to use it effectively. For example, Melin Homes have produced the information leaflets '*How to live with your wall insulation*' and '*How to live with your voltage optimiser*'. These leaflets are comprehensive, but perhaps contain more technical detail than is necessary and use terminology that might not be easily understood by the average householder. .

Where possible, householders are talked through the handover pack, including an explanation of how to use the measures installed.

Both scheme managers have a complaints process to deal with any issues and the handover packs included contact details of the people whom householders need to contact should they encounter problems with the measures installed. Householders are encouraged to contact scheme managers while the scheme is still ongoing, but the scheme managers will revisit closed schemes if there are genuine reasons for complaint and will arrange for contractors to revisit the property if necessary.

5 Householder satisfaction survey results

This section presents the results of both the householder survey, and the follow-up survey. Questions relating to the initial survey process, installation process, scheme managers and overall experience were only asked in the first survey in the home. Questions relating to current energy use were asked in both the initial survey and the follow-up survey in order to identify the impact of the measures installed, including the impact on (estimated) fuel poverty. The follow-up survey also included questions specifically related to comfort and health, in order to identify any impacts on these as a result of living with the installed measures.

Feedback on householder satisfaction surveys was provided to scheme managers throughout the survey process, in the form of meetings and teleconferences with the scheme managers and Welsh Government. In addition, a summary report was provided to the scheme managers on completion of the surveys to highlight the key issues and feedback reported by householders. This live and continuous feedback was important to ensure that the scheme managers could take this in to account for subsequent schemes.

5.1 Initial Survey

5.1.1 South Wales

81% of householders surveyed (347) reported the initial survey process as either 'excellent' or 'good'. Less than 5% of householders surveyed (19) rating the initial survey process as 'poor' or 'inadequate'. The majority of householders surveyed were satisfied with the level of information received during the initial survey process. Some householders surveyed thought the work was explained very well. Positive feedback on the initial survey process included:

- Clear communication
- Disruption was kept to a minimum
- Timescales were explained

A small number of householders surveyed were not satisfied with the detail of explanation of the processes involved in the work to be conducted. Typical feedback relating to the initial survey process also included complaints that more work was initially discussed than what was completed (commonly associated with window replacement or EWI at the rear of terraced properties). Discussions with the scheme managers helped put this in to context, as they explained that in a very small number of cases, windows were replaced, for example where the EPC assessment identified single glazed windows in properties where EWI was being installed.

5.1.2 North Wales

Of the householders surveyed within the North Wales schemes 72% (201) rated the initial survey as 'excellent' or 'good'.

8% of householders surveyed (23) rated the initial survey as 'poor' or 'inadequate'. During the initial survey a number of householders stated that a wider range of measures were discussed but not all were eventually installed which they found disappointing. For example, some householders surveyed stated that they were promised draught proofing and loft insulation but they did not receive them because they were not deemed appropriate measures following assessment. Householders felt they had been made 'empty promises'. One householder explained that he felt that they had been 'messed around', as they were initially told they could not have any measures, but then ended up having 3 separate surveys. One householder reported that they had two surveys scheduled but both cancelled at the last minute. The property was then wrongly removed from the list of properties to receive measures and that Willmott Dixon only became aware of this when the householder contacted them to check the progress of work.

5.2 During installation

5.2.1 South Wales

During the installation process, 76% of households surveyed (327) responded that this work was 'excellent' or 'good'. Feedback from householders included:

- Workers were quick, clean and tidy and were friendly.
- Workers helped solve other small problems.
- Detailing was good.

10% of householders surveyed (44) responded that the installation process was 'poor' or 'inadequate'. These responses were typically relating to EWI installation timescales, disruption and untidiness and scaffolding being up for longer than necessary.

5.2.2 North Wales

During the installation of the measures, 71% of householders surveyed (197) rated the work as 'excellent' or 'good'.

Some householders surveyed identified delays in starting work resulting in scaffolding being up for longer than necessary or were unhappy with communication between Scheme Managers and site workers.

5.3 Scheme managers

5.3.1 South Wales

The support and information from Scheme Managers was rated as 'excellent' or 'good' by 63% of householders surveyed (271). Of the households surveyed 13% (57) rated the Scheme Managers as 'poor' or 'inadequate'. The majority of the issues raised were due to communications and the management of expectations, see Section 4.3. The rating of Scheme Managers varied between schemes as a result of the type of measures implemented and how effectively problems were dealt with. For example householders in some schemes were more satisfied than others due to problems being resolved quickly. It was evident in some cases that householders were not aware of who the scheme manager was, and some thought the site contractor was the Scheme Manager. Our auditors were often asked for contact details of who to contact to report a problem, even though they would have been provided with this information in their handover packs. There was no direct correlation between the performance of the scheme manager and specific schemes.

5.3.2 North Wales

63% of householders surveyed (176) rated the support and information from the scheme manager as 'excellent' or 'good'. 17% of householders surveyed (47) rated the scheme manager as 'fair' and 16% as 'poor' or 'inadequate' (45). A number of householders identified communication to themselves and to site workers could be improved to prevent problems escalating and to keep householders updated on the progress of work. This was identified as a key area where communications could be improved, and this was fed back to the scheme managers.

5.4 Overall experience

5.4.1 South Wales

Despite some problems or complaints about the installation process, overall householder satisfaction of the entire scheme was reported 84% as 'excellent' or 'good'.

Figure 1 summarises householder satisfaction of the South Wales schemes throughout the installation process.

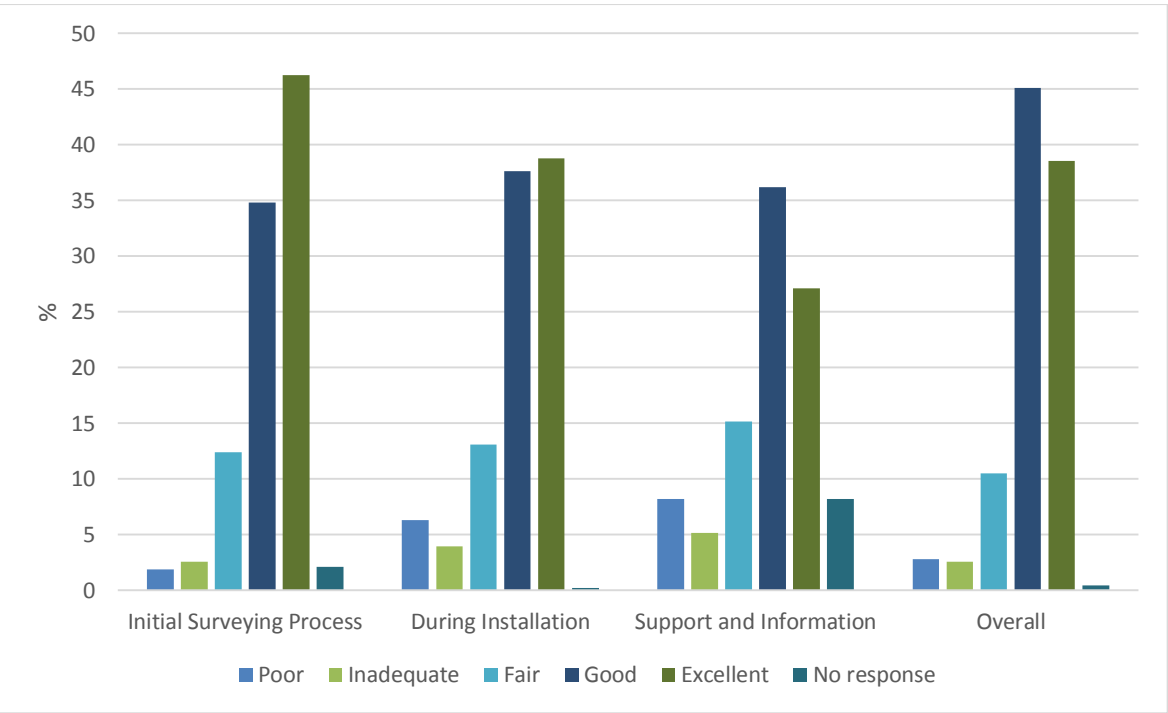


Figure 1: Summary of householder satisfaction - South Wales

5.4.2 North Wales

Of the households surveyed 71% (198) rated the overall experience as ‘excellent’ or ‘good’. One householder in a Year 1 scheme wrote a poem for the site workers, thanking them for their hard work and stated that her quality of life since the work has been completed has improved greatly. Another householder was very pleased that since the work the damp in her property had completely gone. 12% of householders surveyed (33) rated their overall experience as ‘poor’ or ‘inadequate’.

Error! Reference source not found. summarises householder satisfaction of the North Wales schemes throughout the installation process.

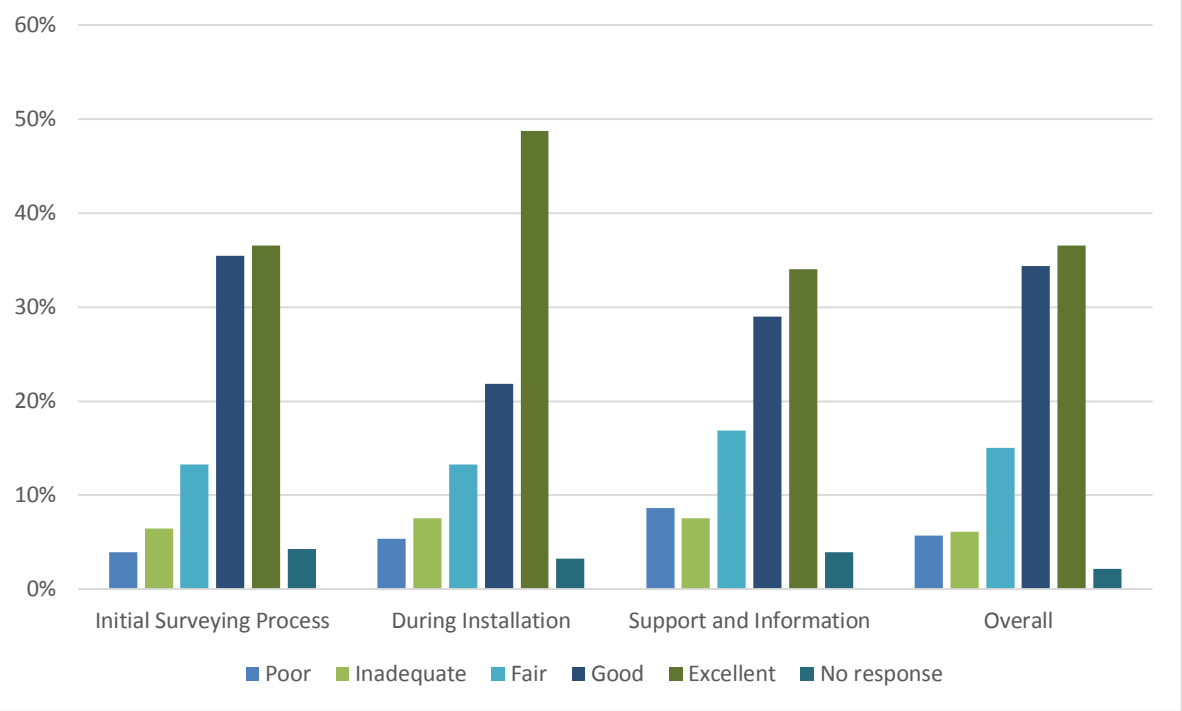


Figure 2: Summary of householder satisfaction – North Wales

5.5 Additional heating use and heating habits – reported during household survey

5.5.1 South Wales

Of those properties surveyed in South Wales, 61% (259) had additional heating sources such as gas fires, electric heaters/ radiators, oil burners, wood burners or coal fires. In many cases, householders reported that additional heating equipment such as gas fires were mainly a decorative feature within a room, and some were even disconnected. Householders were more likely to turn the central heating up than use additional heating sources. Where additional heating was used, some householders identified that this might be in the summer months to 'take the chill off' rather than switching the central heating on. Less than 16% (67) of householders surveyed reported using additional heating often or very often even in winter months. A small number of householders stated that they kept the heating on to try to combat damp and mould problems.

Prior to the installation of measures, some householders reported that they only heated a smaller number of rooms rather than the whole house, in order to keep costs down. After the project, this issue was reduced and this was particularly welcomed by those needing to heat the whole house constantly due to age and ill health.

5.5.2 North Wales

Of those properties surveyed, 70% (190) had additional heating sources such as electric heaters/ radiators, wood burners or gas/open fires. Of those properties that had additional heating methods, they were mainly used in winter months, and never or rarely in the summer.

In terms of how the warmth of their homes impacted on their behaviour (prior to the measure) the most common behaviour was householders needing to put the heating on more often as the house was cold. Some residents only heat a certain number of rooms and some reported they needed to wear extra layers of clothing.

5.6 Summary of feedback from householders

As outlined in Section 4, the main areas of complaint were relating to general communications, and a misunderstanding about the measures that would be installed. This feedback was provided to scheme managers following the survey of each scheme, in order that this could be taken in to account in the delivery of remaining schemes.

During the survey householders gave positive feedback concerning a number of different areas. We found within each particular scheme, that householders' overall assessment varied within schemes depending on their personal experiences.

5.6.1 Site workers

There was a great deal of positive feedback from householders about the site workers. For example a householder was pleased that workers went beyond their normal role by fitting new radiators (that the householder had already purchased) free of charge for an additional room. Other householders had an additional small radiator installed in an airing cupboard where the old boiler used to be. Others commented that the workers had been helpful and 'couldn't do enough' for them. Some householders were impressed with 'their' team of workers about how clean and tidy they were. As well as site workers, householders were generally happy with the scheme managers and found them very helpful in terms of addressing any issues that arose.

5.6.2 Attention to detail

Several householders reported good attention to detail, such as adjusting a porch window after the EWI was installed. A number of householders were pleased with the overall timescales and that work was completed quicker than they had expected with minimal disruption. Some householders reported that there were clear communications and that the work had been explained well.

5.7 Summary of issues reported

The type and extent of specific issues reported by householders varied between schemes due to the measures implemented and the sub-contractors working in each area although there were common issues across a number of schemes. It is important to point out that in almost all cases the issues were satisfactorily resolved within a short space of time.

Where issues were reported they related to minor 'snagging' issues as opposed to significant technical problems. This included issues such as satellite TV dishes not being re-secured adequately, and problems with the reinstatement of other items such as gates, outside taps and downpipes.

Despite the comprehensive engagement and communications work undertaken by scheme managers, issues relating to communications were reported by householders. Communication issues were often related to householders failing to understand the suitability of measures and their energy efficiency benefits. For example, some householders in terraced stone-fronted houses were disappointed that single glazed windows at the rear of the properties were not replaced, and that EWI was not fitted to the rear of the properties. Householders often felt aggrieved that a neighbour had received a particular measure when they had not. Whilst the scheme managers explain to individual householders the measures appropriate to their own property, it is not so easy for householders to then understand why their neighbour has received new windows. A misunderstanding of which measures were eligible under the scheme was also common. As highlighted previously in this report, much of this can be explained by the fact that there was often confusion between Welsh Government Warm homes Arbed EU and other schemes including works undertaken directly by the local authority or other bodies, as highlighted in Section 4. We saw this issue first hand in some schemes. For example, in Barry several householders complained that other properties had received works to improve the appearance of the front of their homes and did not realise that this had been done by the local authority and was not linked in any way to Welsh Government Warm homes Arbed EU⁶. A further cause of confusion may be the list of measures recommended in the EPC certificate, which is likely to include suggested improvements which are not covered by the scheme.

Some householders stated that there was a lack of communication concerning project commencement, delays during the project and overall timescales. For example scaffolding was set up at one house for 8 weeks before work commenced causing inconvenience to the householder. Contractors did not always turn up to do the work when they had said they would, meaning that householders had sometimes stayed at home all day for no reason.

Sign-off paperwork and contact numbers were regularly identified by householders as issues since the workers left the scheme. The scheme managers noted that in some schemes there was a delay in householders receiving their handover packs, and that this process system was improved throughout subsequent schemes.

⁶ <http://gov.wales/topics/housing-and-regeneration/grants-and-funding/housing-renewal-areas/case-studies/castleland-renewal-area/?lang=en>

6 Impacts reported in follow-up survey

6.1 Additional heating use and heating habits

6.1.1 South Wales

A total of 342 householders in the South Wales schemes completed the follow-up survey (36% of householders that had completed the initial survey in Year 1 schemes and 100% of those who completed the initial surveys in Year 2 and 3 schemes). Of these householders, 67% reported that they use their home differently since the measures were installed. This included households stating that they were using more rooms than they did previously (32%), using less supplementary heating than they did previously (31%) and spending more time at home than they did previously (24%).

Examples of feedback from householders included:

- the heating is needed on less as the house is warmer;
- the heating worked in all rooms where previously some radiators did not work; and
- the house got warm quickly so were able to use the central heating rather than supplementary heating; and

24% of householders surveyed (82) reported spending more time in their property since the measures were installed. This included a few householders who had retired in the intervening period but they specifically stated that they felt comfortable spending more time in their homes since the work was completed.

One householder who had fuel switching from oil to gas said that they felt safer with gas, as fuel theft, oil usage and paying large lump sums for oil had all previously been a concern. Since the installation of the gas boiler, the householder now has more flexibility in how to pay for gas with no large bills to pay at once.

19% of householders surveyed (65) reported that they have had other energy efficiency work done since the Welsh Government Warmer Homes Arbed project, either funded by themselves or through other funded schemes. Other work included solid wall insulation, loft insulation, new windows and doors, log burners and new boilers. The fact that there were additional works illustrates the difficulty of evaluating the impact of the Arbed scheme itself, as even if good energy use data before and after installation is available, it is impossible in some cases to break down the impacts between different measures.

11% of householders surveyed (38) who completed the follow-up survey who reported that they had changed energy tariffs since the Welsh Government Warmer Homes Arbed work had been completed. Energy tariff changes can affect the cost of householder's bills and therefore also householders perception of saving on energy bills. Again, even if good metered data were available, changes in fuel prices would still add to the complexity of accurately determining impacts of the Welsh Government Warmer Homes Arbed measures on energy bills.

47% of householders surveyed (160) who completed the follow-up survey stated that they had made an effort to be more energy efficient since the Welsh Government Warmer Homes Arbed measures were installed, as a result of information on energy efficiency provided by the scheme managers. Examples of householders being more energy efficient included:

- Closing curtains;
- Shutting doors;
- Turning individual radiators thermostats down and monitoring the main thermostat; and
- Using timer controls for heating more effectively.

6.1.2 North Wales

A total of 243 householders in the North Wales schemes completed the follow-up survey (38% of householders that had completed the initial survey in Year 1 schemes and 100% of those who completed the initial surveys in Year 2 and 3 schemes). 59% of householders who completed the follow-up survey (143) stated that they use their home differently since the measures were installed. This included using more rooms than they did previously 38% (92), using less supplementary heating

than they did previously 17% (42) and spending more time at home than they did previously 18% (44).

Comments from householders included reports that before the work they would go out rather than spend time in the property or that they would only heat certain rooms, they can use certain rooms whereas they were previously too cold, and the house feels sufficiently warmer that they do not need to wear as many layers of clothing.

16% of householders surveyed (39) who completed the follow-up survey reported that they have had other work since the Welsh Government Warmer Homes Arbed measures were installed, either self-funded by households or through other funding schemes such as the council installing new boilers. Other work included a new roof, new radiators and windows and doors.

Only 10% of households surveyed (24) who completed the follow-up survey reported changing energy providers or tariff since the Arbed work was completed. Energy tariff changes can affect the cost of householder's bills and therefore a householder's perception of saving on energy bills.

15% of householders surveyed (27) who completed the follow-up survey stated that they had made an effort to be more energy efficient since the Arbed scheme, as a result of information provided by the scheme managers. The measures quoted by these householders were mainly related to turning the thermostat down, and switching of heating in rooms not being used.

This is an example of co-benefits of the Arbed scheme – having energy efficiency work carried out increases awareness of energy use and so encourages more efficient behaviour.

6.2 Impacts on comfort and health

The follow-up survey included specific questions which asked the householder whether there had been any perceived impacts on their comfort in their home and their health.

6.2.1 South Wales

66% of householders surveyed (225) who completed the follow up survey said they felt more comfortable in their home and that this was as a result of:

- The house feeling warmer;
- Having hot water available any time of day;
- Gas is 'cleaner and easier to use' (Fuel change from coal or oil)
- Easier to control and manage heating;
- Can enjoy different rooms in the house that were previously too cold;
- House is warmer;
- Area looks more pleasant (due to EWI) and there has been an improvement to appearance of houses; and
- Peace of mind that the boiler is new and efficient.

34% of householders surveyed (116) stated that they did not feel more comfortable since the work or felt no difference. There were no clear trends regarding the type or construction of the house to suggest that it could have impacted on the comfort of a householder and therefore may be perceived by the household.

16% of householders surveyed (55) stated they had noticed improvements to their family's health. These comments were associated with householders with joint issues that had reported being more comfortable due to a warmer home. One householder stated that her disabled son is more comfortable in the house since the work has been completed. Another household mentioned an improvement to their asthmas as the house was warmer and another householder reported less colds. The remaining 84% (287) of households surveyed did not report any improvements in health or that this was not applicable (i.e. no existing health issues identified).

45% of householders surveyed (153) stated that they had damp or condensation issues before the installation of the Arbed measures, and of those householders surveyed 21% (32) identified a reduction in the damp post the Arbed measures being installed, and 7% (11) identified a reduction in condensation. One householder said they had damp before the work and it has not returned since the work was completed. Another householder stated that a small bathroom that had previously been a very damp and cold room was now warm and the damp had gone, following the installation of EWI

and a new radiator in the room. A further householder stated that a problem with condensation had now been eliminated completely following the installation of EWI.

Of the 45% of householders surveyed that reported a damp or condensation issue prior to the Arbed measure, 79% (121) reported no improvement in damp issues.

Houses that received a new boiler as a single measure only may not be expected to experience significant improvements of damp or condensation particularly if householders are restricting the use of heating. Damp and condensation issues after the installation of EWI could be a result of mould still being visible on wall even though the source of damp or condensation has been removed and therefore the issue is still perceived to be present by households.

There was no evidence that damp or condensation has resulted due to the installation of the Arbed measures.

6.2.2 North Wales

81% of householders who completed the follow up survey (197) said they felt more comfortable in their home and that this was as a result of:

- The house being warmer;
- More rooms of the house can be used;
- Reduced draughts; and
- The appearance of the area being improved (EWI)

The remaining 19% of householders surveyed (46) reported no difference in their comfort levels.

12% of householders surveyed (29) stated there had been improvements to families' health, including a reduction in the number of chest infections and improving the health of an asthma sufferer. The remaining 88% (214) of households did not report any improvements in health or that this was not applicable (i.e. no existing health issues identified).

20% of householders surveyed (49) reported damp or condensation issues before the installation of the Arbed measures. Of the 49 householders surveyed, 34 identified a reduction in damp and condensation. The remaining 15 householders did not report any marked improvement in either damp or condensation. Replacement boilers, heating controls and draught proofing only would not be expected to improve damp or condensation issues significantly. A small number of householders (5) that received EWI reported that damp had developed since the Arbed measures were completed.

7 Energy bills and perceptions of fuel poverty

7.1 Determination of Fuel Poverty

A requirement of the Welsh Government Warm homes Arbed EU evaluation was to calculate the change in household energy use and energy bills following the installation of energy efficiency improvements, and to make estimations on the impact on fuel poverty. This was done by asking householders to estimate net annual household income, including housing benefits, and the amount of money spent on energy bills.

In Wales, a household is determined to be in fuel poverty if they spend 10% or more of their income on energy costs⁷. Severe fuel poverty is when a household spends 20% or more of their income on energy costs. For the purpose of this evaluation we are seeking to assess whether the household is likely to be in fuel poverty. This approach has been taken as we do not have accurate or complete energy usage data for a heating season prior to, and following the installation. Neither do we have exact data on household income. We have therefore used householders' self-reported income and their estimated expenditure on energy as a means of estimating if their energy costs are greater than 10% of their income before and after the installation of energy improvements.

In our evaluation, data was collated on estimated annual household income and estimated annual energy expenditure during both the household survey and the follow-up telephone survey. Households were asked to estimate their annual income and expenditure on energy bills. Annual income was defined to the householder as being the total household income, net of taxes and other deductions, but including any housing benefits. This was also explained to the householder that the income is received in to their bank account, unless this is paid directly to a landlord or as a reduction in rent from the local authority. To maximise response levels to this question, households were offered a number of 'income bands', as opposed to being asked for a more specific answer.

Most households were able to provide either weekly or monthly figures for energy bills. The weekly or monthly data was then extrapolated to obtain an estimate of annual energy spend.

Households were also provided with the option of not answering questions relating to income and energy bills, should they prefer not to.

7.2 Limitations of data collected on fuel poverty

Less than 30% of householders surveyed were able or willing to provide information on both household income and fuel bills, and it was not a requirement for their inclusion in the scheme. There were 134 householders in South Wales and 76 householders in North Wales that provided net income and fuel bill data for both pre and post installation of measures.

It should also be remembered that we only surveyed a sample of 10% of the homes across all schemes which had received measures under Welsh Government Warm homes Arbed EU. Another limitation of this data is that by providing a range of income bands, there will be a margin of error introduced, as we have used the mid-point of these bands in calculations. The challenges in collecting accurate data on income and fuel bills from a sufficient number of households in order to make a robust assessment of fuel poverty is one that should be considered in future programmes where an assessment of fuel poverty is required.

Many householders responded with approximate energy bill figures and gave additional comments that they spend extra on their energy meter if they can afford it after they have paid other bills and bought food. This represents a further limitation on the measurement of perceived fuel poverty, as there may be households who spend less than 10% of their income on energy, and do not therefore perceive themselves to be fuel poor, but would be considered fuel poor if they were using sufficient energy to maintain a satisfactory heating regime. In a small number of cases, the amount spent on fuel had increased where a household had previously received free coal and now have to pay for gas.

⁷ A household is in fuel poverty if they spend 10% or more of their income (including Housing Benefit, Income Support for Mortgage Interest or council tax benefits) on all household fuel use required to maintain a satisfactory heating regime.

7.3 Energy bills and perceived fuel poverty pre-installation – South Wales

Figure 3 presents the annual household income of the surveyed householders in the South Wales schemes. 62% of householders (266) did not wish to disclose their annual income. Of those that responded, 3% (11) had annual incomes of less than £5,000, whilst 9% (44) had annual incomes over £20,000. 25% of households (107) who responded had a household income in the range £5,000 - £20,000 pa.

The fact that 62% of householders did not wish to disclose their income meant that the sample of households in which fuel poverty could be estimated was less than the 10% of householders which participated in the overall survey. As those who preferred not to answer are unlikely to be a representative sample, care should be exercised when drawing conclusions from this data.

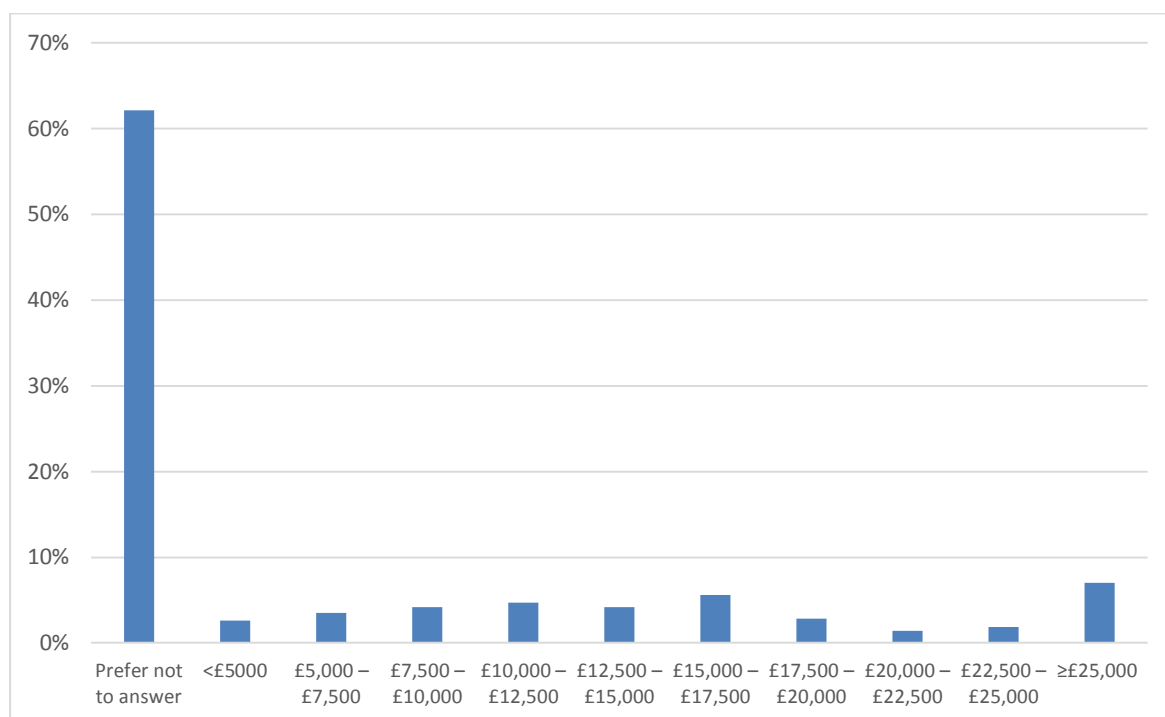


Figure 3: Estimated annual income of households (South Wales)

Figure 4 presents the approximate annual costs of household energy bills in the South Wales schemes at the time of the survey.

The spread of expenditure on energy was very wide with no obvious concentration of energy use around a particular level. This reflects both the diversity of tenure- there are both social housing, privately rented and privately owned properties in each scheme. This was evident during the household visits, for example households included people living alone and on benefits, and more affluent households with one or more persons in employment.

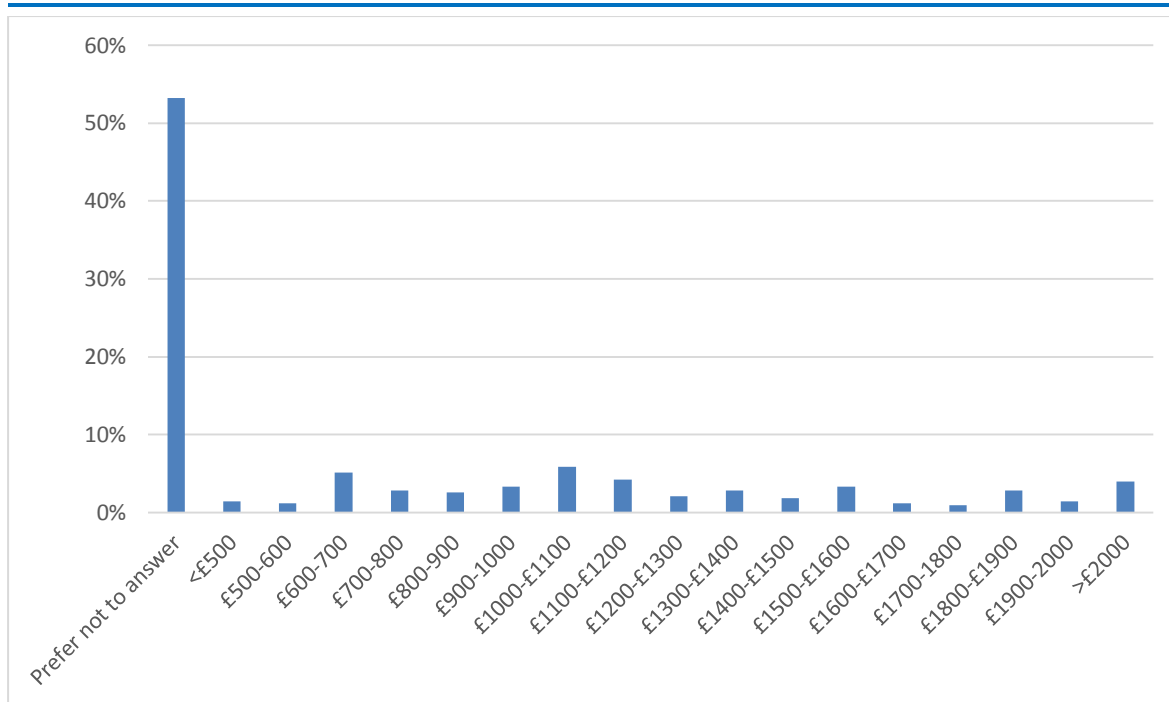


Figure 4: Estimated annual cost of energy bills of households (South Wales)

Of the total householder surveys conducted in the South Wales schemes, only 31% of householders (134) were willing and able to provide a response to both income and energy bill questions and therefore it was possible to estimate fuel poverty for these households only.

Of the 31% of householders that responded to both questions, 34% of householders (46) reported spending more than 10% of their household income on energy and are therefore estimated to be in fuel poverty.

13% of householders (17) reported spending between 10-20% of their income on energy and are therefore estimated to be in severe fuel poverty.

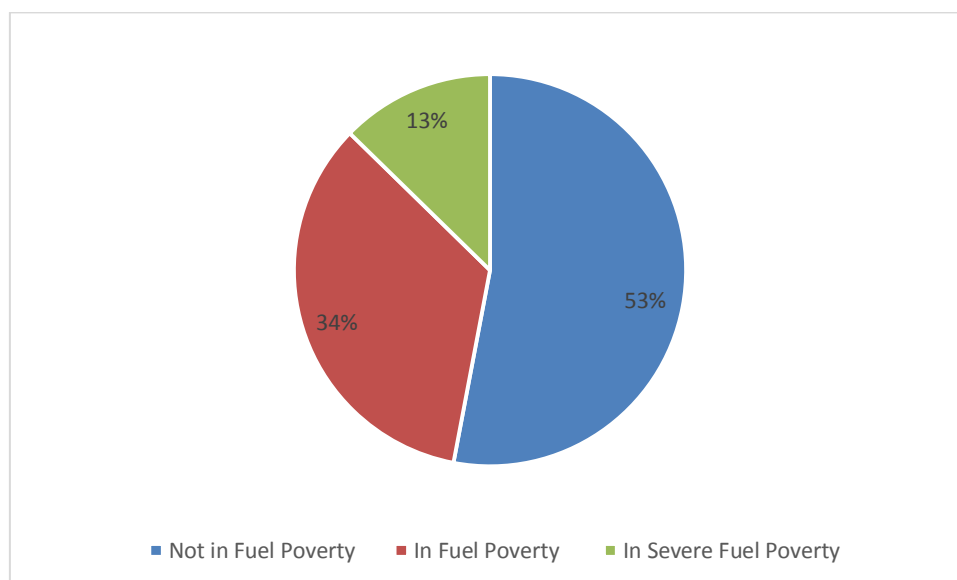


Figure 5: Perception of fuel poverty prior to Arbed measures (South Wales)

7.4 Impacts on energy use and perceived fuel poverty post installation – South Wales

7.4.1 Energy use impacts

Of the 342 householders that completed the follow-up survey (36% of Year 1 schemes and 100% of Year 2 and 3 schemes), 87% of householders (297) said that the house felt warmer since the Welsh Government Warmer Homes Arbed measures were installed. In households that received both EWI and new boilers, householders identified that the central heating warmed the house up more quickly and the new insulation held the heat for longer. One householder said they 'hardly used the heating and only needed it on low' because of the insulation, while another stated that the walls previously felt very cold and never warmed up, however since the EWI was installed the walls are always warm.

85% of householders (291) felt that the heating was on less due to the house getting warm quicker as well as being better insulated.

27% of householders (94) said that there was no difference in the temperature at which they maintained their home since the Arbed measures were installed, which included houses where both EWI and new boilers had been installed. In such cases the improvements will have led to reductions in energy used for space heating.

38% of householders (130) felt their bills were lower since the installation of the measures, with 54% of householders (185) felt there was no difference in bills since the Arbed measures were installed; in these cases it is likely that the house was previously under-heated – as heat losses have been reduced and the same amount of heat is being introduced. Households that had received boiler upgrades and new boilers with fuel switching were more likely to report a reduction in their energy bills.

Only 20% of householders (68) said they now set the thermostat at a lower temperature. 71% of householders (245) stated that they had not changed the thermostat setting but many householders stated that the heating could be turned off sooner with no reduction in comfort and that the house reached the required temperature sooner.

This confirms the conclusion that, overall, householders are using less energy to heat their homes. As heat losses have been reduced and/or more efficient heating systems installed, people can both live in warmer houses and pay less for their heat.

7.4.2 Fuel poverty impacts

Only 31% of householders (134) who completed the follow-up survey in the South Wales schemes were able to provide both net income and energy bill information. For example, some householders reported not knowing the income of all the household or were not responsible for their energy bills, with other family members often dealing with bills for elderly relatives. As outlined previously, 62% of householders did not wish to disclose their income and therefore the sample size for fuel poverty estimations is smaller than the overall survey sample.

Based on the information provided in the follow-up surveys only, 66% of households (88) were estimated to spend less than 10% of their income on fuel and therefore estimated not to be in fuel poverty following the Arbed measures, see Figure 6. This is compared to 53% of households (71) estimated to not be in fuel poverty previously, see Figure 5. Following the installation of the Arbed measures, 27% of households (36) were estimated to be in fuel poverty, a reduction of 7% compared with prior to the Arbed measures. The number of households estimated to be in severe fuel poverty fell from 13% (17) to 7% (10) following the installation of the Arbed measures. At 44% of households (60) who provided income and energy costs, no change in the fuel poverty estimate was calculated.

The reduction in fuel poverty estimates ranged from 0.2% to 11.89%. There a small number of households (8) which saw an increase in the level of fuel poverty. However, this was attributed to a reduction in income as opposed to an increase in bills.

Those that saw the largest reduction in percentage of income spent on fuel were predominantly households who had received a boiler with a fuel switch, for example oil or coal to gas. A small number saw reductions due to a decrease in people living at the property.

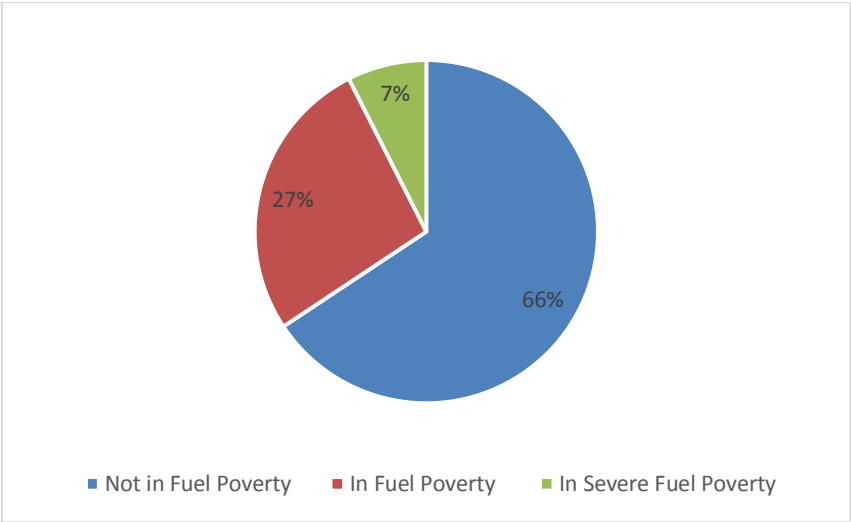


Figure 6: Perception of fuel poverty following installation of Arbed measures (South Wales)

7.5 Energy use and perceived fuel poverty pre-installation – North Wales

Figure 7 presents the annual household income of the surveyed households in the North Wales schemes. 70% of the households (195) preferred not to, or were unable to provide their annual income.

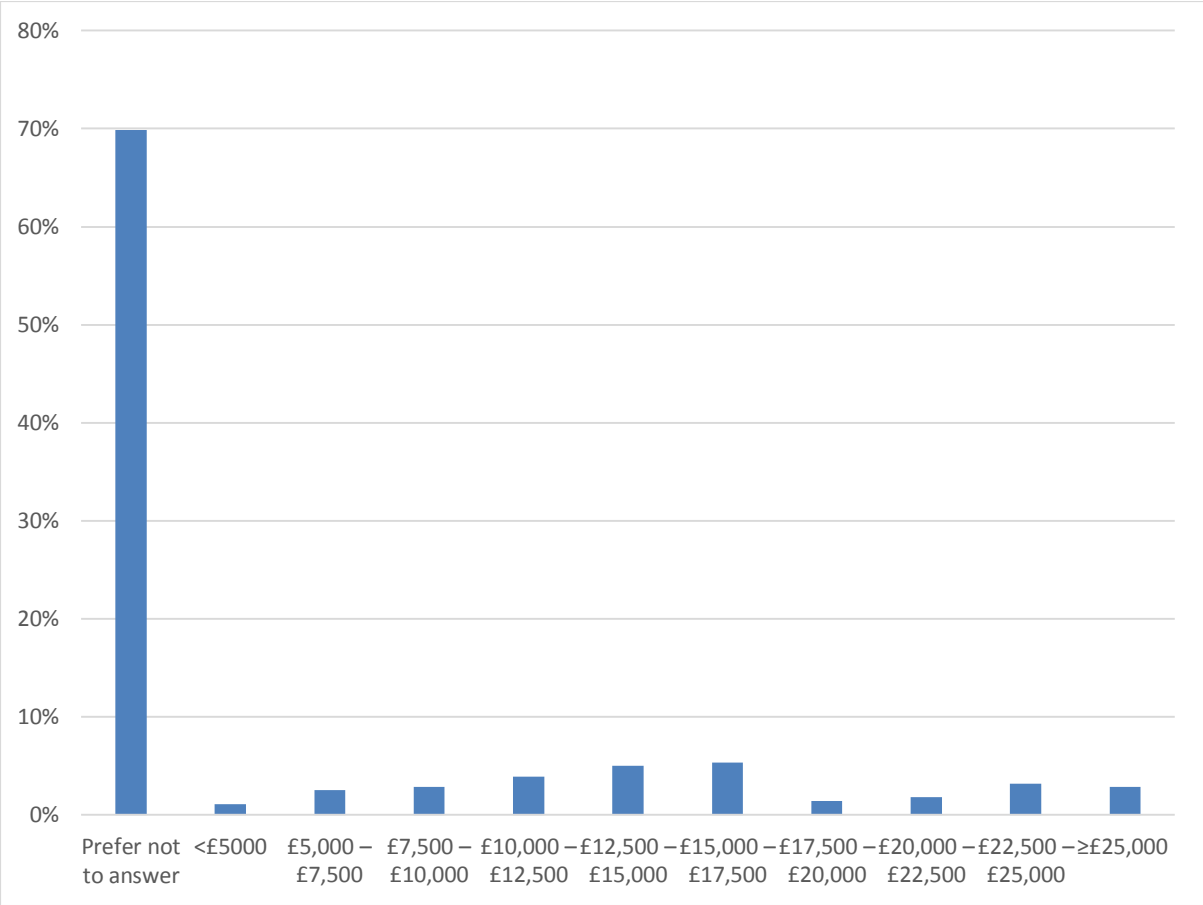


Figure 7: Estimate annual income of households (North Wales)

Of those that responded, 1% (3) had annual incomes of less than £5,000, whilst 8% (22) had annual incomes over £20,000. 21% of households (59) who responded had a household income in the range £5,000 - £20,000 pa.

Figure 8 presents the approximate annual costs of household's energy bills at the time of the survey. It should be noted that the majority of householders did not have exact figures for both household income and energy bills and could only provide approximate figures.

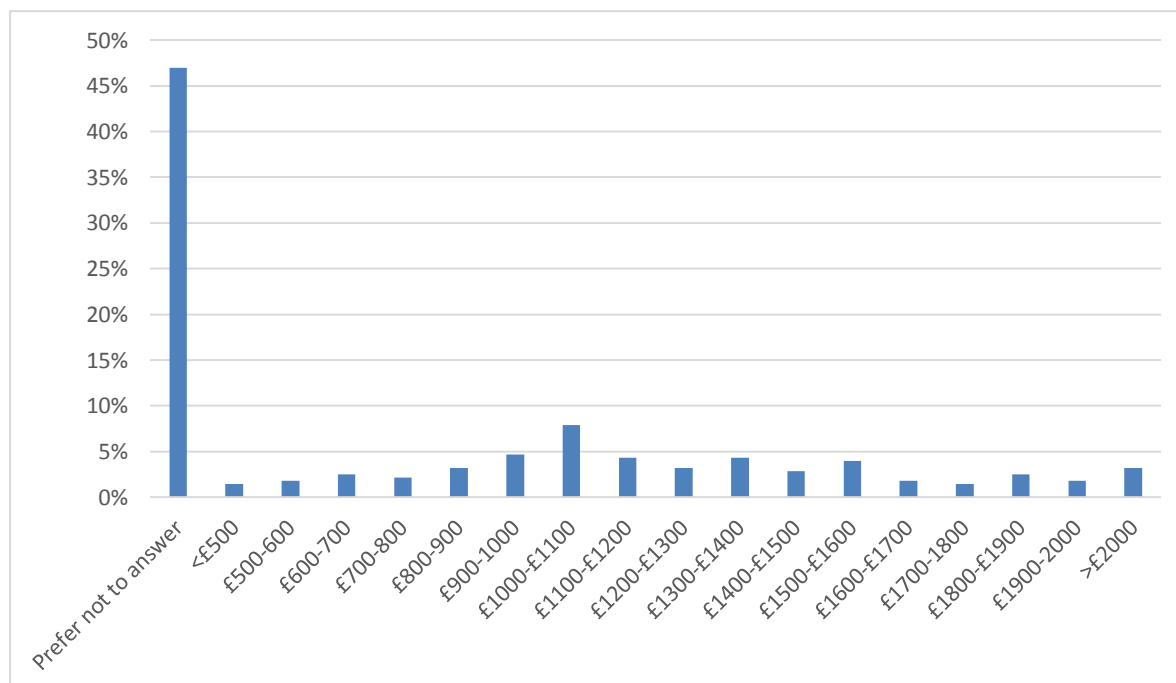


Figure 8: Annual cost of energy bills of households (North Wales)

In North Wales, 27% of householders (76) provided data on both household annual bills and income. Of the households that provided data, 39% of households (30) reported spending less than 10% of their net income on fuel bills and are therefore estimated not to be in fuel poverty, see Figure 9.

Of the householders in the North Wales schemes that responded to both questions, 43% of householders (33) reported spending more than 10% of their income on energy and may therefore be estimated to be in fuel poverty. A further 17% reported spending between 10-20% of their income on fuel and are therefore estimated to be in severe fuel poverty.

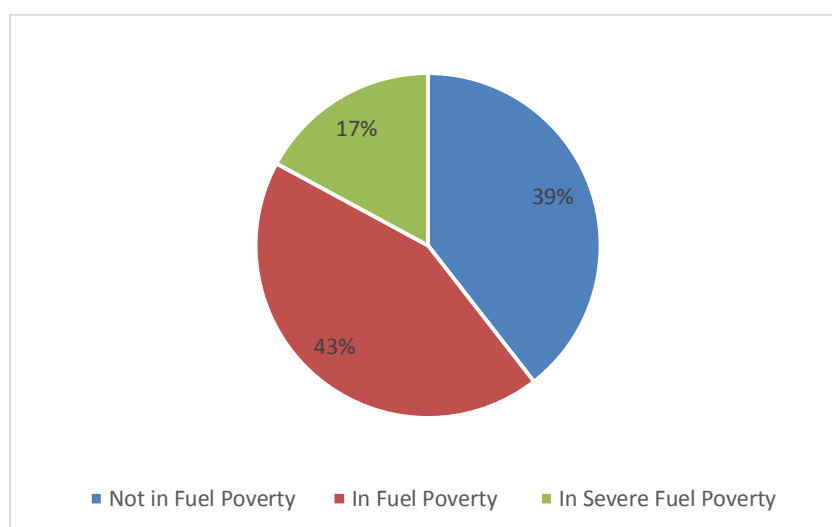


Figure 9: Perception of fuel poverty prior to Arbed measures (North Wales)

7.6 Impact of measures on energy use and perceived fuel poverty post installation – North Wales

7.6.1 Energy use impacts

A total of 243 householders in the North Wales schemes completed the follow-up survey (38% of Year 1 schemes and 100% of Year 2 and 3 schemes).

Of the 243 householders 76% of householders (185) said that the house felt warmer since the Welsh Government Warmer Homes Arbed measures were installed. Comments from householders included the house would get warmer quicker, the house retained the heat for longer and there were less draughts.

77% of householders (187) felt that the heating was on less due to the house getting warm quicker as well as being better insulated.

20% of householders (49) said that there was no difference in the temperature at which they maintained their home since the Arbed measures were installed. Whilst the temperature differences may not be noticeable to the householder in all cases, the improvements will have led to reductions in energy used for space heating.

42% of householders (102) who completed the follow-up survey stated that their bills were lower, 38% (93) thought there had been no difference to their bills whilst 2% (5) thought their bills were higher and the remaining 18% (44) were unsure of any impacts on energy bills.

Although 38% of householders thought that their bills had not changed, the majority of these households all reported that their houses were warmer. It is therefore likely that the house was previously under-heated – as heat losses have been reduced and the same amount of heat is being introduced.

7.6.2 Fuel poverty impacts

27% of all householders (76) surveyed in the North Wales schemes were able and willing to provide both net income and energy bill information.

Based on the information provided in the follow-up surveys only 55% of households (42) were estimated to spend less than 10% of their income on fuel and therefore estimated not to be in fuel poverty following the Arbed measures, see Figure 10. This is compared to 39% of households (30) estimated to not be in fuel poverty previously, see Figure 9. Following the installation of the Arbed measures, 36% of households (227) are estimated to be in fuel poverty, a reduction of 7% compared with previously. The number of households estimated to be in severe fuel poverty fell from 17% (13) to 9% (7) following the installation of the Arbed measures. At 36% of households (27) who provided income and energy costs, no change in the fuel poverty estimate was calculated.

The reduction in fuel poverty estimates ranged from 0.7% to 14.34% with the largest reductions in percentage of income spent on fuel observed in houses where new boilers and fuel switching from coal or oil to gas were the measures implemented.

As with the South Wales schemes, other factors such as changes in income and people moving in or out of the household were also recorded as reasons being changes in the fuel poverty estimations.

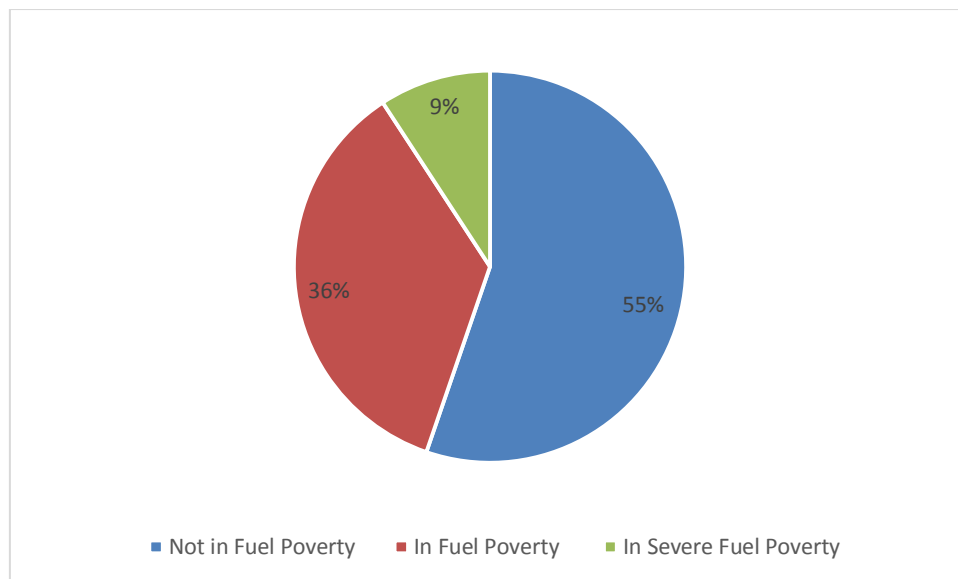


Figure 10: Perception of fuel poverty following installation of Arbed measures (North Wales)

7.7 Summary

From this very limited data it is not possible to conclude whether the scheme has had a significant impact on fuel poverty. However, given that many houses were under-heated prior to the Arbed measures being introduced and that this phenomenon has been sharply reduced, there is likely to have been a significant reduction in the number of houses who have difficulty maintaining their homes at an acceptable level of thermal comfort, so there will have been a net reduction in fuel poverty. There may have been further impacts on fuel poverty through the creation of jobs locally and the associated multiplier effects (see Section 3: Community Benefits).

8 Technical survey results

8.1 Methodology

A technical survey was carried out at 10% of the houses which had received measures in each scheme. The technical survey was undertaken at the same houses where the householder satisfaction survey was undertaken. Householders were required to provide permission to the scheme managers that they were happy to be contacted by Ricardo Energy & Environment to participate in the evaluation. Due to data protection, only a sample of householder contact details was provided to Ricardo Energy & Environment for each scheme. Households were selected for survey by Welsh Government, prior to the household details being sent to Ricardo Energy & Environment in password protected files.

The households were selected for survey to ensure that the sample for each scheme reflected the mix of measures installed and property type within each scheme.

The actual sample of houses surveyed was also impacted on by householder availability and willingness to answer questions/answer door. Even where appointments had been made in advance, householders were not always at home or willing to participate. In this case, alternative houses were selected by the surveyor from the list of 25% of households in each scheme, to ensure sufficient houses were surveyed.

Overall, our auditors did not identify large numbers of technical faults, and those that were identified were more usually related to minor snagging issues, as opposed to major faults. In general the quality of installations inspected has been very good.

There was often a difference between householder perceptions of a technical problems, and actual problems where measures were found to not be compliant with specifications or had a poor quality finish. For example, householders complained about needing to paint walls where a boiler had been moved, or having to undertake other decorative work. The extent of decoration to each property will be agreed in the customer agreement, but is generally restricted to making good and preparing ready for householders to redecorate, i.e. making good where existing equipment is removed and making good all disturbed finishes. The detail of the work to be undertaken is outlined in the customer agreement that householders sign up to, but in some cases householders have misunderstood this.

The majority of complaints expressed by householders have been covered in the householder satisfaction survey results in Section 5. In this section therefore, we have focussed on technical issues which may impact on the performance of the measure, or have an adverse impact on the property, or are of a poor quality and finish.

The technical survey was also used to make an assessment of the appropriateness of measures used.

8.2 Overall scheme selection

Our evaluation also considered the overall schemes selected, to evaluate not only the appropriateness of measures installed as discussed above, but also the suitability of each scheme in general. Schemes proposed by local authorities were evaluated by Welsh Government against the following criteria:

- The schemes ranking on the income table in the Welsh Index for Multiple Deprivation, or the percentage of households on a means tested benefit.
- The percentage of privately owned homes in the scheme.
- The percentage of homes that are not connected to mains gas.
- The percentage of homes that are of a solid wall or hard to treat cavity construction.
- The scheme being located in a regeneration area.
- The scheme being located in a "Communities First" area.

Local authorities had the option to use either the LSOA method or the number of households which are on means-tested benefits, in order to maximise the score from this section of the scheme

evaluation. This was enabled so that micro areas of high percentage means tested households could be identified within high ranking areas of LSOA.

As can be seen in Table 7, the schemes selected were almost all in the lowest 10-30% most deprived areas according to the Welsh Index of Multiple Deprivation (WIMD), which takes in to account income, employment, health, education, access to services, community safety, physical environment and housing. For the purpose of this assessment, the schemes ranking within the table are for income only.

In addition to the schemes being located in areas of low income households, the housing stock in each scheme typically contains a very high proportion of houses which are 'hard-to-treat'.

The process for scheme selection also means that privately owned homes occupied by households on average or higher incomes would still benefit from the improvements that would be made to the typically thermally inefficient housing stock in the scheme. The approach to scheme selection has been successful, in that schemes are in locations most likely to be heavily impacted on by fuel poverty, both due to typically low average incomes and also due to the construction type of the houses in each scheme

Overall we have concluded that the right areas were targeted in schemes which included the selection of the right type of houses, and households and where benefits and energy efficiency improvements could be maximised.

Table 7: Scheme selection – Welsh Index of Multiple Deprivation and hard-to-treat homes

	Scheme	LSOA	Regeneration area	Income ⁸ (2014)	WIMD Rank	Scheme overview – typical hard-to-treat homes in each scheme
Year 1	Fochriw, Caerphilly	Darran Valley 2	Heads of the Valley	282	10% most deprived	Circa 1940's solid wall, 1900's stone.
	Penywaun, Rhondda Cynon Taf	Penywaun 2	Heads of the Valley	16	10% most deprived	Circa 1950's, non-traditional construction
	Blaenavon, Torfaen	Blaenavon 2	Heads of the Valley	259	10-20% most deprived	Circa 1930-1949, cavity and solid brick wall, pre-1900.
	Malpas, Newport	Malpas 2		61	10% most deprived	Circa 1950's, BISF
	Shingrig/Garden Village, Merthyr Tydfil	Bedlinog 2	Heads of the Valley	564	20-30% most deprived	Circa 1950's, non-traditional construction
	Castleland 1, Vale of Glamorgan	Castlelands 2H	Barry	252	10-20% most deprived	1900's solid wall
	Morrison, Swansea	Morrison 7	Swansea	232	10% most deprived	Pre 1900's solid wall
	Holywell, Flintshire	Holywell Central	North Wales Coast	129	10% most deprived	1930-1949, cavity wall
	Colwyn Bay, Conwy	Glyn (Conwy) 2	North Wales Coast	104	10% most deprived	Pre 1900's and 1900's solid wall
	Rhyl, Denbighshire	Rhyl West 2	North Wales Coast	1	10% most deprived	Pre 1900's and 1900-1939, solid wall
	Holyhead, Anglesey	Porthfelin 1	Môn a Menai	249	10-20% most deprived	1900-1949, solid wall
	Nantlle, Gwynedd	Llanllyfni and Clynog	Môn a Menai	765	40-50% most deprived	Pre-1900's, off-gas
	Caerau, Cardiff	Caerau 7		280	10-20% most deprived	1950-66 solid wall, 1930-49 non-traditional construction
Year 2	Castleland 2, Vale of Glamorgan	Castleland 2	Barry	208	10-20% most deprived	Pre 1900, 1900-29, stone
	Penydarren, Merthyr Tydfil	Penydarren 1, Penydarren 2	Heads of the Valley	191	10% most deprived	1950-66, solid wall, 1930-49 non-traditional construction

⁸ The purpose of this domain is to capture the extent of deprivation relating to income. It focuses on the proportion of people with an income below a defined level. The income domain is made up of one indicator, containing three elements: 1. Income-Related Benefit claimants, 2. Tax Credit recipients, 3. Supported Asylum Seekers. This indicator is expressed as a percentage of the residential population for each LSOA

Year 3	Hollybush, Caerphilly	Argoed 2	Heads of the Valley	121	10% most deprived	Pre 1900, 1900-1929, stone. 1983-2007, cavity wall.
	Caerau, Bridgend	Caerau 1, Caerau 2	Western Valleys	161	10% most deprived	1900-29, stone
	Six Bells, Blaenau Gwent	Six Bells 1, Six Bells 2	Heads of the Valley	586	30-40% most deprived	1900-29, cavity wall. 1900-29, stone.
	Maerdy, Rhondda Cynon Taf	Maerdy 1	Heads of the Valley	390	20-30% most deprived	1900-29, stone
	Upper Brynamman, Carmarthenshire	Quarterbach 1, Quarterbach 2	Western Valleys	233	10-20% most deprived	Pre-1900, 1900-29, 1930-49, stone
	Llandysul, Ceredigion	Llandysul Town		105	10% most deprived	1950-82, cavity wall.
	Rhyl 2, Denbighshire	Rhyl West 3	North Wales Coast	136	10% most deprived	1900-1960, solid wall
	Fron & Carmel, Gwynedd	Talysarn	North Wales Coast	287	10-20% most deprived	Pre 1900, 1900-29, solid wall
	Llay 1-3, Wrexham	Llay 3		375	10-20% most deprived	1939-49, solid wall
	Phillipstown, Caerphilly	New Tredegar 3	Heads of the Valley	269	10-20% most deprived	1900-29, stone
	Castle, Swansea	Castle 1	Western Valleys	144	10% most deprived	1967-75, cavity wall. 1930-49 cavity wall/solid wall. Pre 1900, 1900-29, stone.
	Llanelli, Carmarthenshire	Tyisha 2	Western Valleys	175	10% most deprived	Pre 1900, 1900-29, stone.
	Castleland 3, Vale of Glamorgan	Castleland 1, Castleland 2	Barry	265	10-20% most deprived	Pre 1900, 1900-29, stone/solid wall.
	Deiniolen, Gwynedd	Deiniolen	Môn a Menai	368	10-20% most deprived	Pre 1900, 1900-29, solid wall
	Prestatyn, Denbighshire	Prestatyn Central 2	North Wales Coast	153	10% most deprived	1930-45, solid wall/cavity wall
	Oakenholt, Flintshire	Oakenholt 2		408	20-30% most deprived	1900-29, solid wall. 1930-50, cavity wall.
	Llay 4, Wrexham	Llay 1, Llay 2		128	10% most deprived	1900-29, solid wall. Post 1946, non-traditional construction

8.3 Appropriateness of measures

When determining the range of measures for individual schemes, the overriding principle is that each household should receive the most cost effective package of measures and technologies in order to improve the energy efficiency of a home to an Energy Performance Certificate 'C' rating. If attaining an energy efficiency of a home to EPC 'C' was not achievable within the funding available, then the aim was to achieve the highest possible EPC rating below 'C' and to increase the EPC rating by an average of 2 bands.

In terms of determining the most cost effective package of measures, the cost of the enabling works was also taken in to account. If the cost of enabling works was deemed as high as the cost of installing the measures, a decision would be made not to install the measures.

The average pre installation SAP was 51, an EPC rating of E, increasing to an average of 61 post installation, an EPC rating of D⁹.

Table 8 lists the eligible Welsh Government Warm homes Arbed EU measures in terms of priority measures, supporting measures, and those which need to be leverage through other funding.

Table 8: Welsh Government Warm Homes Arbed EU - eligible measures

Welsh Government Warm Homes Arbed EU project – eligible measures		
Priority* (subject to cost effectiveness and value for money)	Supporting **	Leveraged***
Solid wall insulation	Water saving devices	Fuel switching
Heat pumps	Draught proofing	Loft insulation
Solar hot water	Energy saving advice	Cavity wall insulation
Heating system upgrades (including biomass)		

* Priority measures are those which should be prioritised in schemes wherever possible (subject to cost-effectiveness and value-for-money).

** Supporting measures are those which should be included in schemes wherever appropriate, on the basis that they are low-cost, high-impact.

*** Leveraged measures are those which should be funded through induced external investment but which can be funded by WG wherever external investment is not available (subject to cost-effectiveness and, value-for-money).

The scheme managers used this information to estimate CO₂ reductions for each potential measure, and estimate costs of work before a decision was taken as to the measures to be applied to each property. Scheme designs submitted by scheme managers were reviewed by Welsh Government, to assess if the measures and technologies proposed for each home and for each scheme demonstrated cost-effectiveness and value for money.

EWI in general was not applied to traditional (pre 1919 solid walled) buildings, for example stone-fronted terraced houses. We agree that this is a sensible precautionary approach as, in addition to the heritage impact, the technical risks of applying insulation to buildings of traditional construction are many and varied and have not yet been fully understood. Most solid walled terraced housing has a

⁹ A: 92-100 SAP points (most efficient)

B: 81-91 SAP points

C: 69-80 SAP points

D: 55-68 SAP points

E: 39-54 SAP points

F: 21-38 SAP points

G: 1-20 SAP points (least efficient)

EPC data has been provided by the Welsh Government.

high proportion of windows on the front elevation so the savings from EWI would have been limited. In addition, properties which would have required a significant amount of enabling works were not recommended for this measure.

EWI was applied to many houses of a later construction, which had poor insulation levels. In addition to improving their thermal performance this has significantly improved their appearance and their longevity and so this would seem to be a most appropriate measure for many households in the schemes selected. In a small number of cases, windows were upgraded where this was necessary to achieve the full benefits of EWI.

Boilers and heating controls were applied where needed, and in particular at properties where EWI was not appropriate.

A further technical assessment was made of each property before the final decision for each property was made and offered to the householder. The aim of this assessment was to look at the specific practicalities of installing specific measures, and ensuring there were no physical or logistical constraints which would mean a particular measure would not be viable or cost effective. This assessment procedure gave further confidence of the appropriateness of the measures installed, as installation decisions were not made purely on theoretical calculations alone.

The scheme design and due diligence undertaken by both the scheme managers and Welsh Government have ensured that only the most appropriate measures have been installed both at each scheme and at each individual household. The technical surveys were undertaken by energy assessors trained to assess the appropriateness of measures for any particular building. Therefore we have concluded that measures appear to have been selected and applied appropriately across all schemes and are in line with the priority measures and technologies set by Welsh Government.

8.4 Quality Assurance (QA)

Our technical audits confirmed evidence of the robust Quality Assurance (QA) procedures adopted by both scheme managers. The QA process begins with the selection of appropriately qualified contractors. For example both scheme managers have made it mandatory that EWI installers are PAS 2030 accredited. PAS 2030 sets out the requirements that installers need to comply with to ensure that the installation of new energy efficiency measures related to the Green Deal scheme are completed properly. PAS 2030 addresses topics such as installation methods and quality control, installer competence, equipment, inspections, handover and corrective action procedures. PAS 2030 was developed by an expert working group, including trade associations relating to the construction, building, energy and manufacturing sectors, businesses and consumers. As a result of this requirement, the number of companies who have achieved PAS 2030 accreditation has increased in North Wales in order to meet this demand.

Both the site contractors and scheme managers were required to sign off work at each stage. Melin's approach included weekly site surveys, and the establishment of a benchmarked exemplar property at the beginning of each scheme. EWI was also inspected and photographed at each stage, including inspections and sign off by the system manufacturer. A 25 year EWI guarantee was provided by the system installer, and endorsed by the system manufacturer.

On the completion of each scheme, the scheme manager makes a final inspection of works and the householder also signs to confirm they were satisfied.

Further guarantees and quality assurance certificates were included in the handover pack provided to the householder, and would include, where appropriate, building regulations compliance certificate, gas boiler commissioning checklist, Gas Safe Building Regulations & Benchmark certificate, CP1 Gas test Certificates, FENSA certificate, the 25 year EWI guarantee to cover workmanship or materials minor electrical installation works certificate and other minor works certificates.

8.5 External wall insulation

The measures supported under Arbed are mostly boiler replacement, heating controls, voltage optimisation and external wall insulation (EWI).

The first three of these are well established measures, the parameters are known and quality control is good. By contrast, EWI is a relatively new technology and is complex to install. It is also a major intervention which changes the way in which a dwelling behaves, in terms of both thermal and

moisture transmittance, so the risks of installation are much higher. The majority of observations – and householder complaints – also relate to EWI. For these reasons, our technical assessment is focussed on issues arising from EWI.

EWI is complex to install for several reasons:

- Many houses have been extended to the side or to the rear.
- There are numerous services attached to, embedded in, or penetrating through the external walls of houses. When EWI is installed, all these services have to be accommodated or removed and refitted.
- Window openings are frequently adjacent to walls returning at right angles. Adding thickness to these walls causes issues for window openings.
- Roof projections are often not sufficient to accommodate EWI so eaves and gables have to be extended – or the insulation capped.
- Window sills are normally not sufficient to accommodate EWI, so sills need to be extended.

All buildings are different so a bespoke specification is required in each case¹⁰. Many decisions about detailing seem to be made on site, perhaps by installers or the site manager with no further reference to an architect. Budgetary constraints and the time pressure of fixed price contracts also mean that there is no incentive to undertake additional work using other trades (drainage, electrical etc.), and the involvement of statutory service providers will have a direct impact on the bottom line.

There are two key risks arising from EWI – damp and indoor air quality. These can cause issues for the health of building fabric and for the health of the occupants. There have been recent cases of failures of EWI schemes where there has been a substantial impact on the residents, so it is important that the Arbed Phase 2 scheme does not suffer the same issues.

8.5.1 Quality of finish

The majority of householder complaints relating to EWI concern the reinstatement of services. There are numerous instances of outside taps not being correctly refitted, satellite dishes not being secure etc. Side gates are often an issue (as EWI reduces the width of the passage) and the re-fixing of cables on the exterior skin is especially poor. There are also many instances of minor irregularities in the finish, and damaged or missing render at the base of the insulation, particularly at door reveals. Whilst all of this is important to residents, none of it is likely to cause significant issues in terms of damp or indoor air quality.

However, where timber bearers have been inserted to allow for reinstatement of fixings (e.g. satellite dishes, external taps, hanging basket holders etc.) there are instances of cracking around these bearers, which will lead to water ingress and trapped moisture which will move towards the inner face.

8.5.2 Moisture ingress

The issues which are likely to lead to moisture ingress are as follows:

- Ineffective capping of EWI at eaves and gables;
- Poorly fitted rainwater goods; and
- Excessive use of sealants.

It can take some years for rainwater penetration to become visible internally and therefore for any weaknesses in the external skin to be identified. However, it is important to note that once rainwater enters a wall that has been externally insulated with impervious materials (as here), there is no pathway for moisture (as water or as vapour) to exit so, once identified the problem cannot easily be rectified with the insulation in place. Of even more concern, where the integrity of the external skin relies on silicone sealants, these will break down as differential movement occurs due to different rates of expansion and contraction between the materials being joined, and with annual extremes of temperature. Once these seals have broken, the failed joint serves as a capillary attractor of water which then enters (and is trapped in) the wall matrix.

¹⁰ The Arbed Phase 1 report notes that “An individual specification should be provided in advance and checked on completion.”

Instances of all these issues have been noted in the Arbed schemes where EWI has been installed. . Cappings have been cut to facilitate running outlets from gutters, rainwater downpipes are vulnerable where tracking across elevations or routed at ground level, seals around window frames are in some cases poor or already failing and there are numerous thermal bridges due to detailing around gas pipes, soil pipes and at wall/roof junctions where the insulation stops short and is capped.

There have been no reports of increased damp as a result of the application of EWI, so far, which is encouraging. However, given that in all these cases it will take time for any defects to become manifest internally, it is essential to revisit a sample of properties at 5 year intervals after completion of the works, and to monitor the condition of seals in particular. It is also essential to provide a clear pathway for householders to report any instances of damp or damage/decay so that faults can be remedied before they give rise to issues for building fabric and human health.

8.5.3 Thermal bridging

Thermal bridging is a risk because thermal bridging leads to condensation and mould growth, with impacts on human health and building fabric. Where there is thermal bridging, it may take some time before this leads to sufficient condensation for moulds to form and become visible.

Insulation at window reveals is necessarily limited or non-existent. Following the application of EWI, the inside of the window reveal is likely to be significantly colder than other wall sections so condensation becomes more likely at this point. Other features leading to thermal bridging are the cutting of EWI around gas pipes – so an area of external wall is left uninsulated. This could be reduced or eliminated by better design to allow access for the network operator whilst reducing the bridge at this point. There have been examples of successful innovation in EWI application, and this is one area which merits further attention in future schemes, in discussion with the gas provider.

Thermal bridging does not always lead to condensation. There are other risk factors such as the level of moisture produced internally (for example from clothes drying on radiators) and the level of ventilation. As with moisture ingress and indoor air quality issues, it is important to keep this under review and to check a selection of properties at regular intervals.

8.5.4 Indoor air quality

Indoor air quality (IAQ) has not been tested as part of the Arbed completion process (nor is ventilation in new buildings checked by building inspectors). However, it is known that many modern airtight properties already fail to meet the requirements of Part F of the Building Regulations. For the Arbed properties, of varying ages, EWI will have reduced natural ventilation by adding a new sealed skin to the exterior of the building.

There have been no significant studies to date of IAQ following EWI retrofit so we do not yet know the extent of the risks but it would be prudent to flag this up and keep it under review as understanding in this area improves. At the very least, reduction in ventilation together with trapped moisture is a combination which could lead to the growth of pathogenic moulds and pose significant risks to human health, and there are many other indoor air pollutants to be considered. Testing of IAQ should therefore be carried out in a sample of properties both now and at 5 yearly review points in the future.

8.6 Voltage optimisers

There were a number of issues reported with voltage optimisers by householders, with many stating that they had noticed a change in power – for example kettles taking longer to boil. Several householders stated that they didn't understand the function of the voltage optimisers and that this had not been explained to them. This suggests that householders had either not read, or had not understood the information on voltage optimisers provided both during the initial engagement, and also in the handover process. In terms of their installation, no quality issues were observed.

8.7 Boiler upgrades and heating controls

There were very few technical issues observed relating to the installation of new boilers and heating controls. There were reports of initial teething problems with boilers, i.e. leaks or pressure drops, but after these had been resolved householders were generally satisfied.

The main issue relating to the use of new boilers was a lack of understanding on how to control thermostats and timers. This is an important issue as savings will not be achieved in full if controls are

not clearly understood, correctly set and easily changed. In the worst cases, energy consumption may even rise if the new controls are not as easily to use as the previous controls. This is a particular problem for elderly people who are not familiar with electronic controls. Information on the controls is provided in the handover pack and, where possible, explanations of the controls were given in person by the site contractor or scheme manager staff. Despite this, some householders were still experiencing difficulties – indicating that the design of control panels for elderly/vulnerable residents is not yet optimal. Feedback on this issue was provided to scheme managers, who have developed simplified instructions and also ensured that site staff spend more time explaining the operation of a new boiler to householders where needed.

9 Conclusions

9.1 Community benefits

In terms of Community Benefits the Welsh Government Warm homes Arbed EU project has been a great success. This includes measurable changes such as increases in local employment – the best way to reduce fuel poverty is to reduce poverty; the economic multiplier (£2.0 and £1.9 for South and North Wales respectively) demonstrates that the work has had a wider economic benefit.

There are also benefits which are less easy to quantify but possibly more important, such as the significant visual improvements that EWI has made to many streets throughout the schemes, evidenced through many grateful comments made to our surveyors. This had led to sustained benefits as more people take pride in the appearance of their neighbourhoods, and the scheme has gone some way to alleviating the sense of communities being ignored or forgotten. Poverty of expectation and ambition is reduced to some degree and the renovations have also promoted cohesion as there has been a great deal of communication between residents as the works were planned and installed.

9.2 Energy bills and perceptions of fuel poverty

Ricardo Energy & Environment conclude that it is likely that the Welsh Government Warm Homes Arbed EU project has reduced fuel poverty through EWI, boiler replacement and fuel switching. For reasons set out in this report, it is not possible to quantify the effect on fuel poverty with any degree of certainty, but the verbal evidence clearly shows that bills have been markedly reduced and that people are able to heat their homes for longer periods or at higher temperatures. Clearly some people will have moved out of fuel poverty as defined by Welsh Government (spending >10% of disposable income on fuel) but there will be people still in fuel poverty whose situation has been improved significantly, and improvements for households who were not in fuel poverty before the measures were installed. All these gains are important and should be valued.

9.3 Householder satisfaction

Whilst a high proportion (74%) of households reported that they had experienced an issue of some kind during the installation, this did not generally impact on their overall satisfaction of the scheme and of the measures installed. Where issues were reported, many of these were linked to a misunderstanding of what measures they would receive, or disappointment that they had not received the same measures as other households. Each home received a detailed 'whole-house' assessment, with the decision of which measures to be installed depending on a wide range of factors such as construction type, fuel type, current heating system age and type, current insulation levels, structural issues and structural fabric repairs. This often means that houses in the same scheme receive a range of different measures, which leads to confusion by householders on the type of measures they would receive. This also means that not all houses assessed will receive measures if they are not deemed appropriate. There were also difficulties for householders in distinguishing between other energy efficiency schemes being delivered in the area but which were unrelated to Welsh Government Warm homes Arbed EU. Other issues reported were largely relating to minor snagging issues, and some issues relating to a perceived lack of communications by site contractors or scheme managers.

84% in South Wales and 71% in North Wales rated the overall experience of the scheme as excellent or good.

There was a great deal of positive feedback from householders about the site workers, with some householders commenting that the workers had been helpful and 'couldn't do enough' for them.

The majority of householders surveyed were very satisfied with the scheme. Householders are already reporting warmer houses and reductions in fuel bills. Householders were particularly appreciative of the improved visual appearance in some schemes and other community benefits such as the creation of local jobs.

9.4 Technical survey

The quality of boiler replacement and the installation of heating controls, voltage optimisers was all of a high standard. In general the quality of EWI installation was high but there were variations between schemes and across different property types. The use of cappings and sealants is a cause for concern, as these may fail in the medium to long term, admitting and trapping water. Of equal concern are condensation risk arising from thermal bridging and reduced natural ventilation but negative consequences will take time to appear so it is not yet possible to say that EWI has been technically successful. It is therefore essential to keep this under review at a representative selection of properties.

9.5 Appropriateness of measures installed

The approach taken to determine which measures were to be implemented at an individual household consisted of several stages. Each house was visited by a qualified energy assessor and a SAP assessment made. This information was used to estimate CO₂ reductions for each potential measure, and estimate costs of work before a decision was taken as to the measures to be applied to each property. This was in line with the overriding principle that each household should receive the most cost effective package of measures and technologies in order to improve the energy efficiency of a home to an Energy Performance Certificate 'C' rating as far as possible.

A further technical assessment was then made of each property to look at the specific practicalities of installing specific measures, and ensuring there were no physical or logistical constraints which would mean a particular measure would not be viable or cost effective. This assessment procedure gave further confidence of the appropriateness of the measures installed, as installation decisions were not made purely on theoretical calculations alone.

The scheme design and due diligence undertaken by both the scheme managers and Welsh Government ensured that only the most appropriate measures have been installed both at each scheme and at each individual household. Therefore we conclude that measures were selected and applied appropriately across all schemes, and are in line with the priority measures and technologies set by Welsh Government.

However, it is important to note that energy efficiency measures can lead to [unintended consequences](#)¹¹ and it is necessary to evaluate the long term effects on heritage and health as well as energy efficiency. In general, EWI was avoided on houses of traditional construction so the impact on heritage has been minimal. This approach should clearly be retained in future schemes.

The health impact of EWI is currently positive as fuel poverty has been reduced and comfort levels increased but, as noted in the conclusions on Technical Survey, the long term risks of moisture ingress and poor air quality are not known and there have been many instances of poor detailing. Properties fitted with EWI must therefore be kept under regular (5 yearly) review and provision made to gather any reports of increased damp or condensation if they arise some years later.

9.6 Scheme selection

The schemes selected were almost all in the lowest 10-30% most deprived areas according to the Welsh Index of Multiple Deprivation (WIMD), which takes in to account income, employment, health, education, access to services, community safety, physical environment and housing. In addition to the

¹¹ 2014 UCL report 100 unintended consequences of measures to improve the energy efficiency of the UK housing stock

schemes being located in area of low income households, the housing stock in each scheme typically contains a very high proportion of houses which are 'hard-to-treat'.

The approach to scheme selection has been successful, in that schemes are in locations most likely to be heavily impacted on by fuel poverty, both due to typically low average incomes and also due to the construction type of the houses in each scheme.

Overall we have concluded that the right areas were targeted in schemes which included the selection of the right type of houses and households, and where benefits and energy efficiency improvements could be maximised

9.7 Lessons for future schemes

The key lessons to be learned for future domestic energy efficiency schemes in Wales may be summarised as follows:

- The strategic aims – Social, Economic and Environmental – should be retained.
- The focus on areas of multiple deprivation is successful and should be maintained. There are great opportunities to use retrofit to regenerate communities, and future schemes could do even more to stimulate local economies, but a different procurement route may be needed.
- External Wall Insulation has a huge impact in improving the lives of residents, not only reducing energy use and improving comfort levels but also in raising the appearance of previously run-down areas. This is greatly appreciated by the residents. For technical and aesthetic reasons, EWI should continue to be avoided for buildings of traditional construction in most cases.
- EWI is a relatively new technology and there have been instances of poor quality installation. Best practice guidance is emerging and we recommend that all specifiers and installers should be trained on courses recognised by key industry, heritage and sustainability bodies. It is important to ensure that this does not become a market entry barrier for local contractors.
- A feedback loop and 5-yearly follow-up survey are required so that the long term effects of EWI on moisture levels and indoor air quality can be monitored, good practice shared and poor practice avoided in future.
- It is very difficult to measure energy savings from specific measures as there are many variables and historical consumption data is required. The advent of smart metering will make this process easier, but if clarity is required earlier then it will be necessary to gather data for a full year before measures are installed. Savings in metered energy use do not reveal the extent of previous under-heating due to fuel poverty.
- Flexibility is required in procurement, to enable necessary repairs to be made to poor state of windows or doors to be made by contractors prior to retrofit.
- The quality of scheme management is critical. Where communication was good, householders had fewer complaints, and the initial engagement is important to ensure that expectations are managed correctly.
- A Whole House approach to retrofit is essential to achieving the strategic aims and to reduce the risk of unintended consequences.

Appendix 1 – Householder survey

Current home and energy use.

Question		
How many people currently live in the property?	No. of adults:	No. of children:
In addition to your main source of heating, do you use any of the following extra sources of heating?	Electric radiators/fires Gas fire Open fire Wood burning stove	
If you do, how often do you use these extra sources of heating?	In Summer: Never Rarely Often Very Often	In Winter: Never Rarely Often Very Often
Prior to the installation of the Arbed EU measure, did the warmth of your home impact on the way you use it in any of the following ways? Give Options:	Only heat a certain number of rooms Wear extra layers of clothing rather than putting the heating on Go out rather than spend time at home	

Householder satisfaction with support during surveying, installation and aftercare.

Question	Poor 1	Inadequate 2	Fair 3	Good 4	Excellent 5
How would you rate your experience of the initial surveying process?	1	2	3	4	5
During the installation, how would you rate your experience?	1	2	3	4	5
How would you rate the support and information provided by the scheme manager?	1	2	3	4	5
How would you rate your experience overall of the Arbed EU Programme?	1	2	3	4	5
Have you experienced any problems related to the measure installed?	Yes		No		
Could the overall experience have been improved in any way?					
Is there anything else, good or bad, which you would like to add about the Arbed EU programme?					

Data collection to assess impact on fuel poverty

<p>How much do you spend on your energy bills per year? Including electricity, and gas/coal/oil/wood?</p> <p>Cost per year</p>	<£500	£1300-£1400
	£500-600	£1400-£1500
	£600-700	£1500-£1600
	£800-900	£1600-£1700
	£900-1000	£1700-1800
	£1000-£1100	£1800-£1900
	£1100-£1200	£1900-2000
	£1200-£1300	>£2000

Appendix 2 – Technical survey

External wall insulation

The technical survey of properties at which EWI had been installed included checks on:

- adjustment to roofline at eaves/gables
- returns at reveals
- windowsills
- any bridging of damp course
- quality of external finish
- side gate reinstatement (if present)
- surface water drainage reinstatement
- any moving of underground drainage
- reinstatement of any other services
- vents – including subfloor
- outside taps
- exterior lights
- power points
- satellite TV/Aerial
- Ventilation
 - Is this adequate now leaks have been sealed?
 - Are all vents functioning and not covered?

Further questions were put to the householder:

- Have all services been reinstated and are functioning?
- Have adjustments to heating controls been made?
- Have any radiators been changed to reflect changes in heat demand?
- Have TRVs been fitted to all radiators?
- Has a thermostat been fitted?
- Is a timer fitted?
- Was clean-up adequate?

Boiler Upgrades

Technical survey of boiler upgrades included the following checks:

- Pipes clipped to walls
- TRVs to all radiators
- All radiators bled
- Termination of condensate pipe
- Controls – thermostat, timer/programmer etc.
- Making good

Further questions were put to the householder:

- Was information provided and clear?
- Do you understand how to operate the boiler?
- Is the system functioning well?
- Temperature of hot water ok?
- No over- or under-heating?

- Were vent keys provided?
- Annual servicing – plan in place?

Heating controls

Technical survey on new heating controls included the following checks:

- Appropriateness of location of thermostat
- Accessibility of system heating controls
- Whether TRVs had been fitted to all radiators (allowing for one radiator as heat dump if necessary)

Further questions were put to the householder:

- Have instructions been provided?
- Do you understand how to operate the controls?
- Have the controls been set to match your pattern of occupation?

Draught proofing

Technical survey on new draught proofing included the following checks:

- Effectiveness of draught exclusion
- Whether any areas had been missed
- Quality of workmanship
- Functioning of all doors and windows treated

Further questions were put to the householder:

- Have any adjustments been made to heating controls
- Is there a noticeable reduction in draughts?
- Any issues with closure of doors or windows?

Voltage optimisers

Technical checks of voltage optimisers consisted simply of checking the presence of an inline switch – breaker/isolator (plus bypass for Vphase units) and that tails were less than 3m. Householders were also asked to comment on whether the electrical supply was operating correctly.

Solar water heating

Technical survey on solar hot water systems included the following checks:

- Collectors
 - free from over shading
 - correct angle of installation (approx. 35°)
 - correct orientation (within 45° of south)
- Cylinder
 - Insulated twin coil cylinder fitted
 - All pipes insulated
 - Controller accessible
- Making good

Further questions were put to the householder:

- Have instructions been provided?
- Do you understand how to operate the controls?
- Does the solar loop pump operate during warm weather?
- Have there been any issues with operation?

Appendix 3 Household telephone follow-up survey

Current Home and Energy Use (to identify factors which may affect comparability of energy use before and after the measures are installed)

Question	
How many people currently live in the property?	No. of Adults:
	No. of Children
	Electric radiators/fires
	Gas fire
	Open fire
	Wood burning stove
	In Summer:
	Never
	Rarely
	Often
	Very Often
	In Winter:
	Never
	Rarely
	Often
	Very Often
If you do, how often do you use these extra sources of heating?	
Do you use your home any differently since the Arbed measure was installed?	Yes/No
If 'Yes', select as appropriate:	Use more rooms
	Use less supplementary heating
	Spend more time at home
	Loft insulation
	Solid Wall insulation
	New boiler
	Air Source Heat Pump
	New heating controls
	Double glazing
	Draught proofing
Have you made any other energy efficiency improvements at the same time or since the Arbed measures were installed?	Yes/No
Have you changed your energy tariff or supplier in the last year?	If no, proceed to next question
Do you think that participating in the Arbed scheme has encouraged you to change your behaviour in any of the following ways?	<ul style="list-style-type: none"> Setting timing controls to avoid heating house when you are out Turning down thermostat Keeping doors and windows closed

<p>If Yes enter details</p>	<ul style="list-style-type: none"> • Closing curtains at night • Switching off radiators in unoccupied rooms • Taking shorter showers
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Householder perception of savings in energy use and bills

Question	
<p>Compared to the same time last year, and now that the measure is installed, do you think your home is...</p> <p>Following the Arbed measures and compared to last year, do you find that you need to switch on the heating....</p> <p>If Less Often, what is the reason?</p> <p>If More Often, what is the reason?</p>	<p>Warmer/No Difference/Colder</p> <p>Less often/No Difference/ More often</p> <p>House is warmer House is better insulated House is less draughty Warmer weather</p> <p>House is colder Can afford to have the heating on more often Colder weather</p>
<p>Since the measure was installed, what difference do you think it has made to your energy bills?</p> <p>Since the measure was installed, have you changed the level that you set the temperature to?</p> <p>If temperature is set lower, what is the reason?</p> <p>If temperature is set higher, what is the reason?</p>	<p>Lower/No Difference/Higher</p> <p>Lower Setting/No Difference/ Higher Setting / Don't set it to a particular temperature</p> <p>House is warmer House is better insulated House is less draughty Trying to save energy</p> <p>House is colder Can afford to have the heating on a higher temperature</p>

Householder perception of improvements to comfort and health

Question	
Since the measure was installed, do you feel more comfortable in your home?	Yes/No/No difference
If Yes, for what reason?	House is warmer Reduced draughts Other, comment.
If no, for what reason?	
Since the measure was installed, have you noticed any improvements to you or your family's health?	Yes/No
If Yes...	Reduced incidence of colds/respiratory issues Reduced arthritis/joint issues Other, comment.
Did you have any problems with damp or condensation before the installation?	Yes/No
If yes, has there been any improvement since the Arbed measure was installed? select as appropriate:	Reduction in damp issues Y/N Reduction in condensation Y/N
Do you think that the Arbed scheme has had an impact on the local community?	

Data collection to assess impact on fuel poverty

"The Welsh Government would like to work out whether the scheme has had a significant impact in terms of reducing the number of households who spend more than 10% of disposable income on fuel. Disposable income is defined as income after tax but before rent or mortgage is paid."

Question	
What is the estimated net household income in the last 12 months?	£5,000 – £7,500 £7,500 – £10,000 £10,000 – £12,500 £12,500 – £15,000 £15,000 – £17,500 £17,500 – £20,000 £20,000 - £22,500 £22,500 - £25,000 >£25,000

<p>Do you have the energy bills available over the last 12 months? (Surveyor to total and input value in boxes)</p> <p>Note if bills are actual or estimated readings</p>	Cost per year
	<£500
	£500-600
	£600-700
	£800-900
	£900-1000
	£1000-£1100
	£1100-£1200
	£1200-£1300
	£1300-£1400
	£1400-£1500
	£1500-£1600
	£1600-£1700
	£1700-1800
	£1800-£1900
£1900-2000	
>£2000	

Aftercare

Question	
Have you experienced any problems related to the measure installed?	Yes/No
If yes, please detail:	
If aftercare was required, were the issues resolved quickly and to your satisfaction?	Yes/No
If no, please detail:	



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