Hot off the Grid: Delivering energy efficiency to rural, off-gas Scotland

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Consumer Futures Unit

Contents

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Foreword

Background

Mains gas is the cheapest way to heat a home but 23% of Scottish households[1] rely on more expensive fuel types, such as bottled gas or electricity, to heat their property. Consumers without mains gas generally pay more to heat their home, and are more likely to be in fuel poverty[2]. Many off-gas households are located in rural areas and are vulnerable to fuel poverty owing to a number of additional factors, such as a greater prevalence of colder properties which are harder to treat with energy efficiency measures. As such, rural, off-gas areas can have significantly higher instances of fuel poverty than the Scottish average[3].

Retrofitting energy efficiency measures in Scotland's existing housing stock has been central to the Scottish and UK Government's efforts to reduce consumer energy bills, rates of fuel poverty and greenhouse gas emissions. The Scottish government have committed to continued investment in energy efficiency through designation of energy efficiency as a national infrastructure priority. This commitment, in addition to the transfer of further powers over energy efficiency funding through the Scotland Act 2016 will see the introduction of Scotland's Energy Efficiency Programme (SEEP) will offer support to ensure that all buildings (domestic and non-domestic) in Scotland can achieve a good energy efficiency rating.

The research project

Both the Scottish and UK governments previously identified off-gas households as a particular priority for their fuel poverty strategies and the Scottish government has committed to support those in rural and remote areas of Scotland. In our role as the energy watchdog for Scottish consumers, the Consumer Futures Unit (CFU) commissioned independent research in an attempt to identify whether fuel poverty and energy efficiency schemes are, and have historically been, designed with consideration for meeting the specific needs of rural, off-gas consumers.

Further to this, Scottish Citizens Advice bureau advisors had identified qualitative case evidence on issues consumers brought to the service in 2015. Social housing providers or private landlords had replaced the domestic heating systems in their off-gas housing stock, as a result of which consumers reported instances of higher costs or an alternative system that was otherwise deemed unsuitable. We wanted to test whether these cases were isolated or whether the issue was widespread and compounding problems for rural, off-gas consumers. The research therefore also aimed to ascertain whether energy efficiency support effectively reaches off-gas, rural households and if the consumers receiving these measures were satisfied with the outcome.

The report includes geographic mapping of the distribution of measures installed in rural areas [4] and a review of the provision for rural, off-gas consumers within the design of past and present energy efficiency and fuel poverty schemes. The report also contains perspectives from both social housing tenants and their landlords, examining their experience of retrofitting and living in off-gas, rural properties where different types of heating systems have been installed.

1 Insights paper on households with electric and other non-gas heating. Ofgem 2015

2 Offgas consumers: Information on households without mains gas heating. Consumer Focus 2011

3 The Energy Advisory Service (2014) "Fuel Poverty Report 2014" for Comhairle nan Eilean Siar has suggested that over 70 per cent of households living in the Western Isles may be living in fuel poverty.

4 Please see the report for data limitations

The work was undertaken in attempt to further understand how best to target support to consumers in off-gas, rural areas and to ensure that specific groups of consumers are not suffering detriment, such as higher energy bills or unsuitable domestic heating systems, as a result of the decarbonisation agenda. It is hoped that lessons learned can be extrapolated to guide project delivery in other areas, for example, if regulation of energy efficiency standards in the private residential sector is introduced in Scotland.

Findings and recommendations

The report finds that up until ECO, rural areas have not benefitted significantly less than urban areas in terms of the number of the total measures installed through energy efficiency and fuel poverty schemes. In fact large urban areas are as likely not to benefit as rural areas, owing to factors such as hard-to-treat property types located in city centres. However, the CFU reads this finding with caution as, for example, ECO has clearly delivered greater volumes of measures to urban areas and urban areas are likely to have benefitted from a number of schemes for longer. Furthermore the urban/rural distribution does not take into account factors such as the higher levels of fuel poverty and the lower energy efficiency of properties that we know to exist in certain rural areas.

The research also highlights that whilst savings are likely when replacing a household's central heating system, they are not always realised. It was beyond the reach of this research to measure actual savings, however further work is required to determine why some consumers are reporting an increase in their bills after certain heating system installations, and to determine whether this can be negated through further support and information.

The report underlines the importance of sufficient instruction and guidance accompanying any energy efficiency installations. A number of consumers reported that they did not feel confident using their new central heating system after it was installed. Effective guidance is significant as an effective central heating system is integral to the comfort levels and running costs of a home. New technologies may have entirely different controls and may operate in a different way to a previous and familiar system.

The recommendations provided within the report were produced by Changeworks on behalf of the CFU. The recommendations therefore do not necessarily represent the views of CAS however we hope that they will provide the basis for further discussion on the appropriate ways of reaching rural, off-gas consumers with future energy efficiency and fuel poverty schemes in Scotland.

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Hot off the Grid: Delivering energy efficiency to rural, off-gas Scotland

Report by Changeworks and CAG Consultants for C

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EXECUTIVE SUMMARY

Almost a quarter of Scottish householders do not have access to mains gas or do not use it as their main heating fuel. Many of these consumers also live in rural areas where, as well as relying on more expensive fuels, other factors make them more vulnerable to fuel poverty. Fuel poverty rates in some of these areas are much higher than the national 35 per cent figure in Scotland[5]. Citizens Advice Scotland (CAS) was keen to know whether consumers in these areas were benefiting as much as their urban counterparts from UK and Scottish Government efforts to improve the energy efficiency of homes. In addition, CAS was aware of a number of cases coming into their Citizens Advice Bureaux (CABx) of social housing tenants in rural, off-gas areas reporting unaffordable new heating systems and wanted to explore this topic further.

Aim

CAS commissioned Changeworks and CAG Consultants to carry out research to:

1) determine what level of support is currently available to rural, off-gas consumers through energy efficiency and fuel poverty schemes, and whether this support is reaching these consumers
2) determine what types of replacement heating systems are being fitted into social housing in rural, off-gas areas, and whether they are consistently lowering household bills
3) understand social landlords' strategies to replace heating systems in rural, off-gas areas, including an understanding of decision-making, installation procedures and evaluation methods being applied
4) understand the consumer experience of new heating systems

Method

The research was carried out via:

- an analysis of Scottish and UK energy efficiency schemes, including data analysis and geographic mapping
- gathering cost data on heating replacements
- energy modelling (using RdSAP, the software behind EPCs) to determine running costs and the effects on 'SAP scores'[6]
- a survey of 30 Scottish social landlords in rural, off-gas areas, supplemented by interviews with nine social landlords
- interviews with 30 social housing tenants living with replacement heating systems in rural, off-gas housing

Key findings

The research found that, overall, energy efficiency schemes delivered until the start of ECO did not have an urban bias i.e. overall, urban areas have not benefited more than rural areas from these schemes. On average, homes in rural areas have received slightly *fewer* measures than the overall average across Scotland. However,

[5] In 2014, 34.9 per cent of households were deemed to be in fuel poverty. Source: http://www.gov.scot/Topics/Statistics/Browse/Housing-Regeneration/TrendFuelPoverty

[6] These are the scores behind EPC ratings which rate the energy efficiency of a property.

homes in ‘large urban areas’ also received fewer measures than the average for all areas and it was other types of urban areas that received more measures per household than average.

Economies of scale that can be achieved in delivering energy efficiency schemes in urban areas and developed supply chains mean that urban areas may have benefited from schemes earlier and over longer periods. However this is offset by a number of factors: (a) specific elements of schemes designed to target rural, off-gas areas, (b) fuel poverty programmes targeting properties with poor energy efficiency ratings (which are more prevalent in rural areas), and (c) Scottish area-based schemes which ensure that all local authority areas benefit.

A variety of heating systems are being fitted into social housing in rural, off-gas areas including air source heat pumps (ASHPs), ‘smart’ storage heaters, electric boilers, biomass / multi-fuel boilers or stoves, infrared systems and solar thermal (for hot water only). By far the most commonly installed technology is ASHPs, with ‘smart’ storage heaters also being commonly installed and to some extent, biomass boilers/multi-fuel stoves.

Energy modelling suggests that replacement heating bills will reduce from replacing heating systems, sometimes considerably so. This was backed up by most experiences of social landlords and tenants; however, there were cases where bills were reported to not have decreased and in some cases, increased. The energy modelling suggests that higher cost technologies (such as ground source heat pumps (GSHPs)) are likely to reduce tenants’ energy bills more than lower cost technologies (ASHPs, ‘smart’ storage heaters and electric boilers).

Landlords are replacing heating systems because of cyclical replacement programmes, needing to meet the Energy Efficiency Standard for Social Housing (EESSH) and the desire/aim to reduce tenants’ fuel bills. The choice of technology is based on a number of factors such as installation cost, tenant satisfaction, and maintenance requirements. Decision-making processes differed between landlords, with some finding it more difficult / complex than others. Lack of information was cited by some as an issue.

Critical to the success of any of the heating systems is ensuring tenants understand and can use it effectively. This is more challenging for some systems which may be considered new or complex (such as ASHPs). All landlords reported that they are delivering advice to tenants and recognise the importance of this; however more needs to be done to ensure advice is sufficient and delivered in an easy-to-understand manner.

Few landlords have carried out robust monitoring and evaluation of the impact of heating system replacements, but where done on a smaller scale it is reported to have helped inform technology choice.

Consumer experience of technologies was generally positive in terms of ease of use, warmth provision and affordability. No technology emerged as clearly the ‘best’ technology or the ‘worst’ technology (although it should be caveated that sample sizes for this part of the research were small). Problems were encountered with some

technologies; for example, heat provision of ‘smart’ storage heaters in the afternoon / evening. However many of the problems encountered seemed likely to have been easily resolved following advice from landlords or installers which led to better user behaviour.

Recommendations

1. UK and Scottish energy efficiency and fuel poverty schemes should continue to be pro-actively designed in such a way that rural, off-gas areas benefit as much as urban areas. Given that fuel poverty rates tend to be highest in rural, off-gas areas, consideration could also be given to providing greater support to these areas.

2. Landlords should provide appropriate guidance and support to tenants to ensure effective use of systems to maximise heating bill reductions, provision of warmth and tenant satisfaction. This should include:
    - demonstrations and in-home explanations on how to use the system
    - easy-to-understand and simple written instructions
    - follow-up advice to ensure correct understanding
    - greater support for vulnerable tenants e.g. elderly tenants
    - advice for new tenants when moving into the home, as well as when new systems are fitted
    - advice on the most appropriate tariff (and in some cases advocacy to resolve disputes with energy suppliers).

3. More monitoring and evaluation should be carried out on the impact of heating replacements in rural, off-gas areas to better understand the impact on running costs, the life cycle costs of newer technologies and to better understand the experience of tenants. This is particularly important for vulnerable tenants.

4. Where feasible, landlords should give tenants a choice of replacement heating systems. In these situations, tenants should be given appropriate information to ensure they can make a well-informed choice.

5. Landlords should have a thorough understanding of the impact of heating replacements on SAP scores so that the impact on EESSH compliance is known. However landlords must also factor in wider considerations such as tenants’ acceptance of the technology (influenced by real or perceived understanding of ease of use or disruption during install).

6. In their choice of technology and scheme design (e.g. tenant engagement methods, evaluation, etc.), social landlords should seek to share information with other landlords and undertake their own pilot schemes to derive learning.

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Highland Council
Lochaber Housing Association
Orkney Council
Scottish Borders Housing Association
South Lanarkshire Council

We would also like to thank the social housing tenants who took part in this research.

1. INTRODUCTION

Fuel poverty is a reality for over a third of Scottish households. However in rural, off-gas parts of Scotland the extent of fuel poverty is even greater; for example, half of households in the Highland Council area and 70 per cent in the Western Isles are in fuel poverty. Mains gas is the least expensive heating fuel, leaving the 541,000 householders[7] in off-gas areas, or who do not use gas as their main heating fuel, with reduced heating options and the likelihood of using higher cost fuels to heat their homes. In addition their vulnerability to fuel poverty is also increased in rural areas through other factors including lower-than-average income levels and poor home energy efficiency.

Both the UK and Scottish Governments have identified off-gas households as a particular priority for their fuel poverty strategies. As part of this, a series of policies have sought to increase the energy efficiency of domestic properties such as the UK's Energy Company Obligation (ECO) scheme and The Scottish Government's Home Energy Efficiency Programmes for Scotland (HEEPS) scheme. However there was a sense that consumers in off-gas, rural areas may not be benefiting from these schemes as much as consumers living in urban areas. Therefore, this research set out to explore the extent to which these schemes are designed to help, and are reaching rural, off-gas consumers.

With typically more than half of a household's energy bills going on space and hot water heating, the choice of heating system and fuel have a significant impact on a householders' vulnerability to fuel poverty. Citizens Advice Scotland (CAS) was also keen to find out more about the decision-making process landlords use when choosing heating system technologies for rural, off-gas social housing and subsequent landlord and tenant experiences. This follows a number of issues raised by Citizens Advice Bureaux (CABx) of replacement heating systems proving unaffordable for tenants in these areas. In the context of relatively new Energy Efficiency Standards for Social Housing (EESSH), this research set out to explore which heating technologies have been installed, for what reason, and landlord and tenant experiences of the technologies.

This report details research on these two topics: the delivery of energy efficiency schemes in rural, off-gas areas, and heating replacements in social housing in these areas. The research was undertaken by Changeworks and CAG Consultants for CAS in early 2016.

Note: a glossary is provided in Appendix A of technical terms used throughout this report.

[7] Off-gas consumers: Information on households without mains gas heating. Consumer Focus 2011. 23% of Scottish homes do not have or use gas for heating: 13.6% are off the gas grid, 7.3% are in a gas postcode but do not use gas and 2.3% use gas for other appliances but not for heating.

2. RESEARCH OBJECTIVES

The research was split into two main sections, each with three objectives:

Section 1: Review of energy efficiency schemes

1. What level of support is currently available to rural, off-gas consumers through energy efficiency and fuel poverty schemes?
   - *Has the targeting of off-gas properties been designed and embedded into past and current schemes?*
   - *What types of measures were available through schemes?*
   - *What was the level of funding available for off-gas properties?*

2. To what extent is this support reaching these consumers?
   - *What number and which type of measures were actually installed?*
   - *Where have measures been installed?*

3. If possible, to quantify how much money rural, off-gas consumers have contributed to schemes, such as ECO, and how much they have received from it.
   - *How much money is being paid into schemes (and specifically ECO) by consumers in off-gas areas?*
   - *How much (via measures) have off-gas consumers received from schemes?*

Section 2: Heating system replacements in social housing

1. When energy efficiency measures (specifically heating systems) are delivered to off-gas consumers are they consistently lowering household bills and are they suited to those households receiving them?
   - *What is the impact of replacement heating systems on running costs?*
   - *How well suited are systems to tenants' needs and lifestyles?*

2. To understand how energy efficiency measures (specifically heating systems) are delivered in off-gas properties by engaging with social landlords to understand the strategy, decision-making, installation procedures and evaluation methods associated with the project
   - *What impact are local or national strategies having on social landlords' decision-making processes for low carbon heating system replacements or upgrades?*
   - *What are the underlying drivers and criteria influencing decision-making?*
   - *What cost-benefit analysis are social landlords undertaking to inform choice of upgrades?*
   - *What engagement took place with tenants during the installation process?*
   - *What evaluation of heating upgrades was undertaken and how was it integrated in heating replacement schemes?*

3. To understand the consumer experience of new energy efficiency measures (specifically heating systems)

- *What was the level of consultation and engagement experienced pre-, during, and post-install of replacement heating systems?*
- *What has been the impact on running costs?*
- *What has been the tenant experience of the new heating system (ease of use, acceptability, impacts on wider health and wellbeing)?*

3. METHODOLOGY

This section outlines the project methodology. As per the research objectives, this has been split into two sections. Additionally, there was a brief background review which informed the overall project.

A glossary is provided in Appendix A of technical terms used throughout this report.

3.1 Background research: case evidence review

The research was informed by a very brief background review in the form of CAS evidence provided. CAS identified evidence of cases that had come through their CABx of issues arising regarding heating replacements in rural, off-gas areas. Eight CAB from different locations around Scotland identified issues with heating system replacements as a social policy issue[8]. Changeworks reviewed these cases to identify key issues arising. These informed the remainder of the research, particularly the tenant and social landlord interviews.

A summary of the issues in these eight cases, and two case study examples are provided in Section 4, the Background.

3.2 Section 1: Review of energy efficiency schemes

This part of the research looked at what level of support is currently available to rural, off-gas consumers through energy efficiency and fuel poverty schemes, and whether support was reaching the consumers.

There is a long history of energy efficiency and fuel poverty schemes in the UK so to ensure the review was manageable, it was decided to review the main schemes which have operated since the Carbon Emissions Reduction Target (CERT) was introduced (2008). This included:

- the UK-wide supplier obligations
- other UK-wide energy efficiency schemes
- Scotland-specific energy efficiency and fuel poverty schemes
- UK-wide cash-benefits schemes
- renewable energy schemes

The review involved exploring, for each scheme, whether any specific components were included to facilitate delivery of measures to rural, off-gas consumers.

Geographic mapping

In addition, data was sought on the geographic distribution of measures delivered under each of the schemes in the review and any previous schemes, in order to

[8] The majority of Citizens Advice Bureaux in Scotland use a real-time electronic case recording system, and send case notes from client enquiries which demonstrate services or policies which they feel are failing to meet clients' needs to the Policy Team at Citizens Advice Scotland. These case notes, known as Social Policy Feedback Forms (SPFFs), are typically between 100 and 500 words, and are written up by the CAB adviser directly following a client interview.

assess the extent to which energy efficiency and fuel poverty schemes have delivered to rural, off-gas consumers. The principal sources of data on geographic distribution were:

- The Energy Saving Trust supplied data from their Homes Energy Efficiency Database (HEED), at datazone level, on energy efficiency measures which have been installed under the following programmes:
    - Energy Efficiency Commitment (EEC)
    - Carbon Emissions Reduction Target (CERT)
    - Community Energy Saving Programme (CESP)
    - Home Insulation Scheme (HIS)
    - Energy Assistance Package (EAP)
- Local authority-level data on measures installed under ECO and some of the other UK-wide schemes published by Ofgem
- Local authority-level data on many of Scotland-specific schemes published by the Energy Saving Trust (EST)
- The Scottish Government supplied local authority-level data on measures installed under HEEPS:ABS in 2013-14

3.3 Section 2: Heating system replacements in social housing

This part of the research had three specific areas, as outlined below. In total, they aimed to look at heating system replacements in social housing in terms of:

(a) Costs and benefits of heating systems
(b) Approaches social landlords are taking to undertake heating replacements
(c) The consumer experience of heating replacements

(a) Costs and benefits of heating systems

Analysis of install costs

This task sought to collect data on the costs of purchasing and installing different heating technologies in rural, off-gas areas. The variety of different 'replacement' heating systems currently being installed throughout off-gas accessible and remote rural Scottish regions is relatively wide and therefore six 'replacement' heating system types were selected to reflect a range of the most common technologies and fuels: ground source heat pumps (GSHPs), air source heat pumps (ASHPs), biomass boilers, oil boilers, electric boilers and 'smart' storage heaters.

Indicative install costs for these six 'replacement' heating systems were collected by gathering data from a number of sources[9]:

- Changeworks Development and Delivery team (responsible for programme management of a number of HEEPS:ABS programmes)
- Home Energy Scotland / the Energy Saving Trust (from actual installations in private housing)
- Previous data researched for other projects by the Changeworks Consultancy team

[9] Actual sources included: Home Energy Scotland (EST), Grant UK, Highland Council, John Rae/ Update Systems, Heating Scotland, Neat Heat and Solarae.

- Contact with installers

When sourcing costs from the various contacts listed above, a high level generic figure was requested. It was specified that the cost should account for installation of the heating technology plus heat distribution system (pipework and radiators) for a standalone property (3/4 bedroom) located in an accessible or remote rural location. Awareness was given to the fact that a high number of other variables would normally affect such a costing but that for the purposes of this study, a 'ball park' figure was required.

The costs gathered for each of the six 'replacement' heating systems were averaged to create one high level generic figure for each technology type. Due to the disparity[10] in the level of cost data available / sourced for each technology in conjunction with the generic nature of the costs provided, the heating systems have been categorised as follows:

- High install cost: >£15,000
- Medium install cost: <£15,000 but >£10,000
- Low install cost: <£10,000

These per property cost assumption categories have been used as references or comparisons in various sections throughout the report.

Energy (SAP) modelling

Modelling (using RdSAP software[11]) was completed in order to:

1. provide theoretical running costs and SAP scores for three property archetypes using six 'existing' and six 'replacement' heating systems
2. enable a review of SAP recommendations for different scenarios (property postcode, property size and level of energy efficiency / insulation) and how these might be guiding installation of heating systems in social housing depending upon the Scottish regions.

Details of the methodology followed to fulfil these two tasks are detailed below:

1. Theoretical running costs and SAP scores

<u>Example properties</u>

Three property archetypes were selected based on those most common throughout Scottish rural, off-gas areas[12]:

1. 4-bed detached stone house (pre 1919)
2. 3-bed semi-detached cavity wall house (1965-75)
3. 4-bed detached timber frame house (2003-07)

[10] Low numbers of costs were available for some heating systems versus extremely high numbers for others; for example only three costs were received for 'smart' storage heaters versus 500 plus for biomass boiler systems.
[11] NES One online software using RdSAP v9.92.
[12] Property sizes are based on assumptions provided by the Energy Saving Trust. See http://www.energysavingtrust.org.uk/corporate/our-calculations

Energy modelling (using RdSAP) was carried out for each of the three property archetypes using, firstly the six 'existing', and secondly the six 'replacement', heating systems as outlined below.

Heating systems

The six 'existing' and six 'replacement' heating systems used to complete the modelling across the three property types outlined above (36 scenarios) were selected[13] as being those most common to Scottish rural, off-gas areas (Table 1).

Table 1: Six 'existing' and 'replacement' heating system types used in modelling

Existing heating systems	Replacement heating systems
Open fire & plug in heaters (i.e. no central heating)	'Smart' storage heaters
Electric traditional storage heaters	ASHPs (air to water)
Bulk LPG boiler	GSHPs
Aga/ Rayburn, solid fuel back boiler system	Biomass boilers
Auto feed solid fuel floor mounted boiler	Electric boilers
Oil boiler	Oil boilers (condensing)

Other assumptions

Using the property type and heating system information as detailed above, RdSAP modelling was carried out to generate theoretical running costs and SAP scores across each of the 36 scenarios.

To enable this modelling to be completed, various constants and variables were assumed across the three property types including: rurality, heating regime, property size, insulation levels, glazing type, appliance costs and fuel costs. Full details of these assumptions are outlined in Table 1 in Appendix B.

2. SAP Recommendations

The RdSAP modelling completed as part of the first task ('Theoretical running costs and SAP scores') provided an overview of those property archetypes and heating system combinations that would give the highest / lowest heating system running costs and best / worst SAP scores.

To further the initial analysis and review how SAP recommendations[14] might guide or be guiding heating system selection across different Scottish regions, modelling (also using RdSAP software) for a number of additional scenarios was undertaken. These scenarios focused on how changing the following parameters might affect property SAP scores and theoretical heating system running costs:

1. The location (postcode)
2. The size of a property
3. The level of insulation.

[13] These systems were selected and agreement sought from CAS prior to proceeding.
[14] Based on the inputs and assumptions used in the RdSAP software.

Full details of the scenarios used for the RdSAP modelling and the various parameters assigned are outlined in Table 5 in Appendix B.

(b) Social landlord survey and interviews

Survey

An online survey was designed to gather views of social landlords regarding heating replacements in rural, off-gas parts of Scotland. It explored: which technologies had been installed and replaced, views on performance and the effectiveness of different technologies, the decision-making process, costs and funding, tenant advice and evaluation.

The survey was distributed via Changeworks' own contacts and via the Scottish Federation of Housing Association (SFHA)'s online newsletter. It was live for two weeks in February 2016. A reminder was sent to encourage completion.

Thirty responses were received to the survey. There are approximately 200 social landlords in Scotland[15], giving a response rate of 15 per cent, which is typical for online surveys. However it is not known how many of the 200 have properties in rural, off-gas areas.

A copy of the survey is given in Appendix C.

Interviews

Interviews were undertaken with nine social landlords to gather in-depth perspectives on their experiences and decisions in relation to heating replacements. Survey respondents were asked if they would be willing to participate in an interview; however, few responses were received and Changeworks directly contacted other landlords to arrange interviews.

The nine interviewees included:

- Six housing associations and three local authorities
- Organisations with a range of housing stock numbers under management (<1000 to >3000)
- Organisations based in different locations in Scotland, including remote rural areas

A copy of the topic guide is in Appendix C.

(c) Tenant interviews

Interviews were undertaken with 30 tenants with replacement heating systems in rural, off-gas areas. The tenants were from five different social landlords across Scotland and had a variety of heating systems. Given the short timescales to conduct the research, Changeworks was only able to gather data from a limited number of landlords and therefore limited technologies. It had been planned to get an even spread of technologies through these interviews (i.e. interview five tenants with each technology) but this was not possible. However the numbers (see Table 7 in Section

[15] Scottish Housing Regulator: Directory of Social Landlords

8) reflect the popularity of the technologies. For instance, more tenants were interviewed with ASHPs and this reflects the fact that this technology has been installed more than others (as shown in the social landlord survey).

The interviews explored tenant satisfaction with the heating system including ease of use, provision of warmth and affordability. They also explored tenant perspectives on the advice / information provided by their landlord and the installation process. A copy of the topic guide is provided in Appendix C.

The interviews lasted 25 – 30 minutes and were carried out over the phone. Shopping vouchers (£20) were provided as an incentive to participate in the interviews.

Tenant details were gathered from social landlords who were willing and able to provide this data. Tenants were then contacted and asked if they would be willing to participate in the interview.

4. BACKGROUND

CAS has commissioned this piece of research to assist in developing a greater understanding as to the means of support available for rural, off-gas householders in Scotland and to determine the full range of impacts that specific changes to domestic heating systems can have, particularly in social housing.

Currently Scotland has approximately 541,000 households (23 per cent) that are not connected to the mains gas grid or who do not use it for their main heating fuel[16]. Mains gas is currently the lowest cost fuel for domestic space heating and therefore those without mains gas generally pay more to heat their home and are more likely to be in fuel poverty[17].

Rising fuel costs and UK and Scottish Government pledges have furthered the drive to install energy efficiency measures in homes including new domestic heating systems. Such drivers include:

- the requirement to reduce Scotland's greenhouse gas emissions annually toward an 80 per cent reduction by 2050
- a statutory obligation that requires Scottish Ministers to eradicate fuel poverty, as far as reasonably practicable, by November 2016
- the Scottish Heat Policy Statement (June 2015) that outlines the Government's aims to largely decarbonise the country's heat system by 2050
- social landlords compliance of the Energy Efficiency Standard for Social Housing (EESSH) by 2020.

The EESSH aims to encourage landlords to improve the energy efficiency of social housing in Scotland by setting out minimum SAP ratings that must be complied with by 2020. The SAP ratings differ depending upon dwelling and fuel type used as well as the SAP version used to complete the modelling (see Tables 2 and 3 in Appendix B, for full details of the compliance scores).

To date, improvements to Scotland's properties have tended to focus on a 'fabric first' approach whereby heating systems are upgraded following a property being fully insulated. However, given the need for social landlords to comply with EESSH, the fact that much of the required insulation measures have already been installed and that heating systems invariably give greater SAP scores than insulation measures, the installation or upgrading of heating systems to 'new' technologies (such as heat pumps, biomass, 'smart' storage heaters and electric / oil boilers) is becoming increasingly prevalent.

Over the past year, CAS has become aware of issues being raised through their Scottish CABxs[18] in relation to social tenants and associated problems with their replacement heating systems. Some evidence of this can be seen in the following examples CAS provided of households who have raised the following issues:

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[16] Off-gas consumers: Information on households without mains gas heating. Consumer Focus 2011. 23% of Scottish homes do not have or use gas for heating: 13.6% are off the gas grid, 7.3% are in a gas postcode but do not use gas and 2.3% use gas for other appliances but not for heating.

[17] Insights paper on households with electric and other non-gas heating: Ofgem 2015

[18] http://www.cas.org.uk/publications/advice-detail-energy-2014/15

- new meter with new electric boiler system caused billing / utility issues
- upfront payment for oil too much for low income householders
- issues with their energy utility company (billing and providing a new meter) since installation of new electric boiler
- unexpectedly high bills likely due to electric boiler
- wrong meter increasing bills for household with electric boiler

This research therefore provides CAS and wider stakeholders with an increased understanding of the support available and associated effects that energy efficiency measures (including upgraded heating systems) have had on rural, off-gas consumers.

The research also follows a body of research looking at social landlords' and tenants' experiences of energy efficiency and renewable technologies. Most notably, Changeworks carried out research into experiences of microgeneration in social housing in 2011-12 for CAS's predecessor, Consumer Focus Scotland[19].

Case Study: North of Scotland

A client in the North of Scotland sought help from a Citizens Advice Bureau (CAB) regarding their high energy bill. Over a three month period they had been paying £150 per month but still owed £252 to their supplier. The client lived in a one bedroom sheltered property rented from a social landlord.

A CAB adviser contacted their energy supplier, enquiring as to why the client's recent bills had been much greater than the projected cost. The energy supplier representative explained it was likely due to the client's electric boiler.

The CAB adviser recommended that the client applied for the Warm Home Discount (WHD) and suggested they call their landlord to discuss upgrading their heating system. There had previously been a plan to replace the heating system in the client's property with a biomass system, however, the local Council decided not to go ahead with this proposal.

Case Study: East of Scotland

A CAB in the East of Scotland reported a social housing client seeking advice on the payments required for their new heating system. The client's storage heaters were due to be replaced with a new oil central heating system and they were concerned about affording the upfront payment of £500 required by the oil suppliers for the first fill of the oil tank.

The CAB signposted the client to advice from Home Energy Scotland (on any grants available), and from a Credit Union via their local Council (to discuss credit for the first oil tank fill).

[19] Consumer Focus Scotland (2012) 21st century heating in rural homes

5. ENERGY EFFICIENCY SCHEMES IN SCOTLAND

Section 5 examines the extent to which the design and reach of previous and current energy efficiency schemes have sought to ensure that they were/are able to reach rural, off-gas consumers, and the extent to which, in practice, they have delivered to rural, off-gas consumers (as far as the data allows).

5.1 Review of the design and reach of individual schemes

Table 7 in Appendix D presents a review of relevant schemes in the context of the research objectives. In summary, it shows that:

- Ensuring delivery in rural, off-gas areas has been factored into the design of the main UK-wide supplier obligations (the Carbon Emissions Reduction Target (CERT) and the Energy Company Obligation (ECO)). For example, the Carbon Saving Community Obligation (CSCO) of ECO has a rural sub-obligation: 15 per cent of CSCO has to be delivered in rural areas to consumers on certain types of benefits. The design of this has recognised the tendency of schemes to favour urban areas because of the economies of scale which can be achieved in some urban locations. However, in spite of their design, all of the UK-wide supplier obligations (including CERT and ECO) have had an urban bias in terms of delivery.
- The Scotland-specific area-based schemes (HIS, UHIS, HEEPS: ABS) have involved distributing funding to all local authorities, which has countered the urban bias brought about by the UK-wide supplier obligations to some degree.
- In addition, the targeted fuel poverty programmes (EAP, EAS and Warmer Homes Scotland) have disproportionately benefited rural areas because of the higher proportion of homes in these areas which have poor energy efficiency ratings (these schemes specifically target such homes).
- The main UK-wide cash benefits schemes (Warm Home Discount and Winter Fuel Payments) have not targeted rural, off-gas consumers but the Cold Weather Payment has had a strong bias towards colder inland rural areas in Scotland (the Grampian and Cairngorm areas in particular).
- All of the renewable energy schemes have had a strong bias towards rural, off-gas areas. This is because most domestic renewables, even with the support of such schemes, tend to be less attractive financially and practically viable in urban on-gas locations.

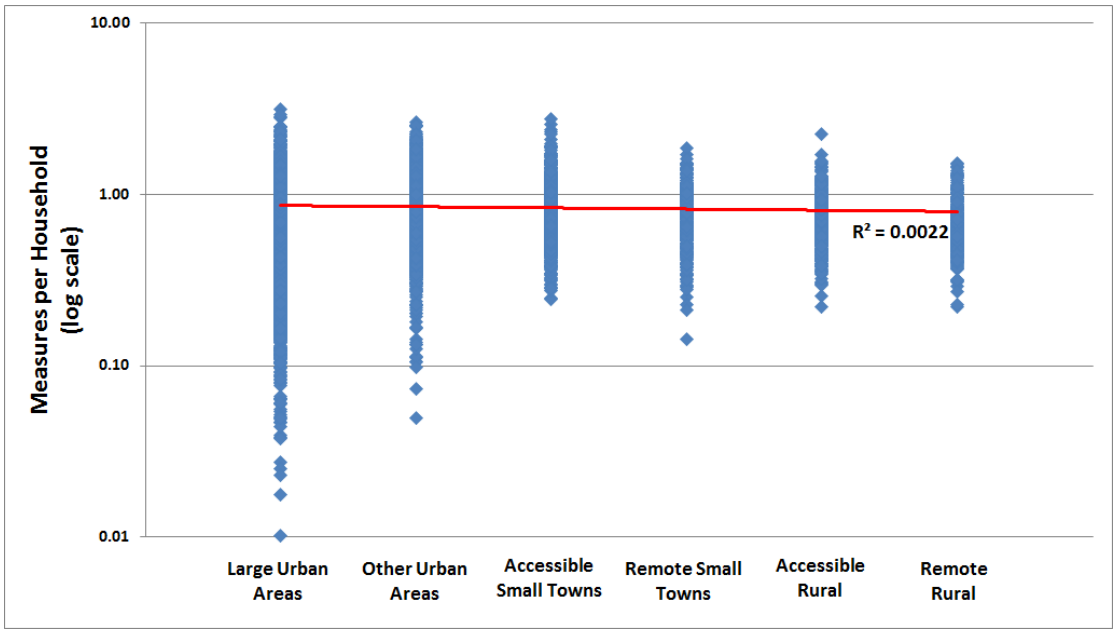
5.2 Analysis of the reach of energy efficiency and fuel poverty schemes

Overall analysis

The distribution of energy efficiency measures contained in HEED is shown in Graph 1. It shows the relationship between the intervention rate in a datazone (number of energy efficiency measures per household) and the urban-rural classification of that datazone. Overall the graph shows that there is a very weak linear correlation between intervention rate and urban-rural classification, i.e. no significant bias overall in the delivery of measures towards urban areas. It should be noted that this is based

on HEED data which only contains data on schemes delivered up until the introduction of ECO.

Graph 1: Correlation between total measures per household in HEED and urban-rural classification[20], at datazone level[21]



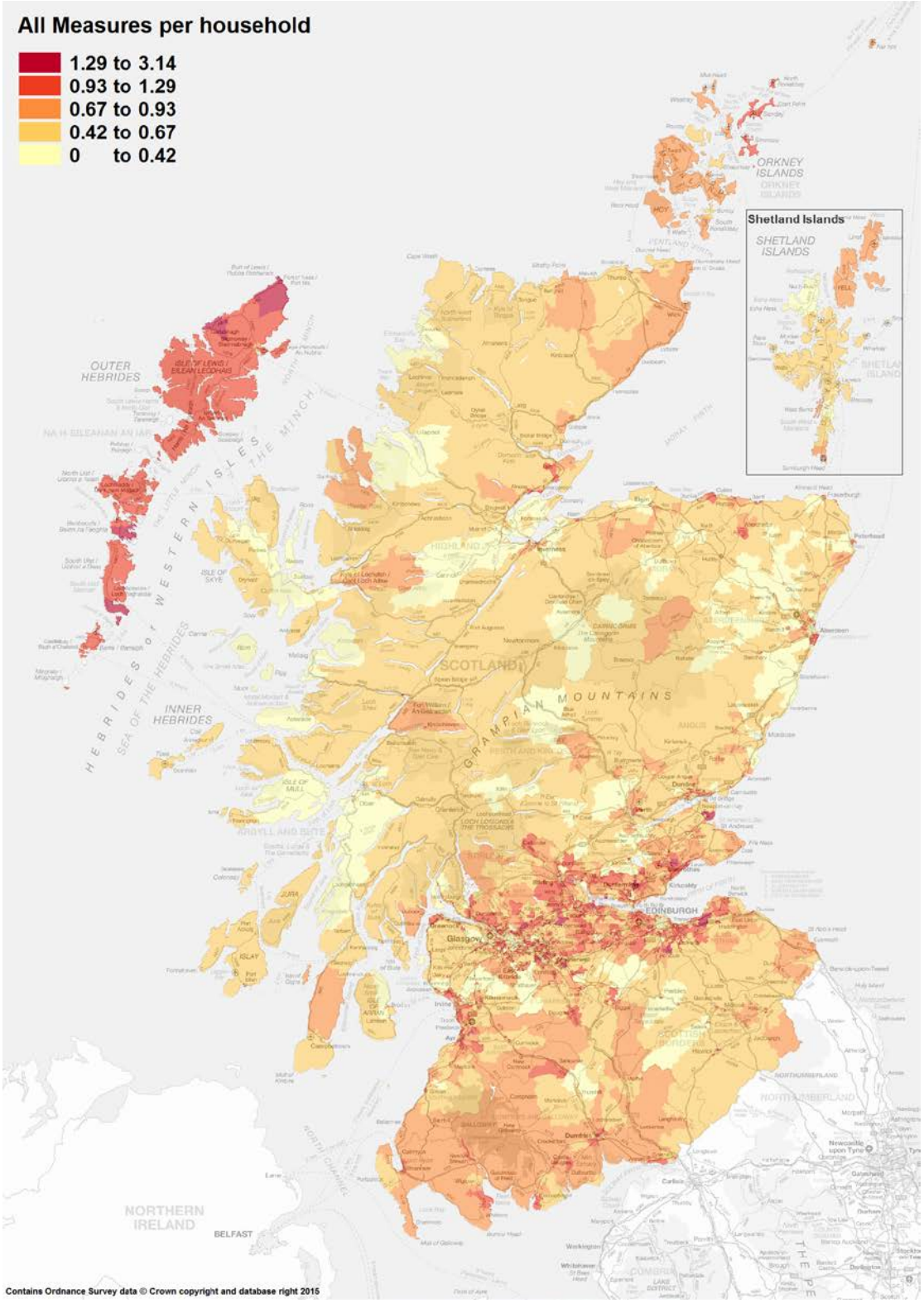
This data has also been mapped (Figure 1). The data presents a complex picture. There appears to be a concentration of higher intervention rates in the central belt, but this appearance is partly caused by the datazones in this area being much smaller in area than in other parts of Scotland, and therefore more clustered.

Taking a closer look at Glasgow (Figure 2), it is apparent that, like in the rest of Scotland, there is a spread of intervention rates across this area. Higher resolution maps for other parts of Scotland confirm this complex pattern of distribution. Some areas outside of the central belt have high intervention rates, with Eilean Siar (the Western Isles) standing out as a particular example.

[20] Urban-rural classification data is published by Scottish Government - http://www.gov.scot/Publications/2014/11/2763/downloads

[21] HEED uses 2001 datazone boundaries. The data was converted to the 2011 datazones using the method recommended by Scottish Government – see http://www.gov.scot/Topics/Statistics/sns/SNSRef

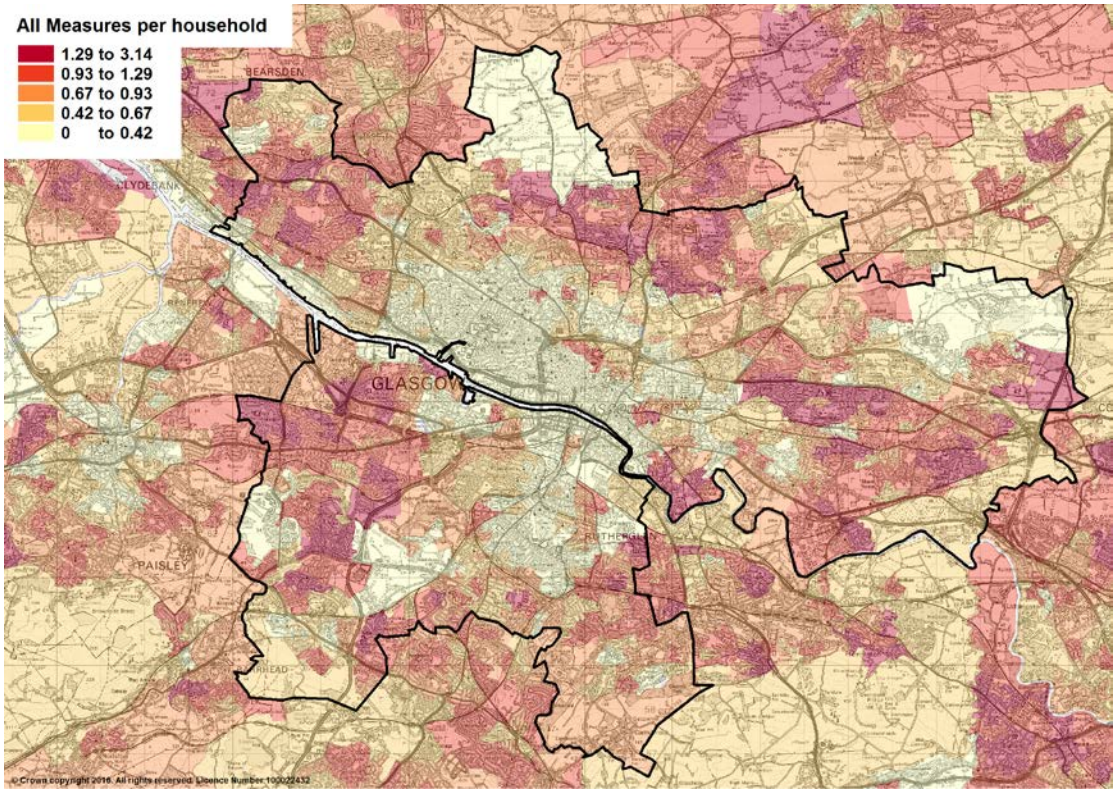
Figure 1: Intervention rate (number of measures per household) for all measures[22] at datazone level, Scotland[23]



[22] Includes all energy efficiency and microgeneration measures installed under the supplier obligations and Scottish-specific schemes included in HEED.

[23] HEED uses 2001 datazone boundaries. These have been mapped to the 2011 boundaries using the guidance produced by Scottish Government at www.gov.scot/Topics/Statistics/sns/SNSRef

Figure 2: Intervention rates (number of measures per household) for all measures[24] at datazone level, Glasgow City



Averaging analysis

Whilst the overall analysis shown in Graph 1 and Figure 1 suggests there is not an urban bias, the average measures per household in each urban-rural classification shows that remote small towns and rural areas have received fewer measures per household than the overall average, as shown in Table 2 below. This does not translate into an urban bias overall because large urban areas, which is the second largest category (in terms of number of datazones with 2,319 (33%)), also received fewer measures per household than the overall average. This is apparent in the Glasgow map (Figure 2) which shows large parts of the city, particularly in the central area, having low intervention rates. This is likely to be because much of the housing stock in these areas are older solid-walled properties and flats which are unsuited to basic insulation measures and can present difficulties in terms of access.

[24] Includes all energy efficiency and microgeneration measures installed under the supplier obligations and Scottish-specific schemes included in HEED.

Table 2: Average intervention rates (number of measures per household) for all measures[25] by urban/rural classification

Urban/rural classification	No. of datazones	Average measures per household
Large urban areas	2,319	0.78
Other urban areas	2,518	0.94
Accessible small towns	663	0.87
Remote small towns	249	0.78
Accessible rural	802	0.74
Remote rural	425	0.68
All	**6,976**	**0.81**

A further point to note is that although these findings suggest no overall bias towards delivery in urban areas, it may well have been the case that, particularly prior to the Scotland-specific schemes being delivered, there was an urban bias. Urban areas may, therefore, have benefited from the measures for longer, with a lag time before rural areas received energy efficiency improvements.

It should be noted that the statistical analysis and mapping above is based on total measures, which includes a very wide range of measures such as insulation, heating controls, boiler replacements, draughtproofing and renewables. Different measures will have a different impact on energy bills and carbon emissions so it should be noted that this analysis is of numbers of measures rather than the impact of those measures.

The data in HEED, since it does not yet include ECO, UHIS or HEEPS: ABS, does not include significant numbers of the more expensive energy efficiency measures such as solid wall insulation. Data on the delivery of ECO and of HEEPS: ABS in 2013-14 is currently available at local authority level only, meaning detailed analysis of geographic distribution is not yet possible. These schemes have a greater focus on solid wall insulation than previous schemes and the data indicates an initial bias in ECO towards the main urban centres in the central belt (Figure 3). There is no such bias in HEEPS: ABS (Figure 4), which is much smaller in scale than ECO. This is due to the fact that funding is distributed across all local authorities in Scotland. However it could be that under HEEPS:ABS there is bias to urban areas within a single local authority area where the area has both rural and urban areas; but there is insufficient data to determine this. However the overall approach of distributing funding to all local authorities should ensure slightly more equitable distribution than under ECO.

It may well be the case that solid wall insulation delivered under ECO is focused on some of those parts of the central belt with a higher proportion of solid walled homes which achieved lower intervention rates under previous programmes. If it were possible to add geographically disaggregated data for more recent schemes to the correlation analysis described above, the analysis may therefore show a slightly stronger overall urban bias.

[25] Includes all energy efficiency and microgeneration measures installed under the supplier obligations and Scottish-specific schemes included in HEED.

Figure 3: Intervention rate (number of measures per household) for all measures under ECO at local authority level, Scotland

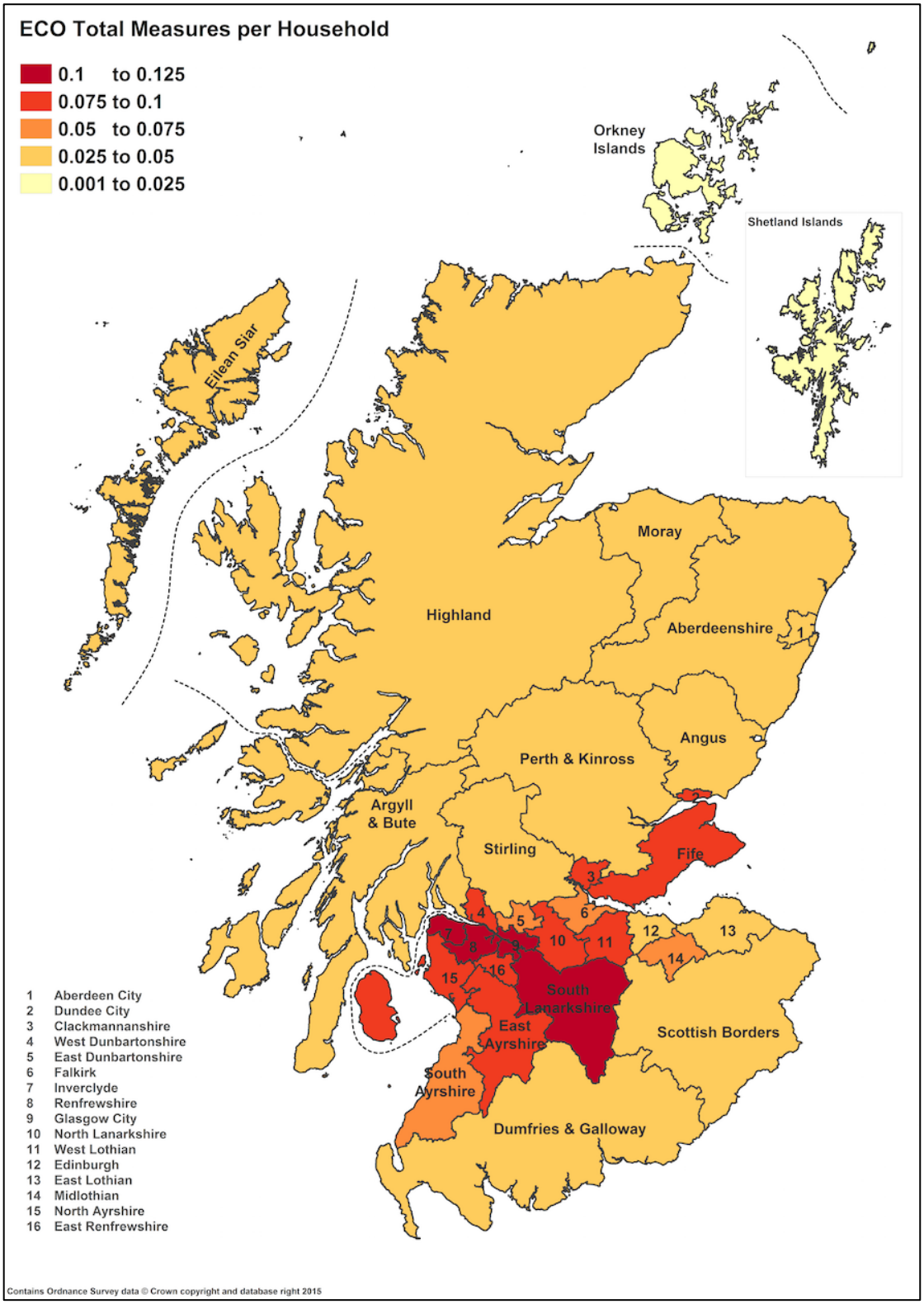
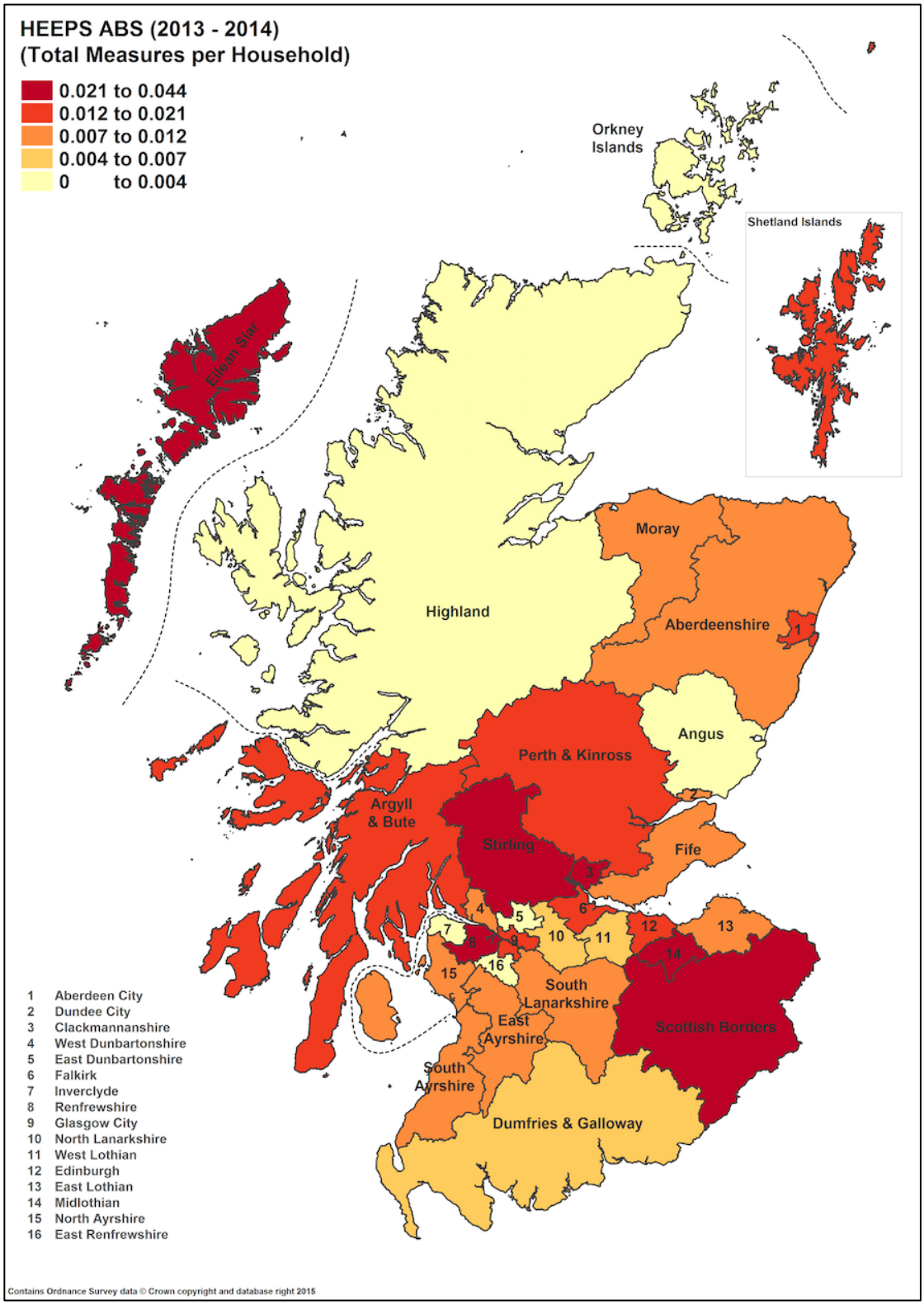


Figure 4: Intervention rate (number of measures per household) under HEEPS:ABS 2013-14 at local authority level, Scotland[26]



[26] For further detail on the distribution of measures please see 'A review of energy efficiency and fuel poverty schemes in Scotland' produced by CAG Consultants on behalf of CAS.

5.3 Key findings

- CERT and ECO were both designed in such a way as to encourage delivery in rural, off-gas areas. In spite of their design, all of the UK-wide supplier obligations (including CERT and ECO) have had an urban bias in terms of delivery. This is likely to be because of the economies of scale which can be achieved in urban areas in addition to their more mature supply chains, making delivery easier and quicker.
- The Scotland-specific area-based schemes (HIS, UHIS and HEEPS: ABS) have involved distributing funding to all local authorities, which has countered the urban bias to some degree. In addition, the targeted fuel poverty programmes (EAP, EAS and Warmer Homes Scotland) have disproportionately benefited rural areas because of the higher proportion of homes in these areas which have poor energy efficiency ratings.
- On balance, the distribution of energy efficiency interventions delivered up until the start of ECO does not demonstrate an urban bias overall.
- However, it should be noted that remote small towns and rural areas have received fewer measures per household than the overall average (based on schemes prior to ECO). This does not translate into an urban bias overall because large urban areas, which is the largest category (in terms of number of datazones), also received fewer measures per household than the overall average.
- It is also likely that urban areas have benefited from these interventions for a longer period since it is likely that many schemes had an initial urban bias due to the economies of scale which can often be achieved in urban areas.
- The delivery of solid wall insulation measures and other measures under ECO has had an urban bias, although changes to ECO in December 2014 have increased rates of delivery in rural areas.

6. HEATING REPLACEMENTS: COSTS AND SAVINGS

This section provides a contextual base on which decisions by social landlords on replacement heating systems can be assessed and interpreted. In particular it focuses on costs and SAP scores associated with 'existing' (traditional) and 'replacement' heating system selections across three of the most common property archetypes through remote and accessible rural Scottish locations.

6.1 Costs of heating replacements

Indicative costs for installing the six 'replacement technologies' across a combination of accessible and remote rural areas were gathered from a variety of sources and collated to provide an individual average install cost for each technology (detail of the process followed is outlined in Section 3, the methodology). Each heating system type was thereafter assigned a cost category ('high', 'medium' or 'low') and listed in order of cost (high to low) in Table 3 below.

Table 3: Average install costs[27] for replacement heating systems (categorised as low, medium and high cost)

Technology	Low, medium or high costs	Cost range
GSHPs	High	>£15,000
Biomass boilers	Medium	<£15,000 but >£10,000
ASHPs	Medium	<£15,000 but >£10,000
Oil boilers	Medium	<£15,000 but >£10,000
Electric boilers	Low	<£10,000
'Smart' storage heaters	Low	<£10,000

As is evident from the figures gathered, costs for installation of systems that are potentially 'newer' (i.e. have not been in the market place for as long), more complex and those that are less 'tried and tested', are deemed to be more expensive. These include systems such as biomass boilers and GSHPs.

Heating systems based on more established technologies that have been around for longer (tried and tested), or that are either simpler or easier to install (physically), tend to be lower cost.

Acknowledgement should however be given to the fact that all costs are based on the installation of individual heating systems on a property by property basis. In reality, social housing providers would most likely install systems across a number of properties at any given time. As such, due to assumed economies of scale, the costs and cost categories are likely to be lower than those detailed in Table 3. In addition, it should be noted that although these costs are averages, they are likely to vary further depending upon the rurality of the property e.g. remote locations may be more expensive.

[27] Actual average costs per 'replacement heating system' type: (i) GSHP: £16,192; (ii) Biomass: £12,126; (iii) ASHP: £10,272; (iv)Oil boiler: £8.845; (v) Electric boiler: £6,816; and (vi) 'Smart' storage heaters: £5,650.

6.2 Energy modelling (RdSAP): theoretical running costs

Modelling using RdSAP software was completed for 36 scenarios (as outlined in the methodology, Section 3) to provide theoretical running costs for six 'existing' and six ' replacement' heating systems across three property archetypes[28]. The results have been collated in Table 4 below to provide an individual theoretical running cost per heating system type for each of the three property archetypes (see Table 1 in Appendix B for full details of heating systems, variables and constants assumed throughout the modelling).

Table 4: Estimated (theoretical) annual heating system running costs[29]

	Heating system	Detached solid stone	Semi-detached cavity	Detached timber frame
Existing	Open coal fire & portable heaters	£4,784	£1,565	£1,763
	Electric storage heaters	£3,330	£1,019	£1,149
	Bulk LPG boiler	£3,401	£1,135	£1,327
	Auto feed solid fuel floor mounted boiler system	£2,037	£665	£766
	Solid fuel open fire back boiler system	£2,852	£953	£1,038
	Aga/ rayburn solid fuel boiler system	£3,124	£948	£1,090
Improvements	Smart storage heaters	£2,331	£769	£894
	Air source heat pump	£2,176	£731	£869
	Ground source heat pump	£1,701	£573	£681
	Biomass boiler	£1,750	£542	£628
	Electric boiler	£2,227	£696	£805
	Oil boiler	£1,664	£539	£629

Key

Lowest cost per house type	Medium cost per house type	Highest cost per house type

The results detailed in Table 4 above show a significant reduction in the modelled running costs of the 'replacement' heating systems when compared with 'existing' heating systems across all three property types. The only exception concerns existing auto feed solid fuel floor mounted boiler systems where a number of replacement systems can increase costs. That technology aside, the most expensive heating system in the detached solid stone property (open coal fire and portable heaters) costs £4,784/year with the lowest cost system being the solid fuel open fire back boiler (£2,852/year). The most expensive heating regime with the replacement heating systems is with smart storage heaters (£2,331/ year), the least expensive is with the oil boiler (£1,664/ year)[30].

[28] SAP 2012 onwards uses location factors at postcode sector level (e.g. AB1, AB2 etc) such as: height above sea level, latitude and longitude, monthly temperatures, monthly wind speeds and monthly solar radiation levels in the calculations used to generate a heating system running costs. NB: these factors are not accounted for when generating a SAP score.

[29] These costs are not inclusive of DHW generation costs.

[30] It should be noted that the costs for the oil system are likely to be low due to the current low oil prices. If oil prices start to rise again then the oil boiler is likely to look less favourable.

The range in theoretical running costs for the 'existing' heating systems is relatively wide with an 'auto feed solid fuel boiler' estimated to be more than 50 per cent cheaper to run than an 'open coal fire and portable heater' system. The range in estimated running costs is not as significant for the 'replacement' heating systems given that the cheapest systems to run (the oil boiler, biomass boiler and GSHP) offer around 30 per cent lower running costs than the most expensive system (the 'smart' storage heaters or electric boiler).

For full details of these results, refer to Appendix F.

6.3 Energy modelling (RdSAP): SAP Scores

As part of the RdSAP modelling work completed above (i.e. to create theoretical heating system running costs), SAP scores for all 36 scenarios were also generated (i.e. scores used in EPC to show the energy efficiency rating of properties). Table 5 below provides SAP scores for each property archetype based on the heating system type used.

Table 5: SAP scores for each heating system

	Heating system	Detached solid stone	Semi-detached cavity	Detached timber frame
Existing	Open coal fire & portable heaters	1	34	48
	Electric storage heaters	23	57	67
	Bulk LPG boiler	13	42	55
	Auto feed solid fuel floor mounted boiler system	41	67	75
	Solid fuel open fire back boiler system	26	56	67
	Aga/ rayburn solid fuel boiler system	21	54	65
Improvements	Smart storage heaters	40	66	73
	Air source heat pump	43	67	73
	Ground source heat pumps	54	73	78
	Biomass boiler	49	72	78
	Electric boiler	43	68	75
	Oil boiler	43	67	74

Key to SAP results

Highest SAP score per house type	Medium SAP score per house type	Lowest SAP score per house type

The results detailed in Table 5 above generally show a substantial and positive impact on SAP scores between the 'existing' heating systems and the 'replacement' heating systems across all three properties.

The range in SAP scores for the 'existing' heating systems is relatively wide with one system having an extremely low score (the 'open coal fire and portable heaters'), and another having a particularly high score (the 'auto feed solid fuel floor mounted' boiler).

The range in SAP scores for the 'replacement' heating systems is not as broad. All apart from one[31] of the 'replacement' heating systems offer significantly higher SAP scores than the 'existing' heating systems. The highest SAP score margins are seen for the GSHPs and biomass boiler with the lowest being for the 'smart' storage heaters.

SAP scores are currently one of the main drivers in the selection of a heating system due to the requirement for all social landlords to comply with EESSH by 2020. As is evident from the above, GSHPs and biomass boilers will provide the greatest increase in SAP scores across all the modelled 'replacement' technologies (see Tables 2 and 3 in Appendix B for details of the minimum SAP ratings required to comply with EESSH).

For full details of the SAP score modelling results, refer to Appendix F.

6.4 SAP recommendations

As outlined in the Background section, EESSH is a key driver for energy efficiency retrofit work that requires social housing providers to reach or surpass specific SAP scores in order to achieve compliance (see Tables 2 and 3 Appendix B for the minimum SAP ratings required to pass EESSH). Target SAP scores are dependent on a number of factors and as such, further RdSAP modelling was completed for a number of additional scenarios in an attempt to review how SAP recommendations might currently be guiding heating system selection across different Scottish regions.

Therefore, this part of modelling focused specifically on how changing various parameters for a three-bed semi-detached property[32] using a 'replacement' heating system with (i) the worst SAP scores[33] ('smart' storage heaters); and (ii) the best SAP scores (GSHP) might affect its theoretical heating system running costs and SAP scores. The parameters that were changed for these additional scenarios were:

(i) **Scenario 1:** Postcode / location
(ii) **Scenario 2:** Property size; and
(iii) **Scenario 3:** Level of energy efficiency / insulation

Full details of the scenarios modelled and the parameters used are presented in Table 5 in Appendix B. Key findings are:

Scenario 1: Modelling the same heating system type in identical property archetypes across different regions had no effect on the SAP scores (i.e. it always stayed the same). Conversely, however, it did have an effect on the theoretical heating system running costs, for example a property located in the Western Isles or the Highlands had running costs (whatever the heating system used) of around 12 per cent and 21

[31] The 'smart' storage heaters have a score marginally lower than the 'auto feed solid fuel floor mounted' boiler; however this would still offer a significant SAP score increase when compared against the other 'existing' technologies.
[32] It was felt that of the three property types (detached stone, semi-detached cavity and detached timber frame) this was the most representative of a social housing property due to its size and type.
[33] This information was taken from the modelling carried out as part of the preceding sections (the 36 scenarios).

per cent more respectively than the same property located in East Lothian (refer to Appendix F, Section 3 'SAP Recommendations – Scenario 1' for full details of the analysis carried out and the assumptions made).

Scenario 2: Modelling the same heating system in properties of different sizes showed that SAP scores generally stay the same for a property whatever its floor area as long as the floor to exposed wall ratio is kept constant. Therefore, properties of the same floor area but with higher ratios of exposed wall area have differing SAP scores – e.g. the higher the ratio of exposed wall area the worse the SAP score.

Scenario 3: Modelling an identical property using differing levels of insulation demonstrated the significant influences a well-insulated property has on SAP scores e.g. the better the levels of insulation the higher the SAP scores.

For full details of the results within each of the above scenarios, see Appendix F.

6.5 Key findings

- In the main, there appears to be no specific evidence from the scenario modelling that SAP directly influences heating system selections for different Scottish regions. SAP is however likely to be influential for social housing providers in terms of replacement heating system selection when reviewing requirements to ensure EESSH compliance.
- It is evident that better SAP scores and (generally) lower running costs (e.g. GSHP and biomass) are currently associated with newer technology types (often those that are more complex and physically disruptive to install whilst poorer SAP scores with (generally) higher running costs (e.g. 'smart' storage heaters[34]) are associated with more traditional or less complex systems. However the SAP scores do not tend to vary widely between the different replacement technologies.
- Newer (and potentially more complex) technology types are generally more expensive to install (GSHPs / biomass boilers / ASHPs) than those more traditional / simpler systems (oil boilers / electric boilers / storage heaters). Although 'smart' storage heaters are deemed cheapest, they are based on a traditional technology (albeit with greater levels of control) that is extremely easy to install and to make operational. Technologies such as GSHPs and biomass boilers are complex and time consuming to install as well as being much newer to the market and with varying experiences for both the landlord and tenant (user).
- Different heating systems generally show lower running costs for more expensive heating systems (GSHPs and biomass boilers) and higher running costs for less expensive systems (electric boilers, ASHPs and 'smart' storage heaters). The main anomaly with this finding is for an oil boiler which is predicted to have the lowest running costs for any of the systems but is in a medium cost category for install. Oil prices have fluctuated considerably in recent years but

[34] Although 'smart' storage heaters are a new technology they are based on a traditional/ simple storage heater that essentially uses higher tech controls.

are unlikely to remain low in the long term. This will have an impact on whether an oil boiler fed heating system is deemed ‘cheap’ or ‘expensive’ to run.

- Modelling the same heating system type in an identical property archetype across different regions has no effect on the SAP scores (i.e. it will always stay the same). Conversely, it *will* have an effect on the theoretical heating system running costs.
- Modelling the same heating system type in an identical property archetype across different regions can have significant effects on a property’s anticipated running costs. A property located in the Western Isles or the Highlands is likely to have running costs (whatever the heating system used) of around 12 per cent and 21 per cent more respectively than the same property located in East Lothian. This is due to the parameters that SAP includes in its calculations: solar radiation, wind speed and typical monthly temperatures.
- SAP scores generally stay the same for a property whatever its floor area as long as the floor to exposed wall ratio is kept constant. Therefore, properties of the same floor area but with higher ratios of exposed wall area will have differing SAP scores – e.g. the higher the ratio of exposed wall area the worse the SAP score.
- Where the insulation specification (i.e. low / medium / high) of an identical property is changed in RdSAP, this demonstrates significant influences on SAP scores. Essentially, the better the levels of insulation the higher the SAP scores and vice versa, This is due to assumptions made in SAP that align higher levels of insulation with reduced energy demand and therefore lower system running costs.

7. HEATING REPLACEMENTS: SOCIAL LANDLORD EXPERIENCES

7.1 Background to organisations

The following analysis is based on responses to a quantitative survey from 30 different social landlords. Following the completion of the survey, seven of this group (and two others) agreed to take part in qualitative interviews. The interviews were designed to enable the research team to explore some key issues in more detail to expand upon the quantitative survey findings.

The respondents in both the survey and interviews represented a range of organisations:

- the survey respondents consisted of eight local authorities, 19 housing associations and one respondent who stated that they worked for a 'project'[35]
- the survey respondents managed considerably different numbers of housing stock: nine organisations had fewer than 1,000 properties, four had 1,000 to 1,999, two had 2,000 to 2,999 and 11 had 3,000 or more properties
- interview participants reported that their housing stock included a wide range of construction and building types; as might be expected the choice of heating technology is heavily influenced by the characteristics of the property
- eighteen survey respondents reported that they had properties in Accessible Rural areas, and 15 had stock in Remote Rural areas[36]. The proportion compared to their overall stock varied and is shown in Graph 8 in Appendix G). Four landlords didn't have properties in either of these areas and as a result did not answer any further questions.

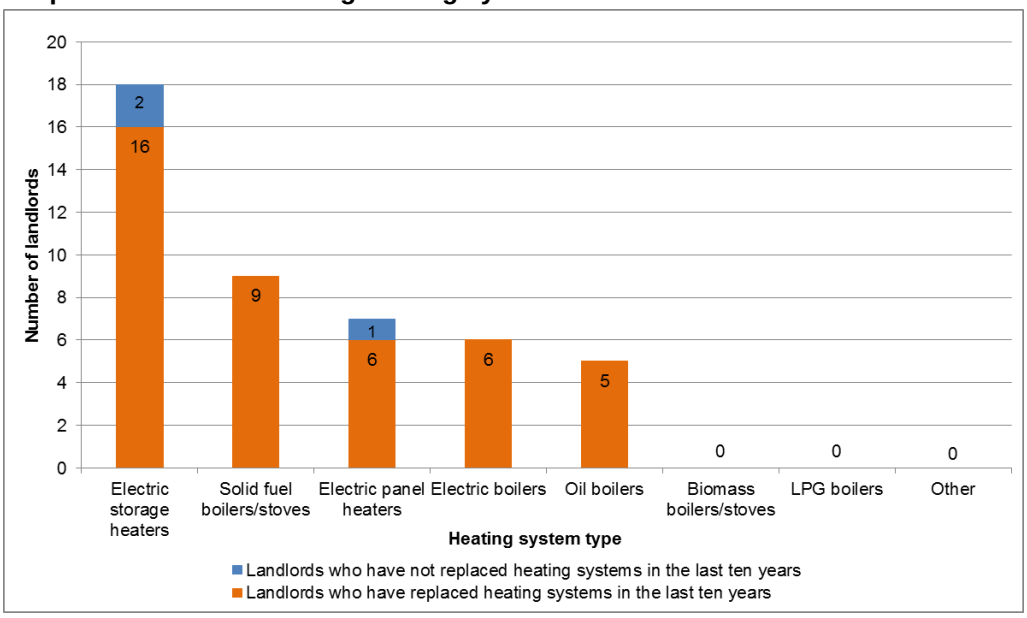
7.2 Heating systems

The majority of landlords (24 out of 30) involved in the quantitative survey said that they have replaced heating systems in rural, off-gas households, in the last ten years. Two said they had not replaced any heating systems in these areas within this timeframe, one of whom explained that this was because they did not have enough finance available. All of those involved in the qualitative research had experience of replacing off-gas heating systems. Landlords who have replaced heating systems were usually replacing 'traditional' technologies, most commonly electric storage heaters (Graph 2).

The number of different technologies reported (in the quantitative survey) as having been installed by individual landlords varied from one to seven. The most commonly installed technologies were ASHPs (air to water) (15) and 'smart' storage heaters (12), as shown in Graph 3.

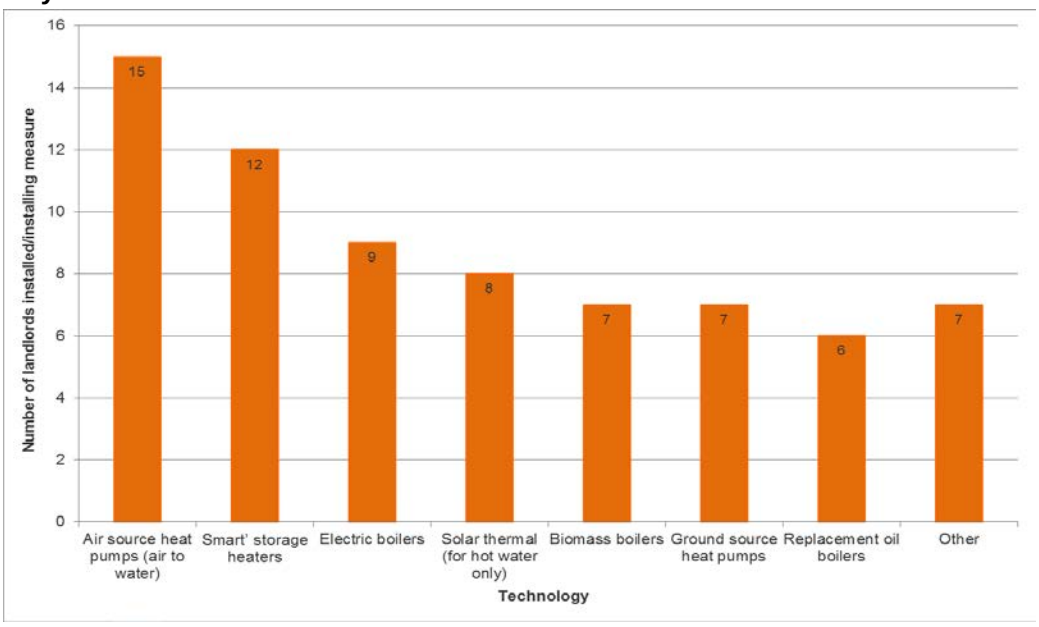
[35] Two did not respond to this question.
[36] Using the definition from the Scottish Government's six fold Urban Rural Classification http://www.gov.scot/Topics/Statistics/About/Methodology/UrbanRuralClassification

Graph 2: Previous / existing heating systems



Base= 2 (not replaced heating systems), 18 (replaced heating systems)

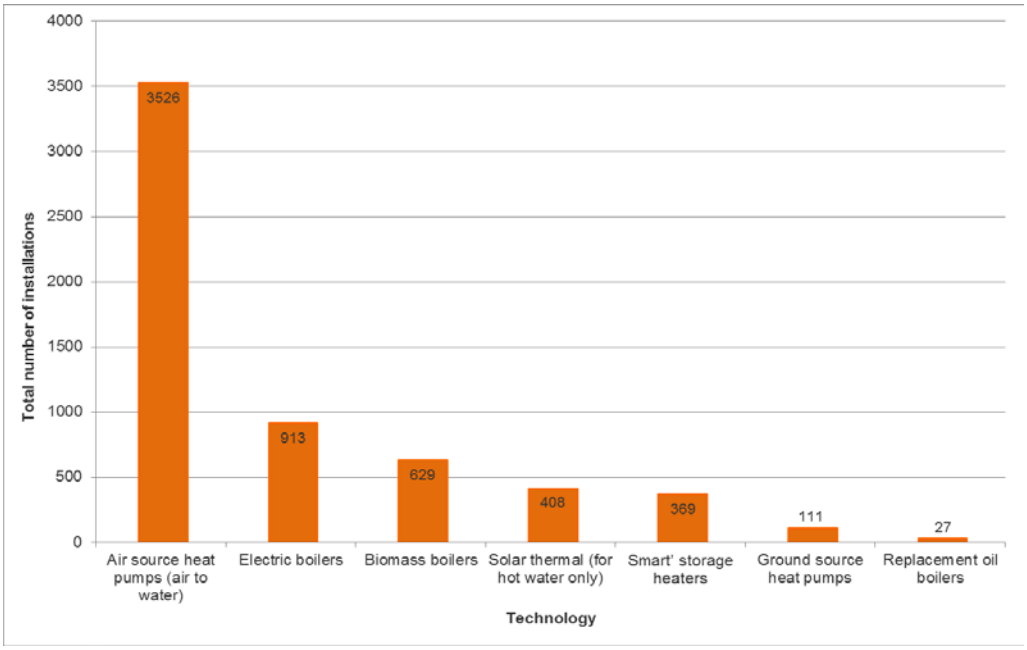
Graph 3: Types of heating technology retrofitted in rural, off-gas households in the last 10 years



Base = 19

The total number of each of these technologies, installed collectively by the landlords, is shown in Graph 4. The number of ASHPs installed is considerably higher than all other technologies, although it should be noted that the majority of these are being installed by just two landlords (1,350 and 1,000).

Graph 4: Total number of each heating technology installed in rural, off-gas households in the last 10 years



Base = 19

Seven landlords stated that they had installed heating technologies listed as 'other', these included:

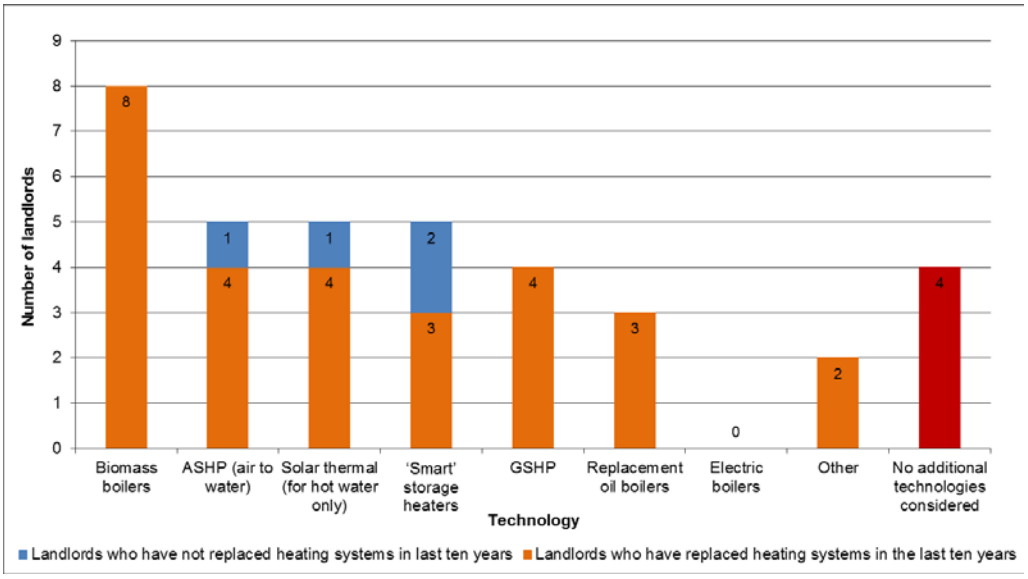
- infrared (46 installed by one landlord)
- traditional storage heaters and electric panel heaters (quantity not stated - installed by one landlord)
- exhaust ASHP (61 installed by one landlord)
- ASHP (air to air) (eight installed by one landlord and 13 installed by another landlord as secondary to existing storage heating)
- solar PV was also mentioned by three landlords, who, in total had installed PV on 243 off-gas households[37].

Landlords were also asked which technologies they had considered but not installed (Graph 5); the most common type was biomass boilers (eight). One participant in the qualitative research noted that they were wary of installing biomass as the operation of these systems required tenants to be reasonably fit to carry out maintenance / fill up fuels, whereas electric systems only required users to be able to manage the controls. Another landlord also referenced problems with fuel supply, which had led them to effectively rule out biomass as an option:

> *"In terms of biomass, for example, one of the biggest problems we've had there is in terms of fuel, fuel supply, pellet supply …….. very few suppliers willing to store the pellets required to feed the systems."* Ref 05

[37] However this cannot be used for space heating.

Graph 5: Heating technologies considered but not installed in rural, off-gas areas in the last 10 years

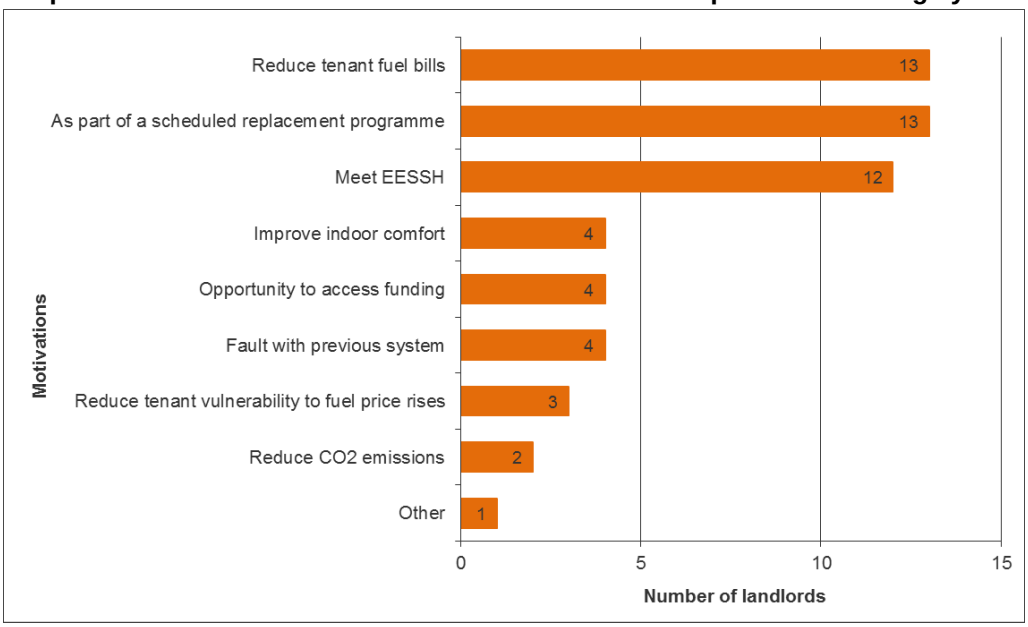


Base = 2 (not replaced heating systems), 17 (replaced heating systems)

7.3 Motivations and drivers

Responses to the quantitative survey indicate that the three most common reasons for replacing heating systems were to: reduce tenant fuel bills, as part of a scheduled programme or to meet EESSH (Graph 6).

Graph 6: The three main reasons behind decisions to replace the heating system(s)



Base = 18

Responses to the qualitative research suggested that social landlords had heating replacement programmes in place i.e. cyclical programmes when heating systems come to the end of their life. When implementing these, landlords looked to take account of EESSH (where necessary), potential running costs / impact on fuel poverty and issues such as maintenance costs and the ability of tenants to deal with

more traditional heating systems. One highlighted the importance of some of these issues:

> *"It's your ability to actually repair them. And then you can add on other issues like cost for tenants of solid fuel and* [if] *they're elderly, do you really want them storing and lugging about the fuel."* Ref 04

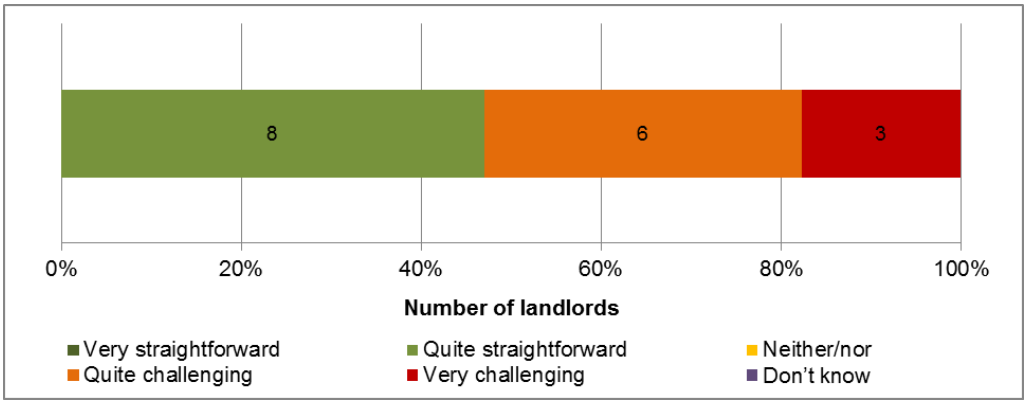
It was not particularly evident how much EESSH was or was not accelerating programmes but in part this depended on how many of landlords' properties did not currently meet EESSH and how this interacted with replacement programmes. For example, some landlords had high levels of EESSH compliance and fewer heating replacements programmed for the forthcoming five years.

7.4 Decision-making

The qualitative research found no clear pattern in terms of how social landlords approached decision-making, much would seem to depend upon the size of the organisation, the size and composition of the team and the identity / role of the final decision-maker.

In terms of how difficult or otherwise social landlords found the decision-making process, responses to the quantitative survey found that there was a relatively even split between those who found it challenging and those who found it straightforward. (Graph 7). However more landlords mentioned that the experience was 'very challenging' (three) than they did 'very straightforward' (none); indicating that this can be a considerable issue for some.

Graph 7: Overall experience of the decision making process



Base = 17

Those who found the experience 'quite straightforward' explained this was a result of good in-house knowledge of technologies, external funding opportunities and projected SAP profiling to inform recommendations. Others stated that they had identified specific technologies which offered them the result they were looking for.

Landlords who found the decision 'quite challenging' said that there were "*too many new and untested technologies"*, and similarly that there was "*differing information"* from users and manufacturers. Others comments on the difficulty of comparing systems, in-house communication challenges between staff with and without

technical knowledge, and the issue of costs when there was uncertainty over the Renewable Heat Incentive (RHI).

Further, those who found the decision 'very challenging' re-stated the issue around funding uncertainty, the requirement to consider a range of factors (e.g. EESSH compliance and tenant experience) and lack of an established supply chain. One commented that they could not meet energy efficiency standards in off-gas and non-traditional properties with the measures that could be delivered[38].

Information for decision-making

Whilst, as reported above, some social landlords reported that they experienced a lack or inconsistency of helpful information, the majority of landlords who participated in the quantitative survey (14 out of 18) said that they had sufficient, useful information to inform their decision. Similarly a lack of information was not identified as a significant issue by those who participated in the qualitative research.

Of those survey respondents who did report problems with information, three landlords said that they didn't feel that the information that they had was sufficient and informative. Others cited similar issues in relation to keeping up-to-date with grant funding availability and lack of reliable data around the impact on EPC ratings of replacement heating systems.

Approach to energy modelling

Participants in the qualitative research were asked about their approach to modelling. Most reported that they had undertaken this in-house, whilst some used external consultants. SAP (RdSAP) software had been used to model scenarios for achieving EESSH and SHQS[39]. This is not surprising as SAP points are required to assess EESSH compliance. Many reported a range of perceived anomalies with SAP. Specific examples include:

- solar thermal getting a better score than heat pumps
- heat pumps, where a single tariff generates a worse SAP score than dual tariff (even if claimed cheaper)
- infrared, which scores poorly
- solar PV, which gets a high score
- biomass boiler getting reduced SAP scores because they are less efficient

Whilst one social landlord observed that they felt SAP was the best available solution a few others were highly critical:

> *"I'm not a great believer of the SAP scoring of a property at all. I don't think it's accurate enough."* Ref 08

[38] No further detail was provided on why delivery was difficult

[39] The Social Housing Quality Standards (SHQS) – the predecessor to EESSH for which compliance should have been achieved by 2015 but some landlords reported some ongoing work towards this standard.

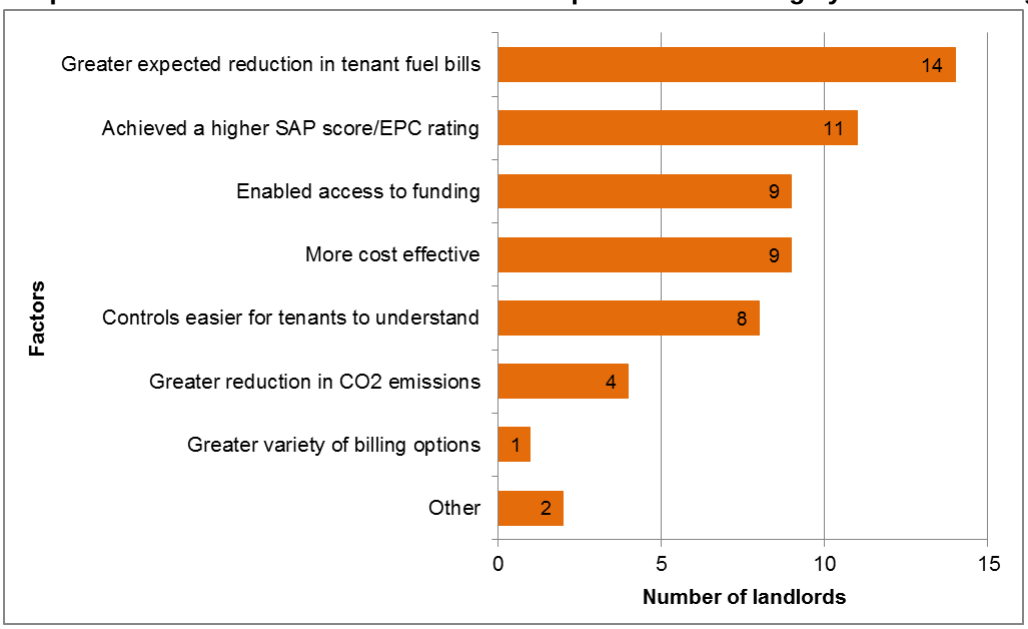
Choice of technology

Landlords were asked what the main factors were in influencing their decision of which technology to install (Graph 8). The results show that the most important factor is which technology will reduce tenants' fuel bills the most and secondly, which will achieve the higher SAP score (to enable compliance with EESSH and SQHS). One participant in the qualitative research expressed a concern that these objectives might not always be complementary:

> *"They're actually putting in heating systems that will cost the tenants more because it meets EESSH, and it's just crazy."* Ref 02

In addition to fuel poverty and the need to meet standards, participants in the quantitative survey also noted other considerations such as: which technology was most cost effective, enabled access to funding and had easy controls for tenants to use.

Graph 8: Factors that influenced choice of replacement heating system technology



Base= 17

A few of the landlords involved in the qualitative research commented on the multitude of factors to consider when selecting technologies, which can make decisions quite difficult:

> *"You're trying to get something that works with the tenants. You're trying to get something that meets EESSH, SHQS. You're trying to get something meets your SAP calcs. You're trying to get something that works with your house and what, you know, fuels that you've got available. There's masses* [of information] *to combine. And it doesn't always work. There's got to be a compromise on some things at the end of the day. So it is quite difficult."* Ref 08

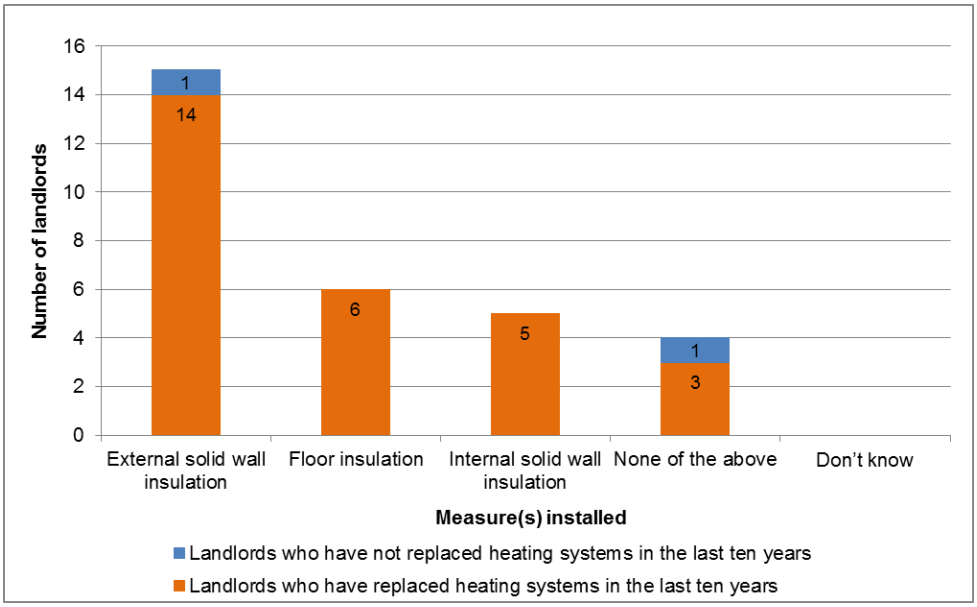
As noted previously in this report (Section 7.3) some participants in the qualitative research reported that they felt it important to take into account the capabilities of their tenants – a particular issue, referred to several times, was the need to ensure that the system could be managed by less able residents:

"But the decision we've taken is to go down the renewables route mainly because our population's getting older and they can't go out and start bringing in coal. They can't deal with, even, pellets." Ref 02

This was raised not just as an issue for current tenants, but also for those who might occupy properties in the future. Some landlords noted that it was safer for them to put in electric systems as this future proofed them against the possibility of having to remove other types of heating system in the event of a change of resident.

Landlords who took part in the quantitative survey were asked whether they had installed any 'advanced' energy efficiency measures (Graph 9). The majority of landlords (16 out of 20) had installed external solid wall insulation, floor insulation or internal wall insulation. Only four had not installed any of these measures.

Graph 9: Measures installed to reduce tenant's fuel bills, reduce CO_2 emissions or meet EESSH



Base= 2 (not replaced heating systems), 18 (replaced heating systems)

7.5 Costs and funding

Installation costs

Table 5 below shows the approximate range and average costs (including equipment and installation), per property as stated by landlords responding to the quantitative survey.

When compared to the results from the cost gathering exercise undertaken for another part of this research (Table 3 in Section 6), the results are broadly similar for individual biomass boilers, electric boilers and 'smart' storage heaters. Communal biomass boilers and solar thermal systems were not covered in the earlier exercise. However, the lower costs for ASHPs and GSHPs quoted by landlords are lower than those in Table 3 (for example, it was expected that ASHPs would cost a minimum of £10,000). The costs of oil boilers quoted by landlords are much lower than those in Table 3. These differences may be due to economies of scale achieved by landlords.

Table 6: Approximate install cost average and range of each technology[40]

Technology	Lowest cost (£)	Highest cost (£)
ASHPs (air to water)	5,500	12,000
Biomass boilers - individual	10,000	13,500
Biomass boilers – communal heating	200,000	250,000
Electric boilers	2,000	6,500
GSHPs	12,000	18,000
Replacement oil boilers	2,500	3,000
'Smart' storage heaters	1,000	7,000
Solar thermal (for hot water only)	2,500	5,500

Base= 11, 2, 2, 7, 5, 2, 9 and 4 respectively

As shown in Table 6 above there is considerable variation in the costs different social landlords are incurring for most technologies. Based on the responses provided through the qualitative research, reasons for cost variation may include:

- reporting including both ad-hoc and large scale renovation activity with ad-hoc, i.e. one offs, being reported as being more expensive
- a lack of local contractors and reluctance for external suppliers to undertake highly dispersed, small scale projects in remote areas
- the additional costs (travel, accommodation, overnight expenses) associated with operating in remote areas often at a distance from a contractor's home base

One interviewee, with a widely dispersed stock in a remote region, noted that:

> "*The average cost / install has been a lot higher than what we would have expected several years ago.*" Ref 05

It was also highlighted by a few landlords that being located in a remote location increased costs because installers had to travel (for example from the central belt to the north of Scotland).

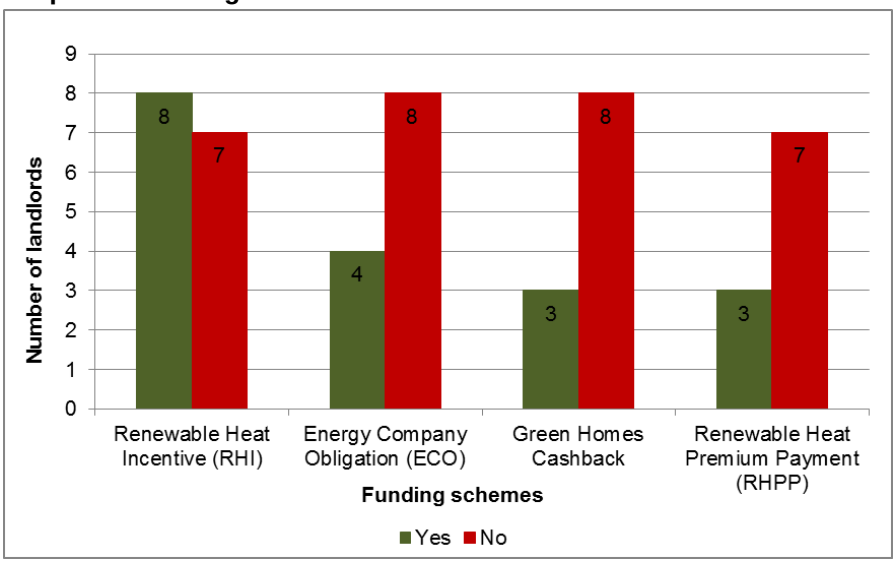
Funding

A total of 11 landlords, who participated in the quantitative survey, reported that they had been able to access some form of financial support; five landlords reported that they had not. The most commonly accessed support scheme was the RHI (Graph 10).

Access to 'other' types of funding was recorded by two landlords and included: fuel supplier funding for installation of GSHP and ASHP (accessed several years ago) and Warm Homes Loan Fund and District Heating Loan Fund from Scottish Government (technology was not stated).

[40] Figures as reported by landlords. Figures are approximate costs per property of both equipment and installation.

Graph 10: Funding for installation accessed / unable to access



Base= 16

Participants in the qualitative research reported other funding sources including the Low Carbon Building Fund and the European Regional Development Fund.

The majority of landlords (11 out of 17) who responded to a question in the quantitative survey stated they would either 'definitely' or 'probably' have installed the technology regardless of funding availability. Four said they 'maybe' would have done so and two stated that they definitely would not have done.

Many participants in the qualitative research noted that the RHI, whilst not a primary driver, was proving to be a valuable mechanism for offsetting the higher installation costs associated with renewable and low carbon measures. Those few who provided figures suggested that they were generating up to £6-7000 per property in best case scenarios. These figures related to ASHP; one interviewee suggested that their experience has been that whilst RHI could be readily accessed for ASHP they had struggled with biomass as they were unable to provide receipts for fuel use for this type of fuel:

> *"They basically want tenant receipts every time they… Well, as kind of proof of fuel use, as such. And that's never going to happen."* Ref 05

One landlord involved in the qualitative research noted that they had installed renewable measures in a new-build development on the basis that they would receive RHI only to be told that they were ineligible. They suggested as a result they would be unlikely to install such measures in the future (owing to higher installation costs of renewable / low carbon options):

> *"So there's the pressure to meet, you know, the building standards and the EESSH, by putting in, you know, sort of renewable or low carbon heating systems, but they've got no incentive to actually do it."* Ref 06

7.6 Tenant guidance and advice

Choice of technology

The qualitative research found that tenants first become involved in heating replacement decisions after the social landlord has undertaken their options appraisal. Most participants in the qualitative research noted that they were mindful of tenant preferences and some noted that they would seek to accommodate them where possible. In practice, however, the landlords themselves are constrained in their ability to provide choice. Therefore where tenants were offered a choice, it was generally restricted to a limited range (two or three) of options, one of which might be to retain their existing system type.

Some however noted that they would actively try to persuade tenants to accept a preferred form of technology and one noted that from their point of view the challenge was:

> *"Not so much giving them a choice, it's convincing them."* Ref 03

Ultimately however all those who provided a response to this question (qualitative research) stated that the tenant had the final say over whether or not a certain form of technology was installed or not.

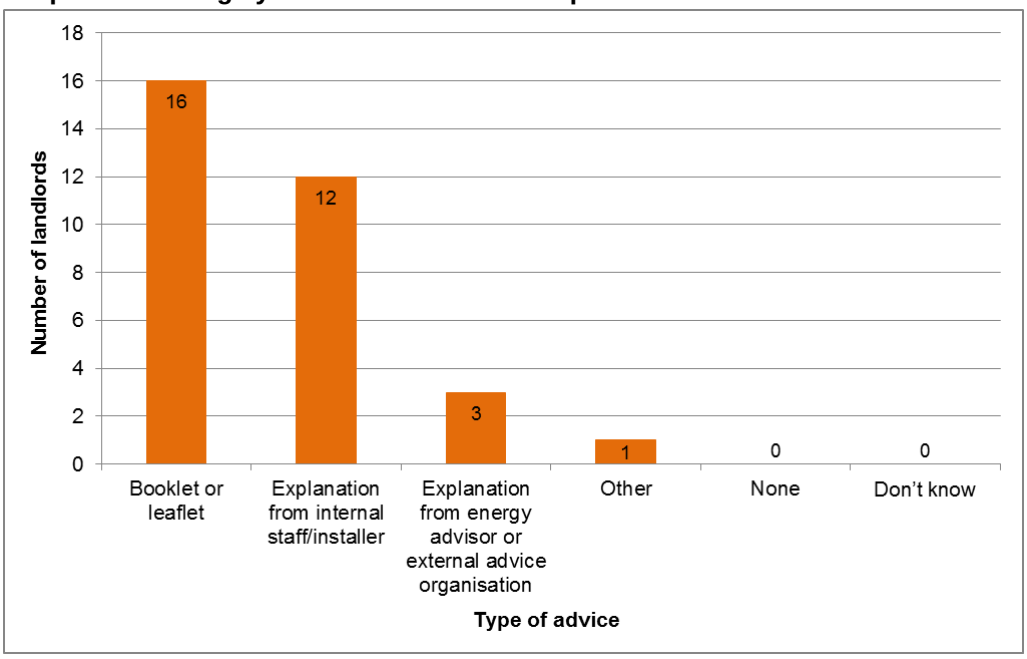
Approaches to tenant engagement (as reported by participants in the qualitative research) included letters, road shows, local adverts and magazine / newsletter articles. One had in-house energy advisors which they felt was particularly successful in providing tailored and effective advice. All of those interviewed said that they either routinely provide or offer to undertake home visits to discuss options. However there was recognition from landlords that they sometimes needed to undertake more or better tenant engagement. Some appeared to have learnt from previous projects where problems had arisen from insufficient / lack of tenant engagement.

Advice on using the system

All of the landlords (17) involved in the quantitative survey said that they had delivered, or intend to deliver, some form of advice to their tenants following the installation of their new heating system (Graph 11). Where this had been done it was most commonly undertaken through a booklet or leaflet (16) - but it would appear that most landlords supported this with a verbal explanation from the installer or an internal member of staff (12):

> *"Once they've been installed and, you know, the tenants are back in their properties, or once their installation is completed, the actual installation engineers will go through and tell them how to use it.*" Ref 06

Graph 11: Heating system advice delivered / planned to be delivered to residents



Base= 17

Most of the social landlords interviewed for the qualitative work noted the importance of aftercare e.g. checking tenants' understanding and getting tenant feedback. Most therefore reported that they provided some form of post installation service:

> *"Any kind of technology that you put in, you can't do the install and walk away."* Ref 07

Some noted issues with controls, particularly in relation to ASHPs, and the need to provide assistance to tenants who wished to change or reset these. One landlord (in the quantitative survey) reported that tenant advice is within the contract with their contractor who visits the tenants up to three times per year to explain the controls and give tenants access to online videos.

7.7 Monitoring and evaluation

Responses to the quantitative survey indicated that seven landlords have completed or are in the process of monitoring the performance of newly installed heating systems (four and three respectively). Nine said that they have not carried out any monitoring but plan to do so. Two hadn't done any monitoring and do not plan to do so and one landlord did not know whether they had done any monitoring or not.

The types of monitoring stated as planned or already carried out included:

- tenant satisfaction survey (12)
- tenant billing data (before and after installation) (7)
- installed monitoring equipment (e.g. temperature, humidity, system output / use) (6)

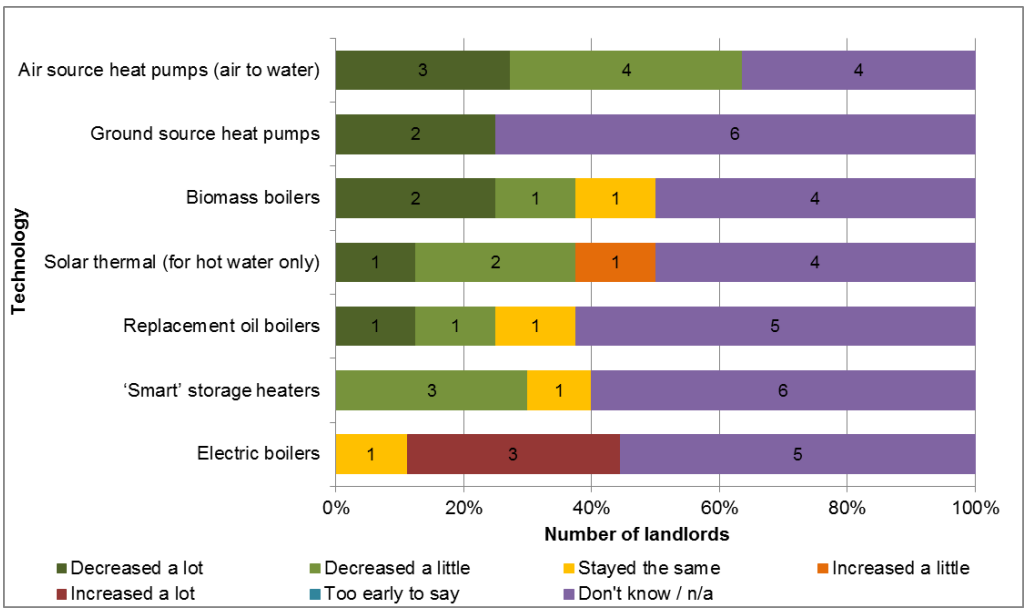
Fuel bills

Graph 12 shows the landlords' perceptions of how tenant fuel bills have changed following the installation of the new heating systems. It should be noted that most landlords did not know how the fuel bills had changed, or stated that this question was not applicable.

From the small number of landlords who were able to respond to this question they felt that tenants' fuel bills had either decreased a lot or a little with the majority of the technologies. The two technologies stated as leading to an *increase* in fuel bills were solar thermal, detailed as increasing 'a little' by one landlord; and electric boilers which one landlord said the fuel bills had 'remained the same' and three outlined the tenants fuel bills had 'increased a lot'. Likewise, electric boilers were the only technology where no landlords stated that they thought bills had reduced.

In contrast, seven out of 11 landlords who had installed ASHPs thought bills had reduced.

Graph 12: Landlord perceptions of the replacement heating system's impact on tenant fuel bills



Base= 14

Many participants in the qualitative research reported that they felt that post evaluation monitoring and evaluation were important but had not undertaken much, if any, work on this issue. Some others though had undertaken some monitoring and had found that the technologies they had installed - ASHPs, 'smart' storage and GSHPs – were all performing well. For example, one landlord commented:

> *"We've more than met our £25 a week, this magic figure that we've always talked about. We've met it so that's the good news on it, and in some cases one-bedroom houses are way down at £13, £14 a week."* Ref 02

All of those who had undertaken monitoring reported that they had been able to use this information to inform their response to complaints from tenants about inadequate temperature and running costs. The fact that complaints were being received and

that the data tended to contradict such complaints may suggest that there are some perceptual and / or behavioural issues associated with some of the less familiar technologies that social landlords are introducing. For example one social landlord reported that:

> *"One of our colleagues had got a call and the woman had complained that her electricity bill was higher now. And she's got an air source heat pump. But she had solid fuel before."* Ref 03

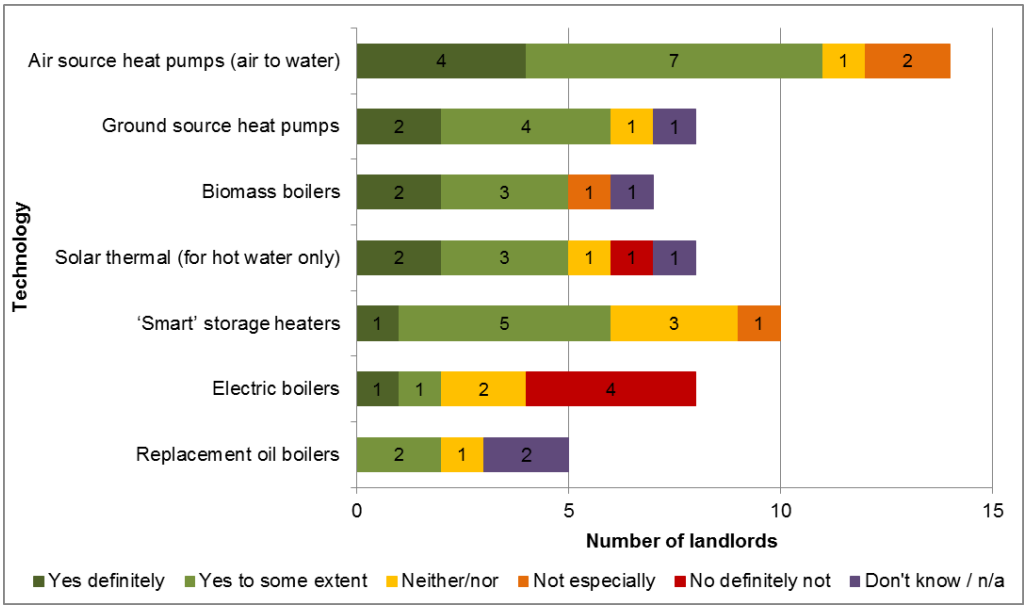
This interviewee went on to note that in this instance the tenant had failed to appreciate that a change to an electric powered heat source would generate an increase in her electricity bills and that she had not accounted for the fact that she was no longer buying solid fuel.

7.8 Experiences of technologies

Overall successes

Graph 13 shows landlords' perceptions of the success of the replacement heating system(s). Electric boilers received the least satisfaction. Perceptions of other technologies, whilst mixed, were generally positive. ASHPs generated the most responses as this is the technology that most landlords have experience of.

Graph 13: Answers to *"on the whole, would you say the technologies you have installed have been a success?"*



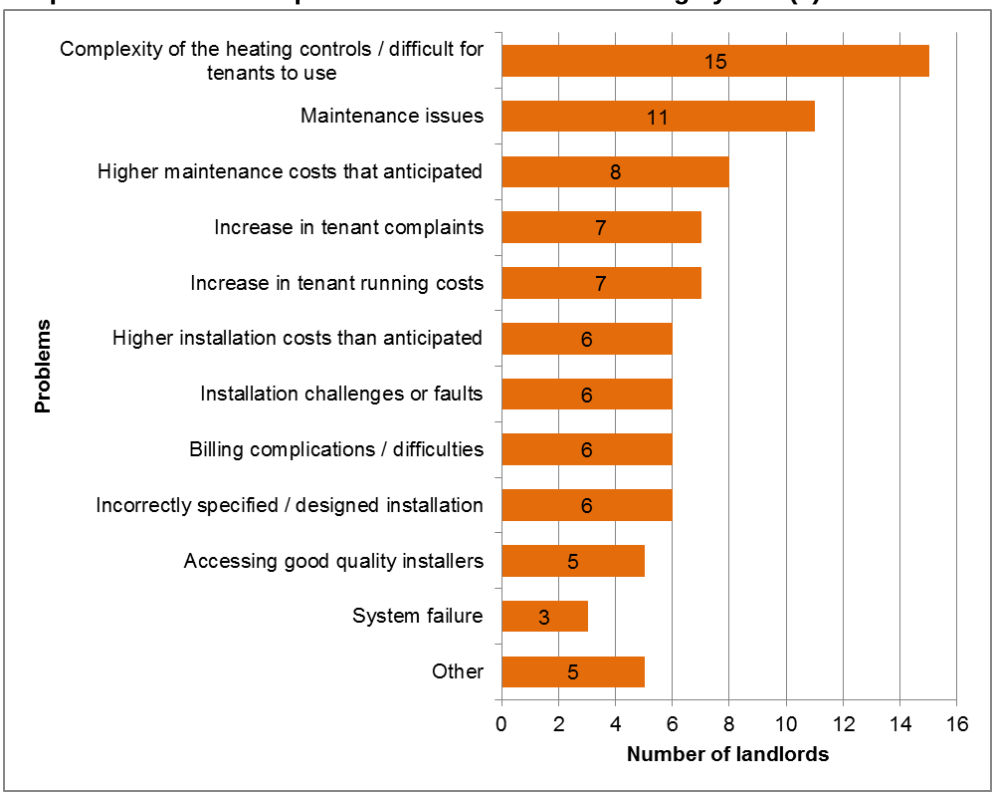
Base= 18

Overall problems

The most common problems associated with new heating technologies – cited by 15 out of 19 landlord participants in the quantitative survey - were associated with system controls (Graph 14). This was in relation to a variety of technologies.

Other common issues were problems were maintenance (11), higher maintenance costs (eight), tenant complaints (seven) and increase in tenant running costs (seven).

Graph 14: Problems experienced with the new heating system(s)



Base= 17

Feedback per technology

ASHPs

Most of the participants involved in the qualitative research had experience of ASHPs, with air to water systems being the most commonly used. A few respondents noted negative experiences of ASHPs:

> *"There are a handful of heat pumps, but literally a handful that were trialled and didn't really go down too well because of usual stories of tenants not really getting on with them particularly well."* Ref 01

However others noted that whilst there had been some initial problems these had now been resolved and for some social landlords, ASHPs were now a preferred replacement option in their heating replacement programmes.

> *"About five, six years ago we started to do the air source heat pumps. So the first ones in have not been great, but since we went on to* [manufacturer name][41] *heat pumps we're not getting any problems with the... well, very few problems with the heat pumps themselves."* Ref 02

> *"Once the property becomes void. We upgrade it at that point. To an air source, obviously, if it's off the gas grid."* Ref 03

[41] Removed for anonymity reasons.

One of these interviewees also reported what they felt to be an important co-benefit of ASHPs:

> *"The mould has disappeared the next day. It just disappeared because the whole house became warm, there were no cold spots. And they had no issues with condensation or mould, even though they'd had them in that house previously.*" Ref 02

ASHPs were also reported by many respondents as also being used in new-builds and overall the qualitative research suggested that this technology either was, or was becoming, regarded as a mainstream option.

Some social landlords (interviewed in the qualitative research) reported that they had experienced problems with ASHPs (including exhaust air heat source pumps[42]) and in one case it was noted that some pumps had been removed and they would not install this technology again.

Overall, many of the social landlords who expressed a view on ASHPs (in the qualitative research) expressed a positive opinion on the technology, citing cost reductions for tenants as their main advantage. However all reported some form of issue with the technology. Key issues included tenants adjusting controls and then needing assistance to reset them and higher maintenance costs (£100-150 per annum reported) in comparison with alternative systems. It was also noted that systems had not been in operation that long and it was unclear how well they would perform over the longer term. One social landlord reported that problems that they had experienced with ASHPs were a result of poor specification, installation and maintenance (in this case external contractors):

> *"You know, we make a big thing about tenants not understanding the air source heat pumps, but you've got to make sure the people that are asked to look after them – the engineers and such like – understand the systems and demonstrate that to you as well."* Ref 07

'Smart' storage heaters

Most social landlords involved in the qualitative research reported some experience of 'smart' storage heaters. As with ASHPs, 'smart' storage heaters seem to be emerging as a major retrofit option for social landlords:

> *"We've been finding that the new* [name removed][43] *slim-line storage heaters, they've been scoring quite well in terms of energy efficiency and performance, so we've been installing quite a few of them in the last few months.*" Ref 05

Most noted that they had only installed small numbers, but observed that they felt these offered a useful alternative option with their relative cost effectiveness (running costs, in relation to standard storage heaters) and familiarity (as a technology) to tenants being seen as positives.

---

[42] An exhaust air heat pump extracts heat from air being expelled from a building via its ventilation system (mechanical exhaust).

[43] Manufacturer name removed for anonymity.

A few respondents noted that ASHPs offered cheaper running costs, but others observed that 'smart' storage was cheaper to install and maintain. A few noted that the only problem they had to date was with tenants not understanding which choice of tariff would be the most economical for this system:

> "*The only issues we've had with* ['smart' electric storage] *heating is some cases where the tenant may or may not be on the most appropriate heating tariff"* Ref 05

Biomass

Based on the responses provided, biomass does not appear to be a favoured technology for most social landlords. One respondent reported successful individual installations but generally responses were neutral or negative. However it seemed that responses were more focused on biomass being widely unsuitable for homes or tenants, rather than performance of the technology.

A particular concern for many interviewees was the need to ensure that the technology was suitable for the tenant, i.e. that tenants could deal with the need to move relatively heavy loads and to maintain the system correctly. Other concerns included issues associated with the need for tenants to have adequate storage (for wood pellets which need to be kept dry) and fluctuating costs and supply. One landlord reported that:

> *"Now, at Christmas time there was a shortage – nobody could get any."* Ref 08

The suitability of biomass systems also depended on the type of fuel. For example the landlord who was most positive about biomass systems had installed multi-fuel stoves where problems regarding wood pellet storage would not necessarily arise.

GSHPs

Some social landlords reported that they had installed GSHPs. Respondents provided mixed feedback in terms of success but all noted that the costs of this technology meant that in most circumstances it was not currently viewed as a viable option because of their high cost:

> *"They kind of got shunted down our list of heating options with, I think, just the sheer cost of installing them"* Ref 05

Other

Other technologies referenced by a few social landlords in the qualitative research included electric boilers, infrared, decentralised heating, solar PV, solar thermal and oil boilers. With the exception of infrared (a technology seen as very promising by one respondent) none of these technologies were seen as representing mainstream options moving forward, although one social landlord expressed an interest in the possibility of linking solar PV systems to ASHPs. For example, oil boilers were not viewed as a suitable alternative except for households with existing oil systems (which appeared to be rare in the social housing in this sample). Further, experience of electric boilers was negative or neutral; for example, one cited that they were *"not a good solution"* and another stated that they did not reduce bills in comparison to old storage heaters.

7.9 Future strategies and lessons

Participants in the qualitative research were asked about their future strategic approach and the factors that would influence and inform this. Responses on these topics were mixed reflecting the organisations differing circumstances in terms of the size of their property portfolio and the type of housing, progress with EESSH compliance, geography and their experience / views on the available technology options.

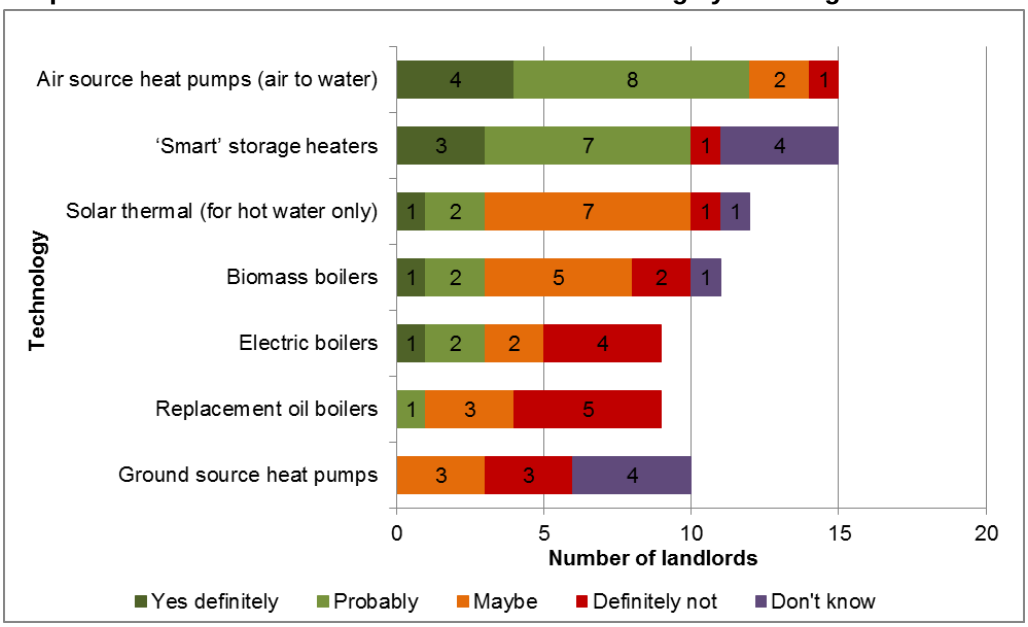
Most landlords explained that they had a multi-year plan for heating replacements. The approach and details of this was very much influenced by their circumstances but in some cases started with ‘easy wins’ or the least energy efficient properties. A few were piloting technologies on a small scale which may influence larger projects or later stages of heating replacement programmes. A small number of landlords commented that they felt EESSH to have too short a timescale (e.g. 2015 – 2020); it would be preferable to them to know what standards would be set past this date so they could plan on a longer term basis.

In general, landlords did not seem to be basing or shaping future plans on the availability of funding. In part this appeared to be due to uncertainties regarding funding, but there was also a recognition that legislative drivers would need to be complied with irrespective of funding. Also, many of the systems would be replaced under cyclical replacement programmes (the same as other components of a home such as bathrooms) and therefore funding was not necessarily expected (perhaps in contrast to other energy efficiency measures). However, funding was seen as a potential opportunity which may influence future decisions; for example one landlord explained they had a strategy based on the minimum they needed to do but they may carry out more advanced work if funding was available.

Technologies

Landlords involved in the quantitative survey were asked whether they would install any of the technologies they had used again (Graph 15). The most positive response was for ASHPs which 12 out of 15 landlords stated they would install again; followed by ‘smart’ storage heaters (10 out of 15). Results on the other technologies (solar thermal, biomass boilers, electric boilers, oil boilers and GSHPs) were mixed.

Graph 15: Whether landlords would install the heating systems again



Base= 18

These findings are consistent with the tone of the views and experiences of those social landlords who were interviewed for the qualitative research (see section 7.8).

Lessons for future projects

Two key messages emerged from both the qualitative and quantitative research. Firstly the need to ensure that tenants received effective pre and post installation support and advice. In particular it was noted that tenants needed to be fully informed of the differences in how different systems worked, the benefits achievable through different systems, but also how they would need to modify their behaviour to achieve optimal outcomes. One landlord noted that this requires that those engaged in working with tenants need to have a good understanding of this issue and that it was important that staff and contractors be kept up to date on good practice:

> *"To be honest, staff need it as well. Your staff change as well, so when you get a new member of staff, they need to then understand not just where properties are so they can go out and visit the tenants or whatever, but they also need to understand what's in those properties and how they work."* Ref 04

The second key lesson related to the need to ensure that contractors involved in the design, specification and installation of new systems are in possession of the necessary expertise:

> "*Moving on to the future, it's like – you know, it doesn't matter what system you put in, if you're not doing a quality installation at the start of the process, you're kind of… You're almost setting yourself up to fail.*" Ref 05

This is in a context where some landlords cited that the supply chain for many technologies had developed in recent years (particularly for renewables due to the Microgeneration Certification Scheme (MCS)).

However, most landlords were able to identify examples of where they felt that poor installations and / or aftercare had caused problems and in some cases these had been significant. For example, one landlord cited:

> *"… but there were definitely major issues …. And their solution was to replace all the filters and that… That ran into hundreds of thousands of pounds* [of] work *needing to be done."* Ref 07

A few landlords reported strong views on some equipment manufacturers noting dissatisfaction both with their products and with their aftercare. They suggested that a change of supplier had meant that initial dissatisfaction with ASHP had been transformed into high levels of satisfaction and the adoption of this technology as a preferred option for off-gas properties.

Additional comments

A few landlords noted that more emphasis should be placed on encouraging tenants to switch energy providers as they had experience of customers running efficient systems but paying unnecessarily high tariffs:

> *"We're trying to switch tenants by encouragement and some tenants we know of who are on* [technology name[44]] *heating systems are still on 19p because they can't get off the Total Heating Total Control tariff just yet, you know? So they've been, for the past two months, they've been spending 19p on it, which is... compared to 9p, which is crazy."* Ref 02

This feedback highlights that some tenants may find switching suppliers a difficult process.

7.10 Key findings

- Most rural, off-gas social landlords in our research had been replacing heating systems. In the most part this was replacing electric storage heaters and some solid fuel boilers / stoves. The most common replacement systems (in terms of numbers of landlords installing them) were ASHPs followed by 'smart' storage heaters and electric boilers. Other technologies included solar thermal, biomass boilers, GSHPs, oil boilers and infrared systems.
- Many heating systems were replaced during a cyclical maintenance programme i.e. end of their lifetime. The choice of system was dependent on a number of factors such as tenant satisfaction, installation cost, expected running costs and anticipated maintenance. Another key driver to install new systems was to meet EESSH and to reduce tenants' fuel bills / reduce fuel poverty.
- Landlords had a mixed experience of decision-making in terms of technology selection. Some appeared to be well-informed by their own knowledge, energy modelling and in some cases pilots of installed technologies. Others felt that they had insufficient or conflicting information (although this was not cited as an issue for most).

[44] Name removed for confidentiality reasons.

- SAP was criticised by a number of landlords as being inaccurate, with some landlords feeling that technologies were being installed to meet EESSH which would not benefit, or may even cost, tenants.
- Installation costs of technologies vary widely. For example for an ASHP costs were quoted between £5,500 and £12,000. This may be the impact of one-off installs compared to economies of scale. However some felt costs were much higher in remoter areas. Such differences are likely to impact the decisions of different landlords. Some landlords had accessed funding and this was seen as useful in driving installations of certain technologies, but it was not generally expected.
- Most landlords did not consult tenants on the choice of technology, but would provide information pre install.
- Advice on using the heating system was provided to tenants through written guidance and verbal explanations. Most interviewees noted the importance of providing follow-up advice.
- Less than half of the landlords who responded to the survey had undertaken monitoring of projects, most commonly carried out via a tenant satisfaction survey but also through tenant bill monitoring or monitoring equipment (e.g. temperature sensors). However those that had carried it out felt it to be useful in informing future technology choices and also providing follow up support to tenants.
- Few landlords knew whether technologies had reduced tenants' fuel bills. Where they did, most thought technologies had reduced bills. An exception was electric boilers which none of the landlords responding to the survey thought had reduced bills.
- Experience of technologies was mixed. Generally ASHPs, as the most commonly installed technology, were viewed positively. Experience of other technologies was less prevalent but on the whole positive. Electric boilers had the most negative response.
- The choice of technology in the future depended on a number of factors. Those interviewed stated a preference for ASHPs and 'smart' storage heaters, with some also stating biomass. However this also relates to the previous heating system; few landlords had oil boilers in their stock and therefore would not normally consider this system. In contrast, most were looking for a replacement system for electric storage heaters for which ASHPs or 'smart' storage heaters often seemed practical.

8. HEATING REPLACEMENTS: TENANT EXPERIENCES

8.1 Background

Interviews were conducted with 30 tenants in rural, off-gas areas from five different social landlords[45]. The number of tenants interviewed for each type of heating system technology is shown in Table 7 below. Tenants with the same heating system technologies came from the same landlord, except for ASHPs where tenants came from three different landlords.

Table 7: Tenant interviews per heating system technology

Technologies	No. of Interviews
ASHP (air-to-water)	8
ASHP (air-to-air)	1
GSHP	3
Biomass boiler / multi-fuel stove	9
Oil boiler	1
Electric boiler	3
'Smart' storage heaters	4
Infrared heaters	1
Total	**30**

The tenants were of a range of ages (e.g. from young parents living with children through to elderly individuals), occupancy types (e.g. at home most of the day) and durations, and employment statuses (e.g. unemployed, in part-time / full-time employment, retired).

Most of the tenants (22 from 30 interviewees, or 73 per cent) had lived in their homes before their current heating system had been installed and so had experience of the overall installation process for their heating systems. Prior to this installation, previous heating systems were mostly open coal fire / back boiler with radiators or storage heaters. Those tenants who had moved into their homes after their heating system was installed were mostly those moving into new-built homes with ASHPs. Many tenants had experience of using gas central heating (GCH) systems in previous homes. Experience among the tenants of using their non-gas heating systems in their current homes prior to the interviews taking place ranged from just a few months to several years.

In many cases the energy efficiency of tenants' homes had previously been improved by the installation of a range of measures: double glazing, loft, wall or floor insulation. Some tenants stated that they would have liked solar photovoltaic (PV) panels installed to their homes as well as their new heating systems, due to perceived energy cost reduction and environmental benefits.

8.2 Experiences of different technologies

Tenants were asked about their experiences of the heating systems in their current homes. They were invited to consider these systems in terms of how easy they are to use, how effective they are at providing warmth and comfort and how affordable they

[45] Four housing associations and local authorities.

are to run. Also, the tenants were asked to reflect on how these heating systems compared to their previous heating systems.

Ease of use and understanding of system

ASHPs

Tenants who had ASHPs installed in their homes stated that they generally found this type of heating system easy to use, but on the whole only after receiving advice and support. Many tenants found that it took them some time (in one case about two years) and several demonstrations from landlord representatives, installers or service engineers, and / or neighbours before they had an adequate knowledge of the ASHP controls. However, one tenant remarked that the ASHP was still "*very complicated*" and "*difficult to use*" and another stated that it "*took a while to get going with it but everything's OK now*". In some cases, tenants found gaining an understanding of the ASHPs was impeded by commissioning problems with their heating systems.

There was a general perception that the service engineers were more able to show tenants the functionality of the ASHPs than landlord representatives, with some tenants claiming that a service engineer's explanation had given them a "*really good understanding*" of how to use it. This demonstration occurred from a week to a year after moving in.

Not all tenants found the heating system operation guidance provided by the landlord to be understandable and helpful. One remarked that "*older people would struggle to understand*" the manufacturer's operation manual while another stated that a landlord demonstration of the system "*didn't make much sense*" and the information pack provided was written in "*double Dutch*".

In some cases the pre-existing timer and hot water settings were not appropriate to new tenants, leading to energy and cost inefficient use of boost functions. However, all tenants now used the timer function, with heating patterns set to suit household lifestyles.

GSHPs

Three tenants who had a GSHP heating system installed found this system easy to use. One tenant remarked that it was "*very, very easy to use*". However, this same tenant stated that the instruction manual provided by the installers was "*almost impossible to understand*" and thought that elderly people would struggle to use the digital control panel. This tenant had self-learned how to use the GSHP. It would seem that the other tenants with GSHPs installed found their systems easy to use because the heating controls were set initially and not changed thereafter.

One tenant noted that when they first moved into their home, they had not been aware that the radiators would operate at a lower temperature compared to GCH, which they had assumed meant it was not working correctly (a reaction apparently shared by other tenants). The tenant claimed that the landlord did not know any different and recommended the tenant turn off the system to resolve the issue (which reportedly led to the problem exacerbating).

Biomass boilers / multi-fuel stoves

Where tenants had biomass boilers these heating systems consisted of a multi-fuel stove, a hot water tank and wet radiators. All tenants were provided with written instructions on how to use their heating systems and were given demonstrations of their use, where required. They all stated that the heating system was easy to use, for example describing controlling the stove as "*easy enough … a blind man could do it*" and another stating, "*just light a fire and that's it … away it goes, it runs itself basically*".

The amount of heat provided by the stove itself was regulated by a simple control knob with five heat settings. The stoves did not have a timer function and were operated manually. One tenant reported that the stove heating control was set to 2.5 during the day and then turned up to 5 in the evening, when more heat was required. The stove was able to be run in the summer at a level that just provided hot water. Heat from the radiators was mostly controlled by thermostatic radiator valves (TRVs).

Those tenants who had previously had a coal fire / back boiler heating system found it easier to maintain a fire throughout the night (to provide heat and hot water in the morning) with the multi-fuel stove heating system. A problem for one tenant with maintaining a fire in the stove overnight was resolved by improving the flow of gases through the flue. Other minor drawbacks with the multi-fuel heating system that were highlighted by tenants included problems getting coal fuel to light within the stove and difficulty keeping the stove clean.

Oil boilers

The tenant with the replacement oil boiler stated "[the controller is] *digital so it's much easier to use*" compared with the old oil boiler. The tenant controlled the heating system manually, using it in conjunction with small plug-in heaters in a cold back bedroom and to control damp. However, the use of the plug-in heaters diminished with the new boiler compared to the old boiler because "*it was easier to use the boiler … as the price of oil has gone down*".

Electric boilers

Three tenants had an electric boiler installed and all had experienced difficulties using them. One tenant did not understand how to use the heating controls, and for several years had switched the boiler off because they felt it was too expensive to run. However, the tenant started using the boiler again following support from an energy advisor who set the heating controls (boiler timer and thermostat) properly.

Another tenant stated that they did not know how to use the electric boiler and found troubleshooting problems with the system difficult. However, instruction by an electrician allowed the tenant to understand how to programme the heating controls so that the boiler became "*self-sufficient*". The final tenant was told by the installer not to touch the heating controls after the installer set them up, although they stated they would have preferred the installer had provided a demonstration on how to use the system.

'Smart' storage heaters

All tenants with 'smart' storage heaters claimed to find these heaters easy to use. However, most of these tenants, who were all elderly, stated that they struggled to

understand the demonstrations given and operation guides provided by the installers. One tenant was shown how to use the new storage heaters by a neighbour with the same heating system installed and found this more informative. Another tenant stated that they had found the heaters easier to use as they became more accustomed to them over a few months.

In most cases the heating controls had not been changed since the 'smart' storage heaters were installed. One tenant did not touch the heating controls, stating: "*I'm frightened I would break it or put it off*". Another tenant remarked that the installers "*just set and I just leave them set to what they are*". Most of the tenants used the 'smart' storage heaters' timer, although there was some uncertainty about when the periods of the day when the heaters gave out or did not give out heat. Where heating controls were actively used there tended to be changes to the thermostat (to provide heat at a greater rate) and use of the boost function (to advance the next period when the heat was timed to release).

Infrared heaters

The single tenant with infrared heaters installed remarked that this heating system was "*really quite simple … you don't have to be a rocket scientist to use it*". A wall-mounted control panel in the living room allowed different temperatures to be easily set in each room of the tenant's home. They did not use the system's timer function but rather, following the installer's recommendation, had setup the system to provide heat all the time.

Heat provision and warmth

ASHPs

The majority of tenants with ASHPs were positive about heat provision and warmth in their homes, with one tenant stating that it was "*very easy*" to keep their home warm and comfortable. In relation to warmth and comfort another tenant remarked that the ASHP heating system "*seems to work okay … I'm happy with it*". One tenant found it easier and cheaper (halving their monthly heating bills) to be warm and comfortable with their ASHP compared with a previous home which had a GCH system.

However, three tenants found their previous homes with GCH warmer and more comfortable than their current homes with ASHPs. One tenant put this down to the layout of their new home (this was the first time that the tenant had lived in a flat) and another tenant explained that their ASHP takes a longer time to heat up the home than their previous GCH system. The third tenant stated that while their previous GCH system was more effective and better at keeping their home warm and comfortable, the tenant liked their new ASHP heating system better as they were able to have it on for longer as it was cheaper to run.

GSHPs

All of the tenants that had GSHPs installed found their homes warm and comfortable with this heating system. One tenant stated that they now found it easy to keep their home warm and comfortable, having initially had some difficulty understanding how to use the GSHP heating controls. Another tenant remarked that their home is "*so*

cosy, it's boon[46] *to me*" and that installing a GSHP was the best thing that their landlord had ever done for them. A third tenant, who previously had storage heaters installed in their home, stated that they now find their home warmer and more comfortable.

Biomass boilers / multi-fuel stoves

Tenants with multi-fuel stoves installed were pleased with the heat provided by this type of heating system. One tenant remarked that it was as "*easy as could be to keep warm*" with the stove. Two tenants stated that they sometimes had to open the windows in their homes as the heat generated by the stove could make their homes too hot.

The tenants found it easier to keep their homes warm and comfortable with a multi-fuel stove heating systems than previous heating systems. Some remarked that this was because the stoves were more efficient e.g. one tenant stated that it was"*200 percent*" easier to keep their home warm.

Oil boilers

The tenant with an oil boiler stated that it was "*quite easy*" to stay warm and comfortable with this heating system and that their home was warmer and more comfortable with the newer oil boiler than it had been with their previous oil boiler. The tenant attributed this to the new radiators that were fitted; the old radiators were reported to not heat up "*all the way to the top*" and often needed bleeding.

Electric boilers

In general, the tenants with an electric boiler installed to their homes were positive about heat provision and warmth with this heating system. However, one tenant had turned off their electric boiler soon after it was installed seven years ago (as it was too expensive to run) and had only recently turned this system back on. Another tenant, who had experienced a number of operation issues with their electric boiler, found it easy to keep their home warm and comfortable when this heating system was working.

All of the tenants with new electric boilers remarked that they had found it easier to keep their homes warm and comfortable since their new boilers had been installed. Two tenants stated that their electric boiler took less time to heat up the home and was more efficient than their previous ASHPs (although one of these tenants did not believe that the ASHP was running at its full potential due to the impact of snow on the ASHP's operation).

'Smart' storage heaters

Of the four tenants who had 'smart' storage heaters installed, only one tenant was happy with the heat provided by this system. This tenant's old storage heaters had been replaced with 'smart' storage heaters; they stated that their home was "*comfortable enough …* [I'm] *not complaining …* [the new heaters are] *as good as the last ones*". However they remarked that their home was not as warm in the mornings with the new heaters because the new heaters used a timer which let out heat during the day and in the evenings, not overnight like the previous storage heaters.

[46] 'A thing that is helpful or beneficial'.

On the contrary, other tenants felt that the new storage heaters provided insufficient heat in the afternoon or evenings when the storage heaters lost their charge. One used a halogen heater to provide additional heat and another went to bed early with a hot water bottle as they found their home too cold at night (which they stated they wouldn't have previously had to do when they had a coal fire).

Infrared

The tenant with infrared heaters installed remarked that it was "*quite easy*" to keep their home warm and comfortable with this system. The tenant stated that the infrared heating system was "*probably the best heating system*" that they had experience of using. Previously the tenant had storage heaters in the home. Since the infrared heating system had been installed, the tenant found the home warmer and more comfortable.

Affordability

ASHPs

Many tenants reported paying less to provide heat with their ASHPs than with their previous heating systems. For example, three stated that they were paying the same or a little less for all their energy bills in their current larger homes with an ASHP, compared to previous smaller homes with GCH. In addition, two claimed that their monthly energy bills were halved in comparison with their previously GCH heated homes.

Some tenants reported that their energy bills had increased using ASHPs. For example, one tenant complained that their monthly energy costs had gone up by £30 per month when they moved into a home with an ASHP. Another stated that their energy bills had risen by £135 a month (from £55 to £185); putting them under financial pressure and now receiving support from their landlord in terms of their energy supplier[47]. However, some of those tenants whose bills had increased acknowledged that the increases were influenced by existing fuel debt or being on an inappropriate tariff. Another ascribed it to their hot water tank being too large.

GSHPs

One tenant reported saving £30 per month on their energy bills using the GSHP in their new home (a flat in a rural location) compared to bills in a previous home (a bungalow in a city). Another tenant reported a total energy bill saving of £42/year after their GSHP had been installed; however they also commented that their previous bills had been low due to not using their storage heaters.

Neither tenant was given advice from their landlord about the most appropriate supplier and tariff for the GSHP heating system, although both felt satisfied with their current supplier and tariff arrangements. One tenant was not aware if there was a specific tariff for GSHPs.

Biomass boilers / multi-fuel stoves

Almost all tenants who had open coal fire / back boiler heating systems replaced by multi-fuel stove and wet radiator systems thought that the greater efficiency of the

[47] Despite this help the tenant stated they were still paying £40 - £50 a week in electricity bills.

stoves compared to the fires meant that fuel (e.g. coal, logs and smokeless fuels, such as ‘duck eggs’) lasted longer. Therefore, they were spending less on fuel. One tenant stated that compared to the coal fire running the stove was "*much cheaper ... less than half the cost*".

Where tenants thought that heating costs had increased this was attributed to switching to a more expensive fuel more suitable to be burnt in a stove but most thought the cost of fuel for stoves was reasonable. One tenant who had “*ineffective*” storage heaters replaced by a multi-fuel stove system felt that it was slightly more expensive to run than the old heating system but the increase in heat within the home was worth the additional expense.

Oil boilers

The tenant with a new oil boiler installed stated that the improved efficiency of the new boiler meant that the oil tank refill “*lasted quite a bit longer*” than it had before, meaning they must be saving money by not having to buy oil as often.

Electric boilers

A tenant with an electric boiler installed was advised to change to a more appropriate energy supplier when replacing an ASHP with an electric boiler. However, the tenant was unable to get the desired tariff (with a cheap rate for electricity during three periods of the day) because the electric system installed did not match the metering requirements for this rate. The tenant reported as a result that their energy costs had increased.

Another tenant claimed that energy bills were cheaper with an electric boiler than with a previously installed ASHP. This tenant had also been advised to change supplier and tariff and had achieved a monthly saving of over £30. However, the supplier later informed the tenant that a combination of the wrong tariff being applied to the tenant’s heating system and rising energy costs would result in a rise in monthly energy bills to £223. The tenant was attempting to resolve this issue with the supplier.

One tenant was paying £95 per month, seven years after the electric boiler was installed, and felt that this was a reasonable increase of £25 compared with when the heating system was first installed. All tenants had turned off their electric boilers during non-peak electricity periods and / or when it got cold in order to save money. Two tenants remarked that this was not something that they had found the need to do with the previous heating systems.

‘Smart’ storage heaters

The one tenant who had ‘smart’ storage heaters to replace their open coal fire / back boiler heating system felt the new heaters were very expensive to run. They felt that the heaters were “*guzzling electricity*” while not generating sufficient heat and would only use one storage heater (in the living room) to save money; in the winter making them feel “*desperate*”.

The other three tenants with ‘smart’ storage heaters had previously had old storage heaters. All had different experiences of their energy bills: one stated they had not changed much (about £30 to £35 per week); another thought they had risen by

approximately £10 per month (although the tenant was in dispute with the energy supplier over previous payments and could not confirm this); and the third reported a 40 per cent drop (although they had quarterly bills and their most recent bill was only an estimate i.e. not based on a meter reading). Such anecdotal evidence makes it difficult to ascertain any changes post installation.

Infrared heaters

The tenant with an infrared heating system previously had storage heaters which they claimed was costing them a minimum of £700 every three months; a cost they felt to be very high. The infrared heating system had reportedly reduced the tenant's electricity bills significantly; with a summer quarterly cost quoted of £115. The tenant stated the electricity bills "*are nothing like they were before … this heating is more economical and more comfortable*".

8.3 Advice and guidance

Tenants were also asked about the quality of the advice and guidance they received concerning their current heating systems, both (where applicable) before the systems were installed and when they were operating.

Pre-installation and consultation

Most tenants stated that they were not given a choice about the type of heating system to be installed to their homes (although a number had moved into the property post-installation of the system). Some tenants had been given limited options and their choice was based on a range of criteria such as their knowledge and/or experience of the new heating systems, or particular heating systems being less disruptive to install. Some tenants stated that they would have liked more help and information from their landlord to allow them to make more informed decisions, such as running costs and appropriate energy suppliers and tariffs.

Most tenants had no initial concerns about their new / replacement heating system and did not change their opinion of the new heating systems after they started using them. Many found their heating bills had reduced as expected, winning over some initial sceptics. However, some tenants with ASHPs did complain that they were noisier in operation than they had anticipated.

Using the system

Most tenants received printed heating system operation instructions at the time of installation or on moving into a property. On the whole they were satisfied with these printed instructions, for example commenting that they were "*perfectly alright*" or "*enough*". However, some tenants, particularly those with ASHPs and other more novel technologies, would have preferred written guidance to be simpler and more understandable.

In almost all cases, tenants preferred or would have preferred to be shown how to use their heating systems by someone with a good knowledge of their operation (e.g. installers, service engineer) rather than relying on an operation manual. In fact some felt they were only able to control their heating properly after receiving this demonstration or an explanation from a neighbour, even though in some cases this

was many months after moving in. On the other hand, the capacity of (particularly elderly) tenants to understand new technology made the demonstration difficult to fully comprehend. Further, some tenants who had moved into properties post-installation complained about not being adequately shown how to control their heating systems when they initially moved in.

In general, tenants reported that their landlords did not follow-up to check that they were still able to use their heating systems effectively post-installation. Instead, many tenants used periodic maintenance visits by service engineers as an opportunity to ask questions about their heating systems and improve their knowledge. Some tenants referred to the written instructions over time to gain a better understanding of the operation of their heating systems and to change the heating settings (e.g. adjust the timer).

8.4 Installation process

Tenants were asked if they had been given enough information about the installation of the new heating system prior to the works taking place. They were also asked about how the installation went and what, if anything, could have gone better.

Pre-installation

Most tenants were satisfied with the pre-installation process and did not require any further information to that provided. In many cases installers surveyed tenants' homes prior to starting the works, telling them when the works would start, how long they would take, what disruption they could expect (e.g. whether they could still live at home during the works). Typically, the installers also provided tenants with further information (e.g. brochures) about the heating system to be installed and informed them of any required actions in advance of the works (e.g. moving furniture to allow access).

Where tenants reported differences between how they were told the installation process would go and what actually happened these tended to be relatively minor (e.g. lifting of some floorboards to allow for electrical access) and well-managed. However, some tenants reported a lack of information about the installation and communication from the landlord e.g. "*just came and did it … they just drilled holes in the wall and that*". One commented that they had to actively contact their landlord to obtain information about the work schedule.

Installation

New heating installation durations ranged from a couple of days to about a week depending on the type of replacement. Replacing storage heaters with 'smart' storage heaters was reported to be the least disruptive process, as the new heaters would most often be installed in the same position as the old heaters with no need for any further electrical of builder's work. In contrast, the level of mess and disruption was higher where systems with a new wet radiator system had to be fitted. Some tenants moved out of their home during the process; some others realised they would have been better to do so.

Tenants were generally quite positive about the installation process itself, with many describing the workers as "*very pleasant*" and "*really good*". Tenants reported that installers mostly cleaned up after the work and were quick to take appropriate corrective actions where they made mistakes. One tenant remarked: "*I could not fault them … they were an excellent team*".

However, in some cases the tenant installation experience was poor and / or could be improved upon. For example, one tenant remarked that the area outside of the home, which had been used to store materials, could have been cleaner and tidier and others stated that carpet and skirting boards had been burnt due to pipe welding without sufficient protection. One tenant stated of the installers that "*none of them knew what they were doing*" and another described the installation as "*an awful experience from beginning to end*", with problems including inadequate pipe soldering leading to a water flood in the home.

Those tenants with a poor experience of the installation process recommended that for future installations the landlord or installers should provide more printed information and schedule the installation to take place during the summer when there was less need for heating.

8.5 Key findings

- From tenants' perspectives, none of the heating systems clearly emerged as the 'best solution'. However, certain heating systems have characteristics (e.g. ease of installation and use, warmth levels, energy costs) that are better (or worse) than others and more (or less) favourable to individual tenant preferences. However these findings must be caveated by the small sample size, especially for some technology types.
- Tenants generally found their heating systems easy to use, but in some cases (such as for ASHPs) this was only after having received considerable advice and guidance. In particular, the multi-fuel stoves with simple five-setting heating controls were said to be easy to use. Positive responses were also received from those with oil boilers, GSHPs and smart storage heaters. In contrast, all three tenants with electric boilers initially encountered difficulties (although these were later overcome in two cases).
- Most tenants found that their heating systems provided sufficient levels of comfort and warmth, in some cases at levels the same or greater than previous GCH systems. A lack of heating availability in the evening emerged as an issue for some tenants with smart storage heaters, although it is unknown from the data whether these systems were set correctly.
- Many tenants reported that their heating costs had remained the same or reduced, compared with previous heating systems (often GCH) in the same or other homes. Tenants with oil boilers and multi-fuel stoves stated that they paid the same for fuel but were saving money due to improved heating system efficiencies. Some tenants with ASHPs and electric boilers reported paying more than they had expected to pay, potentially due to inappropriate tariffs, defective heating systems or issues with their energy supplier. On the contrary, others with ASHPs and those with GSHPs also noted bill savings.

- Correct operation of the heating systems appears fundamental to tenant satisfaction, reducing bills and providing appropriate levels of warmth. Whilst some tenants were satisfied to receive written information about how to use the system, there was a general preference to receive this information via a demonstration by someone with good system knowledge (e.g. service engineer) and explanations from neighbours were also described as helpful. Problems emerged where tenants did not receive advice at the time of moving into a home, did not receive follow-up advice or did not understand the explanation provided at the installation.
- Tenant views on the installation process for heating systems were mixed with some installations being relatively simple and straightforward and others involving considerable disruption and mess (especially where new wet radiator systems fitted). Some felt that landlords could have provided more pre-installation information.
- Few tenants were consulted on the choice of technology but where they were, they felt that additional information would have been helpful.

9. DISCUSSION AND CONCLUSIONS

This section discusses the key findings from the report and provides conclusions.

9.1 Energy efficiency schemes

The first part of this research set out to look at what level of support is currently available to rural, off-gas consumers through energy efficiency and fuel poverty schemes, and to what extent it is reaching these consumers.

The research found that a number of past and current schemes provide support for off-gas consumers. These schemes were analysed to ascertain geographic distribution, although only data on schemes running before ECO was available on a small scale level. This exercise showed that, overall, the distribution of energy efficiency interventions delivered up until the start of ECO does not demonstrate an urban bias (in terms of number of measures installed). Whilst remote small towns and rural areas have received fewer measures per household than the overall average, this does not translate into an overall urban bias because large urban areas (which is the largest category in terms of number of datazones), also received fewer measures per household than the overall average.

Delivering schemes in urban areas enables scheme operators to quickly achieve economies of scale (owing to the existence of better developed supply chains and the density of housing) and as a result, urban programmes commenced earlier. Urban areas therefore may have benefited more at the start of some schemes, such as CERT and ECO, and for a longer period. However this urban bias has been off-set by a number of factors:

- some schemes have been designed specifically to ensure rural homes are targeted e.g. the CSCO element of ECO
- the targeted fuel poverty programmes (EAP, EAS and Warmer Homes Scotland) have disproportionately benefited rural areas because of the higher proportion of homes in these areas which have poor energy efficiency ratings
- area-based schemes in Scotland (HIS, UHIS, HEEPS: ABS) have involved distributing funding to all local authorities which means all areas benefits[48].

In addition, all the renewable energy schemes have had a strong (although unintentional) bias towards rural, off-gas areas. This is because many types of domestic renewables, even with the support of such schemes, tend to be less financially attractive and practical to install in urban on-gas locations.

A further objective of this research was to quantify how much money rural, off-gas consumers have contributed to schemes such as ECO and how much they have received from it. It was decided that this calculation was not required since, as stated above, rural and urban consumers are in fact receiving proportionately similar benefits[49].

[48] Note that funding is not allocated on a proportionate basis but based on need.
[49] The data required to carry out this calculation was also not fully available.

KEY FINDING:

- Analysis shows that, overall, energy efficiency schemes (up until the start of ECO) have not had an urban bias. On average, rural areas have benefited slightly less (in terms of number of measures installed) than the overall average, but this does not equate to an overall urban bias because large urban areas have also benefited less than average.
- Urban areas are likely to have benefited more from schemes during their early stages owing to the existence of supply chain and economies of scale. However, over time this has been offset by (a) specific elements of schemes designed to target rural, off-gas areas (b) fuel poverty programmes targeting the least energy efficient properties (prevalent in rural areas) and (c) area-based schemes in Scotland which ensure that all local authority areas benefit. In addition, renewable energy schemes have benefited rural, off-gas areas more.

9.2 Costs and benefits of heating systems

The second part of the research looked at whether heating replacements in social housing are consistently lowering household bills. The scope of the research meant that this could only be determined by (a) energy (RdSAP) modelling and (b) anecdotal evidence from social landlords and tenants.

The energy modelling found that all replacement technologies modelled are likely to make significant savings on bills when compared with older technologies. The only exception concerns existing auto feed solid fuel floor mounted boiler systems where a number of replacement systems can increase costs.

Modelled costs vary dependant on technology. For example, in a semi-detached cavity property, GSHPs (a high cost technology) would cost £573/year to run whereas 'smart' storage heaters (a low cost technology) would cost £769/year: a considerable difference. Generally, technologies that achieve lower running costs and higher SAP scores cost more to install. Higher running costs tend to be associated with lower cost replacement systems. Other technologies with modelled low running costs (in a semi-detached cavity property) are oil boiler (£539) and biomass boiler (£542), and those with expected higher running costs are ASHPs (£731) and electric boilers (£696). However as highlighted above, older technologies would cost considerably more: for example, traditional storage heaters would cost £1,019/year and an open coal fire with plug in heaters would cost £1,565/year.

Few landlords had undertaken monitoring of installed systems and therefore evidence of actual running costs was only anecdotal. The feedback for most technologies was generally good, with most landlords believing they had reduced tenants' bills. However situations were discussed where this was not the case and where bills had increased (particularly in the case of electric boilers). Importantly, tenant behaviour is often a strong influencing factor on whether bills reduce.

It was difficult to draw conclusions from the tenant feedback; the sample was small for some technologies and a number of tenants had moved into their home post heating replacement. Most reported that their heating costs had remained the same

or reduced. This was easiest to determine for those with more efficient versions of the same technology i.e. more efficient multi-fuel stove. Mixed responses were provided to the savings achieved for ASHPs and 'smart' storage heaters. However it appears that some problems were the result of inappropriate tariffs, defective heating systems and potentially poor user behaviour. These issues highlight that determining the actual running costs of technologies can be difficult. A further issue raised by landlords was that fuel prices (e.g. oil, biomass) can fluctuate widely and may also be prone to supply chain disruption.

KEY FINDINGS:

- Energy modelling suggests that replacing heating systems in rural, off-gas areas should reduce energy bills, in some cases quite considerably. Higher cost technologies (such as GSHPs) are generally likely to achieve greater running cost reductions compared to less expensive technologies (ASHPs, 'smart' storage heaters and electric boilers).
- Evidence of bill savings achieved is limited but anecdotal tenant and landlord feedback suggests that the majority of replacement heating systems have reduced heating bills, or at least kept them the same. In a minority of cases, bills have gone up following replacements, and this was most commonly reported of electric boilers. The actual impact on running costs will depend on a number of factors such as user behaviour, tariffs and fluctuations in fuel price.

9.3 Heating replacements in social housing: strategy and decision-making

This part of the research sought to understand how heating replacements are being delivered in rural, off-gas areas by social landlords. It sought to do this by investigating their strategies, decision-making processes, installation procedures and evaluation methods.

Most landlords in rural, off-gas areas are replacing heating systems as part of their cyclical replacement programmes i.e. heating systems coming to the end of their life, to meet EESSH or reduce tenants' bills. When selecting technologies, landlords take into account a number of factors such as installation cost, tenant interaction and maintenance.

High installation costs (such as for GSHPs) can deter landlords from installing certain forms of technologies. Decision-making does not appear to be heavily influenced by the possible availability of grant funding although social landlords are aware of the RHI and, in some cases, have found that this scheme has generated significant benefit.

The extent to which EESSH is a driver varies between landlords depending on the energy efficiency of their stock. In these cases the results of energy modelling (SAP) are critical and the energy modelling carried out as part of this research confirmed that more expensive technologies generally generate higher SAP scores (as well as lower running costs). It also showed that SAP scores will not change on the basis of

a property's location. Some landlords were critical of SAP's accuracy and in some cases felt that technologies were being installed to meet EESSH that might actually increase tenants' bills.

Decision-making processes differed between landlords depending on their circumstances e.g. size of organisation. Some appeared to be well-informed (for example, from in-house knowledge, energy modelling and pilot projects) whereas others cited lack of information, or conflicting information, as an issue.

ASHPs were the most commonly installed technology by the landlords in this research, followed by smart storage heaters and electric boilers. Other technologies included solar thermal, biomass boilers, GSHPs, oil boilers and infrared systems. Landlords' experience of all technologies was mixed but for most technologies there tended to be more positive experiences than negative experiences. However there were also unsuccessful experiences with all technologies, particularly electric boilers.

All social landlords involved in this research had or were planning to deliver advice to tenants on how to use their new heating system. Most commonly this was through written information, often complemented by a verbal explanation. The importance of tenant engagement appeared to be recognised by landlords and many had learnt from past experience; for example, many now provided follow-up advice to tenants. However it was viewed as challenging to undertake due to resources required and different needs' of tenants, especially with more complex technologies like ASHPs. Landlords did not generally consult tenants on the initial selection of technologies, but sometimes offered tenants a choice of two or three technologies during the pre-installation period.

Evaluation of heating replacement schemes in social housing has been limited. Fewer than half of landlords in our sample had or are in the process of carrying out any monitoring. The most common form was carrying out a tenant satisfaction survey, but tenant billing data evaluation or installed monitoring equipment (e.g. temperature sensors) were also used. Large scale monitoring was rare as it was normally only carried out for a handful of homes or for a pilot project. However information appeared to be useful in shaping future programmes and/or resolving tenant disputes. It was generally considered that more evaluation would be helpful.

KEY FINDINGS:

- Most social landlords are installing new heating systems in rural, off-gas homes as part of cyclical replacement programmes (systems coming to the end of their life). Key drivers are the need to meet EESSH and a desire to reduce tenants' fuel bills.
- Selecting the best technology can be complicated and is often based on a number of factors such as installation costs, tenant satisfaction, SAP score and maintenance requirements. Decisions were informed by energy modelling, in-house knowledge and pilot projects. Some landlords stated that they lacked knowledge or consistent / sufficient information and that this hampered their ability to make decisions regarding competing forms of technology.
- Landlords have installed a range of technologies with ASHPs being most prevalent. 'Smart' storage heaters and biomass boilers are also relatively

common.

- The importance of tenant engagement, especially with using a new heating system, is acknowledged by social landlords. It is usually provided by both verbal and written guidance, but some recognise they need to carry out more or more effective support.
- Monitoring and evaluation of projects is not carried out often but has been helpful where done.

9.4 Consumer experiences of heating replacements

This element of the research sought to understand the consumer experience of new heating systems in rural, off-gas areas. Findings are based on interviews with 30 tenants who are living with new heating systems in rural, off-gas social housing.

Consultation and engagement

Few tenants were consulted on the choice of technology but most were informed of the decision and the required work to their homes. Some of those that *did* receive a choice felt that more information to help them would have helped them make an informed decision.

Most tenants received advice on how to use their heating system through an in-home demonstration and written information. The demonstrations were considered to be most helpful but only where the person providing the explanation had a thorough understanding of the technology. Further support may also be needed for vulnerable tenants; for example it was found that some elderly tenants struggled to understand explanations. Written information was viewed as useful but sometimes insufficient and sometimes difficult to understand. Many tenants stated that they would have benefited from follow-up advice to confirm / assist their understanding, and new tenants sometimes did not receive advice when moving into their property.

Tenant views on the installation process for heating systems were mixed with some installations being relatively simple and straightforward and others involving considerable disruption and mess (especially where new wet radiator systems were fitted). Some felt that landlords could have provided more pre-installation information on the works schedule.

Experience of new systems

From tenants' perspectives, none of the heating systems clearly emerged as the 'best solution'. Certain technologies have characteristics (e.g. ease of installation and use, warmth levels, energy costs) that are better (or worse) than others, but tenants preferences also vary. These findings must be caveated by the small sample size, especially for some technologies.

Tenants generally found their heating systems easy to use, but in some cases (such as for ASHPs) this was only after having received considerable advice and guidance. In particular, the multi-fuel stoves with simple five-setting heating controls were said to be easy to use. Positive responses were also received from those with oil boilers,

GSHPs and smart storage heaters. In contrast, all tenants with electric boilers encountered difficulties (although issues for two if these tenants were later resolved).

Most tenants found that their heating systems provided sufficient levels of comfort and warmth. However some of those with smart storage heaters felt there was insufficient heat provided in the afternoon / evening by these heaters.

KEY FINDINGS:

- Most tenants were broadly satisfied with their replacement heating system, with no technology overall emerging as the 'best' or 'worst' technology. Heating systems were generally found to be easy to use, although some needed considerable support (such as ASHPs). The heating systems were generally considered to provide adequate warmth, although some tenants with 'smart' storage heaters felt they lacked warmth in the evening.
- Tenants generally received support from their social landlord via written instructions and an in-home demonstration. However further support was needed to make written information easier-to-understand, following-up advice at a later date, with new tenants and vulnerable tenants who needed greater levels of support.

10. RECOMMENDATIONS

The recommendations from this research are as follows:

1) UK and Scottish energy and fuel poverty schemes should continue to be designed in such a way that rural, off-gas areas benefit as much as urban areas. Without specific design ensuring this happens (like the CSCO element of ECO), urban areas may benefit more, particularly at the start of schemes. Given fuel poverty rates tend to be highest in rural, off-gas areas, consideration could also be given to providing greater support to these areas.

2) Landlords should provide appropriate guidance and support to tenants to ensure effective use of systems to maximise heating bill reductions, provision of warmth and tenant satisfaction. This should include:

   - demonstrations and in-home explanations on how to use the system
   - easy-to-understand and simple written instructions
   - follow-up advice to ensure correct understanding
   - greater support for vulnerable tenants e.g. elderly tenants
   - advice for new tenants when moving into the home, as well as when new systems are fitted
   - advice on the most appropriate tariff (and in some cases advocacy to resolve disputes with energy suppliers)

3) More monitoring and evaluation should be carried out on the impact of heating replacements in rural, off-gas areas to better understand the impact on running costs, the life cycle costs of newer technologies and to better understand the experience of tenants. This is particularly important for vulnerable tenants.

4) Where feasible, landlords should give tenants a choice of replacement heating systems. In these situations, tenants should be given appropriate information to ensure they can make a well-informed choice.

5) Landlords should have a thorough understanding of the impact of heating replacements on SAP scores so that the impact on EESSH compliance is known. Modelling of different scenarios will also indicate potential savings on running costs compared to the initial investment as well as the level of future proofing against future changes in standards. However landlords must also factor in wider considerations such as tenants' acceptance of the technology (influenced by real or perceived understanding of ease of use or disruption during install).

6) In their choice of technology and scheme design (e.g. tenant engagement methods, evaluation, etc.), social landlords should seek to share information and lessons with other landlords. Undertaking their own smaller pilot schemes is also recommended as a way to test a technology in their own stock and derive lessons for wider roll-out.

The Consumer Futures Unit seeks to put consumers at the heart of policy and regulation in the regulated industries of energy, post and water. Part of Citizens Advice Scotland, it gathers, develops and acts on evidence, advocating and empowering to improve consumer outcomes. It develops practical policy solutions that lead to consumers being informed, engaged and protected.

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