Taking the Temperature: A review of energy efficiency and fuel poverty schemes in Scotland

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citizens advice scotland

Consumer Futures Unit

Contents

Contact: CFUenergy@cas.org.uk

Tel: 0131 550 1061

www.cas.org.uk
www.citizensadvice.org.uk/scotland

Citizens Advice Scotland
Spectrum House
2 Powderhall Road
Edinburgh, EH7 4GB

The Scottish Association of Citizens Advice Bureaux –
Citizens Advice Scotland (Scottish Charity Number SC016637)

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Foreword

Background

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. In Scotland in 2015, energy efficiency was designated a national infrastructure priority. Furthermore the Scotland Act 2016 devolves powers to determine how supplier obligations in relation to energy efficiency and fuel poverty, such as the Energy Company Obligation and Warm Home Discount, are designed and implemented.

The Scottish Government have announced that they will introduce Scotland's Energy Efficiency Programme (SEEP) in the coming years. This scheme will make use of the new powers over energy efficiency funds. Given the current political interest and potential levels of investment, CAS believes that it is important to ensure that the impacts resulting from undertaking large-scale energy efficiency installations are fully understood.

The research project

As the advocate for Scottish energy consumers, the Consumer Futures Unit (CFU) commissioned independent research to review the government and energy supplier funded energy efficiency and fuel poverty schemes that have been, and are being, delivered within Scotland. The research was commissioned to enable us to further understand the full range of impacts that past and current energy efficiency and fuel poverty activity has had on Scottish consumers. By filling this gap we believe that important lessons can be learned that can help refine current and inform the design of future schemes.

The resulting report is comprised of three parts and is intended to serve as a reference document for analysing previous schemes, to support the design of future programmes:

- A literature review examines existing evidence on the impacts expected to result from undertaking large scale energy efficiency interventions;
- The report then catalogues and reviews past and current energy efficiency and fuel poverty schemes in Scotland;
- Where possible, geographic maps highlight the reach of measures delivered through schemes across Scottish datazones.

Key findings and recommendations

A number of assumptions are tested within the extensive literature review. It is clear that further evidence is required in a number of areas to ensure that schemes are delivering positive, measurable benefits. Key suggestions include consideration of how vulnerability could be used as a concept to define and measure fuel poverty [1] and a call for further work to understand and address the impacts of poor quality housing on mental health.

1 This is currently being reviewed by Glasgow Caledonian University

The cataloguing of schemes provides insight into the benefits and limitations of each scheme's design from the Home Energy Insulation Scheme (HIS) through to the most recent Energy Company Obligation (ECO2). This provides a comprehensive resource for reviewing and comparing scheme design and also flags up the importance of formally monitoring and evaluating schemes to ensure that such evidence can be compiled and utilised for future scheme design.

A significant finding from the mapping exercise is that an urban bias is not as pronounced in Scotland as often assumed. This is clear when the number of measures delivered to rural vs urban areas are considered together across all schemes[2]. 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 mapping exercise further demonstrates that area-based schemes in particular have been successful in distributing energy efficiency measures across different parts of the country. However, to avoid a postcode lottery for consumers, it is clear that certain local authority areas require significant levels of support to ensure that they are consistently delivering measures to the housing stock in their area.

However the recommendations provided within the report were produced by the independent research company, CAG. They do not necessarily represent the views of CAS. In particular, CAS does not support the recommendation to move away from universal provision of the Winter Fuel Payment. In addition to avoiding the known risks associated with selectivity, we believe a more universal approach within the target populations is the most effective and efficient means of achieving the desired outcome: maximising the incomes of low income and vulnerable households for help with their heating costs during the winter months.

CAS hope that the recommendations will provide the basis for further discussion on the appropriate design of future energy efficiency and fuel poverty schemes.

Kate Morrison, Energy Policy Officer

2 That distributional evidence is available for – please see the full report for data limitations

Citizens Advice Scotland

Taking the Temperature: A review of energy efficiency and fuel poverty schemes in Scotland

A report by CAG Consultants

in association with Glasgow Caledonian University, Andrew Faulk and the Energy Agency

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Authors: Tim Maiden (CAG), Keith Baker (GCU) and Andrew Faulk
Additional members of the research team: Helen Snodin (CAG), Jake Sales (Maps4Planners), Emma Jones (CAG), Alan McGonigle & Liz Marquis (Energy Agency)
With thanks to: the Energy Saving Trust for assistance with extracting data from the Homes Energy Efficiency Database (HEED), Ronald Mould and Alex Clayton (both GCU) for contributing references to the literature review and a wide range of stakeholders who contributed via participating in research interviews and/or attending the project workshop.

To contact CAG Consultants:

CAG CONSULTANTS
150 Minories
London EC3N 1LS
Tel 020 8555 6126
Fax 020 7900 1868
hq@cagconsult.co.uk
www.cagconsultants.co.uk

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Executive summary

It is widely accepted by governments, health professionals and other civil society organisations that retrofitting existing homes with energy efficiency measures will lead to positive outcomes for consumers. Given the commitment to significant financial investment in Scotland's housing stock, it is important to understand the impact and effectiveness of previous schemes and the full range and, at times contradictory, consequences of undertaking such measures. This is particularly important if investment is further ramped up in the wake of the Scottish Government's announcement that energy efficiency will become a national infrastructure priority.

This report presents the findings from a review of energy efficiency and fuel poverty schemes in Scotland and a review of the evidence on the impacts of energy efficiency and fuel poverty interventions. The research was carried out by a consortium led by CAG Consultants on behalf of the Consumer Futures Unit of Citizens Advice Scotland (CAS).

As a result of significant effort and investment in energy efficiency and fuel poverty schemes, the modelled energy efficiency of Scotland's homes has been improving year-on-year. This has especially been driven by installations of loft and cavity wall insulation delivered by mass-market schemes, complemented by increasing levels of efficient boilers.

Despite this progress, modelled rates of fuel poverty have continued to rise, largely as a result of rising energy costs, with the latest figures suggesting that more than a third of Scottish households are fuel poor[3]. While increased energy efficiency helps to mitigate fuel poverty, the evidence shows that it is not sufficient on its own to eliminate it.

There will be continuing downward pressure on public spending which will impact on resources available to meet the challenges of energy efficiency and fuel poverty. In contrast the physical measures required to meet these challenges will be increasingly expensive, because most of the available lower cost measures (such as cavity wall and loft insulation) have now been completed. There is a need for more intensive support to households to maximise energy savings and to provide the more holistic support (such as advice on behaviour change and benefit and tariff checks to complement physical measures) which is often needed to lift households out of fuel poverty.

There is currently a complex delivery landscape, with multiple energy efficiency and fuel poverty schemes, many overlapping, some short term and often subject to significant changes. This makes it challenging and uncertain for those involved in delivery, but also confusing for consumers.

The Scotland-specific schemes appear to have been effective in countering much of the central-Scotland bias apparent in delivery of the UK-wide supplier obligations. However, the data from current schemes highlights the risk of a bias in the delivery of solid wall insulation towards the bigger urban areas, particularly in the central belt.

The devolution settlement and the Scotland Bill 15/16 provides an opportunity to simplify the delivery landscape and provide a stable, long-term, strategic and equitable approach. This approach will need to address a number of key challenges:

[3] Scottish Government, 2015. Scottish House Condition Survey 2014: Key Findings

Striking the balance between energy efficiency and fuel poverty

There are synergies between improving energy efficiency and addressing fuel poverty but there can be conflict between the two, since the most cost-effective approach to addressing energy efficiency will not be the most cost-effective means of addressing fuel poverty. Striking the right balance between the two, and ensuring that both are of sufficient scale to meet the stated ambitions, will remain a constant challenge for policymakers.

Funding

Scotland has, historically, been successful in leveraging a disproportionate amount of UK-wide energy efficiency and fuel poverty funding relative to the number of households in the country. However, this may no longer be possible following the devolution settlement. In any event the public funds available now and in the future on their own will be far from sufficient to address the scale of the challenge. Householders themselves will increasingly need to take responsibility for improving the energy efficiency of their homes.

Consumer demand

Consumer demand for insulation and other energy efficiency measures is low. With increasingly constrained funding meaning fewer grants and subsidies are available, generating the consumer demand necessary will require radical new approaches to drive consumer awareness and interest in improving energy efficiency.

Behaviour change

Driving consumer demand for energy efficiency measures will not be sufficient on its own. How people use energy following such interventions is complex and not well understood, but it is clear that the potential energy efficiency benefits are rarely fully realised because of a lack of awareness and understanding.

Dealing with hard-to-treat properties

The remaining opportunities for basic insulation measures such as loft and cavity wall insulation are increasingly limited. There should be more focus on measures such as solid wall insulation. Such measures are far more expensive and disruptive, further exacerbating the issues of consumer demand and funding constraints. In addition, there is concern that solid wall insulation may be physically and/or aesthetically damaging for some older properties.

Rurality

Scheme design needs to better account for the impacts of rurality, particularly the higher risk of fuel poverty in rural areas. Delivering interventions in rural areas tends to be more expensive so a greater focus on rural areas will increase the overall costs of delivery. Nevertheless, the greater prevalence of fuel poverty in rural areas necessitates such a focus and there is, therefore, a need to develop the supply chain across the whole country in order to manage costs, whilst at the same time ensuring that interventions are of the requisite quality.

Understanding ‘real world’ impacts

The data used to inform policy and scheme development is modelled and there are significant differences between modelled and actual outcomes. This is exacerbated in Scotland by its diversity of geography, climate and housing stock, which does not lend itself well to standard modelling. It is vital for future schemes and policies to be informed by a better understanding of how energy is used and the ‘real world’ impacts of energy efficiency and fuel poverty interventions.

Effectively targeting the fuel poor

Targeting of the fuel poor is currently based on proxies (benefits) and, for those schemes not administered by central Government, based on benefits checks rather than centrally held data. Relying on benefits checks increases the complexity and expense of scheme delivery. Perhaps more significantly, however, receipt of benefits is often a poor proxy for fuel poverty and there is a need to develop more effective ways of targeting fuel poor households.

Recommendations

In the light of these challenges, the report includes a number of recommendations for the design and delivery of future energy efficiency and fuel poverty schemes in Scotland. In summary, these include:

1. Developing a long-term approach to addressing energy efficiency and fuel poverty, including long term funding commitments to schemes.

2. Continued, and increasing public funding, to match the scale of the stated ambition, founded on a clear understanding of the economic, social and environmental benefits of large scale energy efficiency improvements.

3. Robust quality assurance processes for all aspects of delivery.

4. Renewed consideration to moving away from universal payment of the Winter Fuel Payment in order to better target vulnerable consumers[4].

5. Greater integration between energy efficiency funding and the funding for health, public health, social care, economic development and regeneration.

6. Greater integration in the delivery of public services, particularly those involved in frontline health and social care making referrals to energy efficiency and fuel poverty schemes[5].

7. Establishing the true remaining potential for cavity wall insulation in Scotland, taking into account current uncertainties.

8. Further research into the appropriate measures for different types of hard-to-treat properties, and how the costs of treating such properties might be reduced.

9. A major marketing and communications campaign to promote awareness and understanding of the benefits of energy efficiency measures and energy efficient behaviour.

10. Regulating minimum standards of energy efficiency in private homes in order to further drive consumer demand, along with consideration as to how further use can be made of

[4] It should be noted that Citizens Advice Scotland support ongoing universal payment of the Winter Fuel Payment. In addition to avoiding the known risks associated with selectivity, Citizens Advice Scotland believe a more universal approach within the target populations is the most effective and efficient means of achieving the desired outcome: maximising the incomes of low income and vulnerable households for help with their heating costs during the winter months.

[5] Citizens Advice England and Wales will be launching a pilot housing and health referral service, taking forward new NICE guidelines on excess winter deaths and researching the public health case for better energy standards.

the provisions of the Tenement Act to overcome ‘blockers’ to energy efficiency measures being installed in flats.

11. Providing attractive loan finance for those able to pay, alongside regulation.

12. Increasing the levels of advice and support which are provided alongside the delivery of measures.

13. Piggybacking referrals for other forms of energy efficiency and fuel poverty support on the smart meter rollout.

14. Ongoing refinements to eligibility criteria to reflect likely actual energy consumption and expenditure, e.g. for those with higher than standard levels of occupancy and those on lower incomes. This could include use of tax credits within the eligibility criteria, in order to better support the working fuel poor.

15. Increasing the involvement of grassroots and community organisations, alongside local authorities, in the delivery of schemes (particularly in engaging householders and making referrals to the delivery bodies).

16. Building independent formal evaluation into the design and management of all schemes. Aim to achieve a cycle of continuous improvement, to build an understanding of the impact of different energy efficiency and fuel poverty interventions and to help build the business case for investment in energy efficiency.

17. Including sample monitoring of actual behaviour and energy use in evaluations.

Contents

Introduction

Aims of the research

This report presents the findings from a review of energy efficiency and fuel poverty schemes in Scotland, which was carried out by a consortium led by CAG Consultants on behalf of Citizens Advice Scotland (CAS). The aims of the project were:

- to review from a consumer perspective the evidence on the impacts expected to result from undertaking large scale energy efficiency interventions, including the potential risks and benefits from undertaking such activity;
- to catalogue and review past, current and, where known, future energy efficiency and fuel poverty schemes in Scotland; and
- geographically mapping where past and current schemes have and have not reached in Scotland.

Significance of the research

The research was conducted in the context of:

- the recommendations made by the Smith Commission following the independence referendum[6], which included devolution of responsibility for supplier obligations relating to energy efficiency and fuel poverty;
- the draft Scotland Bill for further devolution of powers to the Scottish Parliament that is currently making its way through the UK Parliament[7]; and
- calls for energy efficiency to be made a national infrastructure priority[8,9] which the Scottish Government has since announced it intends to do[10].

It is widely accepted by governments, health professionals and other civil society organisations that retrofitting existing homes with energy efficiency measures will lead to positive outcomes for consumers. However, as a significant financial investment in Scotland's housing stock, it is equally important to understand the full range and, at times contradictory, consequences of undertaking such a major investment; particularly if this investment is further ramped up in the wake of the Scottish Government's national infrastructure priority announcement.

The research is intended for use by CAS in its policy and advocacy work aimed at refining and improving the design and implementation of current and future energy efficiency and fuel poverty schemes in Scotland. This includes ensuring that the most vulnerable people in our

[6] Report of The Smith Commission for further devolution of powers to the Scottish Parliament.
[7] The draft Scotland Bill was published on 22nd January 2015.
[8] Washan et al. (2014) Building the Future: Economic and fiscal impacts of making homes energy efficient. Report for the Energy Bill Revolution.
[9] Existing Homes Alliance Scotland (2015) Joint Statement.
[10] Scottish Government (2015) Press Release: Climate Change Action Heats Up.

society are not threatened in unexpected ways in the short-, medium- or long- term as new policies are proposed and implemented.

The research is also intended to enable CAS to identify links to other connected policy areas (e.g. wider housing policy, transport, energy generation, etc.), including the wider prevention agenda (e.g. health, income, inclusion, attainment and inequalities, etc.).

Scope of the research

The project had three inter-related strands.

1. A review of the literature on energy efficiency retrofit and fuel poverty schemes with reference to health, social, environmental and economic impacts, recognising that not all of these impacts are well understood or widely appreciated.

2. Cataloguing and reviewing past, current and, where known, future energy efficiency and fuel poverty schemes in Scotland. This involved:

    a. identifying the main features of each scheme or programme, including eligibility criteria; and

    b. assessing the main benefits and limitations of each programme or scheme, based on the available evidence.

    A series of interviews (15 in total) were conducted with stakeholders as part of this review.

3. Geographically mapping where past and current schemes have and have not reached in Scotland.

Following the preparation of a draft report, key stakeholders, including representatives from energy suppliers, the Scottish Government, EST, energy advice agencies and a wide range of other organisations attended a workshop in mid-March 2016. At this workshop, the findings and draft recommendations were presented and discussed, and participants' comments and suggestions have been incorporated into the final report.

Structure of this report

Section two sets the context for the research. The findings from each of the three strands of the research are then presented in turn. Section three summarises the findings from the literature review, section four presents the review of schemes, and section five presents the findings from our analysis of the geographic distribution of energy efficiency and fuel poverty interventions carried under previous and current schemes. Section six presents the overarching conclusions and recommendations from the research.

1 Context

Policy context

The main drivers for improving the energy efficiency of Scotland's housing stock relate to fuel poverty and climate change mitigation. They are:

- a statutory obligation that requires Scottish Ministers to eradicate fuel poverty, as far as reasonably practicable, by November 2016[11]; and
- a legally-binding requirement that Scotland's greenhouse gas (GHG) emissions are reduced annually, up to future target dates in 2020 and 2050[12].

In Scotland fuel poverty is defined as existing when a household is required to spend more than 10 per cent of their household income on fuel to adequately heat their home[13]. The Scottish Government estimates 34.9 per cent of Scottish households are living in fuel poverty; and of these, 9.5 per cent are living in extreme fuel poverty, where they need to spend more than 20 per cent of their household income to adequately heat their home[14]. The situation is estimated to be more severe in remote rural and island communities: recent research has suggested that over 70 per cent of households living in the Western Isles may be living in fuel poverty[15].

The Sustainable Housing Strategy[16] estimated that 85 per cent of Scotland's housing that will exist in 2050 has already been built. Given that over 75 per cent of energy use in homes comes from gas-fired boilers for space and water heating, the domestic residential sector accounts for around a quarter of Scotland's GHG emissions[17]. The potential therefore for carbon emission abatement from the housing sector remains substantial.

The Scottish Government's ambitions and plans for action to tackle both sets of problems are set out in the following:

Fuel poverty:

- Housing (Scotland) Act 2001;
- The Scottish Fuel Poverty Statement 2002; and
- Scotland's Sustainable Housing Strategy 2013.

Climate change:

[11] The Housing (Scotland) Act 2001 requires the Scottish Government to eradicate fuel poverty in Scotland, as far as reasonably practicable, by November 2016.
[12] The Climate Change (Scotland) Act 2009 sets in statute the Scottish Government's economic strategy target to reduce Scotland's emissions of greenhouse gases by 42 per cent by 2020 and by 80 per cent by 2050.
[13] The fuel poverty definition in England differs from the one used in Scotland. The English definition is measured using the Low Income High Costs definition.
[14] Scottish Government (2015) Scottish House Condition Survey 2014: Key Findings.
[15] The Energy Advisory Service (2014) Fuel Poverty Report 2013/2014 for Comhairle nan Eilean Siar.
[16] Scottish Government (2013) Scotland's Sustainable Housing Strategy.
[17] WWF Scotland (2012) Mind the Gap

- Climate Change (Scotland) Act 2009;
- Low Carbon Scotland: Meeting the Emissions Reduction Targets 2010-22. The Report on Proposals and Policies;
- Low Carbon Scotland: Meeting Our Emissions Reduction Targets 2013-27. The Second Report on Proposals and Policies; and
- Low Carbon Scotland: Behaviours Framework.

Installing energy efficiency measures in Scotland's existing housing stock is a key element of meeting the policy aims set out in these documents. While there may be variation in the particular energy efficiency measures that might be installed in a given property, most activity to date has been devoted to:

- insulating people's homes;
- giving people control over heating systems; and
- harnessing alternative forms of energy.

The main current energy efficiency schemes[18] in Scotland are the Scottish Government's Home Energy Efficiency Programmes for Scotland and the Warm Homes Fund. In addition, there have also been a number of GB-wide schemes, including the UK Government's Energy Company Obligation (ECO), financed from levies on the biggest energy suppliers, and the (now defunct) Green Deal[19]. A description and review of current and previous schemes can be found in Section 3.

More recently, Scottish Government has announced that improving the energy efficiency of all domestic and non-domestic buildings in Scotland would be designated a national infrastructure priority[20]. Intended to maximise the additional powers proposed to be devolved to the Scottish Parliament in the latest Scotland Bill, it is anticipated that Scotland's Energy Efficiency Programme (SEEP) will attempt to make available a wider range of funding sources for improving the energy performance of Scotland's entire building stock.

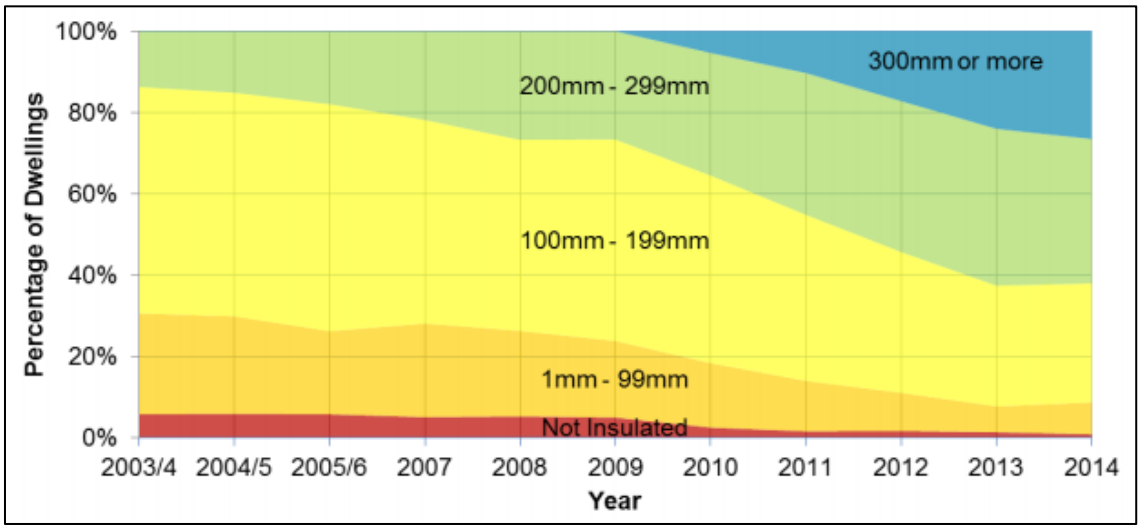
In addition, the largest energy suppliers are currently obligated to install smart energy meters in every house and business in Great Britain by 2020.

Recent Trends in Energy Efficiency and Fuel Poverty in Scotland

Over recent years, Scotland has gained considerable experience of both area-based energy efficiency schemes and those targeted at specific groups of households. As a result of these and other work, there has been substantial progress in the installation of loft and cavity wall insulation and of more efficient gas boilers. An example of this is illustrated in Figure 1.1, which shows the significant increases in the depth of loft insulation in Scottish homes since 2003/4.

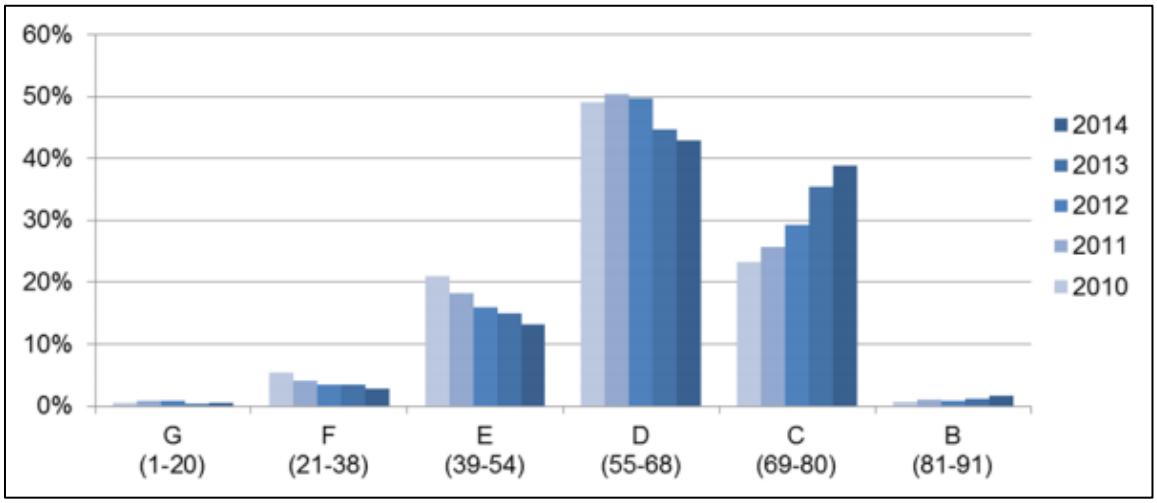
[18] For a review of past and current fuel poverty programmes in Scotland see the Scottish Government (2014) Progress Report on the Scottish Fuel Poverty Statement 2002.
[19] It was announced in July 2015 that the UK government would stop funding the Green Deal Finance Company (GDFC). The GDFC was set up to lend money to Green Deal providers. In effect this will mean that the Green Deal will cease to operate. At the time of writing, no replacement has been announced.
[20] Scottish Government's national infrastructure priority announcement.

Figure 1.1: Depth of loft insulation (where applicable[21]), 2003/4-2014[22]



Accordingly, the proportion of houses in Scotland which are rated as ‚(EPC) 'C' or better has increased year-on-year since 2010, as shown in Figure 1.2 below.

Figure 1.2: EPC ratings of the Scottish housing stock, 2010-2014[23]



Modelled carbon emissions, as an average of all households in Scotland, have also fallen as a result of improvements in energy efficiency, from an average of 7.9 tonnes CO_2/household in 2010 to 7.3 tonnes in 2013[24].

Despite these improvements, modelled rates of fuel poverty have continued to rise, from 32.9 per cent in 2011 to 34.9 per cent in 2014[25]. Scottish Government analysis shows that the biggest factor in the increase in fuel poverty has been the increase in energy costs. The increase in fuel poverty would have been even larger in the absence of improvements in energy efficiency and increases in household incomes[26].

[21] A dwelling is classified as not applicable for loft insulation if it has a flat roof or another dwelling above it.
[22] Scottish Government, 2015. Scottish House Condition Survey 2014: Key Findings
[23] Ibid
[24] Scottish Government, 2014. Scottish House Condition Survey 2013: Key Findings. Note that the 2014 figure is not used here as methodology changes mean that it is not comparable to previous years
[25] Scottish Government, 2015. Scottish House Condition Survey 2014: Key Findings
[26] Scottish Government, 2014. Scottish House Condition Survey 2013: Key Findings.

Role of this research

In order for interventions to be effective, they have to be clearly focused on appropriate solutions, emphasising the need to learn from current and previous energy efficiency and fuel poverty schemes. This will help to generate a clearer understanding of how current and future challenges might best be addressed.

Understanding the distribution of the impacts of current and previous schemes will also help to generate a clearer understanding of which consumers have benefited most from these schemes, where the remaining needs and opportunities are and where future interventions may need to focus.

And, in order to justify the resources needed to deliver activity at an appropriate scale, it is also necessary to understand the links between energy efficiency, fuel poverty and other public policy aims, including economic and social development and health improvements, as well as climate change emission reductions.

2 Literature review

Purpose

Despite current political interest in fuel poverty and energy efficiency, not all of the impacts resulting from undertaking large-scale energy efficiency installations are fully understood. By seeking to address this knowledge gap, CAS believe that important lessons can be learned that can help refine current and inform future schemes. The findings are included in the remainder of this section. A summary of key learning points is provided in Section 0. References are provided throughout. Notes on the approach to the literature review and the full bibliography is included in Appendix B.

Summary of key learning points

2.1.1 Environmental issues

- Building energy models calculate performance under theoretical (often optimal) conditions, and these are rarely experienced in 'real life' post-occupancy studies. Ongoing efforts are needed to enhance the accuracy and sensitivity of the models used.

- The results of modelling exercises need to be treated with caution, and policy makers need to be aware of the strengths and limitations of different models and approaches, and the often significant differences between modelled and actual energy consumption.

- The more non-standard the home and household is, the greater the likely difference between modelled and actual consumption data, and as energy inefficient and fuel poor households tend to be further from the standards, it is even more important to be cognisant of the results of analyses of actual energy consumption data.

- Energy efficiency schemes do appear to have had an appreciable impact on reducing household gas bills. However the evidence for their benefits on expenditure on electricity and fuels used by off-gas households is less clear.

- The costs, benefits, and appropriateness of different energy efficiency measures vary significantly across different dwelling and household types, and across different geographies and socio-economic groups. This emphasises the individual nature of households, and therefore the need for energy efficiency and fuel poverty services and schemes to be sensitive to their conditions and needs.

- Relatively few studies analysing actual energy consumption at a city-scale have been conducted in the UK, and these have been limited in the range of factors they have been able to examine.

- Offering combinations of measures provides the best value for money and the greatest emissions savings per pound spent. Certain dwelling types, for example timber-framed properties, should benefit particularly significantly from such interventions.

- Rural households in Scotland tend to spend significantly more on energy than their urban equivalents, and this 'energy gap' is only partially explained by factors that are already well-understood.

- Energy inefficiency and fuel poverty are not one and the same. The most cost-effective schemes for improving energy efficiency will not benefit many households living in fuel poverty.

- Making energy efficiency improvements to average (non-fuel poor) households generally leads to predictable reductions in energy consumption and emissions. These assumptions cannot be applied to fuel poor households.

2.1.2 Social issues

- Current models are likely to be under-predicting the strength of the rebound and prebound effects from energy efficiency improvements. Whilst these are relatively small and predictable for specific 'one off' behaviours, and where takeback is considered only in terms of increased thermal comfort, the effects become stronger and more variable for non-standard measures and where takeback is considered beyond thermal comfort.

- In light of the nature of the Scottish building stock, the prevalence and complexity of fuel poverty and factors known to influence it, assuming an average rebound effect of around 35 per cent for households in Scotland seems more reasonable than the current 20 per cent assumption.

- More and better monitoring is needed to understand current differences in energy consumption and the likely impacts of energy efficiency measures on fuel poor households.

- Due to the continued prevalence of poor maintenance in Scottish homes and the likely barrier this will pose to both the potential for and effectiveness of energy efficiency interventions, an allowance for maintenance and repairs is likely to bring significant benefits to energy efficiency and fuel poverty schemes.

2.1.3 Economic issues

- Income-based definitions of fuel poverty, such as the current Scottish definition, are more sensitive than expenditure-based definitions to additional factors which may better account for fuel poverty.

- Energy efficiency improvements do appear to be insulating households from increases in gas prices.

- The methods and measures currently used for identifying and targeting fuel poor households in Scotland are simplifications of a complex issue, and ongoing efforts are needed to improve them.

- Evidence suggests the energy expenditure of rural households decreases with income, but increases slightly with income for urban households, and so there is a case for prioritising rural households in fuel poverty interventions.

- Vulnerability may be a useful concept in defining and measuring fuel poverty in the future. However, more work needs to be done to provide evidence on how this might best be done. One possible approach (being developed at Glasgow Caledonian

University) is to define a set of metrics to assess the capacity and resilience of a household against a risk-based framework based on the adapted Speirs attributes. This would enable both the setting of a threshold for vulnerability to fuel poverty and a scale for measuring progress in alleviating it.

- The future nature and levels of non-devolved funding for energy efficiency and fuel poverty schemes is currently uncertain, whilst the evidence for the benefits of greater investment is significant.

- It is inevitable that private finance (householder contributions) will, in some circumstances, need to play an increasingly important role in funding energy efficiency improvements.

- There is evidence of the potential significant wider social and economic benefits of energy efficiency and fuel poverty schemes, which needs to be taken into account in future funding decisions.

2.1.4 Health issues

- Although it is difficult to disentangle the exact strength and nature of the effects, there is substantial and significant evidence that living in poorly maintained, energy inefficient homes is a contributing factor to householders experiencing respiratory illnesses and other related conditions. Levels of VOCs and other indoor air pollutants are also contributing factors.

- The health impacts of poor quality housing appear to be unaffected by socio-economic group, and there appears to be a 'dose-response' relationship.

- Whilst the health benefits of improved energy efficiency will need to be an important consideration in future funding decisions, it is important to note that the overall savings to health services may be less significant than some studies might suggest, as householders might still go on to require support for health conditions, i.e. improving housing quality may just delay the onset of some conditions rather than eradicate them altogether.

- More work is needed to understand and address the impacts of poor quality housing on mental health, and this evidence needs to be incorporated in the design of future schemes.

- There is an on-going, and highly contested, debate over the benefits of designing homes using 'passive' approaches incorporating high levels of air-tightness, mechanical ventilation and heat recovery, and designing them using naturally 'passive' approaches that use natural ventilation and thermal mass. Currently, the balance of evidence suggests the benefits of the former are insufficiently proven.

- Simple measures such as using dehumidifiers and making behavioural changes can improve the health of asthmatic children. There is potential for this advice to be included as part of supporting vulnerable households.

- Fuel poverty is a contributing factor to excess winter deaths, but the relationships between fuel poverty and health are complex. It may be more useful to consider mortality rates in relation to householders being able to maintain an acceptable level of warmth, rather than their ability to pay their fuel bills.

- Energy rationing behaviours are a direct outcome of householders experiencing financial pressures, and such behaviours are likely to lead to more households not being able to maintain acceptable levels of warmth.

- Self-disconnection is the ultimate expression of energy inefficiency and fuel poverty, and although it is a very real phenomenon, very little research has been done to quantify and understand it, not least because of the difficulties of identifying and engaging with such vulnerable households.

Environmental issues

2.1.5 Differences between modelled and actual emissions savings

Scottish Government data on both fuel poverty and GHG emissions is modelled, rather than collected. Actual energy use in any given household could vary significantly from the modelled assumptions and will depend on a wide variety of factors, going beyond the energy efficiency of the building and its heating system to include:

- the household's energy needs and expectations of comfort levels;

- the extent to which they are able to control their energy use effectively (having accessible heating controls or understanding how to use their heating system effectively, for example);

- changes they experience in household income; and

- the payment method and tariff they use.

As an example of how economic factors are a key determinant of fuel poverty, Housing Associations in Scotland already have the most energy efficient stock of all tenures in Scotland (50 per cent of homes rated EPC 'C' or above, compared to 35 per cent in the housing stock as a whole[27]) but the low average incomes of tenants mean that fuel poverty in the sector is higher than the Scottish average (39 per cent compared to 35 per cent)[28]. Consequently, increasing numbers of associations are complementing physical work with: advice on heating system use; income maximisation; accessing competitive energy tariffs[29]. A number of Associations are involved in developing their own energy supply company as an alternative, lower cost approach to energy provision[30].

Under the EU's Energy Performance of Buildings Directive (EPBD)[31] the Scottish Government is required to adopt standard models for reporting emissions from the building stock, which are currently Standard Assessment Procedure (SAP) for homes, and the Simplified Building Energy Model (SBEM) for non-domestic buildings. However, both of these tools have been subject to some criticism for under-estimating demand and for being insufficiently sensitive to Scottish geographies and climates, and the nature of the Scottish building stock[32]. One report on social

[27] Scottish Government, 2015. Scottish House Condition Survey 2014
[28] Ibid.
[29] See, for example, Scottish Federation of Housing Associations, 2015. Funding Energy Efficiency in Scotland's Existing Homes: Learning from Housing Associations' Experience.
[30] http://our-power.co.uk/
[31] EU, 2010. Energy Performance of Buildings (EPBD) Directive. European Union Directive 2002/91/EC, and as amended in 2010/31/EU.
[32] For example:

housing by Affinity Sutton found that SAP over-predicts energy efficiency savings by an average of 77 per cent, which was put down to a number of factors including tenants under-heating their homes. It also notes that although in-use factors have since been added to SAP these do not account for the scale of the difference[33].

Schemes and policies that involve using SAP and its outputs need to be sensitive to the fact that it is essentially a building envelope model and does not always account well for non-standard households, occupancy patterns, and behaviour. The simplified reduced data Standard Assessment Procedure (rdSAP) is the method used for generating EPCs for existing dwellings and is in widespread use for home energy checks as part of both government-led schemes and community-led initiatives. Until recently, SAP's limitations were recognised by the Scottish Household Condition Survey in its additional reporting of home energy performance statistics using the National Home Energy Rating Services (NHER) model, which is arguably more sensitive to these factors[34]. However the funding for this model has now been curtailed.

At an aggregate level the Scottish Government also uses its Domestic Energy Model for Scotland (DEMScot2) to model carbon emissions from housing. This may also under-predict energy demand[35].

Other more general criticism of the accuracy of modelled energy data includes evidence from studies in Scotland[36], Belgium[37], and Serbia[38].

There is evidence from data held by the Scottish Government and Ofgem that actual emissions are rather lower than models suggest. The Scottish House Condition Survey (SHCS) 2014[39] (Table 3.1) shows that modelled emissions per household were 7.3 tonnes CO2 in 2013, as

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Baker, K.J., Emmanuel, R., & Phillipson, M., 2012. Support for RPP2 - Housing Futures. Report for ClimateXChange Scotland.

Baker, K.J., Emmanuel, R., & Phillipson, M., 2012. Support for RPP2 – Abatement – Built Environment. Report for ClimateXChange Scotland.

Beckmann, K., & Roaf., S., 2013. Workshop Report: Climate Resilience for the Scottish Built Environment. ClimateXChange Scotland.

CFS, 2012. Consumer Focus Scotland's response to the Scottish Government Building Standards Division Consultations on: Section 63: Energy Performance of Non-Domestic Buildings; and Energy Performance of Building Directive – Recast. Consumer Focus Scotland.

Jones Lang LaSalle, 2012. A Tale of Two Buildings: Are EPCs a true indicator of energy efficiency? Better Buildings Partnership.

Sanders C., & Phillipson M., 2006. Review of Differences between Measured and Theoretical Energy Savings for Insulation Measures. Department for the Environment, Food and Rural Affairs (Defra), London, UK.

UKGBC, 2010. Zero-Carbon Non-Domestic Buildings. UK Green Building Council, March 2010.

[33] Affinity Sutton, 2013. FutureFit: Final Report Part 2. Affinity Sutton July 2013.

[34] Baker, K.J., 2007. Sustainable Cities: Determining Indicators of Domestic Energy Consumption. PhD Thesis. Institute of Energy and Sustainable Development (IESD), De Montfort University, Leicester, UK.

[35] CAR, 2009, Modelling Greenhouse Gas Emissions from Scottish Housing: Final Report. Cambridge Architectural Research report for the Scottish Government.

[36] Oladokun, M.G., & Odesola, I.A., 2015. Household energy consumption and carbon emissions for sustainable cities – A critical review of modelling approaches. International Journal of Sustainable Built Environment. Vol 4, (2), December 2015, pp. 231-247.

[37] Audenaert, A., Briffaerts, K. and Engels, L., 2011. Practical versus theoretical domestic energy consumption for space heating: Energy Policy 39, 5219-5227.

[38] Kavgic, M., Mumovic, D., Summerfield, A., Stevanovic, Z., & Ecim-Djuric, O., 2013. Uncertainty and modelling energy consumption: Sensitivity analysis for a city-scale domestic energy model. Energy and Buildings, Vol. 60, May 2013, pp. 1-11.

[39] Scottish Government, 2015. Scottish House Condition Survey – Key Findings 2014.

opposed to recorded emissions[40] of 5.1 tonnes CO2, representing just 70 per cent of the former.

Table 2.1: Carbon Emissions and Modelled Emissions in Scottish Housing, 2010-2014

		2010	2011	2012	2013	2014*
Carbon Emissions[1]:	Total (Mtonnes)	13.7	12.1	13.2	12.3	
DECC Domestic sector	per HH (tonnes) [2]	5.8	5.1	5.5	5.1	
	% change per HH	+5.9%	-12.3%	+8.9%	-7.6%	
Modelled emissions:	Total (Mtonnes)	18.6	18.2	18.1	17.4	17.9
Energy model estimate	per HH (tonnes)	7.9	7.7	7.6	7.3	7.4
w/standard behaviours	% change per HH	-	-2.6%	-1.4%	-3.6%	+1.1%

Notes:
Source: SHCS[41].
[1] Local and Regional CO2 Emissions Estimates, DECC.
[2] Number of households (HHs) from Housing Statistics for Scotland.
*Figures for 2014 are not comparable with previous years.

In addition, the 2013 SHCS[42] includes Table 2.2, which gives energy demand in kWh.

Table 2.2: Modelled Annual Energy Consumption and Running Costs

	Energy Requirement			Running Costs		
Year	Mean (kWh)	annual change	since 2010	Mean (£)	annual change	since 2010
2010	29,752	-	-	1,529	-	-
2011	28,881	-2.9%	-2.9%	1,600	+4.6%	+4.6%
2012	28,077	-2.8%	-5.6%	1,718	+7.4%	+12.4%
2013	27,425	-2.3%	-7.8%	1,839	+7.0%	+20.3%

Source: SHCS[43].

The average modelled energy requirement also contrasts sharply with Ofgem data, also dating from 2013[44], which provided consumption data for different household types across GB, divided into twelve archetypes. Only the two highest consuming archetypes in Ofgem's report (better off families living in detached houses) recorded actual energy use comparable to the averages given in the model.

It is likely that some of the difference in energy use relates to fuel poor consumers under-using energy. However, the scale of the difference is such that it seems unlikely this is the only factor.

It is also important to note that median consumption values for mains gas and electricity use, based on observed, i.e. actual use, data and set by Ofgem[45], have changed much more sharply than their modelled data suggest. In 2010, median users were set at 3,300 kWh electricity per year and 16,500 kWh gas per year. These figures fell to 3,200 kWh and 13,500 kWh respectively in 2013, and subsequently fell again to 3,100 and 12,500 respectively in March 2015. However, a word of caution should be applied when making inferences from medians as many people will naturally assume a normal (bell curve) distribution that curves downwards

[40] Based on meter point electricity and gas consumption data, collected annually by DECC
[41] Ibid.
[42] Scottish Government, 2014. Scottish House Condition Survey – Key Findings 2013.
[43] Ibid
[44] CSE, 2014. Beyond average consumption: Development of a framework for assessing impact of policy proposals on different consumer groups. Updated report to Ofgem, March 2014.
[45] Ofgem, 2015. Typical Domestic Consumption Values for Gas and Electricity.

either side of the median. None of the data suggests this is the case, and it seems likely that clusters of energy consumers exist around different levels of consumption related to factors known to influence energy demand (see Section 3.2.3).

It is likely that part of the fall was due to consumers using less energy as a result of rising prices (see Figure 2.5). However, the difference in trends between gas and electricity use suggests that improvements in energy efficiency (which mainly impact on heating use, the most significant element of gas bills) may have had an impact in reducing gas bills.

2.1.5.1 Learning points

- Building energy models calculate performance under theoretical (often optimal) conditions, and these are rarely experienced in 'real life' post-occupancy studies. Ongoing efforts are needed to enhance the accuracy and sensitivity of the models used.

- The results of modelling exercises need to be treated with caution, and policy makers need to be aware of the strengths and limitations of different models and approaches, and the often significant differences between modelled and actual energy consumption.

- The more non-standard the home and household is, the greater the likely difference between modelled and actual consumption data, and as energy inefficient and fuel poor households tend to be further from the standards, it is even more important to be cognisant of the results of analyses of actual energy consumption data.

- Energy efficiency schemes do appear to have had an appreciable impact on reducing household gas bills. However the evidence for their benefits on expenditure on electricity and fuels used by off-gas households is less clear.

2.1.6 Effectiveness of energy efficiency measures for households in different geographic locations and socio-economic groups

Internationally, many previous studies have investigated the impact of socio-economic and physical dwelling factors on household electricity consumption[46], and the list becomes even greater when other energy use (e.g. for transport) is included. However, relatively few of these have been conducted in the UK, and all studies[47] have been limited in the range of factors they have been able to examine (number and type of occupants; age, economic status and education of the household reference person; floors and floor area; space and water heating; proportion of low energy lighting). Ofgem's study of 'beyond average consumption' explored

[46] Jones, R.V., & Lomas, K.J., 2015. Determinants of high electrical energy demand in UK homes: Socio-economic and dwelling characteristics. Energy and Buildings, Vol. 101, 15 August, pp. 24-34.

Jones, R.V., Fuertes, A., & Lomas, K.J., 2015. The socio-economic, dwelling and appliance related factors affecting electricity consumption in domestic buildings. Renewable and Sustainable Energy Reviews, Vo. 43, (2015), pp. 901-917.

[47] Baker K.J., & Rylatt, M., 2008. Improving the prediction of UK domestic energy demand using annual consumption data. Applied Energy, 85, pp. 475-482.

Druckman, A., & Jackson, T., 2008. Household energy consumption in the UK: A highly geographically and socio-economically disaggregated model. Energy Policy, Vol. 36, (8), pp. 3177-3192.

Hamilton, I.G., Steadman, P.J., Bruhns, H.R., Summerfield, A.J., & Lowe, R., 2013. Energy efficiency in the British housing stock: energy demand and the Homes Energy Efficiency Database. Energy Policy, Vol. 60, (2013), pp. 462-480.

Summerfield, A.J., Lowe, R.J., Bruhns, H.R., Caeiro, J.R., Steadman, J.P., & Oreszcyn, T., 2007. Milton Keynes Energy Park revisited: changes in temperatures and energy usage. Energy and Buildings, 37, (7), (2007), pp. 783-791.

Wyatt, P., 2013. A dwelling-level investigation into the physical and socio-economic drivers of domestic energy consumption in England. Energy Policy, Vol. 60, (2013), pp. 540-549.

some, but not all, of these factors and divides households into twelve archetypes for gas and electricity consumption. It shows that consumption varies greatly from both median and average[48].

The relative effectiveness of different energy efficiency measures across different geographic locations has been studied extensively and is incorporated in standard energy models such as SAP, albeit with some criticism (see Section 3.2.2). However, as regards the technical potential of different measures to deliver energy and emissions savings, Scottish Government figures provide evidence that there are other benefits of energy efficiency retrofit schemes that deliver combinations of measures[49].

For example figure 3.1 shows the CO2 savings for a selection of energy efficiency measures applied to three standard building types, calculated using Scottish Government figures. Although the combinations of measures applied differ by house type they demonstrate the benefits of combined approaches, and there is also good evidence on the benefits of area-based schemes for addressing energy efficiency, fuel poverty, and retrofitting[50]. However, in order to maximise these benefits there is also the need to ensure that retrofit schemes offer ranges of measures that are appropriate to the housing type (see Section 3.3.2). Furthermore, the benefits of energy efficiency measures vary by socio-economic group as well as geographical location, and these may of course be inter-related.

[48] CSE, 2014. Beyond average consumption: Development of a framework for assessing impact of policy proposals on different consumer groups, for Ofgem.

[49] For example:

Changeworks, 2010. Street by street, house by house: Area-based retrofit for low carbon homes: Best approaches for Scotland. Report for WWF Scotland.

Bothwell, K., Saich, M., & Mallion, P., 2011. Retrofit of existing housing in the United Kingdom: the carbon reduction possibilities. Architecture and Sustainable Development, Proceedings of the Passive and Low Energy Architecture (PLEA) Conference, Louvain-la-Neuve, Belgium, July 2011.

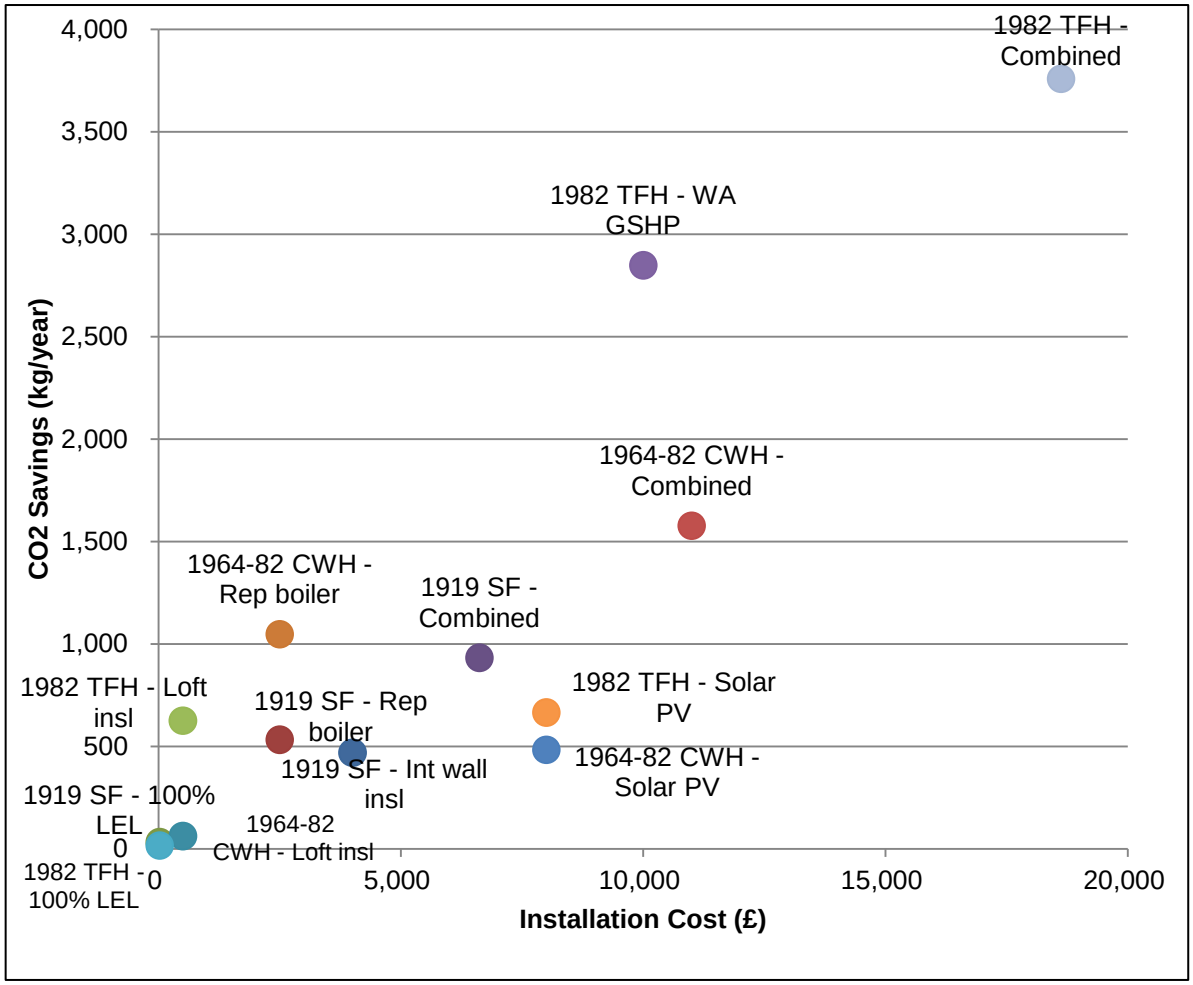
Tadeu, S.F., Alexandre, R.F., Tadeu, A.J.B., Antunes, C.H., Simoes, N.A.V., & da Silva, P.P., 2016. A comparison between cost optimality and return on investment for energy retrofit in buildings: A real options perspective. Sustainable Cities and Society, Vol. 21, February 2016, pp. 12-25.

[50] Baker, K.J., Emmanuel, R., & Phillipson, M., 2014. Review of the Energy Assistance Package. Report for the Scottish Government.

Changeworks, 2010. Street by street, house by house: Area-based retrofit for low carbon homes: Best approaches for Scotland. Report for WWF Scotland.

Walker, R., McKenzie, P., Liddell, C., Morris, C., 2012. Area-based targeting of fuel poverty in Northern Ireland: an evidence-based approach. Appl. Geogr. 2012 (34), 639–649.

Figure 2.1: CO2 savings versus installation costs for selected interventions on three common housing types



Key:
SF – Solid Wall Flat
CWH – Cavity Wall House
TFH – Timber Frame House
Measures are low energy lights, internal wall insulation, loft insulation, replacement boiler, solar photovoltaic panels, a ground source heat pump, and combinations of these (as appropriate, see source).
Also note that costs for PVs are not static.
Source: Baker et al., 2012[51].

A recent review of previous studies, combined with new research that estimated the electricity consumption of 315 households in Leicester, has explored the reasons behind high electricity consumption in households and produced a number of key findings[52]:

- Higher occupancy increases the probability of higher electricity consumption – single occupancy households were significantly less likely to be higher electricity consumers, and households with three or more occupants were significantly more likely to be higher electricity consumers. This also suggests that the use of medians in modelling (see Section 3.2.2) may lead to over-estimating costs for smaller households and under-estimating them for larger households.

[51] Baker, K.J., Emmanuel, R., & Phillipson, M., 2012. Support for RPP2 - Housing Futures. Report for ClimateXChange Scotland.
[52] Jones, R.V., & Lomas, K.J., 2015. Determinants of high electrical energy demand in UK homes: Socio-economic and dwelling characteristics. Energy and Buildings, Vol. 101, 15 August, pp. 24-34.

- Households with one or more children were more than twice as likely to be high electricity consumers, and those with one or two teenagers were more than three times as likely.

- Households with a household reference person (HRP) aged over 65 were significantly less likely to be high energy consumers than those where the HRP was aged between 36 and 50, however this apparent relationship between age and consumption did not extend across all age brackets.

- Retirement (where the HRP was retired) was the only employment characteristic found to be a more probable indicator of higher electricity consumption.

- Neither tenure nor the education of the HRP were found to affect the probability of a household being a high electricity consumer.

- Higher income was found to be a particularly strong indicator of the probability of a household being a high energy consumer, particularly those earning over £50,000 per annum. However, the precision of this estimate was low.

- Dwelling floor area, a well-known and studied factor, was by far the dominant dwelling characteristic affecting energy consumption. Other technical factors previously found to be indicators of higher consumption (dwelling age, number of floors, number of bedrooms) were not found to be significant, and only those using electricity as the primary form of space and / or water heating were found to be significantly more likely to be higher energy consumers, but again the precision was low.

- Households reporting using one or more electric heaters were also more likely to be high electricity consumers, however this may of course be related to the other factors.

These findings merit reporting and discussion in more depth as it represents the first review of the city-scale studies carried out in the UK to date. However, caution should be applied when making inferences about electricity consumption in Scotland due to its significantly different dwelling stock and geographies (and arguably different economic, social and cultural conditions), and particularly about the energy consumption of rural and island households.

A new research project led by Glasgow Caledonian University[53] is addressing this evidence gap by investigating the geographical and socio-economic factors affecting the energy expenditure of rural households in Scotland. This will build on a previous study that showed rural households in Renfrewshire were spending significantly more than their urban equivalents[54] (more than is suggested by current Scottish Government statistics), and is due to report its findings in October 2016.

Such research supports the conclusion drawn in previous research by Citizens Advice[55] that, while all consumers share the same basic energy needs, the approach needed to ensure the aims are delivered varies between different groups. In relation to energy efficiency, the approaches to the appropriate measures and engagement will be different for consumers depending on their house type, tenure, patterns of energy demand, and personal

[53] Baker, K.J., & Mould, R., 2015-2016. The Speird Project. Funded by the Eaga Charitable Trust.

[54] Mould, R., Baker, K.J., & Emmanuel, R., 2014. Behind the Definition of Fuel Poverty: Understanding differences between the Fuel Spend of Rural and Urban Homes. Queens Political Review, Vol. II, 2014, Issue 2, pp. 7-24.

[55] Citizens Advice, 2014. Taking control: Energy policy and the potential for energy consumers to take control of their bills

circumstances. Furthermore, consumer-based research[56] shows that support is needed in relation to retail energy concerns, as well as for physical energy efficiency measures and complementary advice on behaviours.

2.1.6.1 Learning points

- The costs, benefits, and appropriateness of different energy efficiency measures vary significantly across different dwelling and household types, and across different geographies and socio-economic groups. This emphasises the individual nature of households, and therefore the need for energy efficiency and fuel poverty services and schemes to be sensitive to their conditions and needs.

- Relatively few studies analysing actual energy consumption at a city-scale have been conducted in the UK, and these have been limited in the range of factors they have been able to examine.

- Offering combinations of measures provides the best value for money and the greatest emissions savings per pound spent. Certain dwelling types, for example timber-framed properties, should benefit particularly significantly from such interventions.

- Rural households in Scotland tend to spend significantly more on energy than their urban equivalents, and this 'energy gap' is only partially explained by factors that are already well-understood.

2.1.7 Potential conflicts between improving energy efficiency and fuel poverty

Error! Reference source not found.summarises typical characteristics of energy inefficient and fuel poor households and clearly illustrates that there are similarities and differences between the two.

[56] Citizens Advice, 2014. Taking control: Energy policy and the potential for energy consumers to take control of their bills

Table 2.3: Characteristics of Energy Inefficient and Fuel Poor Households

Characteristics of Energy Inefficient Households	Characteristics of Fuel Poor Households
Detached properties	Detached properties
Properties constructed pre-1919	Properties constructed pre-1919
Properties with no central heating	Properties with no central heating
Properties not connected to the gas grid, and particularly those using electricity, coal, or smokeless fuel as their primary heating fuel	Properties not connected to the gas grid or households not using gas as their primary heating fuel
Households in the middle and higher council tax brackets	
Properties classified as 'poor' under NHER	Properties classified as 'poor' under NHER
Households living in rural locations	Households living in rural locations
Households renting from the private sector	Households renting from the private sector or RSLs
	Single pensioner households
Households in the middle and higher income brackets	Households in the lowest income brackets
	Households in the highest council tax brackets living in larger, less energy efficient properties

Source: Scott et al., 2011[57].

This has implications for the design of schemes, and illustrates the need for specific targeting of the fuel poor alongside more general efforts to improve energy efficiency. The most cost-effective means of improving energy efficiency (large, area-based, urban schemes) will miss many of those living in fuel poverty. This is discussed further in Section 3.

Unless the rate of increase in the production of renewable energy can continue to outstrip the rate of increase in demand there is also an inherent conflict between addressing fuel poverty and addressing climate change if the former means substantial numbers of households 'taking back' more of the savings from energy efficiency improvements as thermal comfort (see Section 3.3.1) and others reconnecting or no longer limiting their energy consumption (see Section 3.5.4). So whereas making standard energy efficiency improvements to an average home should lead to relatively predictable energy and emissions savings, bringing a fuel poor home up to modern standards requires a much more complex set of interventions, and behavioural changes, that add significant uncertainty when modelling the likely costs and savings[58] (see Section 3.2.2).

2.1.7.1 Learning points

- Energy inefficiency and fuel poverty are not one and the same. The most cost-effective schemes for improving energy efficiency will not benefit many households living in fuel poverty.

[57] Scott, J., Baker, K.J., & Reid, S., 2011. Improving Energy Efficiency in the Housing Sector in Scotland: Exploring the Role of Regulation. Report for Consumer Focus Scotland.
[58] Jenkins, D., 2010. The value of retrofitting carbon-saving measures into fuel poor social housing. Energy Policy 38, (2), pp. 832-839.

- Making energy efficiency improvements to average (non-fuel poor) households generally leads to predictable reductions in energy consumption and emissions. These assumptions cannot be applied to fuel poor households.

Social issues

2.1.8 The real extent of the 'rebound effect' across households in different geographic locations and socio-economic groups

In recent years, Jevons' Paradox, more commonly known as the 'rebound effect', has received considerable attention from researchers across a range of fields. The 'rebound effect' refers to the phenomenon that actual energy savings are often lower than models predict because households tend to take some of the energy efficiency gains in the form of increased thermal comfort rather than reduced energy use. The results of these studies show a broad consensus that the rebound effect is generally larger than is often assumed[59].

A recent study of household energy efficiency behaviours in 38 EU countries and Norway calculates an average rebound effect of 35.4 per cent for the UK[60], which is notably higher than the EU-27 average of 18.3 per cent but consistent with the group of nations (Sweden, Belgium, France, Luxembourg, Germany, Austria, Ireland, The Netherlands) that have enacted energy efficiency refurbishment schemes, and for which the data was considered most reliable (see Figure 2.2).

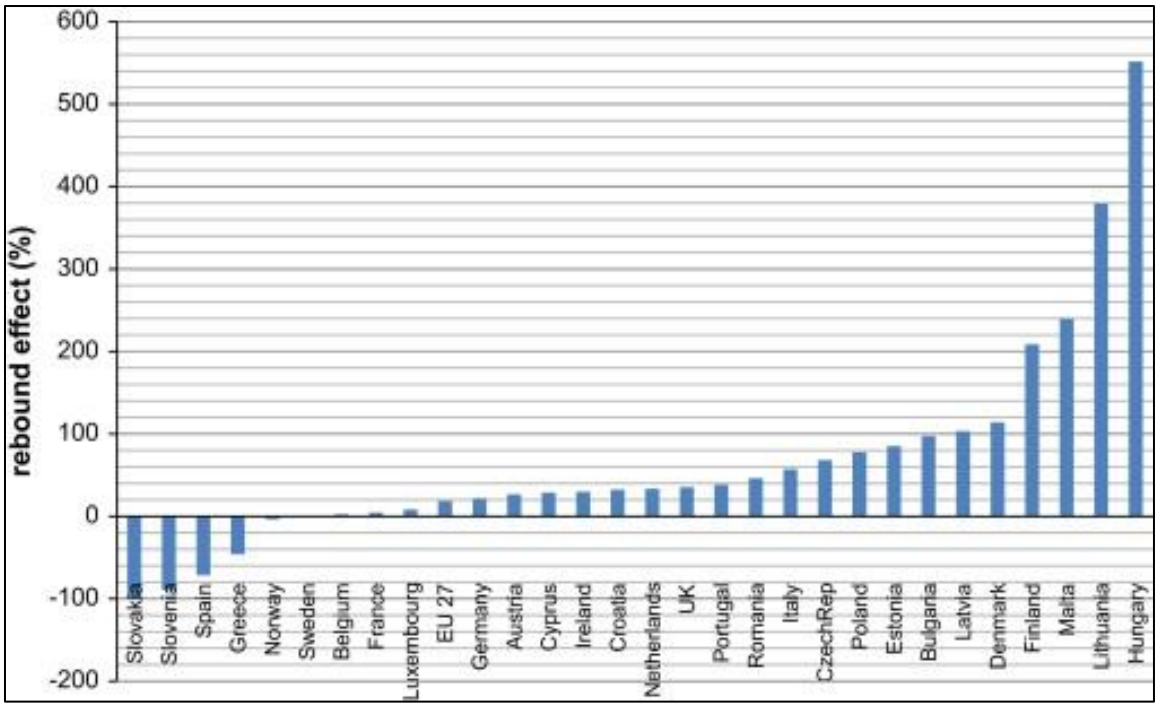
[59] For example:

Greening L.A., Greene, D.L., & Difiglio, C., 2000. Energy efficiency and consumption — the rebound effect — a survey. *Energy Policy*, 28, pp. 389-401.

Sorrell, S., 2009. Jevons' paradox revisited: the evidence for backfire from improved energy efficiency: Energy Policy, 37 (4). 1456-1569. ISSN 0301-4215.

[60] Galvin, R., 2014. Estimating broad-brush rebound effects for household energy consumption in the EU 28 countries and Norway: some policy implications of Odysee data. Energy Policy, 73, 2014, pp.323-332.

Figure 2.2: Year-by-year percentage household energy services rebound effects for EU countries and Norway 2000–2011



Source: Galvin, 2014

Some studies have found much smaller rebound effects for specific behaviours, for example:

- 6 per cent for the average switch to an energy efficient lightbulb[61];
- 7 per cent for turning down a thermostat[62];
- 14.5 per cent for fitting cavity wall insulation[63];
- 14.5 per cent for fitting loft insulation[64];
- 14.6 per cent for fitting water tank insulation[65]; and
- 15.2 per cent for fitting a condensing boiler[66].

However, it would be unwise to infer that results such as these suggest the effect is being over-estimated as they are also consistent with the evidence that specific 'one-off' behaviours are easier to influence[67], and so these would be expected to have smaller rebound effects.

[61] Schleich, J., Mills, B., & Dütschke, E., 2014. A brighter future? Quantifying the rebound effect in energy efficient lighting. Energy Policy, Vol. 72, 2014, pp. 35-42.

[62] Druckman, A., Chitnis, M., Sorrell, S., & Jackson, T., 2011. Missing carbon reductions? Exploring rebound and backfire effects in UK households. Energy Policy, Vol. 39, (6), pp. 3572-3581.

[63] Chitnis, M., Sorrell, S., Druckman, A., Firth, S.K., & Jackson, J., 2014. Who rebounds most? Estimating direct and indirect rebound effects for different UK socio-economic groups. Ecological Economics, 106, 2014, pp. 12-32.

[64] Ibid.

[65] Ibid.

[66] Ibid.

[67] Baker, K.J., Griffiths, P., Teedon, P., & Thomson, C., 2011. Delivering climate change through behaviour change: the work of civil society organisations. Northern European Social Science Conference, Stockholm, June 2011.

Other studies have pointed to the significant gap between theoretical and actual savings. For example, a 2006 study for Defra concurred with the 15 per cent figure for the rebound effects of cavity wall and loft insulation, but only if this was restricted to savings being taken back as improved thermal comfort[68]. Overall, actual energy savings from these measures were found to be 50 per cent lower than theoretically achievable, with the additional 35 per cent attributed to a combination of limitations in modelling and technical limitations, and occupant ventilation behaviour.

To date there is relatively little evidence of the variation of the rebound effect across different socio-economic groups. However, one German study on the rebound effect on domestic heating measures found it to be higher for households and office workers in lower socio-economic groups[69]. These results are consistent with a more recent study into transport behaviour in Germany, which found that the effect was higher (up to 49 per cent) for commuters from more disadvantaged groups[70].

Finally, an important study for the UK's Energy Research Centre found that the direct rebound effect for household heating and cooling interventions to the UK's housing stock to be between 10 per cent and 30 per cent[71], including accounting for behavioural and technical influences. The figure for Scotland may be higher, due to the higher percentage of the population in lower socio-economic groups.

New research has pointed to another problem, the 'prebound' effect[72]. This arises from households under-consuming energy, leading to models over-predicting actual consumption and the savings from energy efficiency measures. This effect may result from householders choosing or adapting to lower internal temperatures, but it also results from behaviours to limit energy use, and so is a strong indicator of fuel poverty.

This study also shows why it cannot be assumed that households with a high prebound effect will have a lower rebound effect after an energy efficiency retrofit, as cultural and social influences affect desire and willingness to pay for higher levels of heating and other forms of take back behaviours. It compares samples of French and German homes upgraded to the same levels of energy performance, and shows greater prebound and rebound effects for the French sample. This means that, for whatever reasons, upgrading the French homes to a modest level of thermal comfort would result in higher than expected energy savings and social benefits, but upgrading them to higher levels of energy performance would lead to occupants taking back more of that energy, and the resulting savings being lower than would be expected[73].

In light of this and the other evidence discussed in this review, the use of a 20 per cent assumption for the rebound effect in the Scottish Government's DEMScot 2 model[74] would seem somewhat conservative. If the German results were found to be broadly true in the UK,

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[68] Sanders, C., & Phillipson, M., 2006. Review of Differences between Measured and Theoretical Energy Savings for Insulation Measures. Report for the Energy Saving Trust.

[69] Madlener, M., & Hauertmann, M., 2011. Rebound Effects in German Residential Heating: Do Ownership and Income Matter? FCN Working Paper no. 2/2011, Energy Research Centre, RWTH-Aachen University.

[70] Galvin, R., 2015. The rebound effect, gender and social justice: A case study in Germany. Energy Policy, Vol. 86, 2015, pp. 759-769.

[71] Sorrell, S., 2007. The Rebound Effect: an assessment of the evidence for economy-wide savings from energy efficiency. UK Energy Research Centre.

[72] Galvin, R. And Sunikka-Blank, M., 2016. Quantification of (p)rebound effects in retrofit policies – Why does it matter? Energy, 95, pp. 415-424.

[73] Ibid

[74] Scottish Government, 2010, DEMScot 2: Scotland's Housing Carbon Model The extensions.

then Scotland, with its higher number of fuel poor households, would be expected to have a larger than average proportion of households with higher rebound effects, meaning a correction factor of at least 35 per cent would seem more reasonable. Further research to investigate this effect in Scotland and develop factors to weight the assumption by socio-economic group could close this knowledge gap and improve the accuracy of the model.

2.1.8.1 Learning points

- Current models are likely to be under-predicting the strength of the rebound and prebound effects from energy efficiency improvements. Whilst these are relatively small and predictable for specific 'one off' behaviours, and where takeback is considered only in terms of increased thermal comfort, the effects become stronger and more variable for non-standard measures and where takeback is considered beyond thermal comfort.

- In light of the nature of the Scottish building stock, the prevalence and complexity of fuel poverty and factors known to influence it, assuming an average rebound effect of around 35 per cent for households in Scotland seems more reasonable than the current 20 per cent assumption.

- More and better monitoring is needed to understand current differences in energy consumption and the likely impacts of energy efficiency measures on fuel poor households.

2.1.9 The contribution of poor maintenance to household energy demand, health inequalities, and fuel poverty

In 2014, 73 per cent of Scottish properties were in need of some repair, 53 per cent were in need of repairs to critical elements, 32 per cent were in need of urgent repair, and 7 per cent were in need of extensive repairs[75]. The need and extent of repair generally increases, and the rate of improvement decreases, with the age of the dwelling. Levels of disrepair are similar across the urban-rural divide, and between the private and social sectors, and they are lowest amongst housing association and cooperatively-owned properties, and higher in public sector and privately-rented properties.

Due to the continued prevalence of poor levels of maintenance it is difficult to disentangle the benefits of repairs from energy efficiency improvements, especially where these are carried out together. However, previous studies consistently show poor maintenance as a factor in increased energy demand, fuel poverty, and poor health[76], and have recommended a greater focus on improving maintenance levels as part of future energy efficiency schemes[77]. Poor maintenance may of course also be an outcome of fuel poverty and the factors that influence it, which emphasises the need to incorporate maintenance as standard in intervention schemes.

2.1.9.1 Learning points

- Due to the continued prevalence of poor maintenance in Scottish homes and the likely barrier this will pose to both the potential for and effectiveness of energy efficiency interventions, an allowance for maintenance and repairs is likely to bring significant benefits to energy efficiency and fuel poverty schemes.

[75] Scottish Government, 2015. Scottish House Condition Survey: Key Findings 2014.

[76] For example:

Healy, J.D., Clinch, J.P., 2004. Quantifying the severity of fuel poverty, its relationship with poor housing and reasons for non-investment in energy-saving measures in Ireland. Energy Policy 32, 207–220.

[77] Baker, K.J., Emmanuel, R., & Phillipson, M., 2012. Support for RPP2 - Housing Futures. Report for ClimateXChange Scotland.

Economic issues

2.1.10 Definition and measurement of fuel poverty in Scotland, the UK and internationally

Currently definitions of 'fuel poverty', where they exist, vary significantly across the EU and internationally. The European Parliament recognises the condition of 'energy poverty'[78] (a 'looser' term than fuel poverty) that is in use globally[79], but is not currently proposing to adopt an EU-wide definition[80] and, as such, current definitions vary widely[81].

How fuel poverty is defined and measured is critical to understanding the problem and formulating effective policy responses[82]. Scotland's current definition[83] is a direct descendent of Brenda Boardman's seminal work which defined fuel poor households as those spending more than 10 per cent of their incomes on energy for heating[84], whilst incorporating the World Health Organisation's guidance on thermal comfort[85] and an adjustment for elderly and long-term disabled households.

Since 2013 the English figures for fuel poverty have been revised to reflect the adoption of an alternative 'low income / high costs' definition[86]. Whilst this approach has its strengths, commentators have also commented on its weaknesses[87], e.g. it excludes households whose energy spend is well in excess of 10 per cent of income but who are not otherwise classified as being in poverty and also has a tendency to exclude low income households in small homes with poor energy efficiency. The static nature of the model also makes it extremely difficult to eradicate fuel poverty (see Figure 3.3)[88].

[78] European Parliament, 2008. Legislative resolution of 18 June 2008 on the proposal for a directive of the European Parliament and of the Council amending Directive 2003/54/EC concerning common rules for the internal market in electricity. Official Journal of the European Union, C 286 E/106.

[79] González-Equino, M., 2015. Energy poverty: An overview: Renewable and Sustainable Energy Reviews, 47, pp. 377-385.

[80] European Commission, 2010. Commission Staff Working Paper: An Energy Policy for Consumers. European Commission, Brussels.

[81] EPEE, 2014. European Fuel Poverty and Energy Efficiency. Intelligent Energy Europe.

[82] Moore, R., 2012. Definitions of Fuel Poverty: Implications for policy. Energy Policy, 49, 19-26.

[83] Scottish Government, 2012. Fuel Poverty Evidence Review: Defining, Measuring and Analysing Fuel Poverty in Scotland.

[84] Boardman, B. 1991. Fuel Poverty: From Cold Homes to Affordable Warmth: London: Belhaven Press. And more recently: Boardman, B., 2010. Fixing fuel poverty: challenges and solutions. Earthscan.

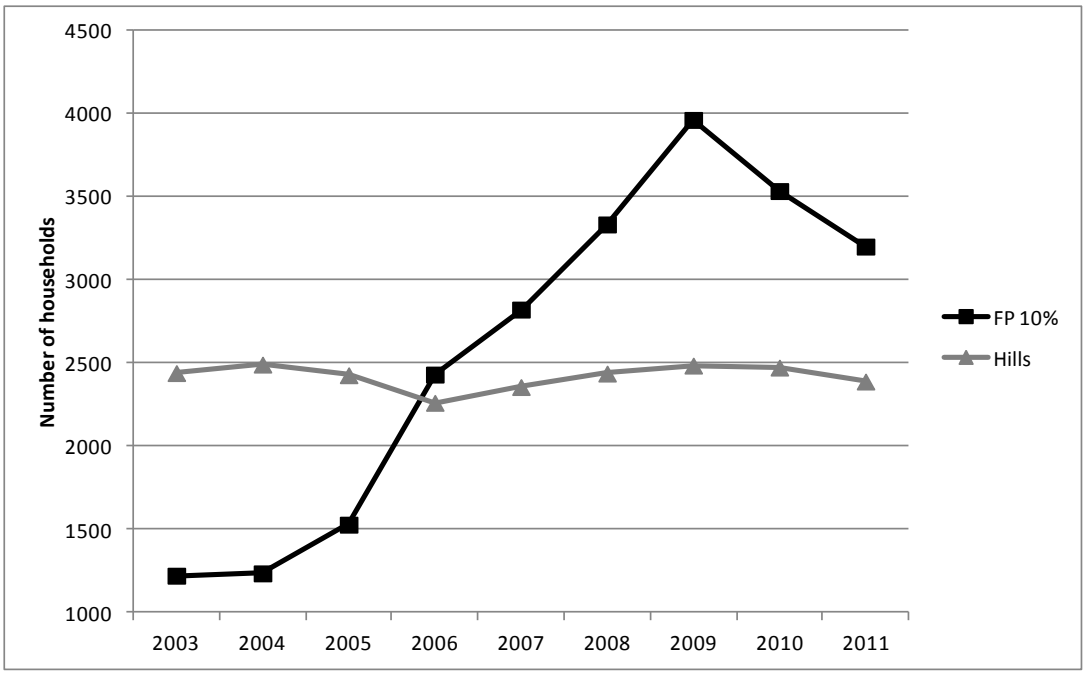
[85] WHO, 1990. Indoor Environment: Health Aspects of Air Quality, Thermal Environment, Light and Noise. World Health Organisation.

[86] Hills, J., 2012. Getting the measure of Fuel Poverty: DECC, Case Report 72 March 2012.

[87] Walker, R., Thomson, H., & Liddell, C., 2013. Fuel Poverty 1991-2012: Commemorating 21 years of action, policy and research. University of Ulster & University of York.

[88] Ibid. And also: Mould, R., 2016. Fuel Poverty Mitigation and District Heating Systems. Forthcoming PhD thesis, Glasgow Caledonian University.

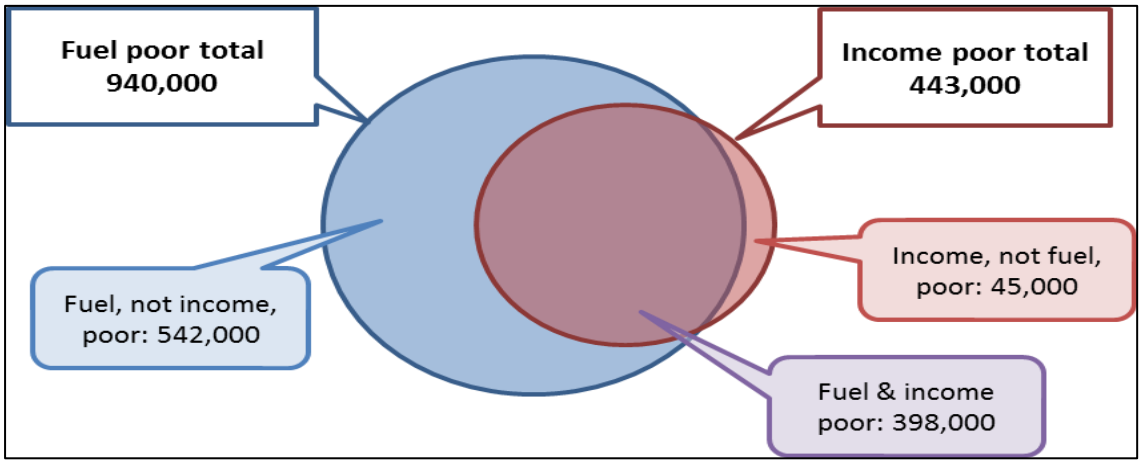
Figure 2.3: Numbers of households in fuel poverty in England according to the Hills 'low income / high costs' definition and the Scottish '10 per cent' definition



Source: Mould, 2016[89]. Based on DECC figures.

An analysis of SHCS data by the Scottish Fuel Poverty Forum shows that, under the current Scottish definition, whilst most income poor households are also fuel poor, fuel poor households exist across all income bands (see Figure 3.4).

Figure 2.4: Fuel poor and income poor households in Scotland, 2013



Source: Scottish Fuel Poverty Forum, 2015[90]

This serves to demonstrate the differences between income and expenditure-based definitions of fuel poverty, with the latter being more sensitive to additional factors which may better account for fuel poverty.

The significance of including energy and thermal comfort in the definition of fuel poverty is underlined by the change in the Scottish figure following the revision of the energy methodology

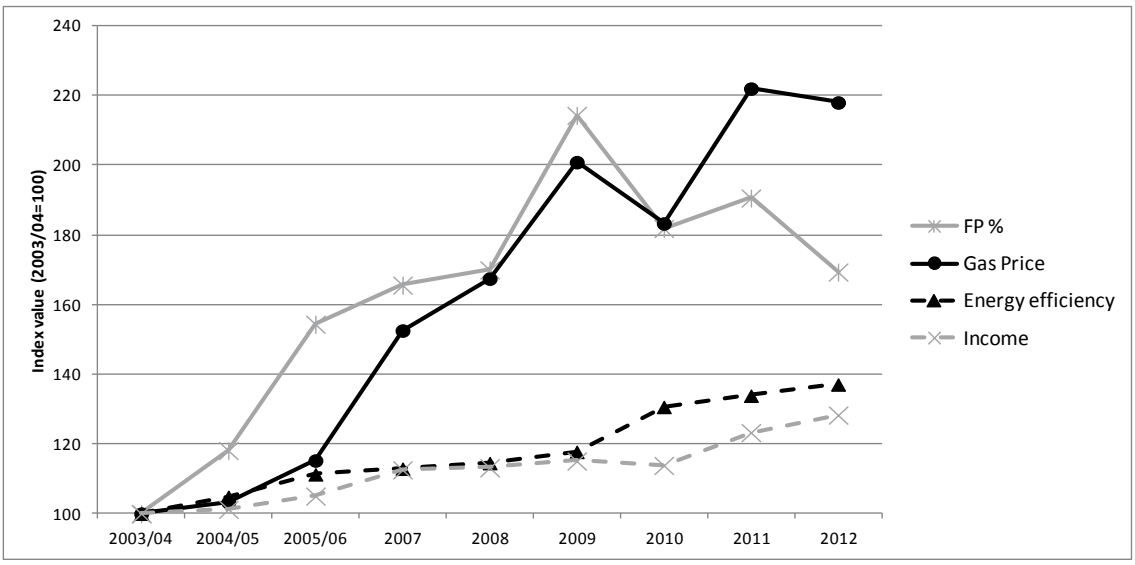
[89] Ibid.

[90] SFPF, 2015. Fuel Poverty and Poverty Briefing Note. Scottish Fuel Poverty Forum.

that underpins the definition, and the findings that 30 per cent of fuel poor Scottish households struggle to stay warm in winter and 13 per cent cannot afford to heat them at all[91].

Finally, Figure 3.5 shows how the number of Scottish households in fuel poverty tracks changes in gas prices, energy efficiency, and income.

Figure 2.5: Fuel poverty in Scotland set against gas prices, energy efficiency, and income



Source: Based on Mould, 2016[92], based on SHCS data.

This figure suggests that energy efficiency improvements are driving a reduction in the impact of gas prices on fuel poverty (see Section 3.2.2).

2.1.10.1 Learning points

- Income-based definitions of fuel poverty, such as the current Scottish definition, are more sensitive than expenditure-based definitions to additional factors which may better account for fuel poverty.

- Energy efficiency improvements do appear to be insulating households from increases in gas prices.

2.1.11 Targeting fuel poor and energy inefficient households in Scotland

The targeting of energy efficiency and fuel poverty schemes in the UK and Scotland generally relies on a number of key statistics, derived from a mix of data collection and modelling. However these are highly complex problems that are subject to a wide range of influences, and recently the appropriateness of using conventional social science methods, which often rely on simplifications and assumptions, to reflect complex problems such as these has been criticised[93]. This conventional thinking, which is built on studies using the best data available at the time, has led to a number of generalisations about energy usage and expenditure distributions that have since been brought into question (see also Section 3.2.3).

[91] Scottish Government, 2016. Scottish House Condition Survey: Key Findings 2014.

[92] Mould, R., 2016. Fuel Poverty Mitigation and District Heating Systems. Forthcoming PhD thesis, Glasgow Caledonian University.

[93] Castellani, B., 2014. Complexity and the failure of quantitative social science. Discover Society, November 2014.

For example, evidence from two important studies into domestic energy consumption in UK households conducted in the mid-2000's[94] found a negligible correlation between total energy consumption and household income, a very weak correlation between gas consumption and disposable income, and a stronger but still weak correlation ($r=0.27$, $p<0.01$) between total energy consumption and disposable income. This is most likely due to gas being used predominantly for heating and is strongly influenced by factors such as the type and energy efficiency of the home, whereas increasing use of electricity would be expected to be influenced by disposable income as households buy and use more appliances. As would be expected, the exception to this widely-accepted generalisation is households in flats, where energy is saved by sharing through the walls and floors.

In more recent years the usefulness of this generalisation for informing both energy efficiency and fuel poverty policies has begun to be brought into question, and particularly in Scotland, due to a number of factors including its distinct urban-rural divide[95]. One recent study has shown that lower income rural households in Renfrewshire actually spend more on energy than those on higher incomes (see Figure 2.6), and that fuel poverty (and fuel spend) is proportionately higher in rural areas[96]. Whilst another has found that urban households tend to experience fuel poverty for longer, and are more likely to do so, whereas rural households are more vulnerable to energy prices, particularly if they live in flats or private accommodation[97].

These and other studies into energy efficiency and fuel poverty amongst different geographic and socio-economic groups[98] all provide evidence that these problems become more significant and complex amongst older, more vulnerable, lower income, and rural households. This raises the question of whether future financial support, for example the Winter Fuel Payment should be implemented universally or targeted at specific social, economic or geographic groups who are known to be more vulnerable.

[94] Dresner, S., & Ekins, P., 2004. Economic Instruments for a Socially Neutral National Home Energy Efficiency Programme. Policy Studies Institute, London, UK.

Druckman, A., & Jackson, T., 2008. Household energy consumption in the UK: A highly geographically and socio-economically disaggregated model. Energy Policy, Vol. 36, (8), pp. 3177-3192.

[95] Mould, R., 2016. Fuel Poverty Mitigation and District Heating Systems. Forthcoming PhD thesis, Glasgow Caledonian University.

[96] Mould, R., Baker, K.J., & Emmanuel, R., 2014. Behind the Definition of Fuel Poverty: Understanding differences between the Fuel Spend of Rural and Urban Homes. Queens Political Review, Vol. II, 2014, Issue 2, pp. 7-24.

[97] Roberts, D., Vera-Toscano, E., & Phimister, E., 2015. Fuel poverty in the UK: Is there a difference between rural and urban areas? Energy Policy, 87, (2015), pp.216-223.

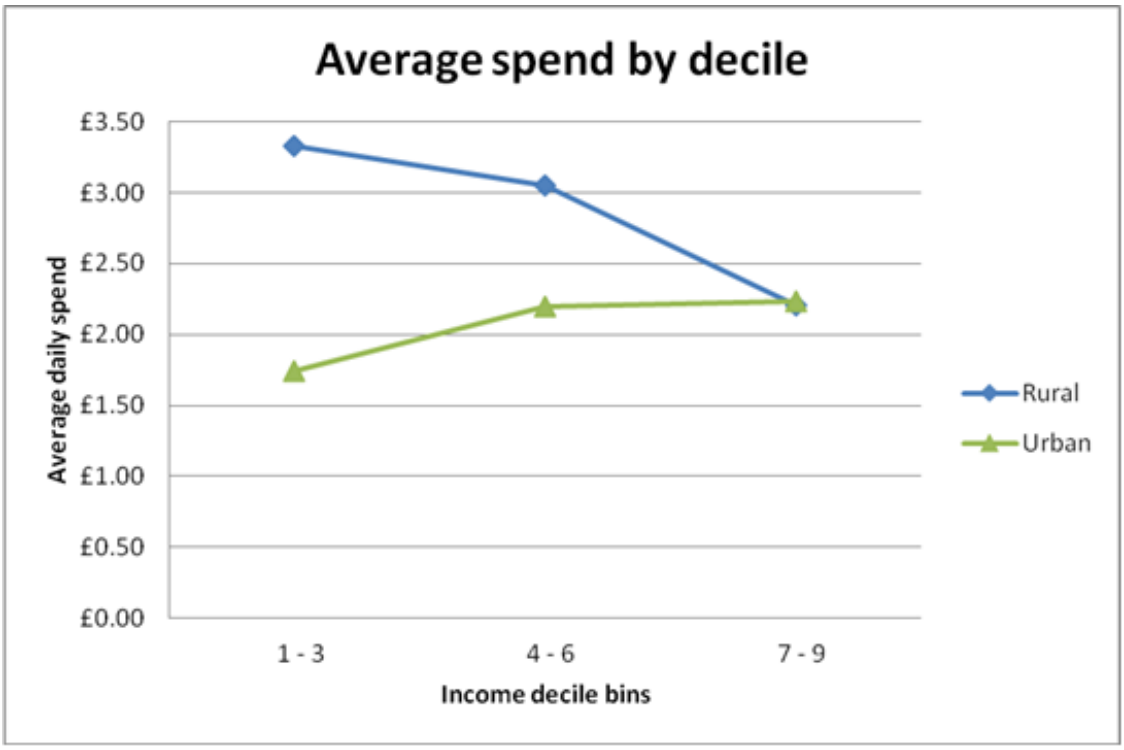
[98] George, M., Graham, C., & Lennard, L., 2013. The Energy Penalty: Disabled People and Fuel Poverty. University of Leicester, report for the Eaga Charitable Trust.

JRF, 2015. Monitoring Poverty and Social Exclusion in Scotland. Joseph Rowntree Foundation, March 2015.

MacInnnes, T., Aldridge, H., Bushe, S., Tinson, A. and Born, T., 2014. Monitoring poverty and social exclusion. Report for the Joseph Rowntree Foundation.

Snell, C., 2013. Fuel poverty and disabled people: the impact of policy change. Report for the Eaga Charitable Trust.

Figure 2.6: Average daily fuel spend of a sample of urban and rural households in Renfrewshire, by SIMD income decile



Source: Mould et al., 2014[99].

Conversely, there is also the need to consider the willingness, ability, and capacity of householders to respond to measures designed to engage them. Ofgem reports consumer engagement with tariff-switching and their energy suppliers across four segments of society: households who are either 'unplugged' (20 per cent); 'on standby' (37 per cent); 'tuned in'; (29 per cent); or 'switched on' (15 per cent)[100]. However this is an outcome-based assessment which may not sufficiently consider the vulnerabilities and capacities to respond of less 'switched on' households. A more useful approach may be to consider those categories in terms of how they reflect the likelihood of a household being able to identify and respond to any significant and / or long term changes in energy prices, i.e. their energy vulnerability.

Applying research from work on vulnerability (see Table 2.4) suggests how engagement methods and assessments could be re-designed to better reflect the more significant and complex problems amongst those least able to respond.

[99] Mould, R., Baker, K.J., & Emmanuel, R., 2014. Behind the Definition of Fuel Poverty: Understanding differences between the Fuel Spend of Rural and Urban Homes. Queens Political Review, Vol. II, 2014, Issue 2, pp. 7-24.

[100] Ofgem, 2015. Retail Energy Markets in 2015.

Table 2.4: Speirs' attributes of emic[101] vulnerability and their application in an energy vulnerability context

Speirs' attributes of emic vulnerability	Definitions	Application to energy vulnerability
Integrity	The person's sense of soundness in the various dimensions of her or his life	The ability to keep warm/cool and therefore live a decent life
Challenge	Vulnerability is experienced when there is a perceived challenge to the integrity with a corresponding uncertainty about the ability to respond adequately	Anything that challenges a household's ability to keep warm/cool
Capacity for action	Capacity for action refers to the individual's perceived ability to withstand, integrate or cope with the challenge	How a household copes with (and perceives itself coping with) the challenges to its ability to keep warm/cool
Multi-dimensional	The fact that vulnerability varies from one person to another and from one experience to another	The fact that energy vulnerability is experienced differently by different people in different circumstances
Power	The extent to which a challenge directs or constrains action, and the extent to which the person perceives the potential for change	The extent to which challenges allow a household to act to avoid energy vulnerability, and the household's perception of their own agency in energy matters

Source: Middlemiss & Gillard, 2015[102].

In effect, these attributes of energy vulnerability set out their own threshold for fuel poverty, in that to be considered to be neither in, nor at risk of, fuel poverty a householder must: be able to maintain a comfortable indoor environment; know how to identify and respond to challenges to maintaining that environment; be able to and capable of responding to those challenges; and to perceive themselves as having the capacity and agency to do so.

In theory, beyond this point, and if given sufficient information, householders could be expected to be free of the limitations that make them difficult to engage, and more conventional approaches to target them for improving energy efficiency can be applied. However, this still assumes that non-vulnerable householders behave optimally even if engaged effectively, and so even once a household is no longer considered vulnerable there may still be a need for discretionary support for making and maintaining behaviour changes.

2.1.11.1 Learning points

- The methods and measures currently used for identifying and targeting fuel poor households in Scotland are simplifications of a complex issue, and ongoing efforts are needed to improve them.

[101] Definition: Defining or related to cultural phenomena viewed from perspective of someone within that society, as opposed to an observer outwith the society (etic).

[102] Middlemiss, L., & Gillard, R., 2015. Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor: Energy Research and Social Science, 6, pp.146-154.

- Evidence suggests the energy expenditure of rural households decreases with income, but increases slightly with income for urban households, and so there is a case for prioritising rural households in fuel poverty interventions.

- Vulnerability may be a useful concept in defining and measuring fuel poverty in the future. However, more work needs to be done to provide evidence on how this might best be done. One possible approach (being developed at Glasgow Caledonian University) is to define a set of metrics to assess the capacity and resilience of a household against a risk-based framework based on the adapted Speirs attributes. This would enable both the setting of a threshold for vulnerability to fuel poverty and a scale for measuring progress in alleviating it.

2.1.12 Impact of planned and proposed changes to funding

It is clear from recent UK Government Spending Review announcements[103] that there will be continuing downward pressure on public spending which will impact on the resources available to meet all public sector policy commitments. As a result of these announcements, ECO will concentrate on the delivery of lower cost measures such as loft and cavity wall insulation, for which there is increasingly limited remaining potential in Scotland (see Section 0).

Notwithstanding the social, economic and behavioural factors described in Section 2, the energy efficiency challenges facing Scotland are increasingly seen as dealing with homes for which basic measures are not appropriate, such as those with solid walls or those without access to mains gas. Solutions to such challenges are significantly more expensive than measures such as loft insulation, cavity wall insulation and boiler replacements, which heightens the significance of the constraints on public finances.

The Green Deal has already ceased and, whilst the devolution settlement will provide Scotland with greater control over energy efficiency spending, the amount of funding available may be less than has been spent in recent years, given that Scotland has historically levered a disproportionate amount of UK-wide energy efficiency spend relative to the number of households in the country.

There is evidence that making investment in energy efficiency an infrastructure priority, providing it is backed by sufficient funding could generate significant benefits: a significant positive impact on growth; enhancements to the quality, sustainability and capacity of energy infrastructure; and the leveraging of significant investment from the private sector[104]. Scotland's Infrastructure Investment Plan states that "by assigning energy efficiency the status of a national infrastructure priority and establishing a clear delivery programme, we will ensure long-term stability for energy efficiency and heat funding and policy to give home and business owners, and our private sector partners, the certainty to invest in improving the energy efficiency of Scotland's buildings"[105]. The Plan sets out the Scottish Government's commitment to maximise investment in infrastructure through the capital budget and by use of alternative approaches that fund investments through revenue instead of capital, and through other innovative financing. Nevertheless, however much public funding is allocated to energy efficiency and fuel poverty in future years, given the scale of the challenge and the higher costs of individual measures, it is inevitable that private finance (householder contributions) will need to play an increasingly important role.

[103] http://www.bbc.co.uk/news/uk-politics-34908612

[104] Frontier Economics, 2015. Energy efficiency: An infrastructure priority. Report for Citizens Advice, Energy Bill Revolution, Energy Saving Trust, Kingfisher Plc and MIMA.

[105] Scottish Government, 2015. Infrastructure Investment Plan 2015.

2.1.12.1 Learning points

- The future nature and levels of non-devolved funding for energy efficiency and fuel poverty schemes is currently uncertain, whilst the evidence for the benefits of greater investment is significant.

- It is inevitable that private finance (householder contributions) will, in some circumstances, need to play an increasingly important role in funding energy efficiency improvements.

2.1.13 Potential for schemes to deliver better and wider social and economic benefits

Perhaps unsurprisingly due to the complexity of the issue, there have been very few academic studies that have tried to capture the wider social and economic benefits of energy efficiency and fuel poverty schemes.

One exception is a 2002 study that modelled the application of a theoretical energy efficiency programme on the English housing stock, and found a cost-benefit ratio of 1:1.2 in terms of pounds spent[106]. This finding is heavily couched in caveats but is a conservative estimate. Others have focused on specific aspects of schemes, such as the benefits of refurbishment versus demolition[107], or the use of certain fuels[108].

A recent major European-wide study on the employment and social benefits of energy efficiency schemes produced a number of key findings relevant to this review[109]:

- UK energy efficiency policy was estimated to have increased the annual rate of economic growth by 0.1 per cent between 2000 and 2007, and to have increased employment by 0.8 per cent (271,000 jobs) between 2000 and 2010.

- Investing in energy efficiency schemes tend to create more jobs than investing in energy generation, as the industry is more labour (and skills) intensive.

- Evidence from national sources shows the potential export market for energy efficiency equipment and services, with the Danish Energy Agency (in 2013) estimating growth of €3.6bn by 2020, supporting 9,000 new jobs, around two thirds of which would be due to exports.

Evaluations of some of the schemes covered in Section 4 provide some evidence of wider economic and social benefit. The review of the Energy Assistance Package (EAP) found evidence that prioritising local contractors could support economic generation in rural and island areas[110]. A significant regeneration impact of external wall insulation schemes was identified in the evaluation of the Community Energy Saving Programme (CESP). The visual improvement was reported to be one of the biggest benefits. CESP case study respondents overwhelmingly

[106] Goodacre, C., Sharples, S., & Smith, S., 2002. Integrating energy efficiency with the social agenda in sustainability. Energy and Buildings, Vol. 34, (1), 2002, pp. 53-61.

[107] Power, A., 2008. Does demolition or refurbishment of old and inefficient homes help to increase our environmental, social and economic viability? Energy Policy, Vol. 36, (12), 2008, pp. 4487-4501.

[108] McKay, H., 2006. Environmental, economic, social and political drivers for increasing use of woodfuel as a renewable resource in Britain. Biomass and Bioenergy, Vol. 30, (4), 2006, pp. 308-315.

[109] Cambridge Econometrics, 2015. Assessing the Employment and Social Impact of Energy Efficiency. Final Report. November 2015.

[110] Baker, K.J., Emmanuel, R., & Phillipson, M., 2014. Review of the Energy Assistance Package. Report for the Scottish Government.

agreed that 'the scheme has had a positive impact on my neighbourhood as a place to live', with over three quarters (77 per cent) agreeing. Stakeholders considered that visual improvements had knock-on-effects to the local economy (rising property prices and letting rates), increasing community pride and activity, reducing antisocial behaviour and improving school attendance. Moreover, in two case studies, CESP schemes had prevented housing from being demolished – extending the life of housing at a lower cost and with less disruption than the proposed regeneration programmes. Other analyses of the schemes suggest that they created social value in the form of energy bill savings, income for businesses, avoided health costs to society, increased government tax revenue and saved maintenance time[111].

2.1.13.1 Learning point

- There is evidence of the potential significant wider social and economic benefits of energy efficiency and fuel poverty schemes, which needs to be taken into account in future funding decisions.

Health

2.1.14 Health benefits of more energy efficient homes, and impacts of poor quality housing

The most commonly cited health impacts of poorly maintained, energy inefficient housing stem from householders experiencing coldness or dampness (leading to mould growth), and often both[112]. However, the complexity of factors influencing occupant health makes it difficult to disentangle and attribute dwelling and occupant characteristics to specific health outcomes.

The relationship between dampness, mould, indoor air pollution, and householders experiencing respiratory illness is well-studied, and although the number of other factors that are known or thought to influence respiratory illness (age, smoking, exposure to pollutants, etc) are extensive and difficult to control for, meaning it is difficult to conclusively state this correlation also reflects causation, the evidence is nevertheless wide-ranging and substantial[113].

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[111] Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC.

[112] EAS, 2012. The relationship between Fuel Poverty and Heath: A discussion paper. Energy Action Scotland.

[113] Annesi-Maesano, I., Lundbäck, B., & Viegi, G., 2014. Respiratory epidemiology. 1st ed. Sheffield: European Respiratory Society.

Bernstein, J., Alexis, N., Bacchus, H., Bernstein, I., Fritz, P., Horner, E., Li, N., Mason, S., Nel, A., Oullette, J., Reijula, K., Reponen, T., Seltzer, J., Smith, A. & Tarlo, S., 2008. The health effects of nonindustrial indoor air pollution. Journal of Allergy and Clinical Immunology. 121 (3), pp.585-591.

Bornehag, C., Blomquist, G., Gyntelberg, F., Järvholm, B., Malmberg, P., Nordvall L., Nielsen A., Pershagen G., & Sundell J., 2001. Dampness in Buildings and Health. Nordic Interdisciplinary Review of the Scientific Evidence on Associations between Exposure to "Dampness" in Buildings and Health Effects (NORDDAMP). Indoor Air. 11 (2), pp.72-86.

CASD, 2010. A Select Review of Literature on the Relationship Between Housing and Health. Communities Analytical Services Division, Scottish Government.

Douglas, M., Thomson, H., & Gaughan, M., 2003. Health Impact Assessment of Housing Improvements: A Guide. Public Health Institute of Scotland, Glasgow.

Fisk, W., Lei-Gomez, Q. and Mendell, M., 2007. Meta-analyses of the associations of respiratory health effects with dampness and mold in homes. Indoor Air. 17 (4), pp.284-296.

Grant, C., Hunter, C., Flannigan, B. and Bravery, A., 1989. The moisture requirements of moulds isolated from domestic dwellings, International Biodeterioration 24, 4, 259-289.

Many of these studies also show clear relationships between poor indoor air quality (IAQ) and increased likelihoods of mortality and conditions related to respiratory illness (i.e. cardio-vascular and pulmonary conditions), with children and elderly people being particularly vulnerable. Furthermore, and unsurprisingly given the relationship between levels of particulates and other indoor pollutants (including volatile organic compounds (VOCs)), it is the presence of mould rather than dampness per se that appears to be the dominant influence on householders experiencing respiratory illness (even if the remedies for these may be the same).

In addition, and although there has been less research into this, these relationships do appear to be largely unaffected by socio-economic group, with one important meta-study conducted in the USA finding dampness and mould resulting in increases of 30-50 per cent of a variety of respiratory and asthma-related health outcomes across a range of population groups, and with high levels of consistency and statistical significance[114].

Finally, there also appears to be consensus that there is a 'dose-response' relationship between poor housing and poor health, with both the experience of living in poor quality housing and the length of exposure both contributing to the probability of householders experiencing ill health[115].

Howden-Chapman, P., Viggers, H., Chapman, R., O'Sullivan, K., & Barnard, L. T., Lloyd, B., 2012. Tackling cold housing and fuel poverty in New Zealand: A review of policies, research and health impacts: Energy Policy 49, 134–142.

Jones, A.P., 1999. Indoor air quality and health. Atmospheric Environment. 33 (28), pp. 4535–4564.

Kim, K., Jahan, S., & Kabir, E., 2013. A review on human health perspective of air pollution with respect to allergies and asthma. Environment International. 59, pp.41-52.

Liddell, C. and Morris, C., 2010. Fuel poverty and human health: A review of recent evidence: Energy Policy 38, pp. 2987-2997.

Mendell, M., Mirer, A., Cheung, K., Tong, M., & Douwes, J., 2011. Respiratory and Allergic Health Effects of Dampness, Mold, and Dampness-Related Agents: A Review of the Epidemiologic Evidence. Environ Health Perspect. 119 (6), pp.748-756.

Nandasena, S., Wickremasinghe, A., & Sathiakumar, N., 2012. Respiratory health status of children from two different air pollution exposure settings of Sri Lanka: A cross-sectional study. American Journal of Industrial Medicine. 55 (12), pp.1137-1145.

Nicolaou, N., Siddique, N. & Custovic, A., 2005. Allergic disease in urban and rural populations: increasing prevalence with increasing urbanization. Allergy. 60 (11), pp.1357-1360.

Norbäck, D., Björnsson, E., Janson, C., Palmgren, U., & Boman, G., 1999. Current asthma and biochemical signs of inflammation in relation to building dampness in dwellings. The International Journal of Tuberculosis and Lung Disease. 3 (5), pp. 368-376.

Park, J., Schleiff, P., Attfield, M., Cox-Ganser, J., & Kreiss, K., 2004. Building-related respiratory symptoms can be predicted with semi-quantitative indices of exposure to dampness and mold. Indoor Air. 14 (6), pp.425-433.

Perez-Padilla, R., Schilmann, A, Riojas-Rodriguez, H., 2010. Respiratory health effects of indoor air pollution. The International Journal of Tuberculosis and Lung Disease. 14 (9), pp. 1079-1086.

Taske, N., Taylor,L., Mulvihill, C., & Doyle, N., 2005. Housing and public health: a review of reviews of interventions for improving health. Evidence Briefing the National Institute for Health and Care Excellence (NICE), UK.

Teedon, P.L., Gillespie, M., Lindsay, K., & Baker, K.J., 2014. Parental perceptions of the impacts the built environment has on young children's health: a qualitative examination and lay assessment amongst residents in four Scottish communities. Health and Place, 28 (2014), pp. 50-57.

Welch, L., 1991. Severity of health effects associated with building-related illness. Environ Health Perspect. 95, pp. 67-69.

Wolkoff, P. et al., 1997. Are We Measuring the Relevant Indoor Pollutants?. Indoor Air. 7 (2), pp.92-106.

Zuraimi, M., Tham, K., Chew, F., & Ooi, P., 2007. The effect of ventilation strategies of child care centers on indoor air quality and respiratory health of children in Singapore. Indoor Air. 17 (4), pp.317-327.

[114] Fisk, W., Lei-Gomez, Q. and Mendell, M., 2007. Meta-analyses of the associations of respiratory health effects with dampness and mold in homes. Indoor Air. 17 (4), pp.284-296.

[115] Taske, N., Taylor,L., Mulvihill, C., & Doyle, N., 2005. Housing and public health: a review of reviews of interventions for improving health. Evidence Briefing the National Institute for Health and Care Excellence (NICE), UK.

However, there may be some variation in the strength of those responses and some evidence that childhood exposure to some indoor pollutants may provide some level of resistance[116].

However, a word of caution applies when estimating potential savings to health services from tackling fuel poverty. Although the evidence is limited, it may be that improving the condition of homes may merely delay the first reporting of an existing or developing health condition[117].

In contrast, the relationships between housing and mental health have received very little attention to date. However, one Scottish study provides evidence to suggest that poor mental health is a contributing factor to fuel poverty through householders being unable to manage their finances, and also an outcome of it due to the stress of falling into debt to energy suppliers[118] (see also Section 3.5.4).

What is clear from both academic[119] and professional[120] evidence is that in order to maximise the health, wellbeing and other societal benefits of energy efficiency and fuel poverty schemes, they need to better address the highly multi-faceted nature of the problems, and provide solutions that are more sensitive to them.

2.1.14.1 Learning points

- Although it is difficult to disentangle the exact strength and nature of the effects, there is substantial and significant evidence that living in poorly maintained, energy inefficient homes is a contributing factor to householders experiencing respiratory illnesses and other related conditions. Levels of VOCs and other indoor air pollutants are also contributing factors.

- The health impacts of poor quality housing appear to be unaffected by socio-economic group, and there appears to be a 'dose-response' relationship.

- Whilst the health benefits of improved energy efficiency will need to be an important consideration in future funding decisions, it is important to note that the overall savings to health services may be less significant than some studies might suggest, as householders might still go on to require support for health conditions, i.e. improving housing quality may just delay the onset of some conditions rather than eradicate them altogether.

- More work is needed to understand and address the impacts of poor quality housing on mental health, and this evidence needs to be incorporated in the design of future schemes.

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[116] Hulin, M., Simoni, M., Viegi, G., & Annesi-Maesano, I., 2012. Respiratory health and indoor air pollutants based on quantitative exposure assessments. European Respiratory Journal. 40 (4), pp.1033-1045.

Isola, D., Kimber, I., Sarlo, K., Lalko, J., & Sipes, I., 2008. Chemical respiratory allergy and occupational asthma: what are the key areas of uncertainty? Journal of Applied Toxicology. 28 (3), pp.249-253.

[117] Walker, J., Mitchell, R., Petticrew, M., & Platt, S., 2008. The effects on health of a publicly funded domestic heating programme: a prospective controlled study. Journal of Epidemiology & Community Health, 2009, 63, pp. 12-17.

[118] SAMH, 2014. Worried sick: Experiences of poverty and mental health across Scotland. Scottish Association for Mental Health, March 2014.

[119] Shortt, N., & Rugkasa, J., 2007. *"The walls were so damp and cold"* fuel poverty and ill health in Northern Ireland: Results from a housing intervention. Health & Place, Vol. 13, (1), 2007, pp. 99-110.

[120] Christie Commission, 2011. Report on the Future Delivery of Public Services. Scottish Government.

Commission on Housing and Wellbeing, 2015. A blueprint for Scotland's future. June 2015.

2.1.15 Evidence of benefits of modern air-tight buildings for occupants with respiratory problems

In recent years building design has tended towards increased levels of air-tightness and the use of mechanical ventilation and heat recovery (MVHR) systems, perhaps confusingly termed 'passiv' design after the German PassivHaus™ standard. Although relatively few homes have been built or retrofitted to this standard the term has been adopted more widely to mean any building that is highly insulated and airtight, and makes use of MHVR. 'Passivhaus' characteristics also tend to include the use of modern and lightweight materials. In contrast, those experts favouring the alternative 'passive' (also called 'natural') approach argue for designing buildings to maximise natural lighting and ventilation, with no need for MHVR. Such buildings are invariably heavier builds to make use of the thermal mass to regulate temperatures, and can be built from more porous traditional materials that allow the building to 'breathe'[121].

The benefits of air-tightness and MVHR versus those of natural and 'passive' approaches (ventilation through windows, stacks and chimneys, porous building materials, high thermal mass, etc.) are widely contested. Some authors argue that over reliance on MHVR to draw in air from the outside can lead to increased levels of VOCs and pathogens[122], whilst others question its benefits to delivering reductions in mite allergens[123], and argue naturally ventilated buildings are more beneficial both for thermal comfort and the general quality of indoor environments[124]. The emission of VOCs from materials associated with modern passive building components, and their interaction with existing components when retrofitted, has also been found to be a potential cause for concern[125], whilst other studies show the potential for using more natural and sustainable building and furnishing materials to improve indoor air quality by absorbing VOCs and regulating moisture and heat[126]. Finally, there are also some concerns

[121] Roaf, S., Fuentes, M., & Thomas-Rees, S., 2012. Ecohouse. Forth Edition. Routledge.

[122] Roaf, S., Crichton, D. & Nicol, F., 2009. Adapting buildings and cities for climate change. 2nd ed. Amsterdam: Architectural Press.

[123] Niven, R.M., Fletcher, A.M., Pickering, A.C., Custovic, A., Sivour, J.B., Preece, A.R., Oldham, L.A., & Francis, H.C., 1999. Attempting to control mite allergens with mechanical ventilation and dehumidification in British houses. Journal of Allergy and Clinical Immunology, Vol. 103, (5), 1999, pp. 756-762.

[124] Aynsley, R., 1999. Estimating summer wind driven natural ventilation potential for indoor thermal comfort. Journal of Wind Engineering and Industrial Aerodynamics. 83 (1-3), pp.515-525.

Luo, Z., Zhao, J., Gao, J. and He, L., 2007. Estimating natural-ventilation potential considering both thermal comfort and IAQ issues. Building and Environment. 42 (6), pp.2289-2298.

[125] Becker, R., Goldberger, I. & Paciuk, M., 2007. Improving energy performance of school buildings while ensuring indoor air quality ventilation. Building and Environment. 42 (9), pp.3261-3276.

Missia, D., Demetriou, E., Michael, N., Tolis, E., & Bartzis, J., 2010. Indoor exposure from building materials: A field study. Atmospheric Environment. 44 (35), pp.4388-4395.

Uhde, E., & Salthammer, T., 2007. Impact of reaction products from building materials and furnishings on indoor air quality—A review of recent advances in indoor chemistry. Atmospheric Environment. 41 (15), pp.3111-3128.

[126] James, J., 2005. Emissions of Volatile Organic Compounds from Several Green and Non-Green Building Materials: A Comparison. Indoor and Built Environment. 14 (1). pp.69-74.

Lee, C., Haghighat, F., & Ghaly, W., 2005. A study on VOC source and sink behaviour in porous building materials - analytical model development and assessment. Indoor Air. 15 (3), pp.183-196.

Osanyintola, O., & Simonson, C., 2006. Moisture buffering capacity of hygroscopic building materials: Experimental facilities and energy impact. Energy and Buildings. 38 (10), pp.1270-1282.

Simonson, C., Salonvaara, M., & Ojanen, T., 2002. The effect of structures on indoor humidity - possibility to improve comfort and perceived air quality. Indoor Air. 12 (4), pp.243-251.

The NEES Project, 2011-2014. University College Cork, Glasgow Caledonian University, Ulster University, University of Umea, and the Arctic Technology Institute (ARTEK). See: www.neesonline.org

over the ability of householders to understand and use MHVR systems to optimise their benefits[127].

Nevertheless, others argue that passive systems with MVHR offer many advantages, including improved air quality, comfort, and ventilation rates, greater control of ventilation and heating, and reductions in carbon dioxide emissions[128]. However, the rate and nature of the turnover of the Scottish housing stock means that those built to Passivhaus™ and similar standards will remain a minority for a long time to come, and whilst retrofitting traditional Scottish homes to the standard has been demonstrated[129], the costs and benefits of large-scale retrofitting of air-tightness measures and MHVR are questionable. Furthermore, it is worth remembering that the overriding problem with the Scottish housing stock is the lack of maintenance, and just because a building is classed as 'traditional' or 'hard to treat' does not mean it would exhibit poor energy performance if restored to its original condition[130] (see also Section 3.3.2).

As such, and in light of the balance of evidence and medical opinion[131] and the relative novelty of using MHVR in housing, it is probably safest to conclude that the benefits of this approach to building design are as yet insufficiently proven.

Finally, and encouragingly, there is also some evidence that simple measures such as using dehumidifiers, indoor air cleaners, and making behaviour changes can also improve the health of asthmatic children[132].

2.1.15.1 Learning points

- There is an on-going, and highly contested, debate over the benefits of designing homes using 'passive' approaches incorporating high levels of air-tightness, mechanical ventilation and heat recovery, and designing them using naturally 'passive' approaches that use natural ventilation and thermal mass. Currently, the balance of evidence suggests the benefits of the former are insufficiently proven.

- Simple measures such as using dehumidifiers and making behavioural changes can improve the health of asthmatic children. There is potential for this advice to be included as part of supporting vulnerable households.

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[127] Macintosh, A., & Steemers, K., 2005. Ventilation strategies for urban housing: lessons from a PoE case study. Building Research & Information, Vol. 33, (1), 2005, pp. 17-31.

[128] BRE, 2011. The Passivhaus Standard. Building Research Establishment, UK.

EnergyStar, n.d. Mechanical Ventilation. Environmental Protection Agency, USA.

Kingspan Ltd, 2016. 6 Benefits of building to the Passivhaus Standard.

Lowe, R.J., & Johnston, D.K., 1997. Mechanical ventilation with heat recovery in local authority, low rise housing: Final report on the Derwentside field trial. CeBE Report no.6 Centre for the Built Environment, Leeds Metropolitan University, Leeds, UK, 1997.

Kraljevska, E., 2014. Estimated Benefits of Achieving Passivhaus and Net Zero Energy Standards in the Region of Waterloo Residential Sector and the Barriers and Drivers to Achieve Them. Masters thesis, University of Waterloo, Canada.

Sundell, J., Levin, H., Nazaroff, W.W., Cain, W.S., Fisk, W.J., Grimsrud, D.T., Gyntelberg, Y.L., Persily, A.K., Pickering, A.C., Samet, J.M., Spengler, J.D., Taylor, S.T., & Weschler, C.J., 2001. Ventilation rates and health: multidisciplinary review of the scientific literature. Indoor Air, Vol. 21, (3), 2011, pp. 191-204.

[129] John Gilbert Architects, 2013. PassivTEN: Upgrading Glasgow's Tenements to PassivHaus standard. John Gilbert Architects, Glasgow.

[130] Roaf, S., Baker, K.J., & Peacock, A., 2008. Evidence on Hard to Treat Properties. Scottish Government.

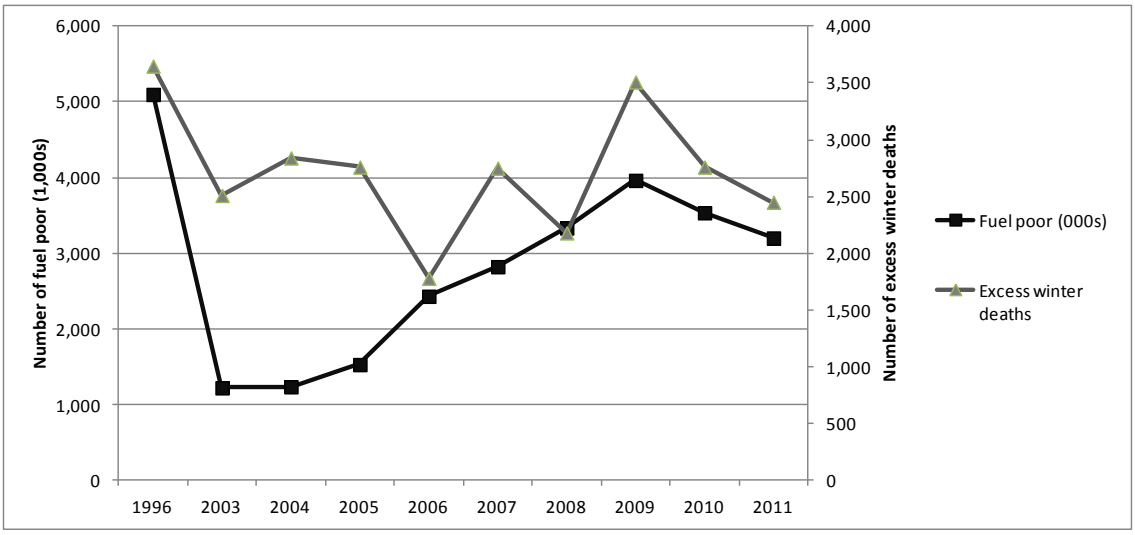
[131] Murphy, P., & Hart, N., 2009. Who benefits from home mechanical ventilation? Clinical Medicine, Journal of the Royal College of Physicians, April 2009, Vol. 9, (2), pp. 160-163.

[132] Johnson, L., Ciaccio, C., Barnes, C., Kennedy, K., Forrest, E., Gard, L., Pacheco, F., Dowling, P., & Portnoy, J., 2009. Low-cost interventions improve indoor air quality and children's health. Allergy and Asthma Proceedings. 30 (4), pp.377-385.

2.1.16 The relationship between excess winter deaths and fuel poverty

As an example of the complexities of the relationships between energy efficiency, fuel poverty and health, there is not a direct relationship between fuel poverty and winter deaths. However, by their nature, fuel poor households are more likely to be struggling to maintain adequate levels of warmth as well as healthy indoor environments. As shown in Figure 3.7, in the early 2000's fuel poverty levels in the UK were relatively low whilst the number of excess winter deaths remained high.

Figure 2.7: Fuel poverty and excess winter deaths in the UK



Source: Mould 2016[133], based on DECC, 2014[134].

The reasons for this have yet to be fully investigated. However, they appear to be due to how fuel poverty is defined and relates to other factors - internal temperatures, thermal comfort, energy prices, etc. However, in light of the evidence to date[135], it would appear to be more effective to consider mortality rates in relation to a householder being able to maintain an acceptable level of warmth, rather than their ability to pay their fuel bills.

2.1.16.1 Leaning point

- Fuel poverty is a contributing factor to excess winter deaths, but the relationships between fuel poverty and health are complex. It may be more useful to consider mortality rates in relation to householders being able to maintain an acceptable level of warmth, rather than their ability to pay their fuel bills.

2.1.17 Evidence of households self-rationing and self-disconnecting

This is an area in which there appears to be plenty of anecdotal evidence but little empirical research. Evidence collected for one Scottish study[136] found clear evidence of less well-off

[133] Mould, R., 2016. Fuel Poverty Mitigation and District Heating Systems. Forthcoming PhD thesis, Glasgow Caledonian University.

[134] DECC, 2014. Fuel poverty additional indicators 2014.

[135] Energy Action Scotland, 2015. Fuel Poverty and Health: Increased Winter Mortality.

Healy, J. D., 2003. Excess winter mortality in Europe: a cross country analysis identifying key risk factors: Journal of Epidemiology and Community Health, 57, 784-789.

Kingman, D., 2014. Excess winter deaths not related to fuel poverty, BBC research suggests. Intergenerational Foundation, UK.

[136] CFS, 2013. Changed Lives: The real cost of high fuel bills: The impact of rising energy prices on struggling households in Scotland. Consumer Focus Scotland.

households making energy rationing behaviour changes in response to rising prices, whilst a second[137] found that support services were reporting instances of householders limiting their expenditure on heating (e.g. by spending a set amount on their pre-payment meters), or not using heating at all.

Similarly, a 2012 study of 699 low-income households in the UK found that their primary response to financial constraints was to reduce spending, including spending on essentials such as food and fuel, and thereby keep up with core financial commitments (e.g. rent). Spending on energy was usually reduced by cutting consumption (self-limiting) - sixty-three per cent of low-income households had cut their energy consumption in winter and 47 per cent had experienced cold homes, and the potential burden (perceived or otherwise) of additional fuel costs following an energy efficiency intervention added to the risk of these households being cold[138]. A 2011 study of four cities in New Zealand found that older people fear disconnection and find using prepayment meters stressful[139]. On the other hand, there is evidence from the UK[140] that many low-income consumers prefer prepayment meters because they provide control over limited household budgets and avoid the risk of large bills.

Self-limiting and disconnection is the ultimate behavioural expression of energy inefficiency and fuel poverty, and so it follows that they pose complex problems. The evidence covered by this literature review shows a wide range and variation of influences on energy efficiency and fuel poverty, and supports the need for future studies to better understand the needs of different geographical, social and economic groups, and future policies to be more sensitive to these.

2.1.17.1 Learning points

- Energy rationing behaviours are a direct outcome of householders experiencing financial pressures, and such behaviours are likely to lead to more households not being able to maintain acceptable levels of warmth.

- Self-disconnection is the ultimate expression of energy inefficiency and fuel poverty, and although it is a very real phenomenon, very little research has been done to quantify and understand it, not least because of the difficulties of identifying and engaging with such vulnerable households.

[137] Baker, K.J., Emmanuel, R., & Phillipson, M., 2014. Review of the Energy Assistance Package. Report for the Scottish Government.

[138] Anderson, W., White, V. and Finney, A., 2012. Coping with low incomes and cold homes: Energy Policy, Vol 49, February 2012, pp. 40-52.

[139] O'Sullivan, K.C., Howden-Chapman, P.L., & Fougere, G., 2011. Making the connection: The relationship between fuel poverty, electricity disconnection, and prepayment meters. Energy Policy, Vol 39, (2), 2011, pp. 733-741.

[140] CFS, 2013. Changed Lives: The real cost of high fuel bills: The impact of rising energy prices on struggling households in Scotland. Consumer Focus Scotland

3 Current and previous schemes

Approach

There is a long history of energy efficiency and fuel poverty schemes in the UK. For example, in 1994 the UK became the first country in Europe to introduce obligations on suppliers to save energy at the customer end. To keep this review manageable, it was decided to review the main schemes which have operated since the Carbon Emissions Reduction Target (CERT) was introduced (2008). The review 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; and
- renewable energy schemes

A full list of the schemes included in the review is included in Table 3.1.

The review involved exploring, for each scheme:

- brief programme description;
- funding sources;
- geographic scope;
- dates in operation;
- eligibility criteria;
- scheme-wide criteria;
- any targeting of particular groups? If so, how is eligibility confirmed?;
- key measures supported;
- outputs (type and number of measures installed), including any national or regional breakdowns;
- consumer journey:
    - methods used to engage consumers;
    - delivery approaches (including organisations involved);
    - any additional support to enable consumers with particular needs to benefit;

- inclusion of any advice/support alongside installation;

- approach to quality assurance;
- approach to monitoring and evaluation;
- evidence on value of investment;
- evidence on cost effectiveness;
- evidence on health, social, economic and environmental impacts;
- key strengths identified; and
- limitations identified.

Table 3.1: Schemes included in the review

Supplier Obligations	Other UK-wide energy efficiency schemes	Scotland-specific schemes	UK-wide cash benefits schemes	Renewable energy schemes
Carbon Emissions Reduction Target (CERT) Community Energy Savings Programme (CESP) Energy Company Obligation (ECO)	Green Deal Big Energy Saving Network Warmzone[141]	Home Insulation Scheme (HIS) Universal Home Insulation Scheme (UHIS) Energy Assistance Scheme (EAS) Energy Assistance Package (EAP) Boiler Scrappage Scheme Home Energy Efficiency Programmes for Scotland: Area Based Schemes (HEEPS: ABS) HEEPS: Cashback Scheme Green Homes Cashback Scheme HEEPS: Loans Scheme HEEPS: Warmer Homes Scotland Scheme Scotland's Energy Efficiency Programme (SEEP) Climate Challenge Fund[142] schemes	Warm Home Discount Winter Fuel Payments Cold Weather Payments	Feed-in-Tariffs (FiTs) Renewable Heat Premium Payments (RHPP) Renewable Heat Incentive (RHI) Energy Savings Scotland Home Renewables Grant Home Energy Scotland Renewables Loans Community and Renewables Energy Scheme (CARES)

[141] Most of these were CERT funded but there may be value in treating the Warmzone area-based approach as a sub-category of CERT

In addition to reviewing published reviews and data on the schemes, 15 interviews were conducted with stakeholders from a range of organisations, including Scottish Government, organisations involved in managing or overseeing the delivery of energy efficiency schemes, local authority representatives, an energy company, lobby groups and a representative from the social housing sector.

A summary of the findings of the schemes review is provided below. For each we provide:

1. a brief overview of the scheme;

2. the available data on the distribution of interventions under the scheme;

3. key strengths identified either in the literature on the scheme or in the stakeholder interviews; and

4. key weaknesses identified in the literature or in the stakeholder interviews.

In addition, overarching learning points are drawn out for each of the categories of schemes shown in Table 3.1.

UK-wide supplier obligations

3.1.1 Carbon Emissions Reduction Target (CERT) (2008-2012)

3.1.1.1 Scheme overview

During its operation, CERT was the main driver for improving the energy efficiency of existing households in Great Britain. It placed an obligation on the six major gas and electricity suppliers (British Gas, EDF Energy, E.ON, npower, Scottish Power and SSE) to meet a carbon emissions reduction target.

Although the scheme was not overly prescriptive about the measures that could be employed to deliver the obligation (e.g. in the early years of CERT, very large numbers of energy efficient light bulbs (CFLs) were distributed), insulation measures dominated energy company activity throughout the programme and accounted for just under two-thirds of the total carbon savings achieved. Professionally-installed loft insulation was the most prevalent insulation measure installed, followed by DIY loft insulation and professionally installed cavity wall insulation. Solid wall insulation (mainly external wall insulation) was installed in nearly 60,000 households[143].

CERT made energy efficiency measures available to all consumers but also required a proportion of reductions to come from low-income households, i.e. the Priority Group (PG), which targeted those on certain qualifying benefits.

An extension to the scheme introduced in 2010 included revisions to a number of the obligations. This included:

- introducing a new Super Priority Group (SPG) as a subset of the Priority Group (PG), including those on a more tightly prescribed list of qualifying benefits;

[142] Many of the CCF-funded energy efficiency schemes also utilised CERT funding but the community-based nature of the projects may mean there is value in treating these schemes as a separate sub-category
[143] Ofgem, 2013. The final report of the Carbon Emissions Reduction Target (CERT) 2008-2012

- introducing an Insulation Obligation (IO), requiring a proportion of the target to be delivered via insulation measures; and

- excluding Compact Fluorescent Lamps (CFLs) from the scheme.

Measures were funded by the six main domestic energy suppliers through a levy on household energy bills. Funding for measures was supplemented from a range of sources, including householders, local authorities and housing associations.

The energy suppliers utilised a range of routes for professionally-installed insulation measures, including:

- direct national offers by the energy suppliers, either to all households or their own customer base;

- direct offers by installers and managing agents, often publicised through local advice centres, but also through direct advertising, employee schemes and door knocking;

- offers in conjunction with local authorities, involving local schemes supported and 'badged' by the local authority;

- offers in conjunction with housing associations, involving schemes supported and badged by the housing association;

- offers in conjunction with national government funding schemes, such as Warm Front in England, the Energy Assistance Package in Scotland or the Home Energy Efficiency Scheme in Wales; and

- engagement by lead generation agencies, often involving direct tele-sales or door-to-door knocking to identify eligible customers for the CERT measures. Customer 'leads' were then sold on to the energy companies or installers.

CERT involved a significant amount of area-based delivery of energy efficiency measures, primarily loft and cavity wall insulation. Projects such as 'Warmzones' promoted a multi-agency, area-based approach to CERT delivery, often driven by fuel poverty objectives. Area-based CERT schemes generally involved intensive marketing of energy efficiency offers, endorsed by the local authority, to particular areas or streets that had been identified as being at risk of fuel poverty. Area-based delivery became more problematic during the final delivery phase when the energy companies had to focus on finding and delivering to the SPG.

Traditional marketing methods, such as mail-outs, were not generally effective in reaching vulnerable people. Many delivery stakeholders in both CERT and CESP areas therefore worked with intermediary organisations which knew their target group and/or were more trusted than the energy companies (e.g. the local authority, Age UK, Care and Repair services, the local mosque).

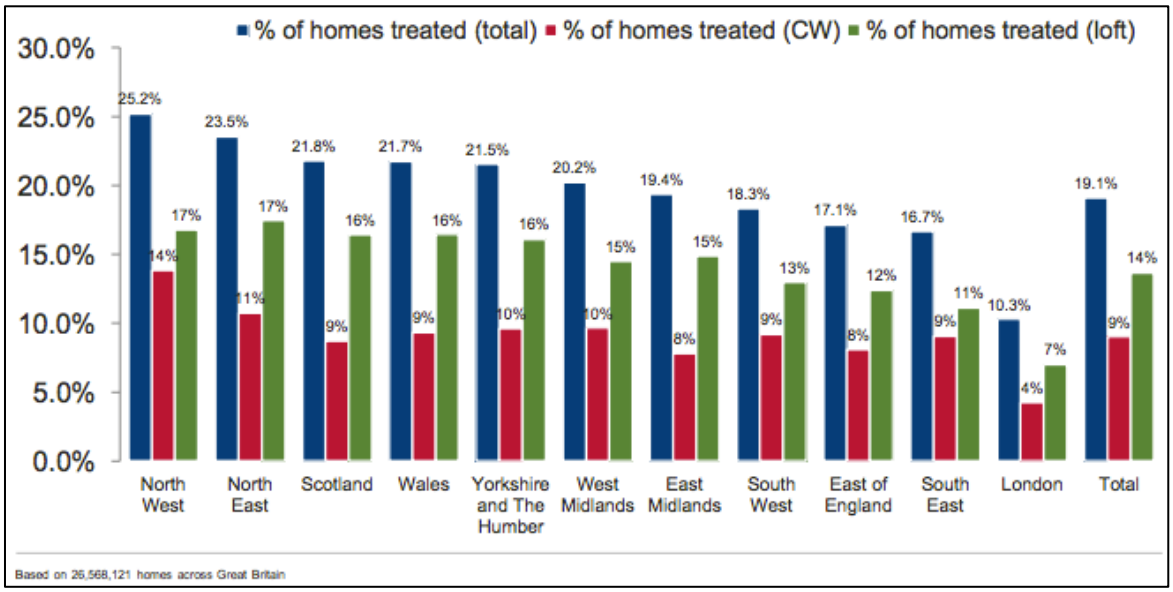
Some schemes included energy advice services and many area-based CERT schemes included benefits checks as part of the package. This was cited in the evaluation of CERT as

having helped to increase the identification and engagement of vulnerable people and generate significant positive impacts for some individuals[144].

3.1.1.2 Distribution of measures

A regional breakdown of the distribution of professionally installed insulation measures is provided in Figure 3.1 below. This shows that the North of England, Scotland and Wales received the highest number of measures as a percentage of total homes. A significant contributor to this will have been the match funding offered by Scottish Government through schemes such as HIS and UHIS.

Figure 3.1: Regional distribution of professionally installed insulation measures under CERT



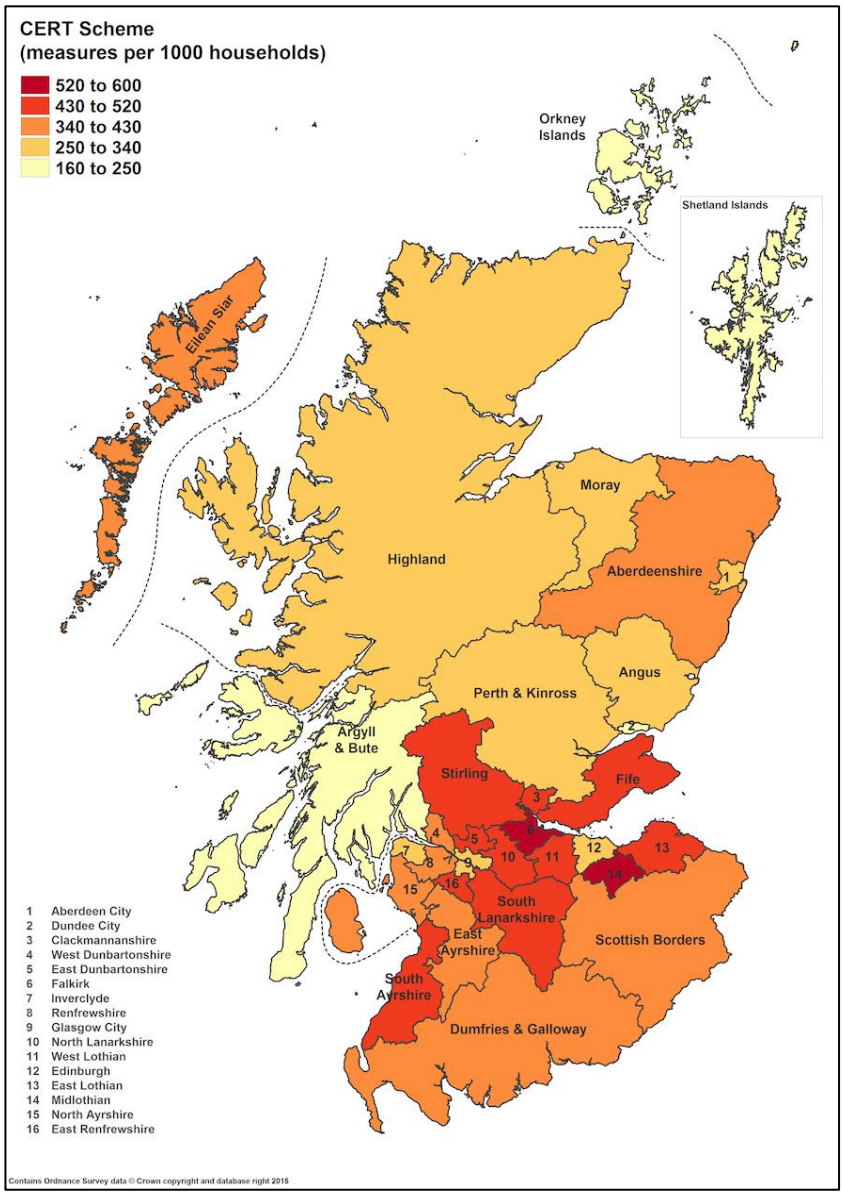
Source: Ipsos MORI, CAG, UCL and EST (2014)

Figure 3.1 shows that within Scotland, delivery of CERT measures was higher in the central and southern areas, although there were exceptions to this. Edinburgh and Glasgow attracted relatively low rates of delivery, most likely due to much of the older housing stock in these areas being unsuitable for basic insulation measures. Eilean Siar and Aberdeenshire attracted higher rates of delivery than other parts of northern Scotland, which points to effective local delivery vehicles being in place in these areas.

Rural areas tended to be neglected under CERT. 82 per cent of households in Great Britain are in urban areas, but 91 per cent of CERT measures were delivered in urban households[145].

[144] Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC
[145] Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC

Figure 3.2: Distribution of total CERT measures in Scotland



Source: Homes Energy Efficiency Database (HEED), Energy Saving Trust

Data from a householder survey carried out as part of the evaluation of the scheme suggests that around a quarter of CERT customers were lifted out of a position of being unable to afford satisfactory heating. However, the evaluation concludes that CERT beneficiaries were often not the neediest; they were more likely to be on higher incomes and less likely to be concerned about their household's financial situation[146].

3.1.1.3 Key strengths identified

- The wide range of measures eligible under the programme was a key factor in the successful reduction of emissions.

- CERT successfully delivered very high volumes of 'quick win' forms of insulation, such as loft and cavity wall insulation, and lighting.

[146] Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC

- Area-based schemes delivered under CERT were particularly effective in securing take-up, and allowed delivery in conjunction with local trusted intermediaries.

- CERT was inclusive, with measures available to all.

- The monitoring and reporting carried out under CERT contributed to a greater understanding of the energy efficiency of the housing stock.

- Deemed carbon savings made the scheme relatively straightforward and cost-effective for the energy companies to administer.

3.1.1.4 Key limitations identified

- The incentive structure in the scheme encouraged delivery of the lowest-cost measures, which in turn resulted in an emphasis on easier to treat properties and properties in more accessible areas. More challenging measures and/or areas were largely side-lined.

- There was an under-representation of the social housing sector and the private rented sector (roughly 90 per cent of beneficiaries were in owner occupied households).

- CERT did not effectively target the neediest households, and efforts to do so (particularly the creation of the SPG) proved expensive and time-consuming to deliver.

- Integration with other funding streams, such as the Energy Assistance Package in Scotland, led to overly complex and inefficient customer journeys.

3.1.2 Community Energy Savings Programme (CESP) (2009-2012)

3.1.2.1 Scheme overview

CESP was designed to improve domestic energy efficiency in the most deprived geographical areas across Great Britain, and to experiment with alternative models of delivery of energy efficiency measures to inform the development of future energy efficiency policy.

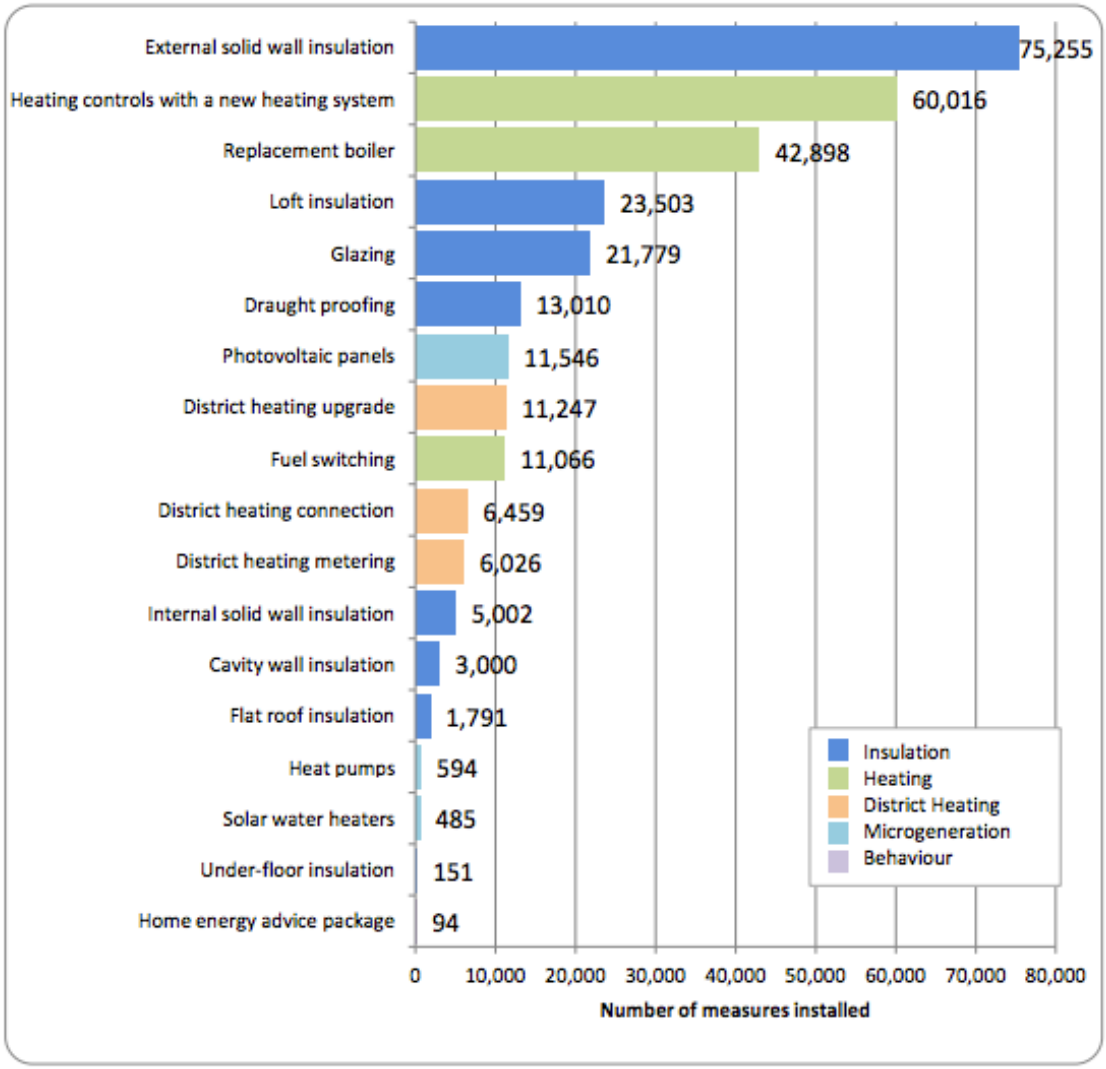
CESP was funded by the six main domestic energy suppliers and the four main energy generators (Drax Power, Eggborough Power, GDF Suez/IPM and Intergen). Carbon emissions reduction targets were set (by Ofgem) for each of the obligated parties based on the number of domestic customers the company had (suppliers) or the amount of electricity it generated (generators).

CESP required that energy saving measures were delivered in geographical areas (Lower Super Output Areas in England and Wales, and Data Zones in Scotland), selected using the Income Domain of the Indices of Multiple Deprivation (IMD) in England, Scotland and Wales. In England the lowest 10 per cent of areas ranked in the IMD qualified and in Scotland and Wales the lowest 15 per cent qualified.

CESP was structured to incentivise the energy companies to install particular measures, and to undertake as much activity as possible in each house treated and in each area targeted.

External solid wall insulation was the most commonly installed measure, as shown in Figure 3.3 below.

Figure 3.3: Breakdown of measures installed under CESP



Source: Ofgem (2014)

Almost all CESP measures were delivered through partnerships with housing associations or by direct promotion to private households, particularly privately owned homes within social housing developments[147].

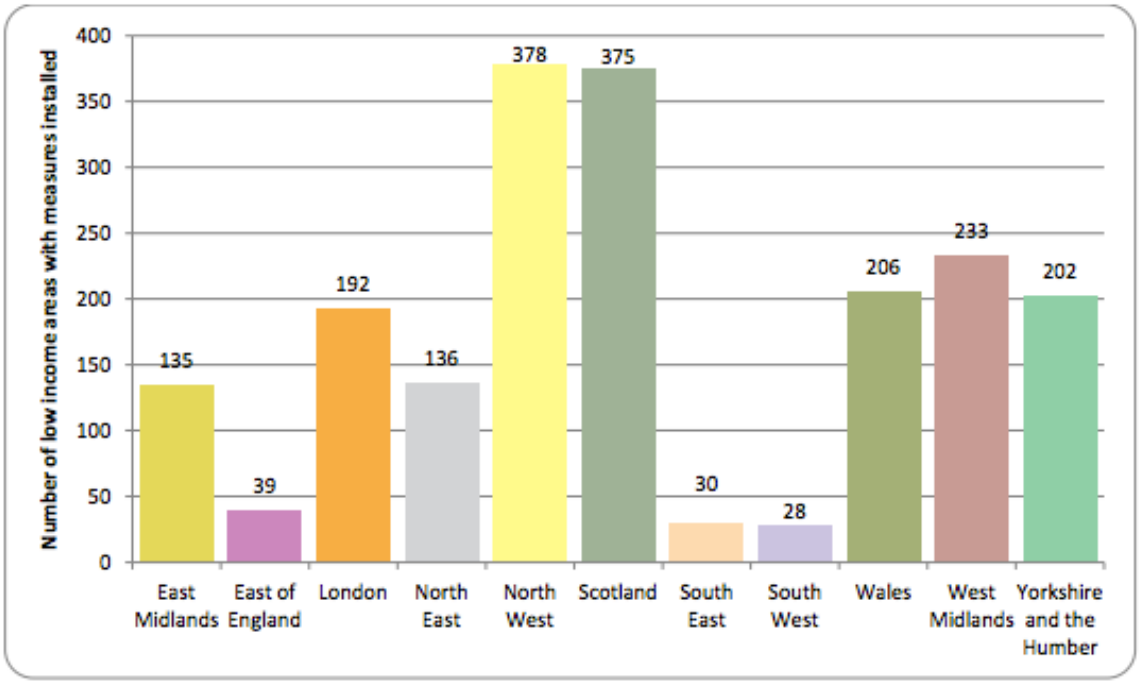
A variety of methods were used to find and engage vulnerable customers: using intermediary organisations; managers or liaison officers on the ground; using referrals from local authorities and health services; running advice services embedded in communities; or offering benefit checks as part of packages to households. In the evaluation, many stakeholders commented that the high visibility of CESP measures (particularly external wall insulation) helped strengthen the success of area-based marketing. Demonstration homes were also used to seek householder buy-in to schemes[148].

3.1.2.2 Distribution of measures

Whilst Scotland received a relatively high number of schemes, as shown in Figure 3.4 below, Figure 3.5 shows that this was not a high number when the proportion of eligible areas is taken into account.

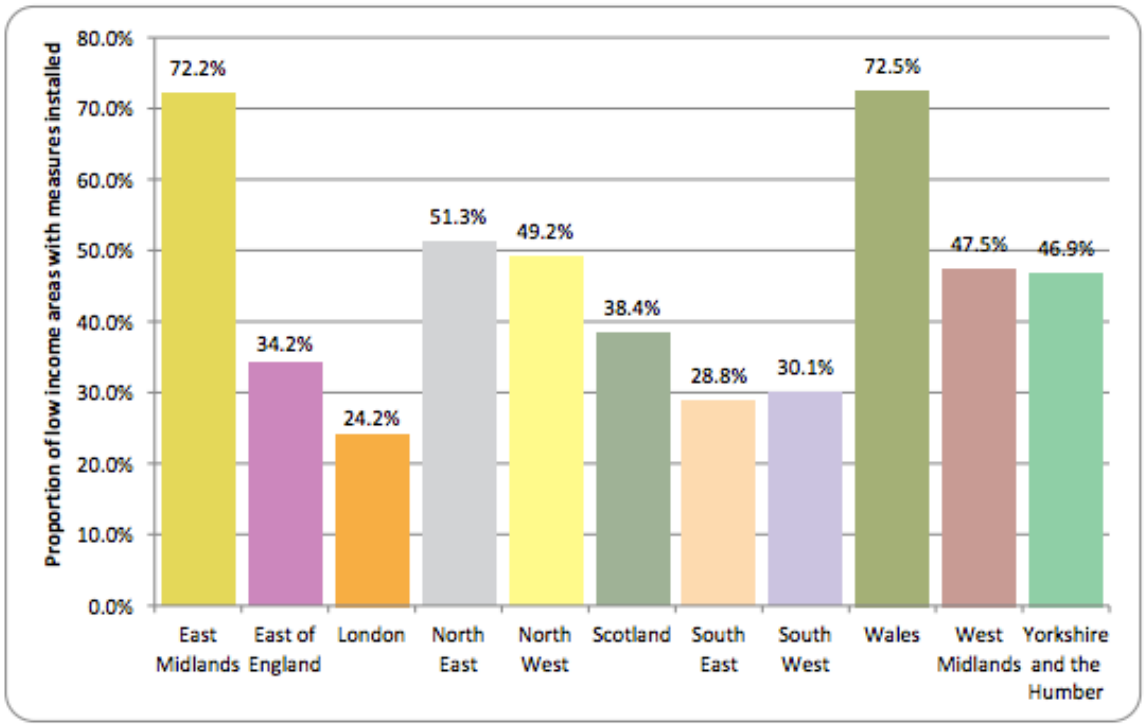
[147] Ofgem (2013) The final report of the Community Energy Saving Programme (CESP) 2009-2012
[148] Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC

Figure 3.4: Number of low income areas with measures installed under CESP, by region



Source: Ofgem (2014)

Figure 3.5: Proportion of low income areas with measures installed under CESP, by region

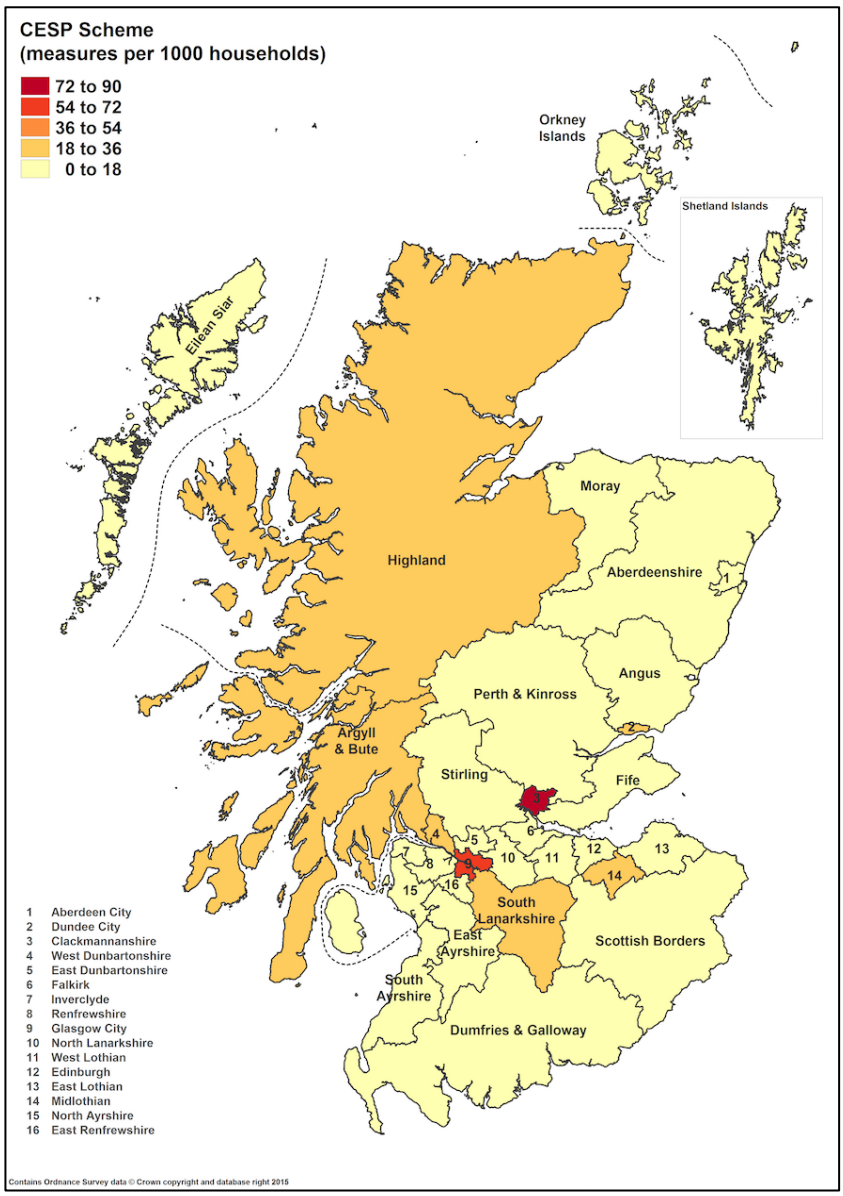


Source: Ofgem, 2014

The relatively small number of CESP schemes which were delivered in Scotland means that there is no clear pattern in the distribution of measures. Figure 3.6 shows that a small number of local authority areas attracted higher rates of delivery, with Glasgow City and Clackmannanshire achieving the highest rates. If more disaggregated analysis of the geographic distribution of CESP were possible, this is likely to show a bias towards urban

areas. The incentive structure within the scheme meant that energy suppliers tended to pursue schemes within larger social housing developments.

Figure 3.6: Distribution of total CESP measures in Scotland



Source: HEED

It is difficult to assess whether CESP was an effective programme for targeting vulnerable customers as no monitoring took place of household demographics. However, the evaluation found incidences of fuel poverty in CESP-eligible areas were higher than in other areas and the deprivation eligibility criteria (albeit at a neighbourhood, and not address, level) did target activity in areas of higher deprivation. Over half of customers in three of the four evaluation case study areas had a gross annual household income of less than £16,000, suggesting that many on low incomes were reached by the programme[149]. No evidence is available on the scheme's success in reducing fuel poverty.

[149] Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC

3.1.2.3 Key strengths identified

- CESP was particularly effective in incentivising the treatment of properties of solid and non-traditional wall construction.
- Incentives for district heating measures drove an expansion in district heating uptake.
- A significant regeneration impact of external wall insulation schemes was identified in the evaluation of the scheme, as summarised in Section 2.1.13 [150].

3.1.2.4 Key limitations identified

- The scheme targets were not met. There was a shortfall of 2.94 Mt CO2 or 15.3 per cent of the overall target[151]. The generators, who had not previously been obligated, found it particularly difficult to deliver their requirements.
- The costs incurred by obligated parties associated with the delivery of CESP were substantially higher than anticipated, and average cost per tonne of CO2 were some 2.5 times higher than for CERT[152].
- The scheme was considered to be overly complex and burdensome to deliver by some of the obligated parties.
- The resulting size of individual schemes was smaller than intended – the areas bonus offered was not particularly effective in incentivising whole-area schemes.
- The whole house approach was largely not achieved – an average of just under 2 measures per house was achieved[153].
- The boundaries of eligible low income areas were often not in line with those of communities and estates.
- The complexity of ownership arrangements (e.g. multiple social landlords) inhibited scheme development.
- Uncertainties over house construction made schemes difficult to manage, e.g. if a house ended up with CWI rather than SWI, that had a massive impact on the deemed carbon savings, and therefore the value of the scheme to the supplier.
- There were significant technical challenges in the scoring of measures, particularly for SWI and district heating measures.

3.1.3 Energy Company Obligation (ECO) (2013-2015)

3.1.3.1 Scheme overview

The ECO was a UK Government scheme to obligate larger energy suppliers to deliver energy efficiency measures to domestic premises in Britain. There were three main obligations under the ECO:

[150] Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC.
[151] Ofgem, 2013. The final report of the Community Energy Saving Programme (CESP) 2009-2012
[152] Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC.
[153] Ofgem, 2013. The final report of the Community Energy Saving Programme (CESP) 2009-2012

- the Carbon Emissions Reduction Obligation (CERO), focused primarily on the installation of insulation measures in hard-to-treat properties;

- the Carbon Saving Community Obligation (CSCO), focused on low income areas. Unlike in CESP, some flexibility was allowed. Adjoining areas, which shared a border with an area of low income could also be included; and

- the Home Heating Cost Reduction Obligation (HHCRO) (also known as 'Affordable Warmth'), focused on reducing heating costs for consumers on certain types of benefits as a way of targeting vulnerable households.

In addition, CSCO had a sub-obligation focused on rural areas (the CSCO rural sub-obligation). 15 per cent of the CSCO had to be delivered in rural areas to consumers on certain types of benefits.

The scheme was modified over time. In December 2013:

- the CERO target was reduced by 33 per cent;

- the eligibility for CSCO was extended from 15 per cent to 25 per cent of the lowest income areas on the Index of Multiple Deprivation;

- the qualifying criteria for the rural sub-obligation was simplified; and

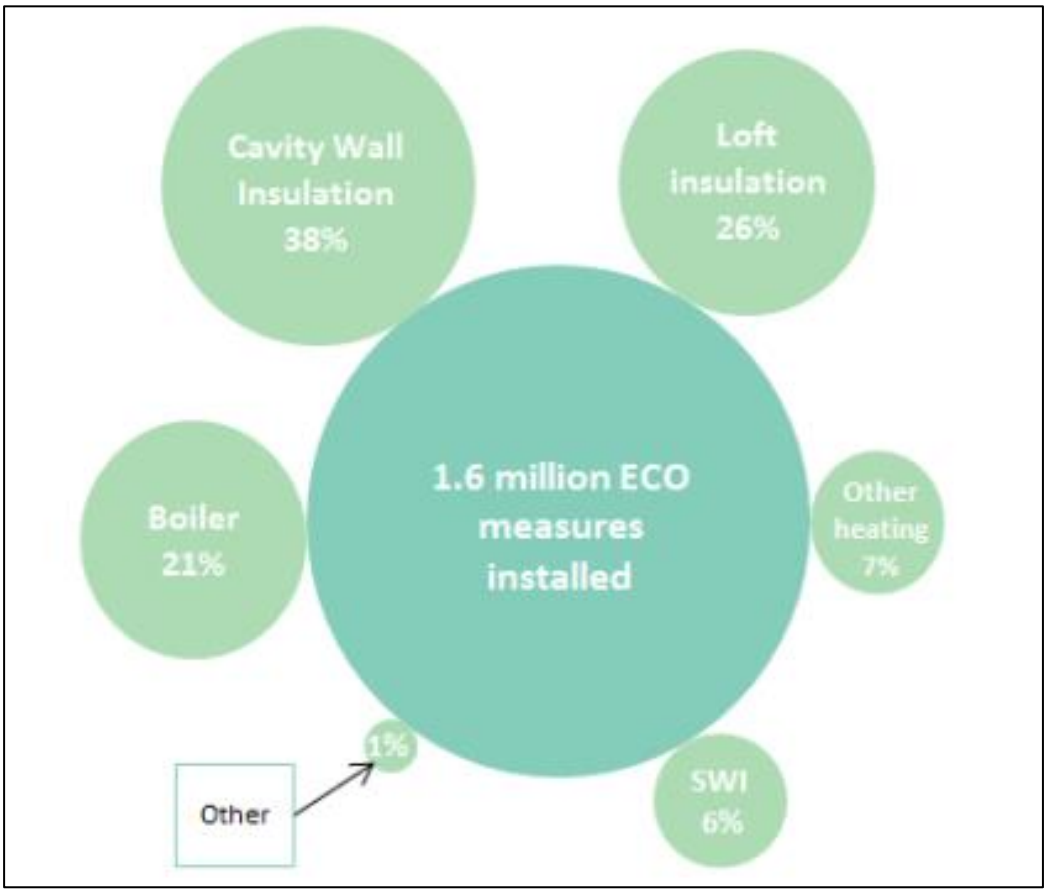
- roof insulation (loft insulation as well as room-in-roof insulation, flat roof insulation and rafter insulation), standard cavity wall insulation and connections to district heating systems (DHS) were added as primary measures in CERO.

ECO was originally designed to work alongside the Green Deal, with the Green Deal providing a finance mechanism to allow able-to-pay households to pay for or subsidise the cost of measures.

The obligated energy suppliers under ECO were British Gas, The Cooperative Energy, EDF Energy, E.ON, First Utility, npower, Scottish Power, SSE and Utility Warehouse.

Overall, the most frequently installed measure type under ECO was cavity wall insulation (including hard-to-treat cavity wall insulation), followed by loft insulation and boiler replacements (see Figure 3.7).

Figure 3.7: Breakdown of measures delivered under ECO up to end of Oct 2015



Source: Ofgem, 2015

Energy companies adopted a variety of approaches to engage households. Some were engaged directly but, most commonly, the energy companies contracted this work to installers or managing agents that arranged and/or carried out installations (potentially involving intermediary organisations such as social housing providers)[154].

According to DECC[155], around a third of all households (32 per cent) had been introduced to ECO via a door-to-door sale (someone had called at their property). Other approaches that households had experienced included: telephone calls (5 per cent of households), or being approached by a salesperson in the street or in a shop (3 per cent). A further 11 per cent of households were introduced to ECO via a leaflet or a letter in the post. Some 13 per cent of households reported that they had been informed about ECO by their landlord, local authority or housing association.

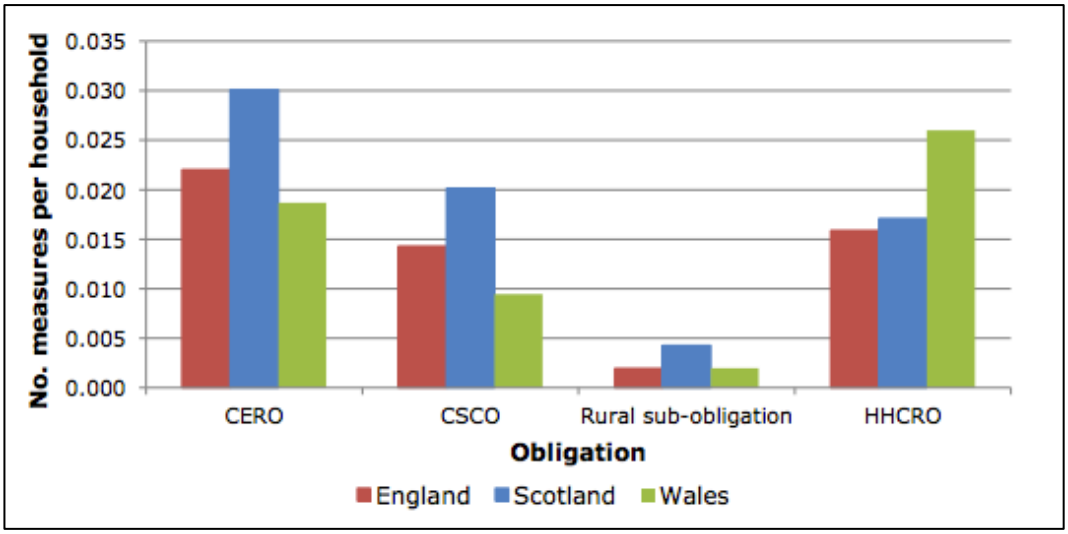
Energy companies could also use another mechanism called 'brokerage'. Brokerage was a blind auction platform developed by DECC where installers could sell 'lots' of measures they would then be contracted to deliver to energy companies in return for funding. This system was created in response to requests from the energy efficiency industry to help smaller and newer installers access the market and to facilitate blending of finance with the Green Deal. 13 per cent of measures were delivered through this mechanism[156].

[154] Ofgem, 2015. Energy Companies Obligation Final Report
[155] DECC, 2014. Summary of findings of research with households that received ECO-funded installations in September 2013
[156] Ofgem, 2015. Energy Companies Obligation Final Report

3.1.3.2 Distribution of measures

As shown in Figure 3.8, a greater number of measures per household were delivered in Scotland for CERO and CSCO than in England or Wales. A greater number of measures per household were delivered in Wales for HHCRO than in England or Scotland. Ofgem suggest that this is likely due to funding made available by the devolved Governments which could be claimed alongside ECO funding[157].

Figure 3.8: Distribution of ECO measures by nation

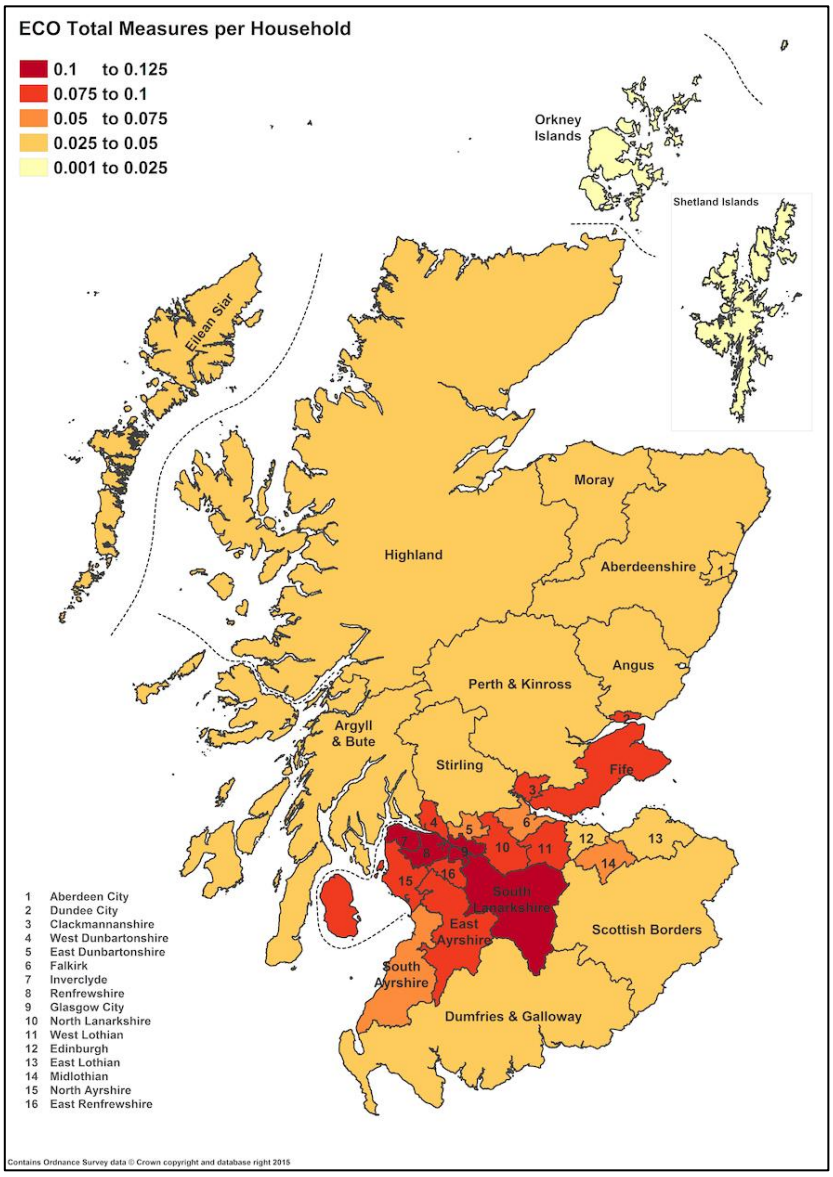


Source: Ofgem, 2015

ECO measures were concentrated on the central belt, as shown in Figure 3.9 below.

[157] Ofgem, 2015. Energy Companies Obligation Final Report

Figure 3.9: Distribution of ECO measures in Scotland



Source: HEED

There were variations in terms of the distribution of individual measures. Solid wall insulation was installed more widely in Scotland and Wales (25 per cent and 22 per cent of CERO measures respectively) than in England where only 9 per cent of CERO measures were solid wall insulation[158].

Up to September 2015, around 90 per cent of ECO measures were installed in properties that used gas as their main fuel type (1,430,068 measures). However this has steadily decreased from 97 per cent in the first quarter of ECO to just 85 per cent in Q3 2015, probably due to the later rise in installations under the rural sub-obligation[159].

According to DECC[160], most ECO households (76 per cent) were owner occupiers and the remaining households were private renters or social tenants (17 per cent and 7 per cent,

[158] Ofgem, 2015. Energy Companies Obligation Final Report.
[159] Ibid.
[160] DECC, 2014. Summary of findings of research with households that received ECO-funded installations in September 2013

respectively). A quarter of households that received installations under Affordable Warmth (25 per cent) lived in private rented accommodation.

3.1.3.3 Key strengths identified

- Every energy company exceeded all of their ECO obligations and sub-obligations[161].
- The brokerage system reportedly made it easier for newer obligated parties[162].
- Costs of delivery were near to Government estimates in the Impact Assessment, although this was in part due to the much lower level of delivery of solid wall insulation than was anticipated in the Impact Assessment[163].
- CSE's early analysis[164] of distribution of measures against the English, Welsh and Scottish indices of multiple deprivation (specifically, income deprivation) found that, in general, proportionally more households in the most deprived areas were receiving measures, when measures from all the ECO strands are added together. They suggested that the policy was more progressive overall than CERT was.

3.1.3.4 Key limitations identified

- ECO did not continue the rise in the installation rates (started in CESP) of solid wall insulation because the suppliers opted, in many cases, for lower cost measures, particularly cavity wall insulation. This contributed to the low demand for Green Deal finance.
- Activity under the HHCRO / Affordable Warmth strand which targets low income households focused on replacing boilers in urban, gas-heated homes, leaving rural households disadvantaged[165].
- The costs and administrative burden of the scheme were seen by the energy companies and the wider supply chain to be excessively high, particularly in the early part of the scheme. This was caused by the precise eligibility criteria and onerous reporting requirements, including energy assessments before and after measures. CSE suggest that for low cost measures like loft and standard cavity wall insulation, the total cost of assessment and reporting may in some cases exceed that of the measure[166].
- Ofgem reported that several issues were identified throughout ECO which raised concerns over the quality of installations. They suggest that there was an improvement in technical monitoring and audit rates throughout the scheme[167].

3.1.4 Energy Company Obligation 2 (ECO2) (2015-2017)

3.1.4.1 Scheme overview

In December 2014 legislation was introduced for a new ECO obligation (referred to as ECO2). It included:

- extending the scheme to 2017;

[161] Ofgem, 2015. Energy Companies Obligation Final Report
[162] CSE, 2014. The ECO: an evaluation of year 1, for Energy UK
[163] Ofgem, 2015. Energy Companies Obligation Final Report
[164] CSE, 2014. The ECO: an evaluation of year 1, for Energy UK
[165] Ofgem, 2015. Energy Companies Obligation Final Report
[166] CSE, 2014. The ECO: an evaluation of year 1, for Energy UK
[167] Ofgem, 2015. Energy Companies Obligation Final Report

- allowing energy companies to carry forward the majority of savings that were not needed to achieve their obligations under ECO towards their ECO2 obligations (referred to as surplus actions);

- introducing a provisional solid wall minimum requirement (PSWMR) of 4 MtCO2 carbon savings to be achieved across all energy companies between January 2013 and March 2017 (i.e. ECO 1 and 2), equivalent to approximately 100,000 solid wall insulation measures; and

- making changes to HHCRO including:

    - introducing uplifts in the cost savings for qualifying boiler replacements and measures delivered to non-gas premises

    - repair and replacement of qualifying electric storage heaters as a new measure, and

    - minimum warranty requirements for replacement boilers and electric storage heaters.

The obligated energy suppliers under ECO 2 were British Gas, The Cooperative Energy, EDF Energy, E.ON, First Utility, npower, Scottish Power, SSE, Utility Warehouse, Ovo Energy and Utilita.

Under ECO 2, cavity wall insulation, loft insulation and boiler replacements remain the most commonly installed measures, but there has been a significant increase in solid wall insulation since ECO. The latest outputs, taken from the DECC website, are in Table 3.2.

Table 3.2: Breakdown of measures installed under ECO 2

Measure category	CERO	CSCO	HHCRO	Cumulative total
Solid wall insulation	11,383	7,532	1	18,916
Park home external wall insulation	-	-	-	-
Cavity wall insulation	60,268	20,509	924	81,701
Loft insulation	36,427	11,111	962	48,500
Other insulation	565	1,826	25	2,416
Boiler replacement	N/A*	N/A	46,097	46,097
Boiler repair	N/A	N/A	-	-
Electric storage heater	N/A	N/A	137	137
Other heating**	N/A	N/A	25,769	20,810
District heating system	1,280	3,975	-	5,255
Micro-generation	N/A	N/A	-	-
Total	109,923	44,953	73,915	228,791

Source: www.ofgem.gov.uk

3.1.4.2 Distribution of measures

The distribution of measures across England, Scotland and Wales is shown in Table 3.3. Given that Scotland has approximately 9 per cent of GB households, it has secured a disproportionately high share of measures under each of the obligations except for the Affordable Warmth obligation. Since the latter obligation is targeted at low income households, it is unusual that Scotland has secured a low share of it, given the higher percentage of low income households in the country. The reasons for this are unclear. Solid Wall Insulation installations have been particularly high, relative to the rest of GB.

Table 3.3: National distribution of measures under ECO 2

Obligation category	% in England	% in Scotland	% in Wales
CERO	81.93	14.09	3.97
CSCO	80.17	16.56	3.27
CSCO Rural	72.85	22.10	5.05
HHCRO	86.37	6.18	7.45
PSWMR	65.20	27.14	7.66

Source: www.ofgem.gov.uk

No further geographic breakdowns of installation rates are available yet.

3.1.4.3 Key strengths identified

- The extension of the ECO scheme provided the energy companies with enough assurance for them to continue delivery, even after they had achieved their obligations under ECO.
- ECO2 has resulted in a significant boost to solid wall insulation.

3.1.4.4 Key limitations identified

- Lower cost measures (cavity wall insulation, loft insulation and boiler replacements) continue to dominate delivery.
- Scottish stakeholders continue to report difficulties in attracting ECO funding beyond the main urban areas.

3.1.5 Learning points from the UK-wide supplier obligations

- Defining the obligation in terms of outcomes, rather than providing fixed sums of money, incentivises low-cost delivery.
- The obligations have successfully delivered very high volumes of ‘quick win’ forms of insulation, such as loft and cavity wall insulation, and lighting.
- Area-based schemes delivered under the obligations have been particularly effective in securing take-up.

- The primary focus on carbon outcomes, coupled with the incentives for low-cost delivery, has limited the impact of the obligations on rates of fuel poverty.

- Adjustments to the obligations over time have allowed them to adapt to changing and/or unforeseen circumstances.

- Sudden and more major changes to the obligations have led to significant uncertainty, which has considerably undermined the supply chain on a number of occasions.

- There is a trade-off between being prescriptive about scheme requirements and the level of risk which is taken in terms of how the scheme will then be delivered. A particular challenge has been in targeting those most in need in such a way that it does not lead to an undue increase in the costs of delivery.

Other UK-wide energy efficiency and fuel poverty schemes

3.1.6 Green Deal (2013-2015)

3.1.6.1 Scheme overview

The Green Deal was intended as a long-term initiative designed to upgrade the energy efficiency of Britain's properties. It was designed to let householders and businesses pay towards the cost of energy-saving improvements to their properties, over time, through savings on their energy bills.

For those most in need and for properties that are harder to treat, extra help could be accessed through the Energy Company Obligation (ECO).

The beneficiary paid back the money through a payment attached to their energy bill, which was cancelled out by the saving made on the bill by the new measures. The loan remained attached to the property, with the duty of paying back the loan falling on whoever pays the bills for the property.

The measures designed to be supported were those that would save the most energy, such as:

- insulation, e.g. solid wall, cavity wall or loft insulation;

- heating;

- draught-proofing;

- double glazing; and

- renewable energy generation, e.g. solar panels or heat pumps.

The total number of measures installed using Green Deal finance was 20,347 up to the end of October 2015. Of these:

- 31 per cent were boilers;

- 29 per cent were PV; and

- 15 per cent were solid wall insulation[168].

In July 2015, DECC announced that there will be no further public funding for the Green Deal Finance Company (GDFC), effectively signalling the end of Green Deal. However, it should be noted that the Green Deal mechanism still exists. If another offer of finance were to be made (whether through the Green Deal Finance Company raising private finance, or another body such as stepping in with an offer), the process of collecting payments through electricity bills could still be used.

3.1.6.2 Distribution of measures

No national or regional breakdown of measures is available. A breakdown is provided of the 626 Green Deal plans which were 'live' (measures were installed, billing had commenced) by the end of 2013 (more recent statistical releases include a breakdown by nation) showed that:

- more than half of Green Deal Plans with measures installed were for properties in Scotland (348 Plans);
- 43 per cent were for properties in England (270 Plans); and
- 1 per cent were for properties in Wales (eight Plans)[169].

The relatively high numbers of Green Deal Plans in Scotland was linked to the requirement for these to be produced as part of accessing other Scotland-specific schemes.

3.1.6.3 Key strengths identified

- Alleviated the need for large upfront payments for energy-efficiency installations. As such it was intended to have little long-term impact on government spending. The "golden rule" was intended to ensure that loan repayments do not exceed energy bill savings (though no guarantee was offered that the charge would be fully offset by the savings; this would have been impractical due in part to the effect of householder behaviour on energy consumption).
- The principle of 'pay-as-you-save' is likely to be important for future funding of energy efficiency measures.
- Some stakeholders suggested that the accreditation process set up for the Green Deal had the potential to drive up standards within the industry.

3.1.6.4 Key limitations identified

- Low take-up and concerns about industry standards led to the scheme being dropped.
- Key factors behind the low take-up were:
    - concerns about high interest rates (higher than the rate somebody would generally pay if they extended their mortgage);
    - the costs associated with the Green Deal process;

[168] DECC, 2015. Domestic Green Deal and Energy Company Obligation in Great Britain, Headline Report, Statistical release, November 2015
[169] DECC, 2014. Domestic Green Deal, Energy Company Obligation and Insulation Levels in Great Britain, Quarterly report.

- official rulings by the Advertising Standards Authority which pointed out that households were not guaranteed to save money[170]; and

- a fear that home buyers may insist that a seller covers the remaining cost of any Green Deal plan before selling, which could have resulted in severe financial penalties, as providers were allowed to charge a substantial fee for early repayment.

- The House of Commons Energy and Climate Change Committee found that the Green Deal had caused frustration and confusion for both consumers and businesses in the supply chain[171].

- The Committee also suggested that the benefits of the Green Deal's market-based approach and of the pay-as-you-save model had been undermined by the fact that the scheme lacked flexibility and clarity, with frequent changes to both the Green Deal and ECO creating uncertainty and insecurity[172].

- Stakeholders queried the extent of enforcement of the accreditation rules within the system and suggested that the process for consumer redress was too onerous.

- Green Deal-related scams were widely reported in the press and led to official warnings being made about the Green Deal name being used to defraud householders[173].

3.1.7 Big Energy Saving Network (BESN) (2013-2016)

3.1.7.1 Scheme overview

BESN is a UK Government grant programme which supports the delivery of outreach work by community organisations (including CAB), targeting vulnerable energy consumers (those least likely to engage in the energy market, e.g. due to their financial situation, access to information, poor health or disability, levels of literacy, geography, or age) over the winter months (October-March). No physical measures are delivered directly. Although the advice includes signposting to energy companies for support through ECO, its main focus is on tariff switching.

The Government is spending approximately £3m over the three years of the scheme. Local organisations bid for funding to take part. A 'cascade' model is used - funding supports the training of champions (by National Energy Action) who then in turn train volunteers, who in turn deliver advice to consumers. 94 champions, one from each participating organisation, were trained in 2013-14[174].

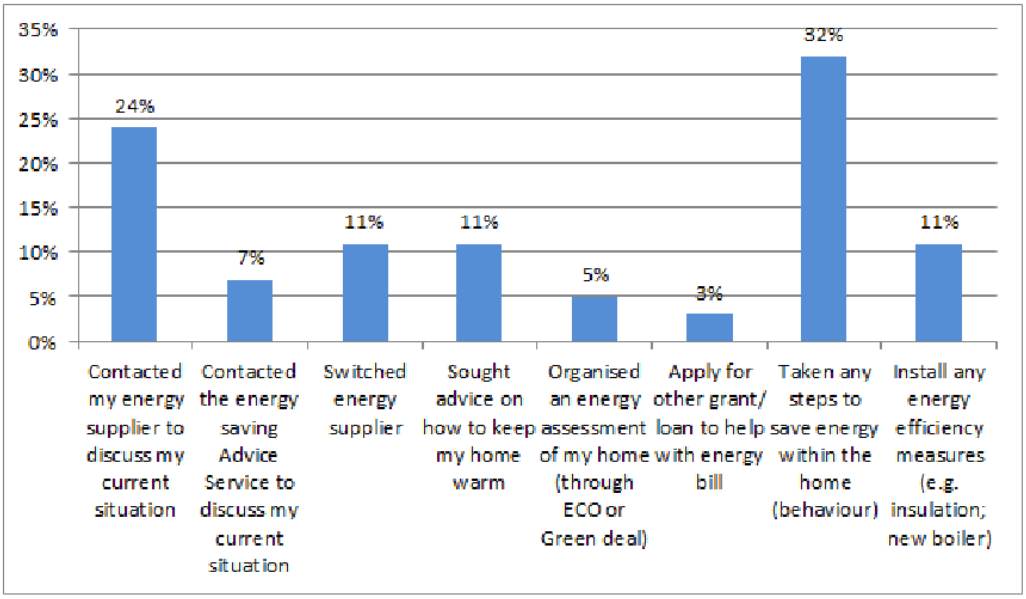
Primarily, consumers were reached through events, although the majority of those were mainstream advice events onto which energy advice was then added. Advice from frontline workers and one-to-one visits were found to be more effective at reaching the most vulnerable groups. Workshops were less good at reaching those for whom English was not their first

[170] https://www.asa.org.uk/Rulings/Adjudications/2014/5/The-Green-Deal-Finance-Company-Ltd/SHP_ADJ_247637.aspx#.Vw5NGhMrKHo
[171] House of Commons Energy and Climate Change Committee, 2014. Green Deal, a watching brief, Third report of session 2014-15.
[172] House of Commons Energy and Climate Change Committee, 2014. Green Deal, a watching brief, Third report of session 2014-15.
[173] See, for example, http://www.actionfraud.police.uk/green-deal-scam-apr13
[174] Sheffield Hallam University, 2015. Evaluation of the Big Energy Saving Network: Final Report, for DECC

language and those with serious health concerns. Outside of workshops, the main delivery route was through raising awareness of frontline workers[175].

Outcomes depend on actions taken by consumers. The evaluation of year 1 included an analysis of actions taken by workshop participants following involvement in BESN - Figure 3.10.

Figure 3.10: Actions taken by workshop participants following involvement in BESN



Base: 400 consumers respondents of a total population of approximately 16,000 consumers

Source: Sheffield Hallam University, 2015

220,000 consumers were assisted over the first two years of BESN, of which one third reported that they took action, and half say they are now paying less as a result of engagement. However, the evaluation notes that the process of interviewing consumers is subject to bias; those contacted who could not remember taking part were excluded from the sample, and this was one third of the telephone survey group. These beneficiaries were ignored, rather than coded as not taking action, in the evaluation[176].

3.1.7.2 Distribution

No geographical breakdown of beneficiaries is available.

The year 1 evaluation[177] included analysis at an organisational level, which revealed that certain organisations were particularly effective in engaging more of certain types of vulnerable consumers, including:

- national charities, Rural Community Councils and social housing providers, engaged more of those aged over 65 than other organisations;
- Rural Community Councils were better at reaching those off the gas grid;
- national charities reached greater numbers with disabilities;

[175] Ibid.
[176] Sheffield Hallam University, 2015. Evaluation of the Big Energy Saving Network: Final Report, for DECC
[177] Ibid.

- local charities, a national advice organisation and social housing providers performed better at reaching benefits claimants; and

- Development Trusts, national advice organisations and social housing providers were better at reaching those on pre-payment meters.

BESN workshops were successful in reaching a range of vulnerable groups including: those aged over 65; households with dependent children, those without access to gas and those without internet access. On the other hand, a comparison of the monitoring data obtained through workshops against national statistics reveal that overall BESN may have been less successful in reaching those claiming or entitled to means tested benefits and those with disabilities, mobility difficulties, chronic illnesses, those without previous experience of switching and those on pre-payment meters.

3.1.7.3 Key strengths identified

- The scheme appears to have been effective at reaching consumers.

- Lessons can be drawn from the scheme for the specific trusted intermediaries which will be successful at reaching specific different vulnerable groups.

- Working with trusted intermediaries allowed BESN events to be piggybacked onto mainstream advice events, increasing the reach – energy-only events were poorly attended[178].

- The focus on how individual consumers could benefit (as opposed to generic benefits) helped to increase impact[179].

3.1.7.4 Key limitations identified

- Overall outcomes are less clear and subject to bias from both excluding those who didn't remember taking part (hence less likely to have done anything) and those who self selected to respond when contacted to take part, and were perhaps more likely to have remembered a positive experience. Plus, outcomes are based on responses, rather than observed evidence.

- Some evidence that those participating were more engaged (switching rates over previous 2 years) than had been anticipated, and not significantly different from the population as a whole[180].

3.1.8 Learning points from other UK-wide energy efficiency and fuel poverty schemes

- The 'pay-as-you-save' principle embodied within the Green Deal may be important for future delivery of energy efficiency interventions. However, the finance package on offer needs to be competitive with mainstream finance offers available, up-front assessment costs may need to be avoided, flexibility for early repayment without penalty needs to be included and the overall scheme needs to be kept as simple as possible so that there is clarity for consumers.

[178] Ibid.
[179] Ibid.
[180] Ibid.

- An accreditation process such as that created by the Green Deal could drive up standards within the industry but stricter enforcement may be necessary and consumer redress made more straightforward.

- The BESN highlights the importance of working with trusted intermediaries and adopting personal and individualised approaches in order to engage vulnerable consumers.

Scotland-specific energy efficiency and fuel poverty schemes

3.1.9 Home Insulation Scheme (HIS) (2009-2011)

3.1.9.1 Scheme overview

HIS was an area-based scheme, which involved promoting and installing free or discounted loft and cavity wall insulation and other energy saving measures. The scheme sought to:

- overcome the limited take-up of conventional insulation measures in the privately owned/rented sector through doorstep advocacy; and

- maximise the economies of scale offered by such an approach, thereby increasing the attractiveness of CERT investment in Scotland for energy suppliers.

The latter issue was significant because of the historically low levels of supplier obligation spending in Scotland.

It was managed by the Energy Saving Trust (EST) and backed by the Scottish Government, with additional funding from local authorities, housing associations and energy companies (CERT).

Areas covered by the scheme were chosen according to criteria including levels of fuel poverty and emissions, the potential number of treatable houses and the potential for complementary funding.

HIS used teams of assessors to carry out doorstep visits to all homes in each HIS area. Prior to the doorstep assessments commencing, intensive marketing was carried out in each area, with some additional local marketing by the delivery partners.

The assessors sought to carry out basic Home Energy Checks to provide all homes with: energy efficiency advice; energy audits, including assessment of the need for insulation measures; and access to benefits advice and a social tariff check. HIS provided free top up loft insulation for all households and enabled households to access CERT funding for virgin loft and/or cavity wall insulation.

In addition, households which were in fuel poverty were referred to the Energy Assistance Package (EAP).

HIS also included an enabling fund which paid for requirements such as loft clearances or scaffolding which were not available under CERT.

The outputs from the scheme are shown in Table 3.4.

Table 3.4: Outputs from HIS

Measure	Number
Loft – virgin	2,813
Loft – top-up	21,576
Cavity wall	4,631

Source: Energy Saving Trust, 2013

3.1.9.2 Distribution of measures

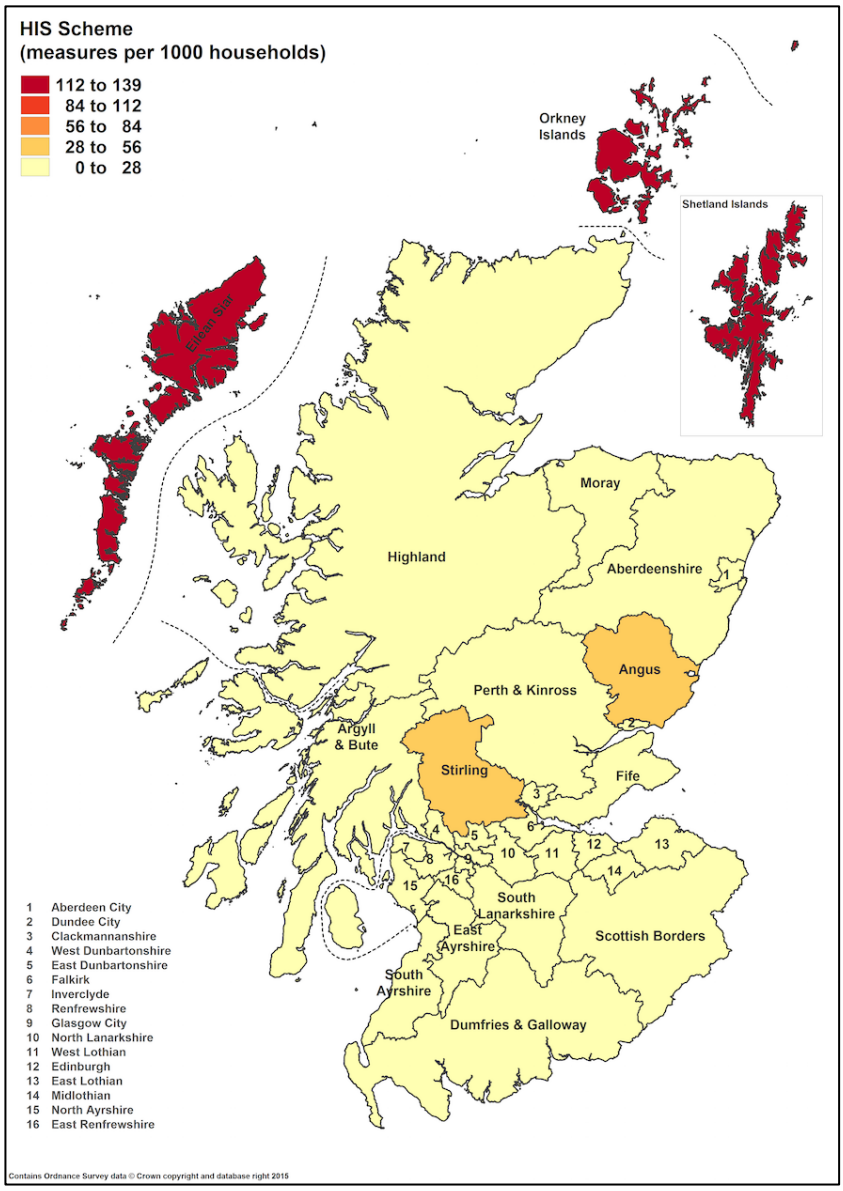
Local authorities were invited to nominate areas for inclusion in the scheme. Schemes were delivered across Scotland. Ten areas, covering a total of 99,283 households, were selected for inclusion in the scheme in 2009/10:

- 19,834 homes in Stirling;
- 13,672 homes in Glasgow;
- 13,133 homes in Edinburgh;
- 13,071 homes in Angus;
- 10,591 homes in Eilean Siar; and
- 9,212 homes in Dundee;
- 8,975 homes in Highland;
- 8,955 homes in Fife;
- 1,453 homes in South Lanarkshire;
- 387 homes in Orkney[181].

In proportion to the number of households, delivery of HIS was biased towards the Northern and Western Isles, as shown in Figure 3.11.

[181] CAG Consultants, 2010. Review of area-based energy efficiency initiatives in Scotland: Final report, for Consumer Focus Scotland

Figure 3.11: Distribution of measures delivered under HIS



Source: HEED

HIS subsidised transport and storage costs for schemes in island areas.

3.1.9.3 Key strengths identified

- Some limited success in leveraging CERT funding – estimated at £2.2m, from a Scottish Government spend of £24.4m[182].
- Intensive area-based marketing campaigns increased take-up rates[183].
- Integration with the Energy Assistance Package increased the reach and depth of the outreach[184].

[182] EST, 2013. Home Energy Programmes Summary Report 2009/2013
[183] CAG Consultants, 2010. Review of area-based energy efficiency initiatives in Scotland: Final report, for Consumer Focus Scotland
[184] Ibid.

- Free top-up insulation and the enabling fund together meant that a wider range of households were supported[185].

- Assessor teams were recruited locally. This was particularly important for the Highland and Eilean Siar schemes, since it enabled those schemes to benefit from their local knowledge[186].

3.1.9.4 Key limitations identified

- Cost effectiveness and value of investment do not compare well to UHIS, in which universally free measures were offered[187].

- Significant numbers of hard to treat properties could not benefit from the measures on offer.

- Delivery was particularly problematic in areas with significant numbers of flatted properties, some of which were mixed tenure[188].

- Engagement with owners of holiday homes on the islands, with householders in sheltered housing, and with non-English speakers, proved to be challenging[189].

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.10 Universal Home Insulation Scheme (UHIS) (2010-2014)

3.1.10.1 Scheme overview

Introduced in 2010-11, UHIS replaced the Home Insulation Scheme (HIS). UHIS was a free-to-all scheme which provided energy efficiency measures, such as loft and cavity wall insulation in selected areas. UHIS closed to new applicants in March 2013 but work continued to complete installations for a further year.

A key difference between UHIS and HIS is that UHIS also included offering free virgin loft and cavity wall insulation to all households in the area irrespective of their ability to pay. In addition, rather than Scottish Government selecting the areas, funding was provided to all local authorities, who were then given responsibility for selecting areas for inclusion.

Scottish Government funded the scheme, supplemented by funding from local authorities, housing associations and energy companies (principally CERT).

The approach to delivery was similar to HIS, with: area-focused marketing and direct mailings to households, followed by visits from doorstep assessors; qualifying households being referred to EAP; and the inclusion of a fund for 'enabling measures' to pay for indirect costs associated with the installation of measures that are not covered by CERT and to subsidise any additional costs associated with delivery and/or storage in island and/or remote rural locations.

The outputs from the scheme are shown in Table 3.5.

[185] Ibid.
[186] Ibid.
[187] EST, 2013. Home Energy Programmes Detailed Report 2009/2013 (Excel)
[188] CAG Consultants, 2010. Review of area-based energy efficiency initiatives in Scotland: Final report, for Consumer Focus Scotland
[189] Ibid.

Table 3.5: Outputs from UHIS

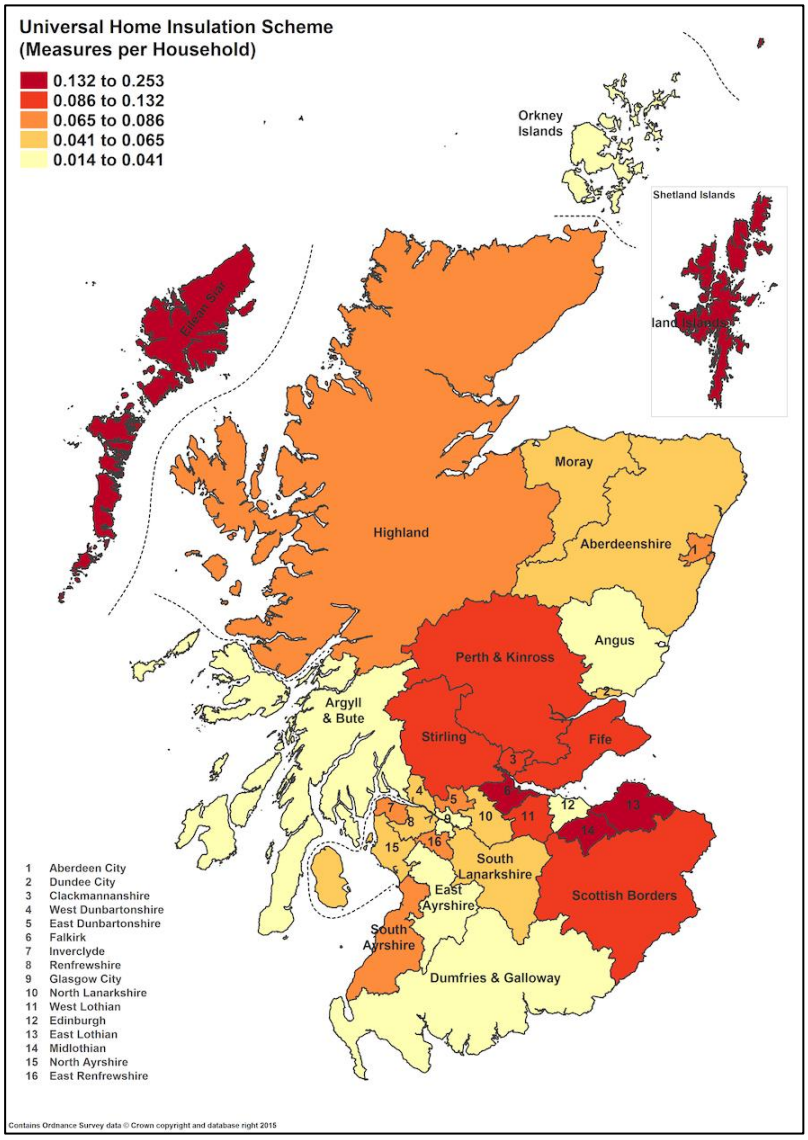
Measures	Number
Loft – virgin	28,197
Loft – top-up	51,206
Internal wall	221
Cavity wall	40,580
External wall	1,158
Other (includes tank/pipe lagging, draughtproofing, radiator panels. home loans, fuel switching, underfloor, gas connections)	22,583

Source: Energy Saving Trust, 2013

3.1.10.2 Distribution of measures

Delivery took place across Scotland, with each local authority receiving money under the scheme. However, there were still some imbalances in the distribution of measures delivered under the scheme, as shown in Figure 3.12.

Figure 3.12: Distribution of measures under UHIS



Source: Energy Saving Trust, 2013

3.1.10.3 Key strengths identified

- Very successful in leveraging CERT and other funding – estimated at £30.5m, from a Scottish Government spend of £44.2m[190].

- Significantly more cost effective than HIS. Carbon emissions savings were estimated at £37 per tonne CO2, compared to £96 per tonne CO2 under HIS[191].

- Providing universally free measures at the point of delivery led to high take-up rates.

- Integration with the Energy Assistance Package increased the reach and depth of the outreach.

3.1.10.4 Key limitations identified

- Only a relatively small number of measures were delivered for hard-to-treat properties under the scheme[192].

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.11 Energy Assistance Package (EAP) (2009-2013)

3.1.11.1 Scheme overview

EAP was designed to provide a package of intensive, targeted support for fuel poor consumers – it was effectively a narrow but deep approach. When initially introduced:

- Stage 1 offered free expert energy advice to anyone who phoned the Home Energy Scotland Hotline. This advice was provided by Energy Saving Scotland advice centres (ESSACs).

- Stage 2 provided benefits and tax credit checks and information on low cost energy tariffs (social tariffs, replaced in April 11 by the Warm Home Discount) to those at risk of fuel poverty.

- Stage 3 provided a package of standard insulation measures (cavity wall and loft insulation) to older households and those on one of a range of benefits.

- Stage 4 offered a package of enhanced energy efficiency measures (insulation and/or new or repaired central heating) to those who were most vulnerable to fuel poverty.

EAP sought to integrate the delivery of insulation, where possible, with CERT, by referring potential beneficiaries to their electricity supplier for measures.

EAP was seen as ground-breaking when it was introduced, in that it brought together support to address both energy efficiency and income maximisation, together with (to a more limited extent) help with energy costs.

[190] EST, 2013. Home Energy Programmes Summary Report 2009/2013
[191] EST, 2013. Home Energy Programmes Detailed Report 2009/2013 (Excel)
[192] EST, 2013. Home Energy Programmes Summary Report 2009/2013

EAP was targeted, on the basis of passport benefits, towards households on low incomes, people with disabilities, those who were over the age of 60 (female pension age at time of delivery) who did not have a central heating system, and those over the age of 75.

In addition, assistance was targeted at homes with an energy efficiency rating of E (SAP 54) or lower.

The scheme was promoted via TV advertising and promotion through third party organisations plus (increasingly over time) referrals via area-based energy efficiency schemes. There was an entry point national phone number, co-ordinated by EST, which was linked to regional delivery organisations.

Delivery was co-ordinated by EST, with insulation delivered through energy suppliers via CERT, benefits checks via Citizens Advice / Pensions Service and a check for social tariff / Warm Home Discount eligibility from the energy suppliers.

The outputs from the scheme are shown in Table 3.6.

Table 3.6: Outputs from EAP

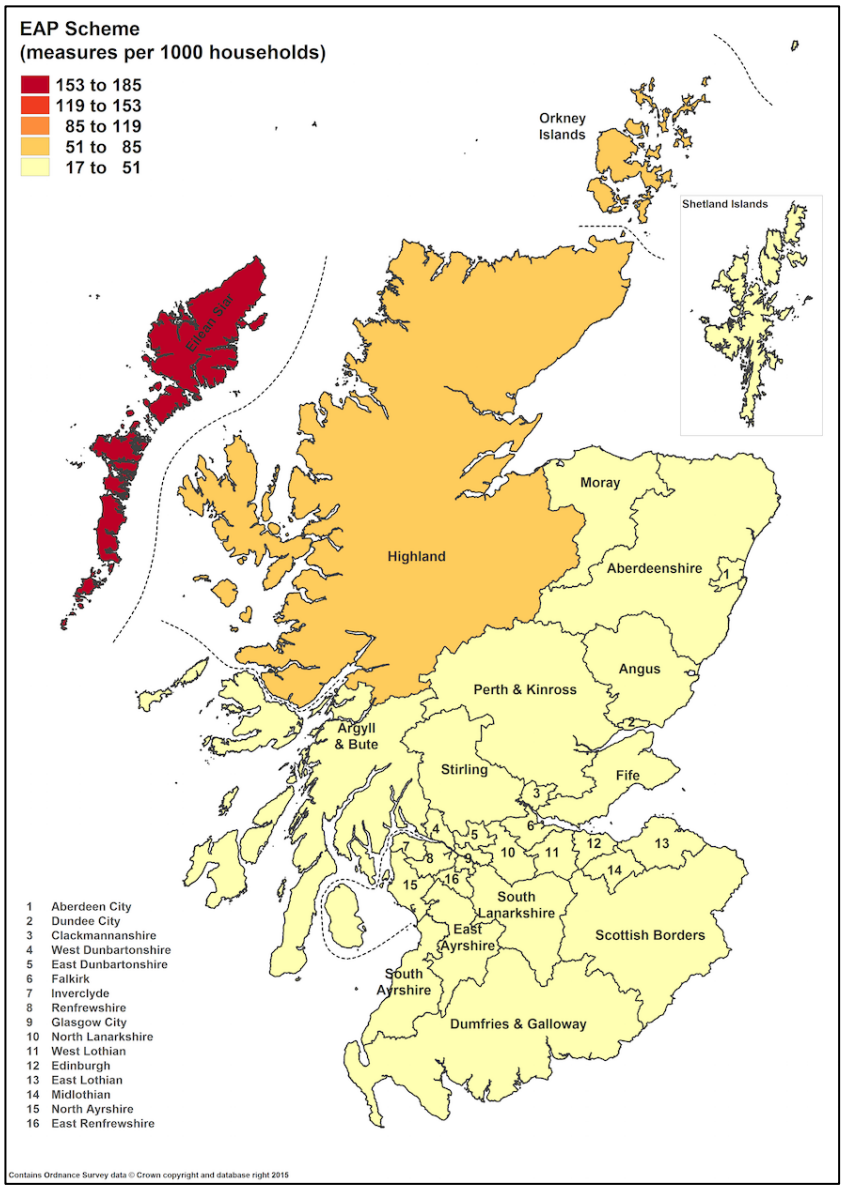
2.5 EAP	2012-13	All years
Total Scottish Government expenditure (estimated)	£37,156,251	**£141,603,801**
Referrals generated by HES:		
(a.) Households enquiring about EAP	55,876	**304,145**
(b.) Households given advice (stage 1)	51,732	**286,715**
(c.) Benefits and tax check referrals	9,933	**48,692**
(d.) Social Tariff referrals	10,735	**69,515**
(e.) CERT-EAP (stage 3) referrals	870	**24,720**
(f.) Stage 4 referrals	20,215	**75,267**
Number of households assisted:		
(a.) Households taking up EAP	53,029	**291,526**
(b.) Customers receiving additional income from a benefits and tax check	402	**3,125**
(c.) Social Tariff:		
i. Households moved to Social Tariif or Rebate	2,851	**11,095**
ii. Customers benefitting from a payment method switch	90	**812**
(d.) Households who received insulation from stage 3	149	**6,730**
(e.) Households who received an installation from stage 4	11,280	**39,873**
Total households receiving physical measures:	11,429	**46,603**

Source: Energy Saving Trust, 2013

3.1.11.2 Distribution of measures

Figure 3.13 shows that there was relatively equal distribution across Scotland. Higher than average intervention rates were achieved in Eilean Siar, Highland and Orkney. This may be at least partly due to a higher proportion of homes in these areas being rated E or worse. There may also have been particularly effective local marketing of the scheme in these areas.

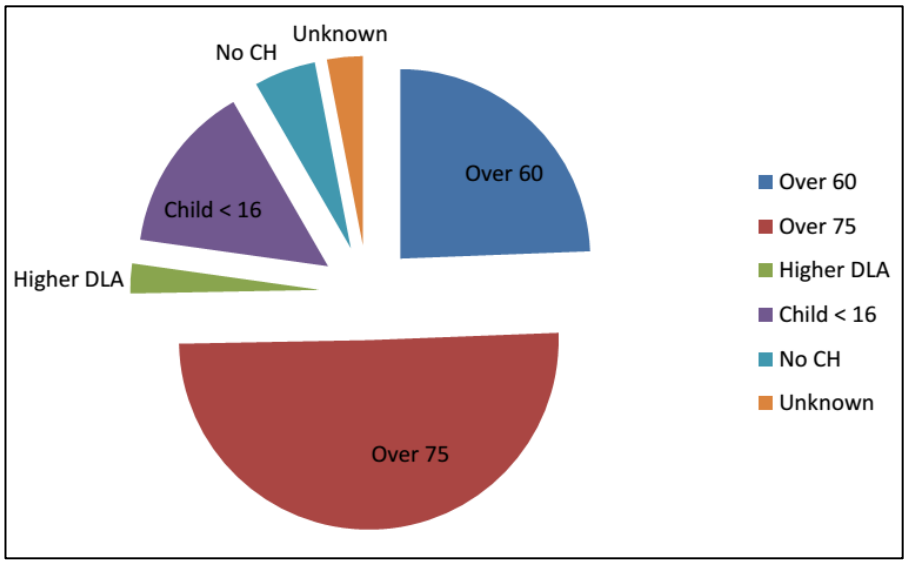
Figure 3.13: Distribution of measures under EAP, stage 4



Source: HEED

The majority of recipients of measures under stage 4 of EAP were in the over-75's category, as shown in Figure 3.14.

Figure 3.14: Recipients of measures under Stage 4 of EAP



Source: Energy Saving Trust, 2013

3.1.11.3 Key strengths identified

- Provided a model of integrated delivery, bringing together advice / benefits / measures and at least some limited work on tariffs.

3.1.11.4 Key limitations identified

- Issues with the nature of the programme meant that cross-referrals created a complex consumer journey. The drop-out rates from referrals made at stage 3 and stage 4 were very high[193].

- The scheme review[194] noted that simplification of the scheme was needed to ensure that the service was appropriate for vulnerable consumers, including detailed aspects like the speed of referrals and minimising the number of steps beneficiaries needed to take during the journey.

- Some sub-contracting of stage 4 measures to local contractors took place. However, the review found that there was a scarcity of such contractors in some rural and island areas, and also suggested that the scheme did not adequately account for the increased costs of delivery in such areas. More generally, the review suggested that there is a clear need to do more to help some contractors understand the needs of vulnerable customers.

- The review of the scheme noted a lack of monitoring data on household before / after costs as a weakness of the scheme. Carbon / cost savings are on the basis of modelled impacts, assuming that homes are heated to required standards before interventions, which is very unlikely to be the case for target groups.

- The annual totals of households assisted were small compared to the numbers in fuel poverty in Scotland.

[193] Glasgow Caledonian University, 2013. Review of the Energy Assistance Package
[194] Ibid.

- The scheme had a higher cost per tonne of CO2 saved than area-based schemes such as UHIS and supplier obligations such as CERT[195].

3.1.12 Energy Assistance Scheme (EAS) (2013-2015)

3.1.12.1 Scheme overview

EAS was the successor to EAP, with the re-design prompted by the closure of CERT and its replacement with ECO. Like EAP, EAS aimed to provide a package of intensive, targeted support for fuel poor consumers – it was effectively a narrow but deep approach. EAS was, at its inception, built on the expectation that ECO would deliver a similar service (loft insulation, cavity wall insulation, new boilers) for all eligible consumers, and hence EAS targeted those outside the ECO Affordable Warmth group. Those applying were therefore screened, with households eligible for ECO Affordable Warmth being referred to their electricity supplier for support for measures.

Stages 1-4 remained the same as under EAP.

The overall aim was for the combined eligibility of EAS and ECO Affordable Warmth to include everyone previously eligible for EAP, and with eligibility extended to those brought in by ECO legislation respectively (under ECO Home Heating Cost Reduction Obligation). Those targeted under EAS included low-income groups with disabilities, with children or over the age of 60. There were no restrictions on income eligibility for over 75s.

In addition, as with EAP, assistance was targeted at homes with an energy efficiency rating of E (SAP 54) or lower.

Outputs data are only available for 2013-14 – see Table 3.7. The data show that EAS overwhelmingly installed full heating systems, and ECO Affordable Warmth overwhelmingly installed replacement boilers. The relative lack of insulation measures may be a result of that work being completed under area-based schemes before referral for a heating system. If so, this would imply that direct applications from consumers were relatively few in number.

Table 3.7: EAS and ECO Affordable Warmth outputs in Scotland, 2013/14

	Affordable Warmth 13/14	EAS 13/14
Gas boiler replacement	2059	
Gas boiler repair	3	
Full gas central heating system	81	5386
Other central heating system	81	1018
Heating controls	552	
Loft	28	
Cavity (normal)	22	
Cavity (HTT)	1	
Solid wall insulation		
Other Insulation		374
Draughtproofing		
windows		
other		
Totals	2827	6778

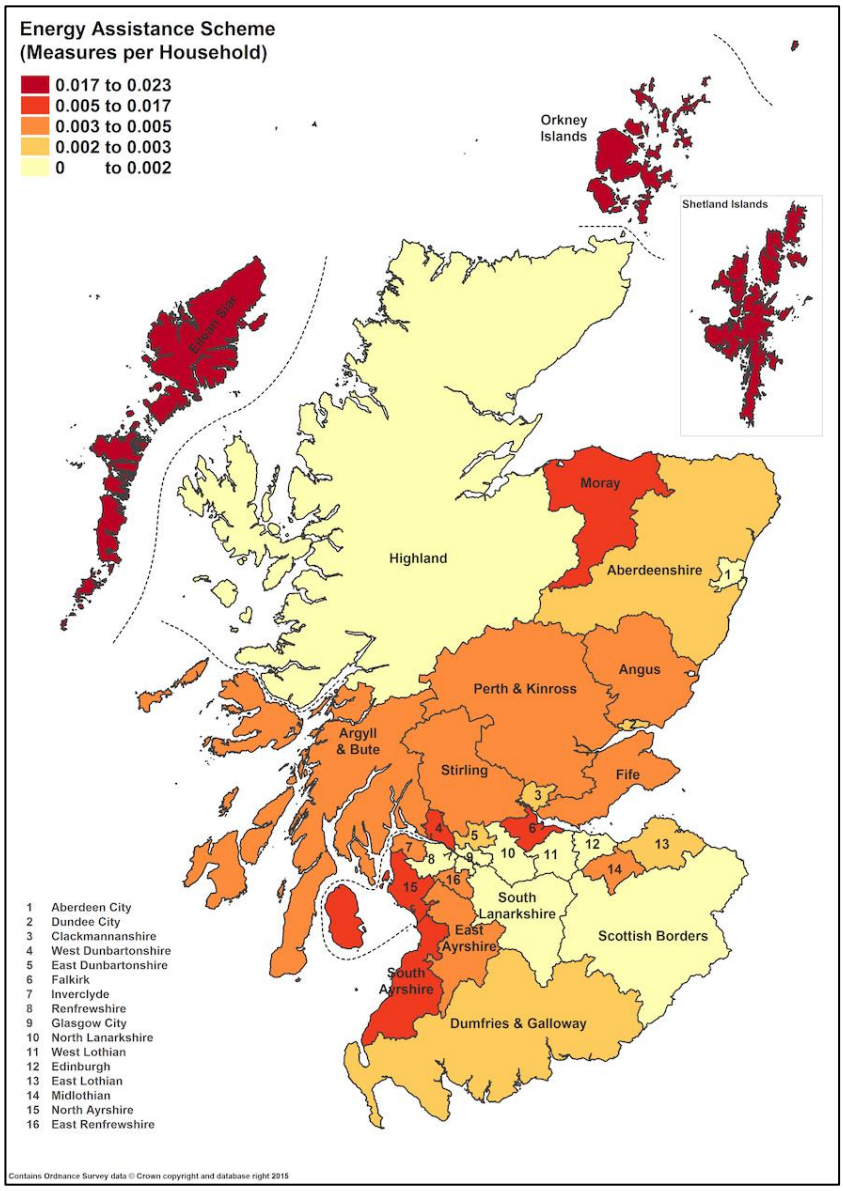
Source: Energy Saving Trust, 2014

[195] EST, 2013. Home Energy Programmes Summary Report 2009/2013

3.1.12.2 Distribution of measures

The distribution of measures delivered under EAS in 2013/14 is shown in Figure 3.15. There is no clear pattern to this distribution but, as with a number of the Scotland-specific schemes, there is something of a contrast with the distribution of measures delivered under the supplier obligations. The latter tended to have a focus on central Scotland. EAS, like HIS, delivered proportionately more measures in local authority areas outside of the central belt, with the Northern and Western Isles attracting particularly high rates of delivery.

Figure 3.15: Distribution of measures under EAS, 2013/14



Source: Energy Saving Trust, 2014

Some two thirds of all EAS measures were received by older consumers (36.9 per cent over 60, 30.5 per cent over 75)[196].

[196] Energy Saving Trust, 2014. Home Energy Efficiency Programmes for Scotland: Summary Delivery Report 2013/14

3.1.12.3 Key strengths identified

- As with its predecessor EAP, the combination of passport benefits criteria and targeting of housing with poor energy efficiency rating means this scheme was likely to be well targeted at the fuel poor.

3.1.12.4 Key limitations identified

- As with EAP, the drop-out rates from referrals to the energy suppliers were high, suggesting that significant numbers of consumers 'fell through the gaps'. The drop-out rate from stage 4 referrals was lower than under EAP, suggesting some improvements in this element of the customer journey.

- The annual totals of households assisted are small compared to the numbers in fuel poverty in Scotland.

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.13 Boiler Scrappage Scheme (2010-2013)

3.1.13.1 Scheme overview

The Boiler Scrappage Scheme offered householders a £400 subsidy to help meet the cost of replacing inefficient boilers with new more efficient alternatives. The scheme was managed by EST, with £16m of Scottish Government funding provided for the scheme over three years.

The boiler being replaced had to be in working order and have a SAP (2009) efficiency rating of less than 70 per cent in order to qualify for the scheme. The scheme was open to owner-occupiers only in 2010/11 but was opened to private sector landlords in 2011/12. There was no means-testing.

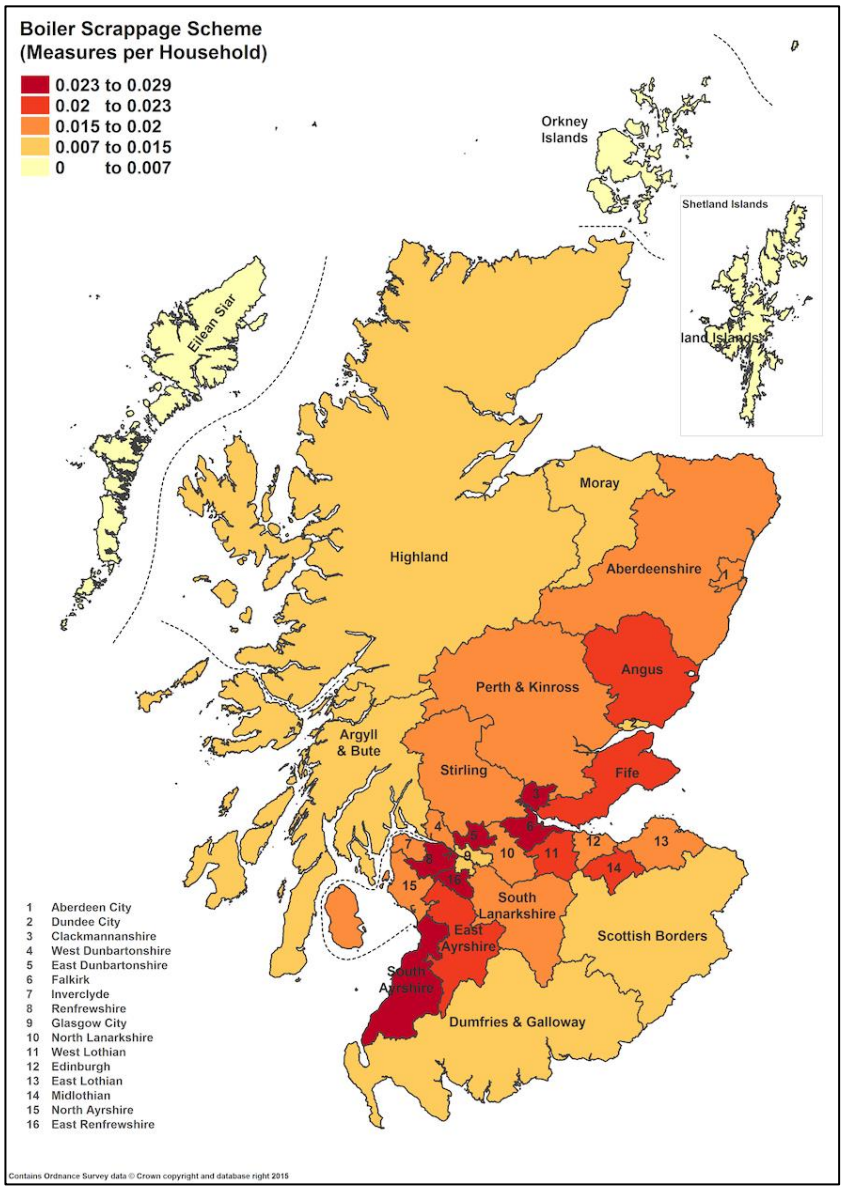
Consumers applied for vouchers via a telephone helpline.

39,324 new boilers were installed under the scheme, equating to 1.7 per cent of all Scottish households.

3.1.13.2 Distribution of measures

Figure 3.16 shows the distribution of boiler replacements carried out under the scheme. This clearly shows the bias towards more urban, on-gas local authority areas.

Figure 3.16: Distribution of Boiler Scrappage Scheme



Source: Energy Saving Trust, 2014

The focus on owner-occupiers and the absence of any means-testing means that it is unlikely to have a significant impact on households in fuel poverty.

3.1.13.3 Key strengths identified

- Very popular with consumers – initial annual budgets were expanded in response to demand.

3.1.13.4 Key limitations identified

- Assuming, as Energy Saving Trust have done[197], that the scheme brought forward the purchase of new boilers by, on average, 1.4 years, the calculated cost-effectiveness of the programme in terms of cost per tonne of CO2 saved, is very poor compared to other energy efficiency schemes at £311.

[197] Energy Saving Trust, 2014. Home Energy Efficiency Programmes for Scotland: Summary Delivery Report 2013/14

- There was no targeting of measures on those most in need. It is therefore unlikely to have had a significant impact on households in fuel poverty.

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.14 Home Energy Efficiency Programmes for Scotland: Area Based Schemes (HEEPS: ABS) (2013-present)

3.1.14.1 Scheme overview

HEEPS: ABS has the following objectives:

- to reduce fuel poverty;

- to reduce carbon emissions;

- to lever ECO funding; and

- to support the local economy and sustainable local economic development.

The programme is made up of two distinct parts:

1. the Core Allocation Programme (CAP) element; and

2. the Proposals for Additional Funding (PAF) element.

This was intended to ensure that all councils had a core allocation based on a needs-based assessment, while enabling the Scottish Government to provide additional funds to councils who were in a position to deliver larger scale and/or more ambitious projects. In 2016/17, the PAF will be removed, with the funding going towards the pilot programme for SEEP (Scotland's Energy Efficiency Programme).

Although restricted to private tenure properties (including private rented), HEEPS: ABS funding is intended to 'unlock' larger mixed tenure schemes, with ECO funding being used for the social housing element.

The model for allocating the CAP was based on:

- 20 per cent for national fuel poor households within a local authority area;

- 30 per cent for total local authority area population which is fuel poor;

- 30 per cent for national share of dwellings which have solid walls; and

- 20 per cent for national share of dwellings with hard-to-treat cavity walls.

The criteria applied to both CAP and PAF proposals included:

- They should clearly target fuel poor areas beginning with those households in most need of assistance.

- They should be for private sector properties (including private sector properties in mixed tenure blocks). Private rented properties will be eligible. Holiday homes and static caravans are excluded.

- They should be made up of a mixture of higher cost measures (such as solid wall insulation) and lower cost measures made available more widely. Following changes to ECO and the perceived risks to EWI and the rural sub-obligation, the 2014/15 guidance stipulated that schemes should have a focus on solid wall insulation and hard-to-treat cavities. However there was an allowance for an element of additional support for basic loft and cavity measures where ECO does not cover the full cost of the installation. Where loft and cavity measures are being offered on a local authority-wide basis, the guidance stated that HEEPS: ABS support be restricted to houses in council tax bands A-C in order to maintain a focus on the fuel poor.

- Proposals should demonstrate that they have considered all available funding options to achieve the proposed work. This would include, where appropriate, the Green Deal and the Green Homes Cashback Voucher.

- Schemes should be designed to maximise carbon reductions.

- Schemes should be designed so as to support the local economy and use local installers as far as possible, within the framework of procurement legislation and best practice.

For private owners, a cap of £6,500 per property operates unless there are ‘exceptional circumstances’.

Schemes are administered by local authorities, although some local authorities sub-contract to third parties.

In 2013/14, the majority of measures (51 per cent) were solid wall insulation. This percentage is likely to increase in 2014/15 given the changes in guidance described above.

Table 3.8: Outputs from HEEPS: ABS 2013/14

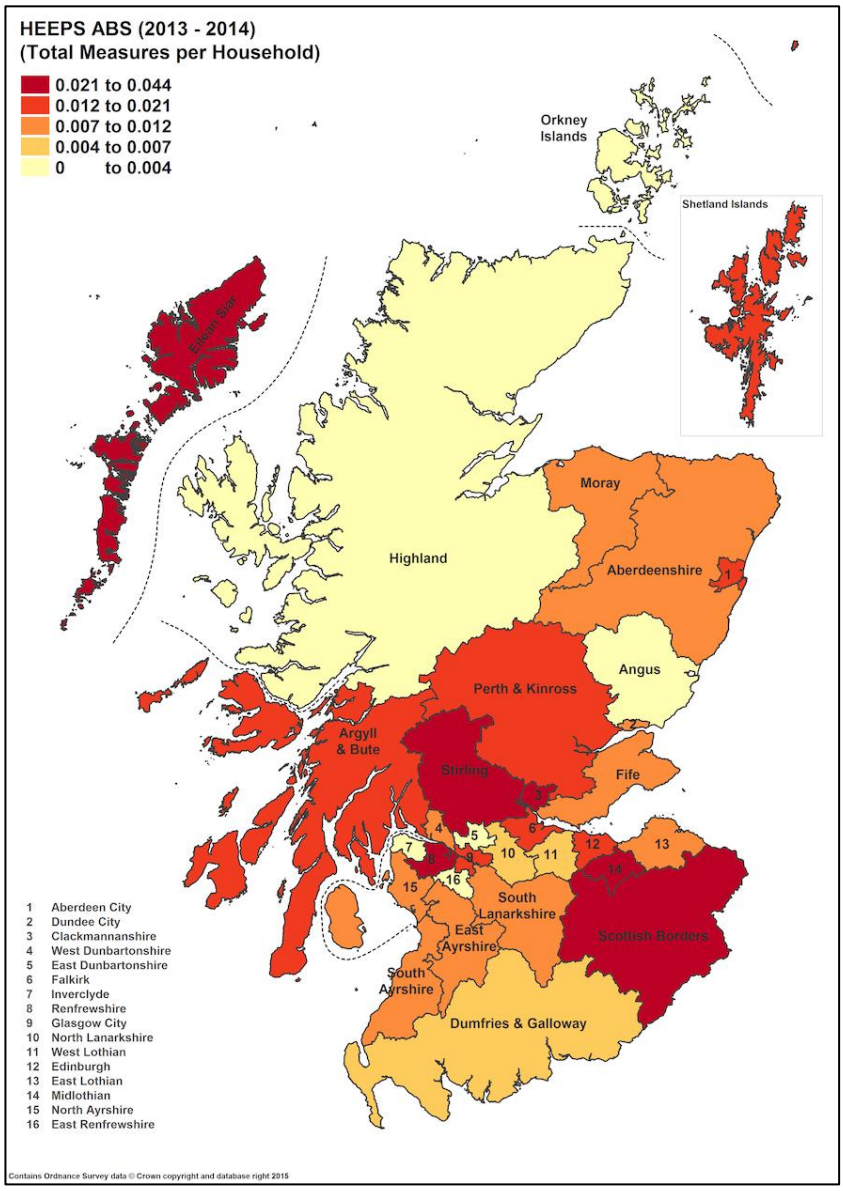
	Owner Occupied	Private rented	Social Landlord	Total
Heating measures				
Gas boiler replacement	1247	239	1536	3022
District heating	41	18	495	554
Renewable/micro-gen	7	1	318	326
Electric storage heaters	125	4	88	217
Total heating measures	1448	264	2437	4149
Insulation measures				
External Wall	6091	220	3741	10052
Cavity (HTT)	3107	158	2235	5500
Loft	1518	178	349	2045
Cavity (normal)	863	133	632	1628
Internal Wall	471	35	522	1028
Window glazing	184	3	256	443
Under Floor	358	13	67	438
Total insulation measures	12762	750	7804	21316

Source: Scottish Government, 2014

3.1.14.2 Distribution of measures

Figure 3.17 shows the distribution of measures delivered in HEEPS: ABS schemes in 2013/14. Angus, East Dunbartonshire and Orkney did not participate in the scheme. There were relatively low levels of measures delivered in Highland, Inverclyde and East Renfrewshire.

Figure 3.17: Distribution of measures under HEEPS: ABS, 2013/14



Source: Scottish Government

No data is available on the extent to which the scheme has benefited different socio-economic groups. However, the fuel poverty criteria in the scheme funding allocations, insofar as fuel poverty data allows, should have resulted in some targeting of the fuel poor.

3.1.14.3 Key strengths identified

- The scheme has helped to sustain higher rates of delivery of solid wall insulation than in the rest of Great Britain.

- The funding structure allowed relatively equitable distribution of funding across Scotland, whilst also allowing some targeting of fuel poverty.

- Giving responsibility for scheme delivery to local authorities is seen to be positive by many stakeholders, as it allows utilisation of their local knowledge and they are perceived to be trusted by consumers.

3.1.14.4 Key limitations identified

- ECO's intended focus on solid wall insulation did not materialise, which undermined many HEEPS: ABS schemes. Further changes to ECO may have further undermined scheme delivery from 2014/15 onwards.

- Uncertainty about the level of ECO funding presented a major challenge to local authorities when attempting to plan schemes and develop firm funding packages for projects that could then be discussed and agreed with participating owners[198].

- Supply chain issues, particularly for delivery of solid wall insulation, were reported in some areas[199].

- Some stakeholders have questioned the capability of some local authorities to deliver such schemes. Some have handed funding back. A number have sub-contracted to third parties, such as energy companies.

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.15 HEEPS: Cashback Scheme (Apr-Nov 2015)

3.1.15.1 Scheme overview

This was a very short life subsidy scheme, targeting the able to pay market. It was funded through the Scottish consequential of UK Government money to support the Green Deal.

A range of insulation and heating measures were supported, e.g. up to £500 was offered for boiler replacements and up to £400 for cavity wall insulation. The qualifying conditions were that:

- applicants commissioned a green deal advice report (GDAR);

- any measures supported under this scheme appeared in the list of recommended measures on the GDAR; and

- EPC had to be carried out after installation to show that the installed measures were no longer recommended.

The scheme was targeted at the lower wealth end of the able-to-pay market, as the Council Tax band of the property had to be A, B or C. There was no other means-testing.

The scheme was open to all tenures – owners, tenants or registered landlords could apply (tenants needed the landlord's written permission).

There was no overlap with other local or central government grant funding such as ECO or HEEPS: ABS. However, cashback could be combined with Green Deal finance.

6,646 vouchers had been issued by the end of November 2015. At the end of January 2016, 3,674 had been redeemed, with a total value of £6.2m[200].

[198] Based on unpublished local authority monitoring reports shared with the research team by Scottish Government
[199] As above

More than half of all measures were boilers (see Table 3.9), so in large part the scheme acted as a continuation of Boiler Scrappage Scheme, although a significant number of solid wall insulation measures were also delivered.

Table 3.9: Outputs from HEEPS: Cashback, up to 31 Jan 2016

Measure	Total number of measures installed*	Percentage of measures
Internal wall insulation	265	6%
External wall insulation	728	17%
Condensing gas boiler	2,435	58%
Condensing LPG boiler	6	0%
Condensing oil boiler	7	0%
Cavity wall insulation	35	1%
Floor insulation	92	2%
Flat roof insulation	2	0%
Fan assisted electric storage heaters	5	0%
Room in roof insulation	3	0%
Loft insulation	384	9%
Draught proofing	200	5%
Heating controls	24	1%
Hot water tank insulation	3	0%
Insulated doors	27	1%
Secondary glazing	3	0%
TOTAL	**4,219**	**100%**

*Please note applicants can apply for more than one measure per property/voucher

Source: www.energysavingtrust.org.uk/heeps-cashback-statistics

3.1.15.2 Distribution of measures

No data is available on the geographic distribution of the measures supported.

The focus on lower council tax bands may have contributed to better targeting of those in greater need.

3.1.15.3 Key strengths identified

- Popular with consumers.
- Straightforward to administer.
- Helped to drive take-up of Green Deal Advice Reports in Scotland.
- Provided some support for hard-to-treat properties through supporting solid wall insulation.

[200] http://www.energysavingtrust.org.uk/heeps-cashback-statistics

3.1.15.4 Key limitations identified

- As the Boiler Scrappage Scheme showed, the cost-effectiveness of subsidising boiler replacements in terms of reducing carbon emissions is low.

- The focus on lower council tax bands may have contributed to better targeting of those in greater need but the scheme is unlikely to have reached many fuel poor households due to the relatively low level of cost subsidy that the cashbacks represented.

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.16 Green Homes Cashback Scheme (2012-2014)

3.1.16.1 Scheme overview

This was a series of short life schemes which subsidised the able to pay market for a range of energy efficiency measures. There was a parallel stream for social landlords. The scheme was funded by Scottish Government, through the Scottish consequential of UK Government money to support the Green Deal. It was managed by EST.

The scheme ran in three phases:

- Phases one and two ran from November 2012 until March 2014, with a total of £13.6m for private sector households, and an additional £3.9m for social landlords.

- Phase 3 ran from June - August 2014, with £10m for private sector housing and a further £5m for social landlords.

A wide range of heating, lighting and insulation measures were supported.

The qualifying conditions (for private sector) were that:

- applicants commissioned a green deal advice report (GDAR);

- any measures supported under this scheme appeared in the list of recommended measures on the GDAR; and

- EPC had to be carried out after installation to show that the installed measures were no longer recommended.

The qualifying conditions for social landlords are unclear.

As shown in Table 3.10, replacement boilers were the single most popular measure in phase 3, and the second most popular (after LED lightbulbs) in phases 1 and 2. LED lightbulbs were excluded from phase 3. The scheme supported a significant level of solid wall insulation measures in phase 3.

Table 3.10: Outputs from Green Homes Cashback Scheme, phase 1&2 (left) and phase 3 (right)

Measure	Total number of measures installed*	Percentage of measures
Cavity wall insulation	1,018	3%
Flat roof insulation	10	0%
Floor insulation	1,817	6%
Loft insulation	3,838	12%
Room in roof insulation	45	0%
Solid wall insulation	964	3%
Condensing boiler	7,447	24%
Cylinder thermostat	131	0%
Double glazing	220	1%
Draught proofing	369	1%
Fan assisted electric storage heaters	22	0%
Flue gas heat recovery system	4	0%
Heating controls	5,240	17%
Hot water tank insulation	237	1%
Insulated doors	36	0%
LED light bulbs	10,014	32%
Replacement warm air unit	5	0%
Secondary glazing	12	0%
Waste water heat recovery	0	0%
Total number of measures	**31,429**	**100%**

*Please note applicants can apply for more than one measure for one property/voi

Measure	Total number of measures installed*	Percentage of measures
Internal or external wall insulation	1,369	30%
Condensing gas boiler	2,108	46%
Condensing oil boiler	19	0%
Condensing LPG boiler	20	0%
Cavity wall insulation	63	1%
Flat roof insulation	1	0%
Floor insulation	180	4%
Loft insulation	555	12%
Cylinder thermostat	25	1%
Room in roof insulation	8	0%
Double/triple glazing	6	0%
Draught proofing	81	2%
Fan assisted electric storage heaters	2	0%
Flue gas heat recovery system	2	0%
Heating controls	106	2%
Hot water tank insulation	13	0%
Insulated doors	0	0%
Replacement warm air unit	5	0%
Secondary glazing	3	0%
Waste water heat recovery	0	0%
Total number of measures	**4,566**	**100%**

*Please note applicants can apply for more than one measure per property/vouch

Source: http://www.energysavingtrust.org.uk/green-homes-cashback-statistics

3.1.16.2 Distribution of measures

No data is available on the geographic distribution of the measures supported, or of the distribution amongst different socio-economic groups. There was no targeting of the fuel poor or lower income groups.

3.1.16.3 Key strengths identified

- Very popular with consumers.
- Straightforward to administer.
- Helped to drive take-up of Green Deal Advice Reports in Scotland.
- Provided some support for hard-to-treat properties through supporting solid wall insulation.

3.1.16.4 Key limitations identified

- The cost-effectiveness of subsidising boiler replacements in terms of reducing carbon emissions is low.
- There was no targeting so the scheme is unlikely to have reached many fuel poor or lower income households.

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.17 HEEPS: Loans Scheme (2015-present)

3.1.17.1 Scheme overview

Under this scheme, the Scottish Government makes available interest-free, unsecured loans of up to £10,000 for installing a variety of measures such as solid wall insulation, double glazing or a new boiler. Loan value and repayment period varies with technology. The loan rate is calculated as 1 per cent plus the highest base rate in force at a selection of banks 28 days prior to entering into the loan agreement.

A total budget of £14m was announced in April 2015.

The scheme is open to owner-occupiers and registered private sector landlords in Scotland. The scheme is available on a first-come, first-served basis and is subject to available funding. Landlords can receive loan funding for a maximum of 5 properties.

Customers access the scheme via the Home Energy Scotland helpline, who send out application forms. Applicants need to have a GDAR carried out before applying and any measures they wish to install must appear on the 'Recommendations for improvement' list on the EPC portion of the GDAR. Work carried out under the scheme must be completed by an installer who is Green Deal certified specifically for the measure to be installed.

Loans are also available to help owner-occupiers and private sector landlords with the costs of connecting to the gas grid. The Gas Infill Loans scheme provides interest-free loan funding between £500 and £5,000 for gas connection costs and installation of a gas central heating system. It is available for individuals wishing to connect to the gas grid, or where the property is included in a gas infill project or gas grid extension project.

The eligible measures and maximum loan values are shown in Table 3.11.

Table 3.11: Eligible measures under HEEPS: Loans Scheme

Measure	Max loan value
Solid wall insulation (external and internal)	£10,000
Cavity wall insulation	£900
Loft insulation (0mm - 270mm)	£500
Loft insulation (top-up 120mm - 270mm)	£500
Room-in-roof insulation	£1,500
Floor insulation (solid floor)	£750
Floor insulation (suspended timber)	£750
Flat roof insulation	£2,500
Boilers - gas, LPG or oil	£3,000
Cylinder thermostat	£500
Double/triple glazing (as a replacement for single glazing)	£4,500
Secondary glazing (for properties with single glazing only)	£500
Fan assisted electric storage heaters	£3,500
Warm air units	£3,500
Insulated doors	£1,000
Waste water heat recovery systems	£1,000
Draught proofing	£500
High heat retention storage heating systems	£7,000
Flue gas heat recovery	£500
Hot water tank insulation (uninsulated tank)	£500

Source: http://www.energysavingtrust.org.uk/heeps-loan-scheme

No outputs data has yet been published.

3.1.17.2 Distribution of measures

No data is available on the geographic distribution of the measures supported, or of the distribution amongst different socio-economic groups. There is no targeting of the fuel poor or lower income groups.

3.1.17.3 Key strengths identified

- Wide range of measures covered.
- Very competitive finance package available.
- Gas Infill Loans - in areas on, or very close to, the existing gas grid, connection to the gas grid is in most cases a cost-effective way of reducing energy bills and tackling fuel poverty.

3.1.17.4 Key limitations identified

- No performance or evaluation data is available. It is not known whether an evaluation of the scheme has been commissioned. This could be extremely valuable, given the likely reliance on loan finance for energy efficiency improvements in future.

3.1.18 HEEPS: Warmer Homes Scotland Scheme (2015-present)

3.1.18.1 Scheme overview

This scheme is the successor to the Energy Assistance Scheme. It opened for applications in September 2015 and is intended to run for seven years.

Scottish Government-funded, the scheme will be worth up to £224m. The contract for the new scheme has been awarded to Warmworks (formed by a consortium of Changeworks, the Energy Saving Trust and Everwarm). The scheme will work alongside the other Home Energy Efficiency Programmes for Scotland (HEEPS) to give vulnerable households living in fuel poverty access to even more measures to make their homes energy efficient.

The scheme is open to homeowners or tenants of private sector landlords, who have lived in their home for at least 6 months, and have a low income.

Assessors recommend measures suitable for the property, including a range of insulation and heating measures, and in most cases costs will be met by the Scottish Government. There will be a need for customer contributions in some instances for certain more expensive measures, such as solid wall insulation.

The household must meet all of the following criteria.

- be homeowners or the tenants of a private-sector landlord;
- live in the home as their main residence;
- have lived there for at least 6 months (unless in receipt of a DS1500 certificate); and
- live in a home with an energy efficiency (SAP) rating of 54 or lower.

They must also meet one of the following conditions:

- aged 60 or over, have no working heating system and be in receipt of a passport benefit;
- aged over 75 and in receipt of a passport benefit;
- pregnant and / or have a child under 16 and in receipt of a passport benefit;
- have a disability and be in receipt of any level of Disability Living Allowance or Personal Independent Payment;
- a carer in receipt of Carers Allowance;
- injured or disabled serving in the Armed Forces and be in receipt of Armed Forces Independence Payment/War Disablement Pension; or
- have an injury or disability from an accident or disease caused by work and be in receipt of Industrial Injuries Disablement Benefit.

The passport benefits are:

- guarantee element of the Pension Credit;
- Attendance Allowance;
- Universal Credit or any of the benefits due to be replaced by Universal Credit (Income Based JSA, Child Tax Credit, Working Tax Credit, Employment and Support Allowance, Income Support, Housing Benefit);
- Council Tax Reduction;
- Carer's Allowance;
- Disability Living Allowance (DLA) or Personal Independence Payment (PIP) Armed Forces Independence Payment;
- War Disablement Pension; and
- Industrial Injuries Disablement Benefit.

The measures offered will depend on a survey of the property. Potential measures include:

- solid and cavity wall insulation;
- loft insulation;
- draught-proofing;
- central heating; and
- renewables.

EST has community liaison officers 'on the ground' who help to engage with people likely to be eligible for the programme. In addition, national marketing campaigns will be conducted.

3.1.18.2 Distribution of measures

No outputs data has been published yet.

3.1.18.3 Key strengths identified

- Long term scheme with a significant level of funding committed to it.
- Community liaison officers working 'on the ground' will help with extending the reach of the scheme and with targeting those most in need.
- This is a grant scheme, which will therefore reach a greater proportion of those most in need.

3.1.18.4 Key limitations identified

- One of the keys to success will be ensuring effective integration with other schemes such as HEEPS: ABS and ECO for those not eligible for direct support under this scheme. Delivery through EST and the ESSACs should improve this compared to EAP and EAS but it is not yet clear how effective this integration will be.

- The eligibility criteria are insufficiently broad to allow all households in fuel poverty to benefit from the scheme.

- It is not known whether an evaluation of the scheme has been commissioned.

3.1.19 Scotland's Energy Efficiency Programme (SEEP) (Initial pilots – 2016-2017)

3.1.19.1 Scheme overview

The Scottish Government announced in June 2015 that energy efficiency will be designated as a National Infrastructure Priority, and that this will be delivered through *Scotland's Energy Efficiency Programme* (SEEP). The new SEEP programme will be defined and piloted over the next 2-3 years through a process in which there will be an emphasis on co-production between the Scottish Government and key stakeholders.

It is anticipated that SEEP will have the following broad features:

- it will seek to create an integrated approach to the delivery of energy efficiency and heat demand reduction improvements across Scotland;

- it will integrate delivery across domestic and non-domestic buildings;

- the aim will be to achieve a good level of energy efficiency performance for buildings across Scotland over a 15-20 year period – what a 'good level of energy efficiency performance ' means in practice will be a key issue for programme design;

- there will be a two year development and piloting stage. Launch of the delivery stage will be in 2018, at which point new powers will be devolved over the Energy Company Obligation and Warm Homes Discount;

- the programme will provide support to overcome the upfront costs of installing energy efficiency measures;

- there will be a strong area-based delivery approach to the programme, although it is recognised that some element of national delivery may be required alongside;

- support will continue to be available for the poorest households in the form of grants for installation of new measures;

- it will involve new cost-effective financial mechanisms for those households and businesses who can afford to pay; and

- it will offer advice to support new energy saving and heat demand reduction behaviours by households and businesses.

The pilot projects may involve:

- the extension of existing energy efficiency measures (such as insulation) or renewable heat supply initiatives (such as district heating, thermal storage or microgeneration schemes) to other properties, communities and/or sectors, based on geographic, demographic or socio-economic indicators; or

- development of tailored approaches to different areas such as mixed tenure areas, where a programme would be developed that integrated treatment of commercial, public sector and industrial buildings with treatment of residential buildings (e.g. on a street-by-street basis, or zoning of areas to ensure systematic action); or

- development of integrated approaches to mixed-tenure buildings where there is shared use and different ownership structures (e.g. buildings with mixture of commercial offices and shops, public sector offices, or third sector premises; and buildings where there is a mixture of owner occupied, social landlord, commercial landlord, private rented and public sector ownership).

The objectives of the pilots are:

- To pilot new and innovative approaches, delivering carbon reductions, scalable and replicable models and testing the mechanisms required to support the delivery of the SEEP themes.

- To accelerate pilot capital projects delivering improvements in energy efficiency to domestic and non-domestic buildings by means of fabric measures or renewable heat supply models; which are developed and delivered in liaison with local stakeholders such as businesses, registered social landlords, public bodies, community groups, financial investors and regulators; identifying fuel poor areas and prioritising those properties in most need of assistance.

- To promote innovation and diversification in the development and delivery of area-based energy efficiency models intended to encourage investment in measures designed to result in long term savings in energy use; determining an optimal level of energy performance for domestic and non-domestic buildings that fall within the scope of the pilot project and will inform target levels of performance improvement for buildings across Scotland; and subsequently, to inform the establishment of a clear baseline of evidence for the potential improvement in energy efficiency of domestic and non-domestic buildings in the targeted areas.

- To provide capital support to pilot energy efficiency projects which have the potential to have a positive social outcome, helping to reduce fuel poverty and health-related issues, and which have a significant impact on the local economy (job creation and retention, income, skills, training opportunities, use of local installers where possible).

- To measure and evaluate the impact of the pilot approach through: assessing the effectiveness of the range of interventions deployed in influencing consumer responses to energy efficiency and heat demand reduction programmes; establishing clear evidence on the approaches that are most effective in driving lasting behaviour change by households and businesses; and presenting clear recommendations on what overall approach can be replicated, scaled up, delivered and effective in the future SEEP programme.

The initial pilots will be funded through the HEEPS:ABS and Low Carbon Infrastructure Transition Programme (LCITP). Up to £14 million of Scottish Government funding will be available from June 2016 to December 2017. There is an expectation that pilot projects will maximise leverage from other funding sources, such as private investment, ECO, SALIX funds, any locally available Central Energy Efficiency Funding, District Heating or SME loans schemes and the Renewable Heat Incentive, i.e. spend-to-save investments by those households and organisations which can afford to pay.

The pilots can include:

- Physical measures to reduce the need to heat or cool a building; improve the performance of existing systems or replace with more effective measures or renewable heat supply models; provide more effective control of systems, including internal sensors to monitor and report temperature where energy efficiency measures have been installed as part of the pilot project; and/or

- Education/training measures promoting behavioural change in the use of the building's energy sources and facilities.

The local authority is expected to be the lead partner, or joint lead partner, in the development and delivery of the pilot projects.

3.1.19.2 Distribution of measures

No measures have yet been completed. Proposals for pilot projects are required to identify fuel poor areas and prioritise those properties in most need of assistance.

There is a single price to the customer for any measures (where there is a customer contribution). This means that, regardless of the cost of the install, the cost of that measure to the customer is the same. This is intended to ensure that householders in rural areas are not disadvantaged.

3.1.20 Climate Challenge Fund schemes (CCF) (2008-present)

3.1.20.1 Scheme overview

The CCF is a Scottish Government scheme that supports communities to take action on climate change. Projects funded by the CCF are community-led and focus on reducing carbon emissions and achieving positive behaviour change. The fund is much broader than energy efficiency and fuel poverty, although some funded projects have focused on these areas. For example, in phase 3 of the CCF, 64 projects cited Home Energy Scotland as a collaborator[201].

The CCF has run since 2008, with funding currently committed until March 2016. Over the course of the entire CCF scheme (2008-16), 696 projects have been awarded over £61 million[202].

All applications must be from community groups and meet the following three criteria to receive funding:

1. Community-led. Both the community group and the project itself must be community-led.

2. Carbon reductions. The project must lead to a measurable reduction in carbon dioxide (CO2) equivalent in the community, improve carbon literacy and/or help communities cope with the impacts of climate change (adaptation projects).

3. Sustainable legacy. The project is expected to demonstrate a sustainable legacy through physical, behavioural, awareness or social change in the community.

CCF has funded a range of projects addressing one or more topics such as food, waste, transport and energy. Some projects have funded 'hard' measures (e.g. insulation), whilst

[201] Changeworks, 2015. Review of the Climate Challenge Fund, for Scottish Government Social Research
[202] www.gov.scot/Topics/Environment/climatechange/howyoucanhelp/communities/ClimateChallengeFund

others have focused on encouraging householders to take up similar 'hard' measures and/or adopt sustainable behaviours, for example, in relation to saving energy or active travel. Many have included elements of awareness-raising, information provision and engagement.

Detailed outputs have not been collated and published. In the 21 projects included in the first review of the CCF, more than a thousand homes had received energy checks, several hundred had been insulated and around 100 homes had installed renewable energy or heating[203].

3.1.20.2 Distribution of measures

Data on the distribution of energy efficiency measures supported by the scheme is not available.

3.1.20.3 Key strengths identified

The first review of the CCF concluded that:

Community projects are well placed to deliver pro-environmental behaviour change because of:

- *their ability to tailor and personalise their messages and interventions to appeal to individual participants' motivations and overcome the particular barriers that apply in each case;*
- *their position in the community as trusted entities that are seen to have the community's interests at heart; and*
- *Their ability to engage those who are 'moderately interested' in the environment and open to the idea of change (who make up a fairly sizeable proportion of the population), and spark them into action.*[204]

The review of the third phase of CCF stated that:

Discussions with stakeholders (both internal and external to the Scottish Government) highlighted that there is a role for bottom-up, community based activities to support the uptake of climate change-related policy area activities and behaviours, including, for example… supporting and encouraging householders to participate in the national energy efficiency programmes and to undertake energy efficiency retrofit activities in general and supporting associated behaviour change activities and agencies (such as HES) to foster energy efficiency in the home[205].

3.1.20.4 Key limitations identified

The evaluation of the third phase reported that:

Many respondents felt that there is scope for better integration and for policy areas or government departments and agencies to more proactively engage with the CCF (and vice versa)… In addition there were some suggestions that national organisations, both in terms of climate change-related activities and community-focused organisations, could proactively foster partnerships with CCF and related groups.[206]

[203] Brook Lyndhurst and Ecometrica (2011) *Review of the Climate Challenge Fund*, for Scottish Government Social Research
[204] Ibid.
[205] Changeworks, 2015. Review of the Climate Challenge Fund, for Scottish Government Social Research
[206] Ibid.

3.1.21 Learning points from Scotland-specific energy efficiency and fuel poverty schemes

- The Scotland-specific schemes appear to have been effective in countering much of the central-Scotland bias apparent in delivery of the UK-wide supplier obligations.

- Of the Scotland-specific schemes for which data is available, area-based delivery of universally free measures has proven to be the most cost-effective approach to reducing carbon emissions from homes.

- There are synergies between improving energy efficiency and addressing fuel poverty but there is also an inherent conflict between the two, since the most cost-effective approach to addressing energy efficiency will not be the most cost-effective means of addressing fuel poverty. The combination adopted in Scotland of large-scale area-based delivery, alongside nationally available targeted support for fuel poor households, represents a useful model.

- Scottish Government has adapted its energy efficiency and fuel poverty schemes over time to account for changing circumstances and learning from previous schemes. For example:

    - area-based schemes, with increasing involvement of local authorities, continue to be a key feature of delivery;

    - the current HEEPS: Loans scheme, with its competitive finance package and relatively simple structure, addresses many of the failings of the Green Deal;

    - the offer of a single price per measure, irrespective of location, in Warmer Homes Scotland, should help to eliminate any urban bias that existed in its predecessor schemes;

    - the use of community liaison officers in engaging households for the Warmer Homes Scotland scheme is likely to help to extend the reach and improve the targeting of support, compared to its predecessor schemes; and

    - the commitment to a seven year programme for Warmer Homes Scotland recognises the benefits of a longer term strategy, particularly for the supply chain.

- However, formal evaluation is absent from most previous schemes. This represents a significant missed opportunity both to improve the management of schemes and to inform the development of future schemes.

- Effective targeting of fuel poor households is challenging. How this can be achieved in future is not helped by the absence of any direct monitoring of the extent to which previous schemes have addressed fuel poverty.

- The reliance on funding from the UK-wide supplier obligations for much scheme delivery has led to significant challenges in project planning, has undermined delivery of some projects and led to complex referral pathways which have limited the impacts of some schemes. The devolution settlement therefore provides a significant opportunity to simplify funding arrangements and associated referral pathways.

- Although the schemes have been relatively successful in maintaining delivery of solid wall insulation, how the Government will incentivise delivery of this measure and other measures for hard-to-treat properties on the scale necessary to meet Government targets, and how the supply chain will deliver this, is unclear.

- Whilst the increasing involvement of local authorities in delivery is positive, there appears to be a need to build the capability of some local authorities or to facilitate improved partnership working with third party organisations without losing the benefits of local authority involvement.

- The experience of the CCF reinforces the potential, evident from the review of the BESN, for community groups to act as trusted intermediaries in the delivery of schemes.

UK-wide cash-benefits schemes

3.1.22 Warm Home Discount (2011-present)

3.1.22.1 Scheme overview

The Warm Home Discount is an obligation placed on larger energy suppliers. It requires them to provide a payment of £140 per annum, through a credit on their electricity bill, to two groups:

- elderly, low-income consumers, identified as those in receipt of pension credit, for whom payment is universal (1.4m payments in 2014[207]); and

- a broader group, on a first come, first served basis. Individual suppliers have discretion over the make up of the broader group, but typically it includes low income consumers with disabilities or with young children (750k payments in 2014[208]).

The above account for around £200m and £100m annual spending respectively. The remainder of each year's budget of around £320m is delivered by suppliers through industry initiatives.

The Warm Home Discount was initially funded by a levy on energy bills. As part of the UK Government's efforts to reduce bills, the cost was transferred to Government for two years from April 2014.

Payments to those on pension credit are automatic, through a data matching process between the Department of Work and Pensions and energy suppliers.

Payments to broader group consumers are through an annual application process, and the total spend is capped – hence not all of those who qualify will receive support in practice. Application processes for this broader group vary between suppliers, but all rely on evidence of qualifying benefits.

3.1.22.2 Distribution of measures

There are no breakdowns of delivery below GB level. Detailed figures for the delivery of Winter Fuel Payments show that around 8.6 per cent of those payments are made in Scotland[209].

[207] Ofgem, 2015. Warm Home Discount: Annual Report 2014/15
[208] Ibid.
[209] https://www.gov.uk/government/collections/winter-fuel-payments-caseload-and-household-figures

Using that figure would suggest that around 119,000 low income pensioner households, the core Warm Home Discount group, would receive the payment in Scotland.

While the Warm Home Discount takes no account of the energy efficiency of homes, it is very clearly targeted at low-income groups who are at greater risk of fuel poverty, regardless of the energy efficiency of their homes.

3.1.22.3 Key strengths identified

- Payments to all recipients are made through electricity accounts, and so have a direct impact on energy bills.

- The overwhelming majority of payments to the core group are made automatically, avoiding the risk of older eligible consumers not applying.

3.1.22.4 Key limitations identified

- The main limitations relate to the broader group. Eligibility variations (although to a limited extent) between suppliers, and applications must be made annually and total spending is capped, meaning that eligibility in theory will not always translate to receipt of funds in practice.

- The payments are unlikely to reach all fuel poor households. Citizens Advice Scotland have identified the Cold Weather Payments group as a reasonable proxy for those at risk of fuel poverty because of low incomes[210]. The Cold Weather Payments includes the great majority of those eligible for the Warm Homes Discount, but in practice, the Cold Weather Payments group is much larger, at 4.1m consumers, than the number receiving the Warm Home Discount.

3.1.23 Winter Fuel Payments (2000-present)

3.1.23.1 Scheme overview

The Winter Fuel Payment is a UK Government universal benefit, paid at different rates to people over the female state pension age, with rates varying depending on age and personal circumstances (see Table 3.12). It is by far the largest source of financial assistance for energy consumers, with a total value of £2.1bn at UK level in 2015-16[211].

Payments are made automatically to those who qualify using data from the Department of Work and Pensions.

[210] Citizens Advice Scotland, 2015. Designing a Social Security System for Scotland: Winter Fuel and Cold Weather Payments
[211] https://www.gov.uk/government/collections/winter-fuel-payments-caseload-and-household-figures

Table 3.12: Eligibility for Winter Fuel Payments

Circumstance	Born on or before 5 January 1953	Aged 80 or over in the qualifying week
You qualify and live alone (or none of the people you live with qualify)	£200	£300
You qualify and get one of the benefits listed*	£200	£300
You live with someone under 80 who also qualifies	£100	£200
You live with someone 80 or over who also qualifies	£100	£150
You qualify and live with your partner or civil partner and they get one of the benefits listed*	Nil**	Nil**
You qualify but live in a care home and don't get one of the benefits listed*	£100	£150

* Benefits: Pension Credit, income-based Jobseeker's Allowance (JSA), income-related Employment and Support Allowance (ESA)

** Your partner getting the benefit will get the Winter Fuel Payment on your behalf

Source: www.gov.uk

3.1.23.2 Distribution of measures

The funding is targeted using the household circumstances described in Table 3.12 above. In 2014/15, there were 8,871,070 households receiving the Winter Fuel Payment and, of those, 761,630 were households living in Scotland (just under 8.6 per cent)[212].

If the proportion of total spending were consistent with this, Winter Fuel Payments would have been worth some £178.5m in Scotland in the same year. Press reports quote a slightly higher figure of £186m pa[213].

As a universal benefit, the Winter Fuel Payment is not targeted at those in fuel poverty. In Scotland, the most recent SHCS states that 58 per cent of single pensioner households and 44 per cent of 'older smaller' households were in fuel poverty in 2014, so the payments do benefit a significant number of fuel poor households.

3.1.23.3 Key strengths identified

- As payments are universal, they are received by all older households, including those in fuel poverty, without application.

3.1.23.4 Key limitations identified

- The absence of means testing means that around half of the Winter Fuel Payment households in Scotland are unlikely to be in fuel poverty.

[212] https://www.gov.uk/government/collections/winter-fuel-payments-caseload-and-household-figures
[213] http://www.bbc.co.uk/news/uk-scotland-scotland-politics-34517896

3.1.24 Cold Weather Payments (1986-present)

3.1.24.1 Scheme overview

Cold Weather Payments are a UK Government benefit, targeted at a range of lower income households, including lower income pensioners. The trigger for Cold Weather Payments is a run of seven days of sub-zero temperatures, measured at local level, between November and March. Given the weather dependent component, the value of CWPs varies very considerably from year to year.

There was an estimated 415,200 payments to 358,600 recipients in the 2014/15 winter season, with an estimated expenditure of £10,380,000. Of these, it is estimated that 234,800 payments were made to recipients of Pension Credit, with an estimated expenditure of £5,870,000[214]. In contrast, the winter of 2013/14 was very mild, and triggered payments in only one area – Braemar, in the eastern Scottish highlands. Total payments that year were limited to £27,500[215].

Eligibility is determined using DWP data. Recipients must be in receipt of one of the following:

- Pension Credit
- Income Support and income-based Jobseeker's Allowance and one of the following:
    - a disability or pensioner premium
    - a child who is disabled
    - Child Tax Credit that includes a disability or severe disability element
    - a child under 5 living with you
- Income-related Employment and Support Allowance (ESA) and one of the following:
    - the support or work-related component of ESA
    - a severe or enhanced disability premium
    - a pensioner premium
    - a child who is disabled
    - Child Tax Credit that includes a disability or severe disability element
    - a child under 5 living with you
- Universal Credit and one of the following:
    - limited capability for work element
    - the disabled child element
    - a child under 5 living with you

[214] https://www.gov.uk/government/statistics/cold-weather-payments-28-to-31-march-2015
[215] Ibid.

3.1.24.2 Distribution of measures

Of the £10.38m paid across Great Britain in 2014/15, given the colder weather, some £6.7m was spent in Scotland[216], despite the eligible Scottish population being only 10 per cent of the Great Britain total.

Within Scotland, payments were concentrated in rural areas, with the majority of payment districts being in the east of Scotland, and the Grampian / Cairngorm area in particular.

DWP say that 380,000 recipients were eligible in Scotland in 2014/15. Of those, 226,000 received at least one payment. Just over half of those receiving a payment were lower income pensioners[217].

3.1.24.3 Key strengths identified

- Citzens Advice has published research which suggests that the group eligible for Cold Weather Payments is closely linked to those at risk of fuel poverty[218].

- Payments are made automatically to qualifying households.

3.1.24.4 Key limitations identified

- Payments vary considerably and are made in arrears. Consumers therefore don't know whether they can rely on payments until after the cold spell meaning this is unlikely to help increase heating use among those most worried about costs[219].

- There are areas – particularly islands but also urban areas – where fuel poverty rates are high but where Cold Weather Payments are unlikely to be allocated due to warmer temperatures in these areas. The payments are triggered by temperatures, and don't take account of windy conditions, which typically affect the west coast of Scotland.

3.1.25 Learning points from UK-wide cash benefits schemes

- The cash benefits schemes are very well-established and are by far the largest source of financial assistance for energy consumers.

- The automatic payment of many elements of these benefits through the use of Department for Work and Pensions data is a key strength.

- There is significant scope for increased targeting of the fuel poor, particularly with the Winter Fuel Payments.

- There is also scope for Cold Weather Payments to be refined in order to be more sensitive to Scottish climatic conditions.

[216] https://www.gov.uk/government/statistics/cold-weather-payments-28-to-31-march-2015
[217] Ibid.
[218] CSE, 2015. Energy tariff options for consumers in vulnerable situations, for Citizens Advice
[219] Ibid.

Renewable energy schemes

3.1.26 Feed-in-Tariffs (FiTs) (2010-present)

3.1.26.1 Scheme overview

FiTs support organisations, businesses, communities and individuals to generate low-carbon electricity using small-scale (5 MW or less total installed capacity) systems.

The owner of the system gets paid a fixed amount by their energy supplier per kWh of electricity generated. The rates vary depending on:

- system size;
- technology;
- when the system was installed; and
- how energy efficient the home is.

Those eligible to receive FiTs benefit in three ways:

Generation tariff: energy suppliers pay beneficiaries a set rate for each kWh of electricity generated. Once a system is registered, the tariff levels are guaranteed for the period of the tariff (up to 20 years) and are index-linked.

Export tariff: energy suppliers pay a further rate for each unit exported back to the electricity grid. At some stage smart meters will be installed to measure what is exported, but until then it is estimated as being 50 per cent of the electricity generated (systems above 30kWp need to have an export meter fitted).

Energy bill savings: beneficiaries make savings on electricity bills by generating their own electricity and buying less from their energy supplier.

The FiTs scheme licensee (electricity supplier) makes quarterly payments to the generator. Licensees recoup these payments through the electricity bills of their customers. The domestic bill impact is estimated at £9 per annum per household on average[220].

FiTs are still in operation but the tariff has been progressively reduced. When the scheme started, domestic PVs earned 43.3p/kWh. From January 2016 this has been cut to just 4.39p/kWh.

The technologies covered are:

- solar photovoltaic (PV) panels;
- wind turbines;
- hydro turbines;
- anaerobic digestion (biogas energy); and

[220] DECC, 2015 Performance and Impact of the Feed-in Tariff Scheme: Review of Evidence Final Report

- micro combined heat and power (micro-CHP).

There were 682,511 FiTs installations to the end of March 2015, of which 640,344 were domestic installations. Total electricity generation was 2,645 GWh in Year 4, providing almost 1 per cent (0.84 per cent) of the UK's final electricity consumption. 60MW of community and shared ownership is supported almost entirely by the FiTs[221].

Home owners applying for a FiT are obliged to undertake a home energy check to make sure their home is as energy-efficient as possible. The resulting EPC is used to work out the FiTs rate.

3.1.26.2 Distribution of measures

DECC publishes a breakdown of installed capacity under FiTs by region[222]. The latest report (2015) shows installed capacity under FiTs for:

- England was 2,774MW;
- Wales 206MW; and
- Scotland 346MW.

3.1.26.3 Key strengths identified

- Very successful in achieving a high number of domestic renewable electricity installations and in supporting school/community owner projects.
- Achieved market transformation of solar PV, contributing to a significant reduction in the price of installations[223].
- Households with FiT-supported renewable energy installations reduce electricity use from the grid and are more likely to also have energy efficiency measures installed. The properties involved are typically large, detached and between 30 and 70 years old[224].
- Public take-up of carbon reduction measures has been encouraged through the FiT not only directly through the uptake of FiT supported technologies, but also through increased energy awareness[225].

3.1.26.4 Key limitations identified

- Since FiTs are funded through energy bills, it constitutes a regressive tax and could have a negative impact on fuel poverty.
- The significant and sudden cuts to the FiTs caused significant disruption to the industry, and there is now considerable uncertainty about the future of FiTs, which further undermines confidence within the market.

[221] DECC, 2015. Performance and Impact of the Feed-in Tariff Scheme: Review of Evidence Final Report
[222] DECC, 2015. Sub regional Feed in Tariffs statistics.
[223] DECC, 2015. Performance and Impact of the Feed-in Tariff Scheme: Review of Evidence Final Report
[224] Ibid.
[225] Ibid.

3.1.27 Renewable Heat Premium Payments (RHPP) (2012-2013)

3.1.27.1 Scheme overview

The RHPP scheme was a Government financial support scheme, administered by EST, which provided one-off grants to help householders and landlords with the cost of installing one of the following renewable heat technologies:

- ground and water source heat pumps (GSHPs);
- air source heat pumps (ASHPs);
- solid biomass boilers; and
- solar thermal systems.

During the lifetime of the RHPP, financial support was given through a Householder Scheme, a number of competitions for Registered Social Landlords, and a Community Scheme. The RHPP scheme closed in March 2014 and support in the take-up of renewable heat technologies in the domestic sector is now provided by the Domestic Renewable Heat Incentive scheme.

The RHPP Phase Two Scheme was directed to help support the renewable heat industry in the period before the domestic Renewable Heat Incentive could be introduced; and to learn about the performance and use of domestic renewable heat installations.

For the householder element of the Scheme, any householder could apply for solar thermal, but only people living in areas off the national gas grid were eligible to apply for heat pumps and biomass boilers.

The off-gas grid eligibility criterion did not apply for the social landlord and communities elements of the Scheme, although it was used as a criterion when rating applications for funding.

Across all phases of the Scheme (but excluding the RHPP2 Extension phase) and all customer groups, 15,634 installations received grant assistance under the RHPP Scheme. Of these,

- 70 per cent were installed by private households (including households in the Communities Scheme); and
- 30 per cent in social housing.

By technology:

- heat pumps accounted for 59 per cent;
- solar thermal for 29 per cent; and
- biomass boilers for 12 per cent[226].

3.1.27.2 Distribution of measures

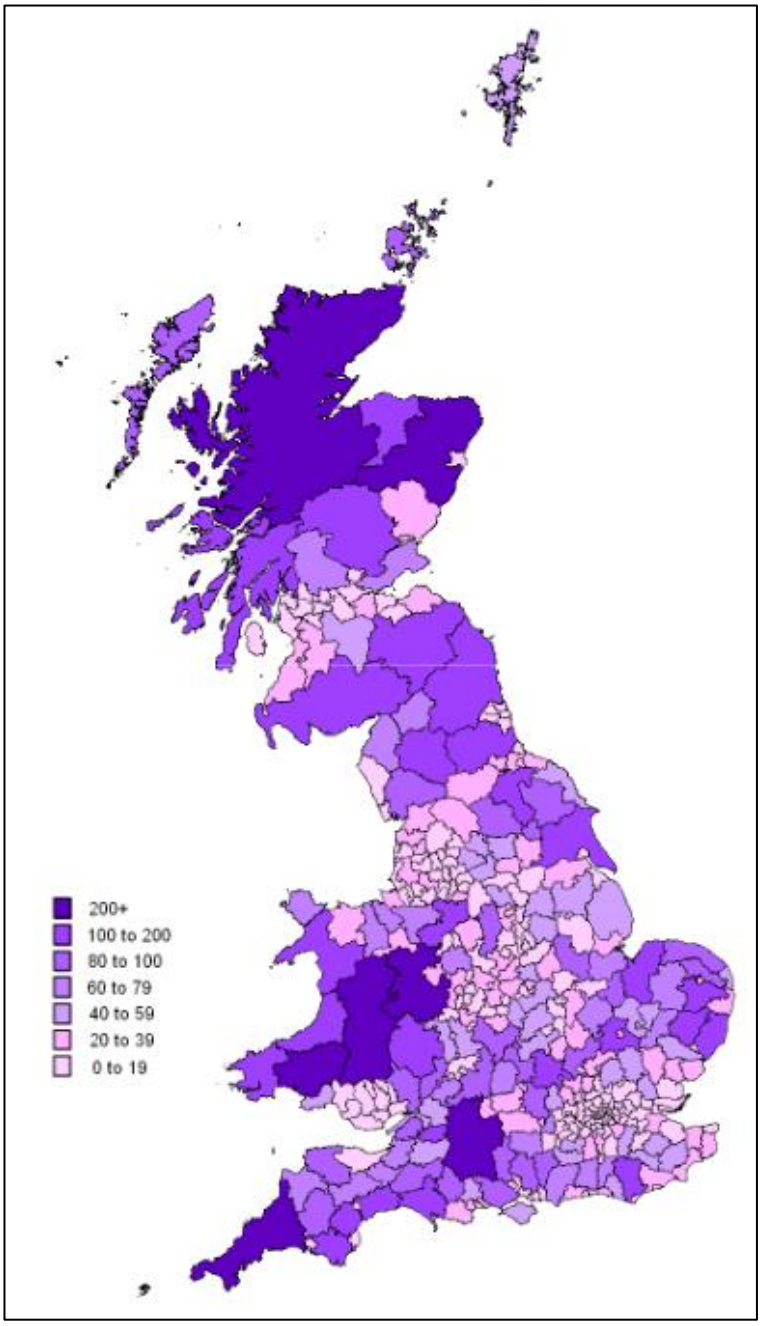
Of the total 15,364 claimed vouchers:

[226] www.gov.uk/government/uploads/system/uploads/attachment_data/file/386859/RHPP.pdf

- 12,046 (78 per cent) were claimed in England;
- 1,933 (13 per cent) were claimed in Scotland; and
- 1,385 (9 per cent) were claimed in Wales[227].

Figure 3.18 shows that higher numbers of RHPP vouchers were claimed in more rural local authority areas, with Highland and Aberdeenshire attracting particularly high numbers.

Figure 3.18: Distribution of RHPP vouchers



Source: DECC

[227] www.gov.uk/government/uploads/system/uploads/attachment_data/file/386859/RHPP.pdf

3.1.27.3 Key strengths identified

- RHPP boosted confidence in the renewable heat market, signalled the introduction of the domestic Renewable Heat Incentive (below) and provided opportunities for housing associations to incorporate renewable heating into their property portfolio[228].

- The scheme helped to provide both funding continuity for installers and incentives to end-users in the absence of the domestic RHI[229].

- Installations in social housing offered opportunities for the growth of renewable heat technologies markets[230].

- The programme provided an opportunity to 'road test' the viability of new technologies in different settings and provided an important demonstration effect[231].

3.1.27.4 Key limitations identified

- Despite the RHPP, the evaluations found that installers emphasised that a number of barriers still existed to the wider market development of renewable heat technologies. The main reason for customers not installing renewable heat technologies was the high initial capital cost.

- The challenging timescales limited the capacity of communities to develop installations[232].

- There was no evidence from installers that the RHPP scheme leveraged new products into the UK market or stimulated innovation[233].

3.1.28 Renewable Heat Incentive (RHI) (2014-present)

3.1.28.1 Scheme overview

The Renewable Heat Incentive (RHI) is a UK Government scheme set up to encourage uptake of renewable heat technologies amongst householders, communities and businesses through financial incentives. It is the first of its kind in the world and the UK Government expects the RHI to contribute towards the 2020 ambition of 12 per cent of heating coming from renewable sources. The tariffs are paid for through general taxation.

The domestic RHI scheme aims to

- incentivise the roll out of renewable heating systems in the domestic sector to help meet part of heat's share of the 2020 renewable target; and

- prepare for mass rollout of renewable heating technologies in the domestic heating sector during the 2020s by building sustainable supply chains, improving performance, reducing costs and reducing the barriers to take-up of these technologies.

The RHI tariffs, which are paid to the owner of the renewable heating system for seven years, have been set by the UK Government at a level designed to compensate for the difference

[228] DECC, 2015, Evaluation of the Renewable Heat Premium Payment Scheme Phase 2
[229] CAG Consultants, 2013, Interim evaluation of the RHPP Phase 1, for the Energy Saving Trust
[230] DECC, 2015, Evaluation of the Renewable Heat Premium Payment Scheme Phase 2
[231] Ibid.
[232] Ibid.
[233] Ibid.

between the costs of installing and operating renewable heating systems and fossil fuel systems, including non-financial costs such as disruption, on the basis of 20 years of heat produced.

The RHI is currently being reviewed. The Government intend to reform the RHI to improve value for money and reduce costs; improve cost control and budget management; and explore the best way to support less able to pay households. As part of this, DECC has said it does intend to include third parties in the scheme if possible (so that third parties could help fund the cost of measures and then receive part of the payment) and is investigating how best it might achieve this.

The eligible technologies are:

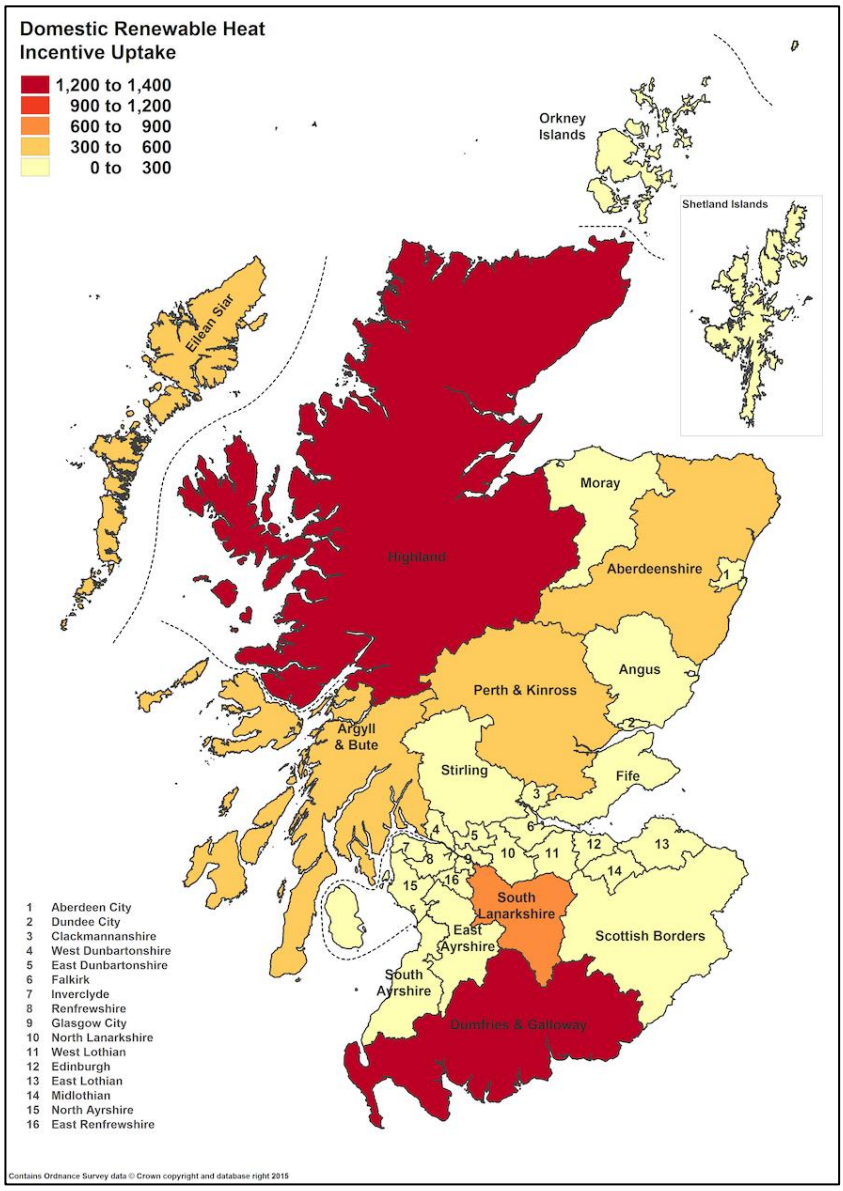
- biomass (wood fuelled) boilers;
- biomass pellet stoves with integrated boilers providing space heating;
- ground to water heat pumps;
- air to water heat pumps; and
- solar thermal panels (flat plate or evacuated tube only) providing hot water.

3.1.28.2 Distribution of measures

By April 2015, almost 33,000 RHI systems had been accredited. 6,314 of these were in Scotland (almost 20 per cent)[234]. Figure 3.19 shows that Highland and Dumfries & Galloway have achieved particularly high numbers of RHI systems.

[234] Ofgem, 2015. Domestic RHI Quarterly report, May 2015

Figure 3.19: Distribution of domestic RHI uptake



Source: DECC

3.1.28.3 Key strengths identified

- Provides assistance to many off-gas households. Analysis of the first 10,000 RHI accreditations showed that almost half of Domestic RHI members used oil as their previous fuel type, suggesting that many people who are off gas-grid are benefitting from the scheme[235].

- By encouraging renewable heat technologies, the scheme is making a contribution to the decarbonisation of the domestic heating system and to the development of the renewable heat supply chain.

- Being paid for through general taxation rather than energy bills (like FiTs) means the scheme is not regressive.

[235] Ofgem, 2014 The first 10,000 Domestic Renewable Heat Incentive accreditations

- The early review of the scheme highlights the quick and straightforward application process[236].

3.1.28.4 Key limitations identified

- It is likely that many of those who benefit from the RHI are wealthier homeowners who are able to afford the upfront cost of investment in the heating system.

3.1.29 Energy Savings Scotland Home Renewables Grant (2007-2010)

3.1.29.1 Scheme overview

The Energy Savings Scotland Home Renewables Grant, formerly known as the Scottish Communities and Households Renewables Initiative, was funded by Scottish Government and offered householders grants of 30 per cent of the cost, up to a maximum of £4,000, for the installation of renewable technologies.

The scheme ceased in 2010 when grants for renewables could no longer be sustained given the increasing constraints on the Scottish Government's budget.

The main technologies supported through the scheme were solar water and space heating, heat pumps (ground, air and water source), wood fuel boilers and automated biomass stoves.

The Scottish Government also provided funding to the Energy Saving Trust to deliver free, bespoke and impartial renewable energy advice to interested homeowners. Advisors could recommend which renewables systems were suitable and also advise on appropriate energy efficiency measures. Following a home visit, advisors sent a personalised report detailing their recommendations, information on potential carbon and financial savings and guidance on next steps.

The following measures were required as a Condition of Grant 'where appropriate and practical':

- loft insulation to 270mm;
- cavity wall insulation where relevant;
- energy efficient light bulbs in all appropriate fittings in main rooms; and
- basic controls for the heating system including a room thermostat and a programmer/timer.

A total of £7.4m of funding was allocated through the scheme[237]. The Government claimed that 2,900 householders had been helped to cut their fuel bills through the scheme, but it is not clear if this includes those who benefited from the EST advice[238].

3.1.29.2 Distribution of measures

No data is available on the distribution of measures.

[236] DECC, 2014. Evaluation of the Renewable Heat Incentive, Interim report from Waves 1-4 of the domestic RHI census of accredited applicants
[237] www.yougen.co.uk/blog-entry/1505/Scottish+home+renewables+grants+expected+to+close+in+3+weeks
[238] http://archive.scottish.parliament.uk/business/pqa/wa-10/wa0324.htm

3.1.29.3 Key strengths identified

- Combining the grants with advice is likely to have generated significant additional benefits in terms of savings in energy use through the installation of complimentary measures and wider behaviour change.

3.1.29.4 Key limitations identified

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.30 Home Energy Scotland Renewables Loans (2015-present)

3.1.30.1 Scheme overview

The scheme provides interest-free loans for owner occupiers of up to £10,000 for 75 per cent of the cost of installations of renewable electricity and heat technologies and up to £5,000 for 100 per cent of the cost of connections to renewables-fired district heating schemes.

The amount that can be borrowed depends on what is being installed, and applicants can choose the repayment period (in years) that they prefer, up to a set maximum.

The Scottish Government is particularly keen that the scheme benefits homeowners who would like more support with their fuel bills or who are heating homes in off-gas areas.

The purpose of the scheme is to help more Scottish householders install a renewables system, further support Scotland's microgeneration industry and contribute towards Scotland's climate change targets. In addition, it is hoped this loan scheme will help as many Scottish householders as possible to install a renewable heating system so they can benefit from RHI payments.

To maximise carbon dioxide reductions and energy saved, a minimum level of energy efficiency measures are a requirement of the loan.

In all cases, a Green Deal Assessment needs to be carried out, the cost of which can be included in the loan application. A condition of the loan is that the following energy efficiency measures are provided; cavity/loft insulation where appropriate, heating controls and low energy lighting.

Eligible technologies include:

- solar PV;
- wind turbine;
- hydro turbine;
- solar water heating system;
- hybrid PV -solar water heating system;
- air, ground and water source heat pumps; and
- wood-fuelled (biomass) stoves and boilers.

3.1.30.2 Distribution of measures

No data is available on the distribution of loans.

3.1.30.3 Key strengths identified

- By providing assistance with upfront costs, this scheme should broaden the impact of the domestic RHI and FiTs in Scotland.

3.1.30.4 Key limitations identified

- The loans available do not cover the full costs of the installations so upfront costs will remain a barrier for many households, particularly those on lower incomes and/or in fuel poverty.

- It is unclear whether a formal evaluation of the scheme has been commissioned.

3.1.31 Community and Renewables Energy Scheme (CARES) (2013-present)

3.1.31.1 Scheme overview

The CARES loan fund aims to provide loans towards the high risk, pre-planning consent stages of renewable energy projects which have significant community engagement and benefit. The scheme is managed on behalf of Scottish Ministers by localenergyscotland.org. The purpose of the scheme is to support the development of locally-owned renewable energy projects which provide wider community benefits.

Preference is given to proposals that demonstrate the highest value of wider community benefit.

Any renewable energy project, up to 5 MW, requiring financial outlay prior to planning consent is, in principle, eligible. Loans of up to £150,000 are available, covering up to 90 per cent of agreed costs. The interest rate is fixed at 10 per cent.

A network of Development Officers provides communities and rural businesses with advice and support and encourage knowledge sharing with other projects by developing case studies and attending events.

No outputs data is available.

3.1.31.2 Distribution of measures

No data is available on the distribution of measures.

3.1.31.3 Key strengths identified

- Providing advice and support alongside the loans should increase uptake and impact.

- A high level of funding is available.

3.1.31.4 Key limitations identified

- The 10 per cent interest rate may prove prohibitive for some schemes.

- No formal evaluation appears to have been carried out, meaning very little evaluation evidence is available.

3.1.32 Learning from renewable energy schemes

- The renewable energy schemes have been popular and have successfully driven uptake in domestic renewable technologies.

- However, sudden and significant changes to the level of support available have damaged the sector and led to uncertainty in the market.

- Renewable energy schemes which are paid for through energy bills are regressive.

- There is no evidence that the renewable energy schemes which have operated to date have had a significant impact on rates of fuel poverty, with most likely to have delivered benefits largely for higher income households.

- Formal evaluation is absent from the Scottish schemes. This represents a significant missed opportunity both to improve the management of schemes and to inform the development of future schemes.

4 Geographic analysis

Approach

This section sets out the findings from our analysis of the geographic distribution of energy efficiency and fuel poverty interventions under previous and current energy efficiency and fuel poverty schemes that have operated in Scotland.

The following data sources have been used:

- 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 is published by Ofgem[239]
- The Scottish Government supplied local authority-level data on measures installed under HEEPS:ABS in 2013/14

In addition to the mapping of data on measures installed, the following data has also been utilised:

- Data from the Scottish House Condition Survey[240] has been used to assess the geographic distribution of the remaining need for energy efficiency measures
- Analysis of the correlation between the distribution of energy efficiency interventions and other variables has been conducted using:
    - Datazone-level data on mains gas connections published by DECC[241]
    - Datazone- level data on rurality published by the Scottish Government[242]
    - Datazone-level data on income deprivation from the Scottish Index of Multiple Deprivation 2012[243]

[239] Ofgem (2015) Ofgem E-Serve in Scotland by Numbers.
[240] 3-year averages are used for the local authority-level data. The latest data is for 2012-14. http://www.gov.scot/Topics/Statistics/SHCS/keyanalyses/LAtables2014
[241] calculated using Lower Layer Super Output Area (LSOA) domestic gas consumption, 2013 (www.gov.uk/government/statistics/lower-and-middle-super-output-areas-gas-consumption) and total number of households per data zone from the 2011 Census
[242] http://www.gov.scot/Publications/2014/11/2763/downloads

- Data on rates of fuel poverty from the Scottish House Condition Survey

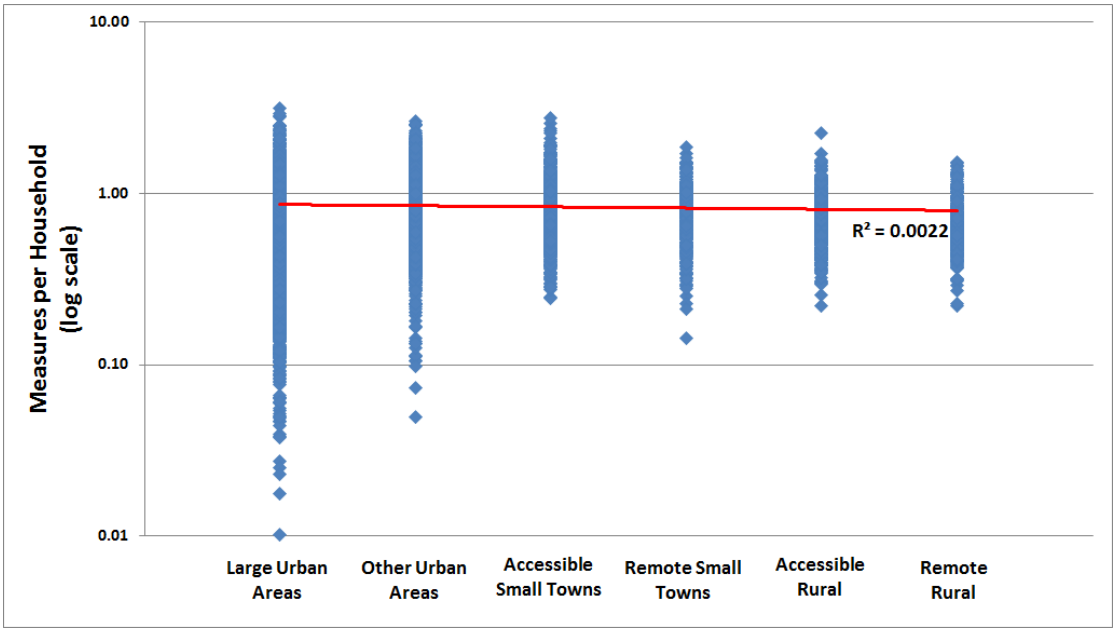
Distribution of energy efficiency interventions

The distribution of energy efficiency measures contained in HEED is shown in Figure 4.2 below. Further mapping of the distribution of individual measures is included in Appendix B.

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 4.3), 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. Figures B.7 to B.10 in Appendix B show the distribution of total measures in Eilean Siar, Argyll & Bute, Shetland and Dundee City.

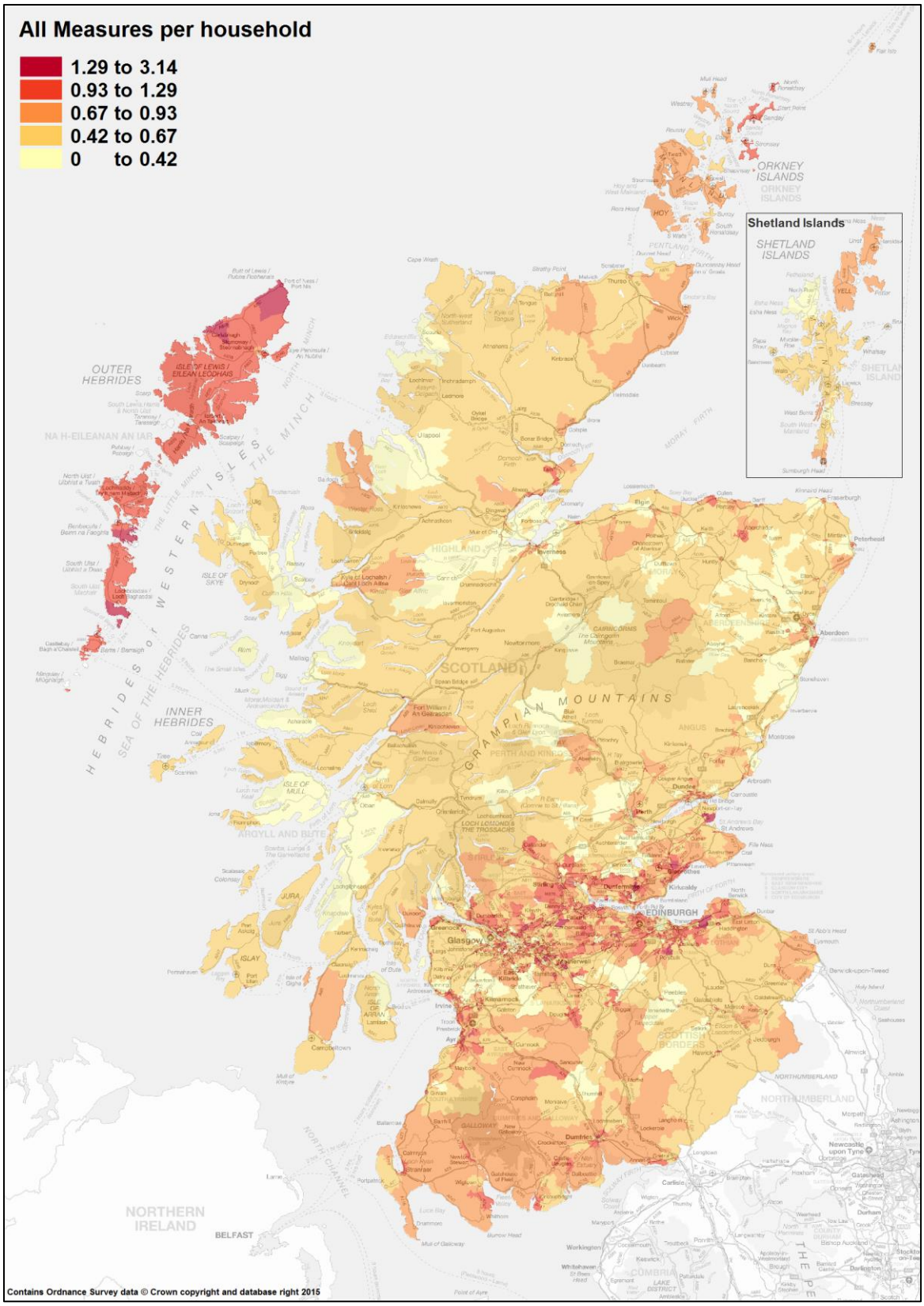
Some areas outside of the central belt have high intervention rates, with Eilean Siar standing out as a particular example. Figure 4.1 shows the relationship between the intervention rate in a datazone (number of measures per household) and the urban-rural classification of that datazone. It shows that overall, there is a very weak linear correlation[244] between intervention rate and urban-rural classification, i.e. no significant bias overall in the delivery of measures towards urban areas.

Figure 4.1: Correlation between total measures per household in HEED and urban-rural classification[245], at datazone level[246]



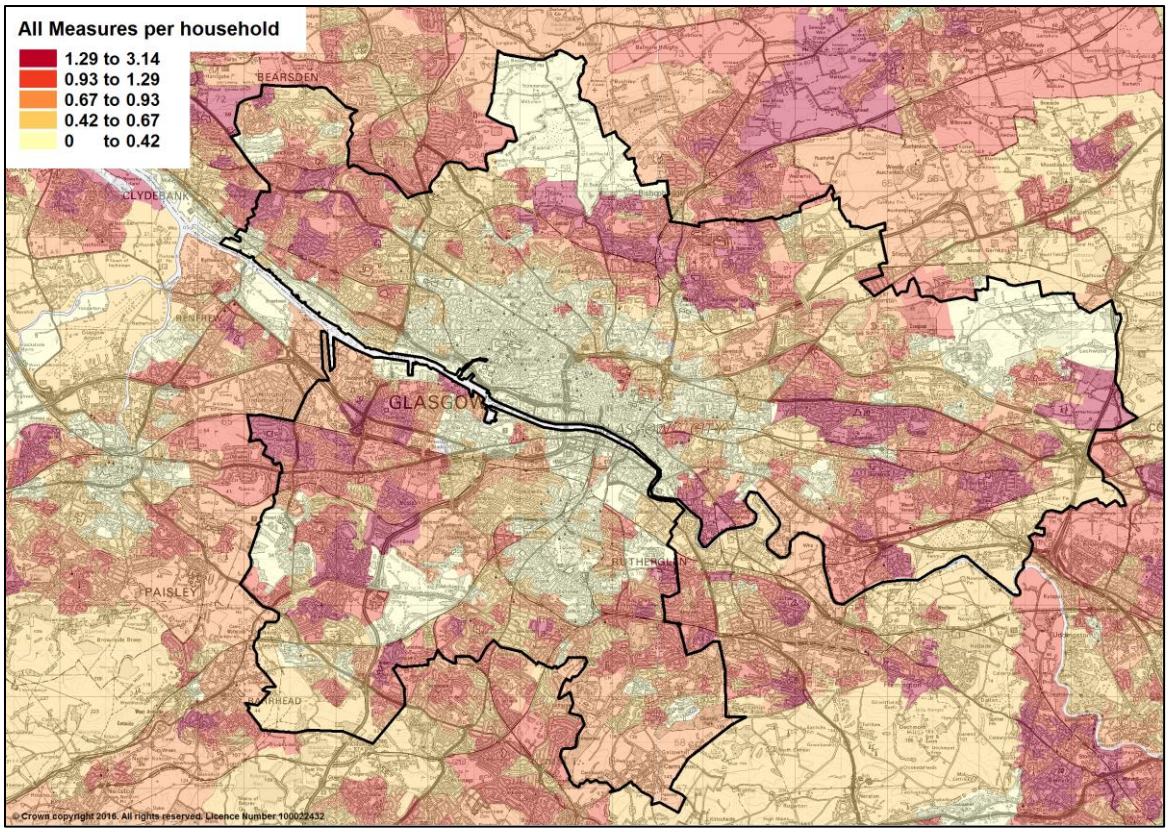
[243] http://www.gov.scot/Topics/Statistics/SIMD
[244] R^2 is the correlation coefficient, i.e. the strength of the relationship between the two variables. An R^2 value of 1 would indicate a perfect relationship, 0.5 a moderate relationship. In this case the R^2 value is 0.0022.
[245] Urban-rural classification data is published by Scottish Government - http://www.gov.scot/Publications/2014/11/2763/downloads
[246] 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 4.2: Intervention rate (number of measures per household) for all measures[247] at datazone level, Scotland



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

Figure 4.3: Intervention rates (number of measures per household) for all measures[248] at datazone level, Glasgow City



Whilst the overall analysis shown in Figure 4.1 and Figure 4.2 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 4.1 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 4.3) 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.

Table 4.1: Average intervention rates (number of measures per household) for all measures 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**

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

The schemes included in HEED had a focus on basic measures, particularly loft insulation, cavity wall insulation, boiler replacements and other heating system upgrades. The data supports the conclusion that the majority of available opportunities for delivery of such measures, whether urban or rural, have been taken. It may be that there was an initial bias towards urban areas, where access is often easier and greater economies of scale can be achieved, and that urban areas may have therefore benefited from these measures for a longer period. However, delivery of such measures may well now be moving towards saturation point across the country.

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 4.4). There is less of a bias evident in HEEPS: ABS (Figure 4.5), which is smaller in scale than ECO. This is due to the fact that funding is distributed across all local authorities in Scotland.

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.

Figure 4.4: Intervention rate (number of measures per household) for all measures under ECO at local authority level, Scotland

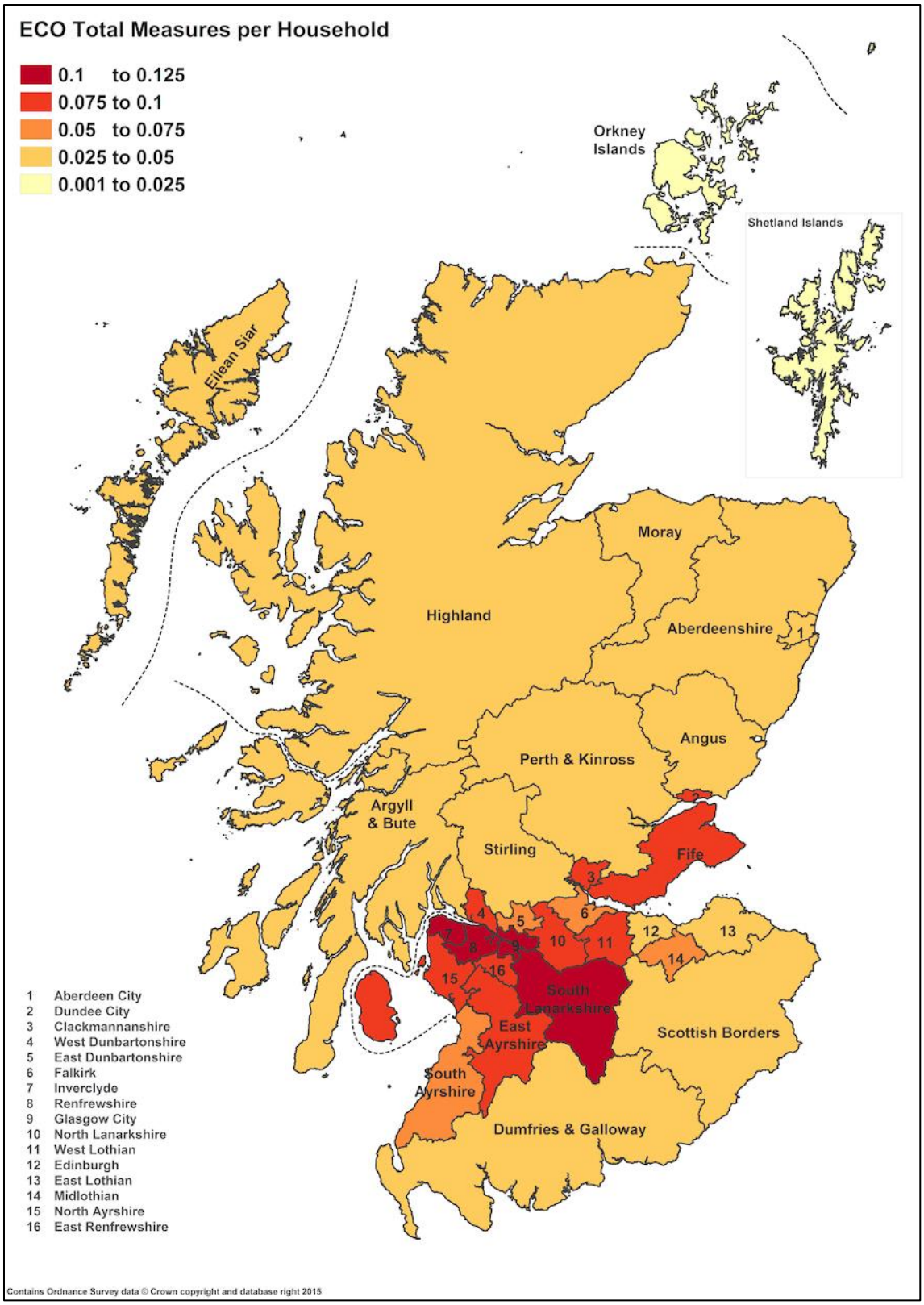
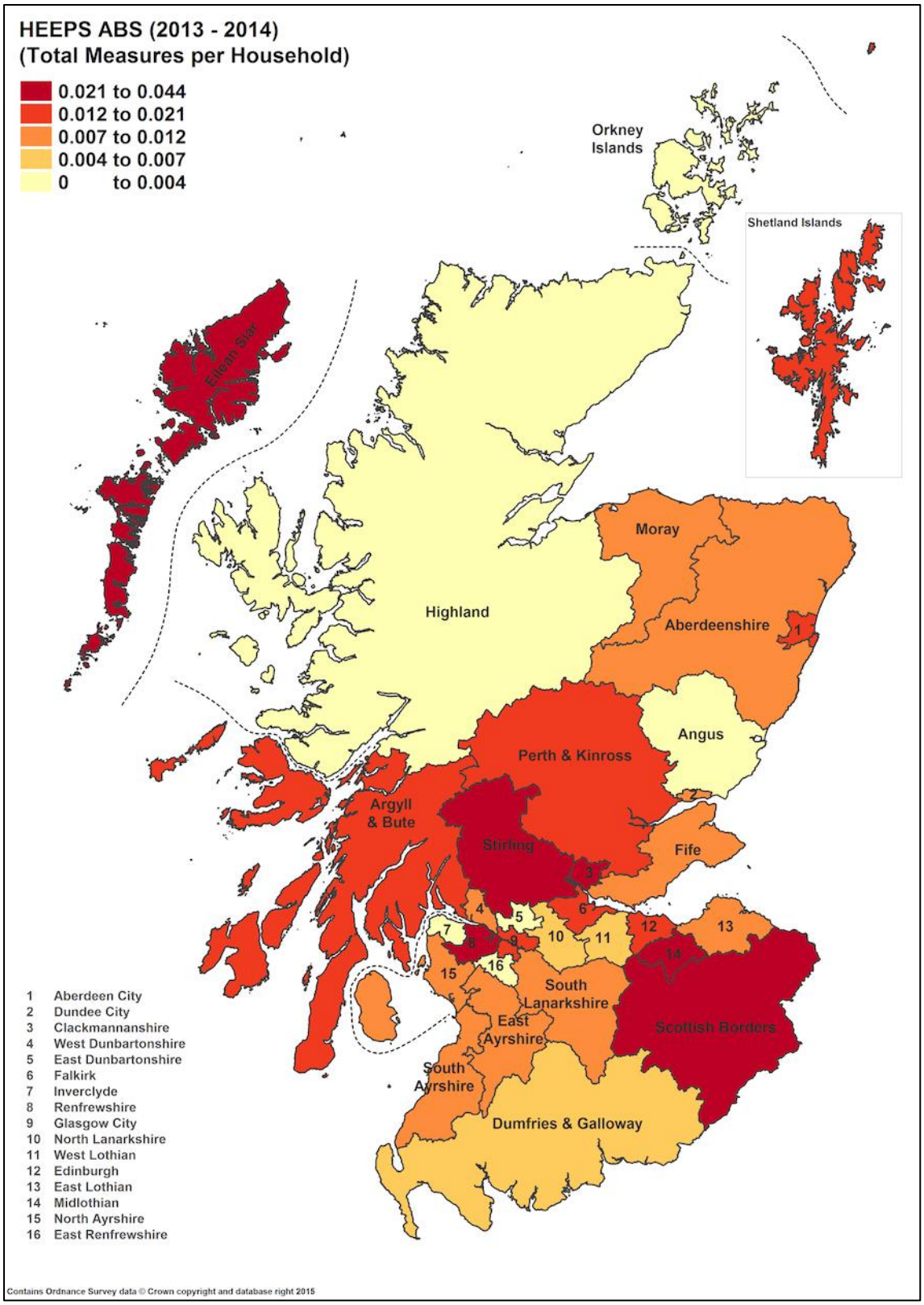


Figure 4.5: Intervention rate (number of measures per household) under HEEPS:ABS 2013/14 at local authority level, Scotland



Distribution of remaining need for energy efficiency interventions

Scottish House Condition Survey data provides an indication of the geographic distribution of the remaining need for energy efficiency interventions. Some caution needs to be applied to this data as it is a sample-based survey, with a relatively small sample size. Local authority level data is averaged over three years to increase robustness. Figures 5.6 to 5.9 show the remaining need for:

- cavity wall insulation;
- loft insulation;
- central heating; and
- solid wall insulation.

In addition, figure 5.10 shows the distribution of houses with an EPC energy efficiency rating of F or G.

The data suggests that there remains significant potential for cavity wall insulation, particularly in local authorities along the west coast of Scotland, suggesting that there will continue to be scope to deliver significant levels of cavity wall insulation in the short to medium term. However, the real remaining potential for cavity wall insulation is likely to be less than the data suggests because of two main factors:

- the SHCS is likely to underestimate the presence of cavity wall insulation as it is reliant on external visual inspection and the recall of the householder (stakeholders at the workshop confirmed that cavity-walled properties are sometimes found, unexpectedly, to already have insulated cavities);
- some of the remaining uninsulated cavity walls will be problematic to fill. This might be caused by, for example: access difficulties caused by physical features such as conservatories; unsuitable wall construction; or the need for several householders to consent to the work, as in the case of flats.

The remaining potential for loft insulation is far less significant and this may also be overestimated by the survey. In addition, there will be a core of people who are resistant to the installation of such energy efficiency measures in their homes and, taking this into account, the data supports the conclusion that delivery of these measures is reaching saturation point.

The remaining potential for solid wall insulation is very significant however, with more than 90 per cent of solid walls remaining uninsulated in large parts of the country, and an estimated 88 per cent overall. There is no clear pattern to the distribution of these opportunities, with all areas having high levels.

However, the data on the percentage of properties with a low energy efficiency rating (F or G) suggests that the more acute need for improvements in energy efficiency is focused away from the central belt, in the more rural northern and southern parts of the country and the islands. Contrasting this with where ECO and HEEPS: ABS are currently achieving high rates of delivery, suggests there is a need for increased efforts to push delivery out to some of the more rural local authority areas – Highland, Orkney Islands and Dumfries & Galloway stand out as areas where there is a high percentage of F & G rated homes but relatively low levels of delivery under current schemes.

Figure 4.6: Percentage of dwellings with uninsulated cavity walls

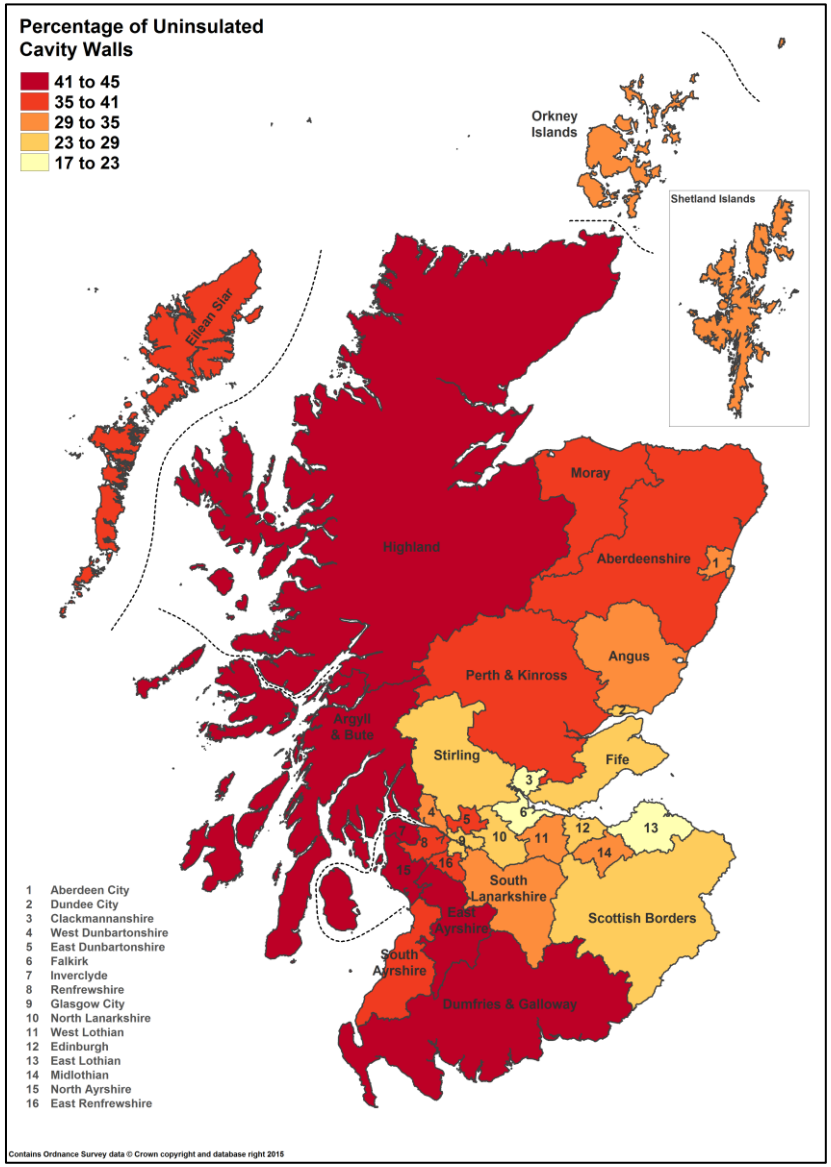


Figure 5.7: Percentage of dwellings with less than 100mm of loft insulation

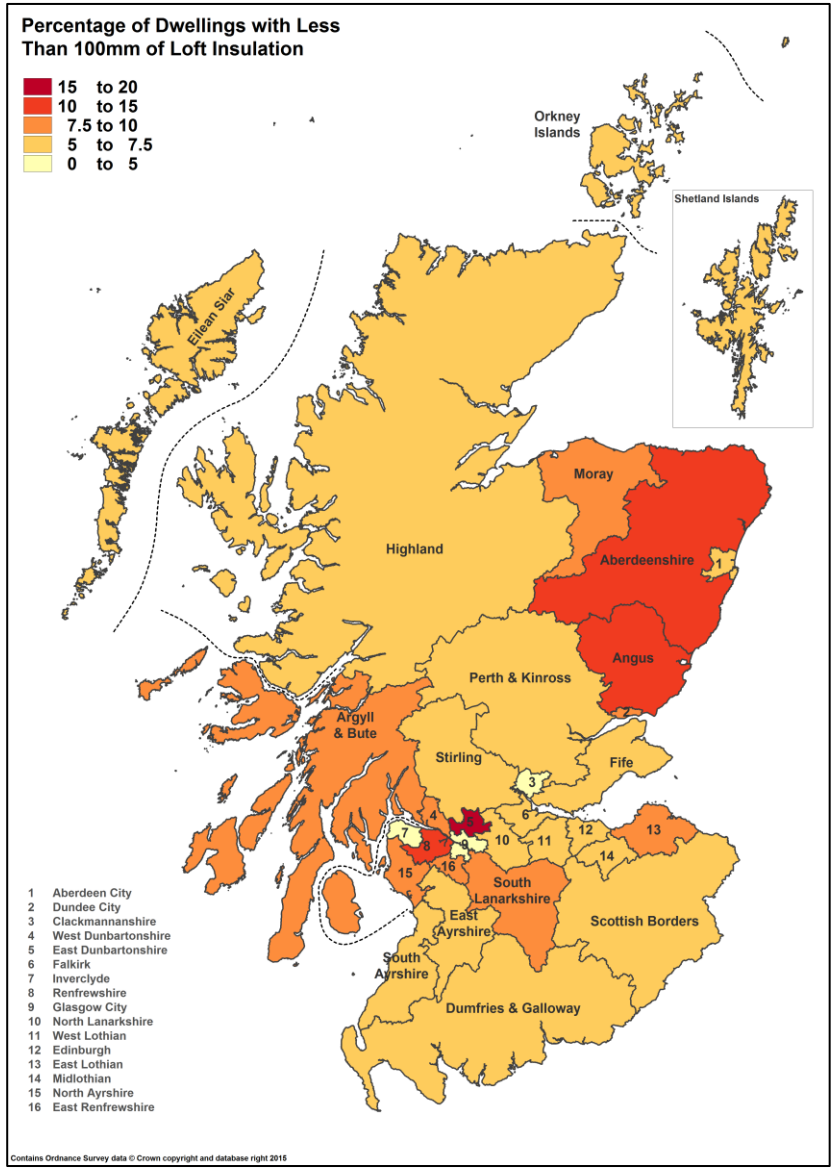


Figure 4.8: Percentage of dwellings with uninsulated solid walls

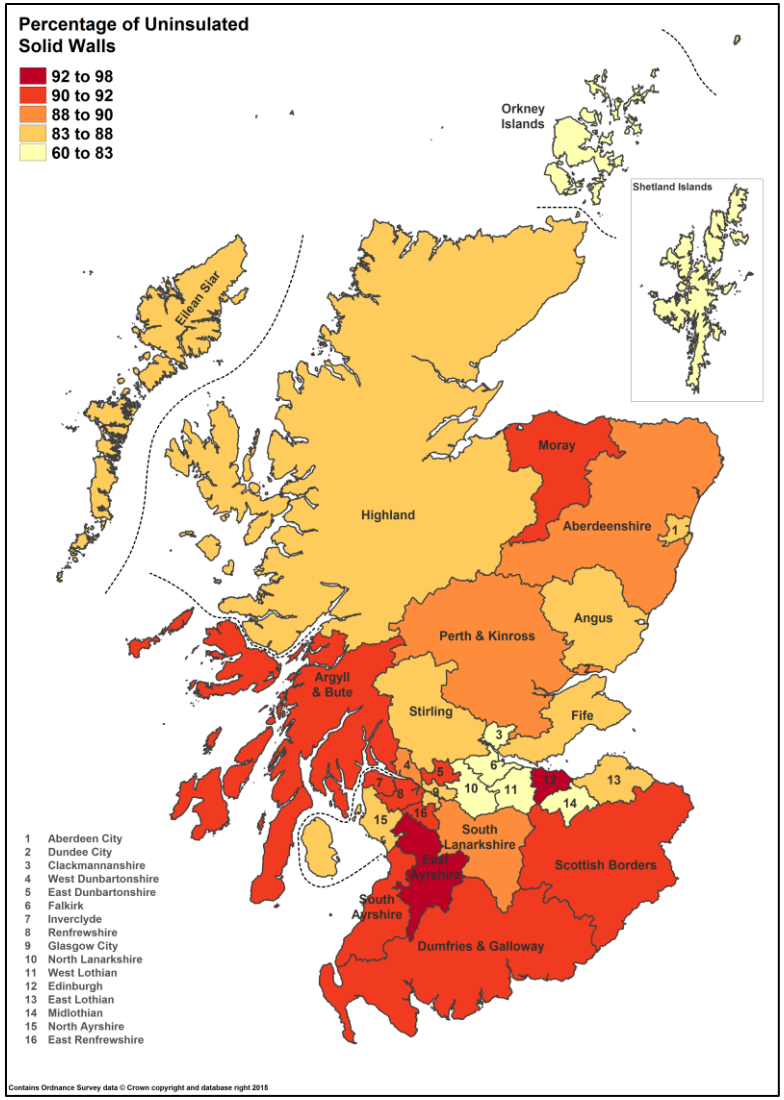
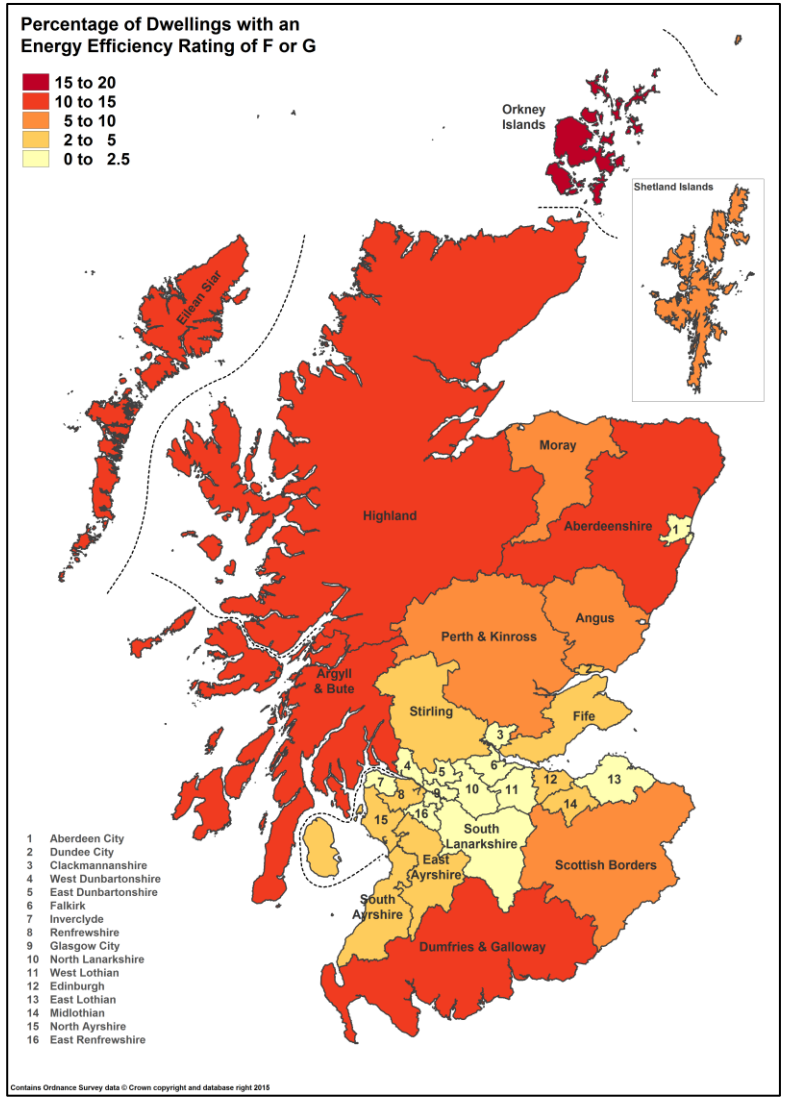


Figure 5.9: Percentage of dwellings with an energy efficiency rating of F or G[249]



[249] SAP 2009 (running costs) is used to calculate the energy efficiency rating

Correlation between energy efficiency interventions and need

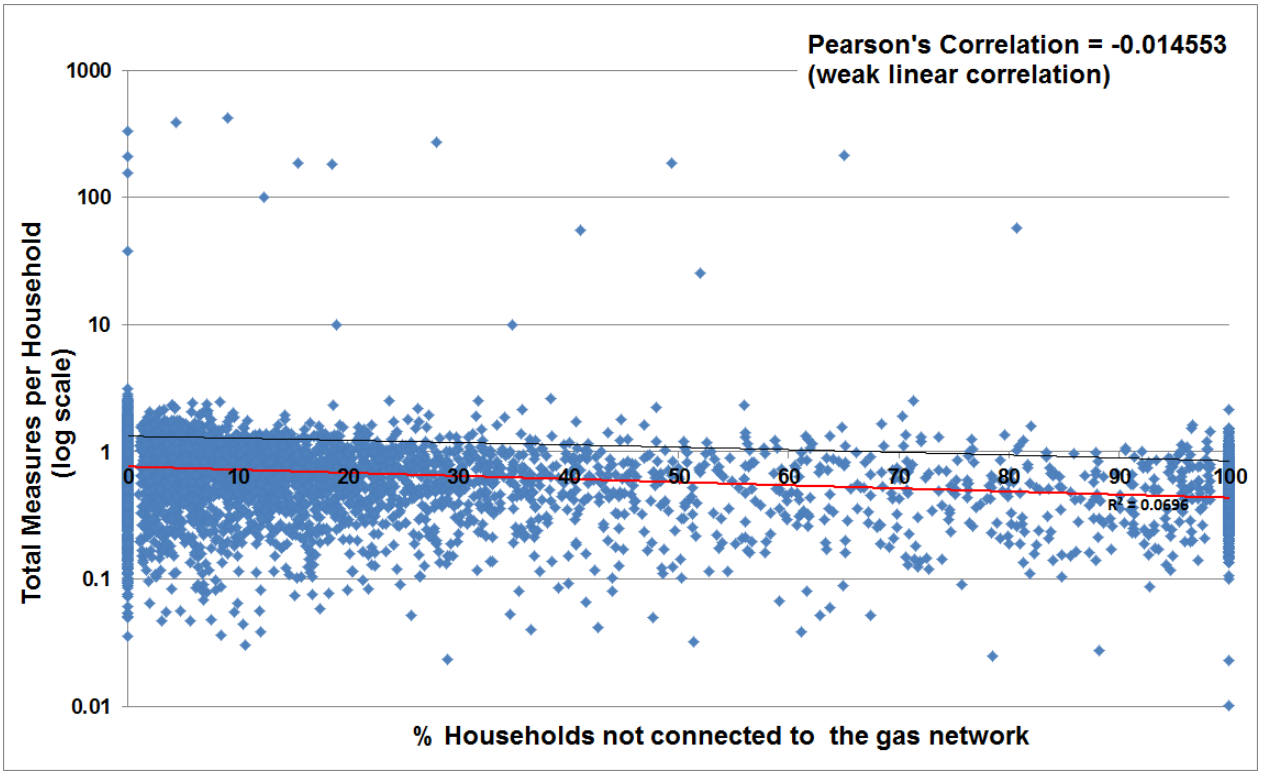
The analysis presented so far has established that the distribution of energy efficiency interventions delivered up until the start of ECO was relatively equitable in geographic terms, although it is likely that urban areas benefited for longer. The delivery of solid wall insulation measures to date has had an urban bias.

The extent to which previous delivery correlates with the percentage of off-gas households and with deprivation has also been analysed. The analysis shows a weak linear correlation between total measures per household (from HEED) and both:

- the percentage of off-gas households; and
- the rank of income deprivation.

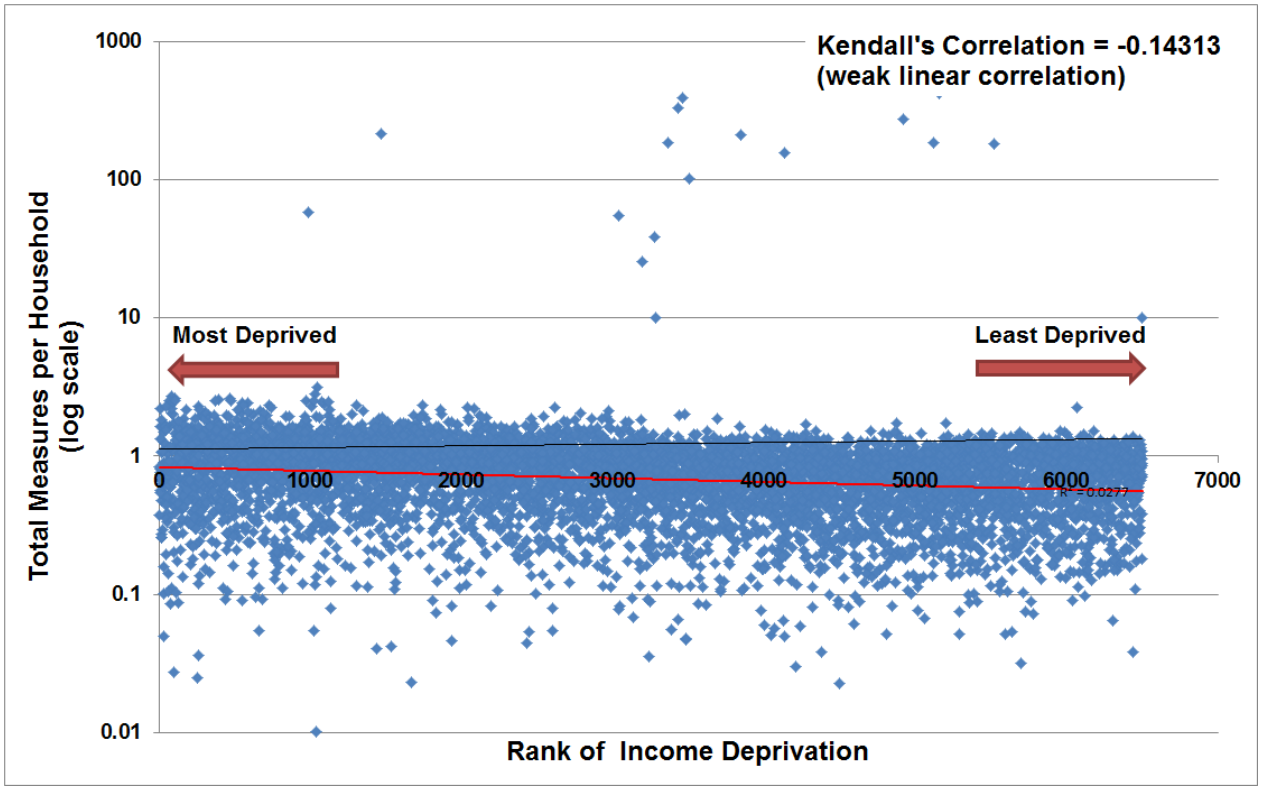
This suggests that, at least up until the commencement of UHIS and ECO, there had been a slight bias in the delivery of measures towards on-gas areas and towards areas with higher levels of income deprivation.

Figure 4.7: Correlation between total measures per household in HEED and percentage of off-gas households[250], at datazone level



[250] Percentage of off-gas households is calculated using gas metering data provided by DECC (Lower Layer Super Output Area (LSOA) domestic gas consumption, 2013 - https://www.gov.uk/government/statistics/lower-and-middle-super-output-areas-gas-consumption) and data on the total number of households per data zone according to the 2011 Census.

Figure 4.8: Correlation between total measures per household in HEED and rank of income deprivation, at datazone level



5 Conclusions

Where we are now

Scotland has in place:

- a statutory obligation that requires Scottish Ministers to eradicate fuel poverty, as far as reasonably practicable, by November 2016[251]; and
- a legally-binding requirement that Scotland's greenhouse gas (GHG) emissions are reduced annually, up to future target dates in 2020 and 2050[252].

Retrofitting energy efficiency measures in Scotland's existing housing stock has been identified as central to achieving both and Scottish Government has announced that improving the energy efficiency of all domestic and non-domestic buildings in Scotland will be designated a national infrastructure priority.

As a result of significant effort and investment in energy efficiency and fuel poverty schemes, the modelled energy efficiency of Scotland's homes has been improving year-on-year. This has been driven in particular by installations of loft and cavity wall insulation delivered by mass-market programmes, complemented by increasing levels of efficient boilers. In contrast to insulation measures, the majority of replacement boilers are installed by private householders.

Despite this progress, modelled rates of fuel poverty have continued to rise, largely as a result of rising energy costs, with the latest figures suggesting that more than a third of Scottish households are fuel poor[253]. While increased energy efficiency helps to mitigate fuel poverty, the evidence shows that it is not sufficient on its own to eliminate it. Many low-income consumers in more efficient houses remain in fuel poverty.

It is clear that there will be continuing downward pressure on public spending which will impact on the resources available to meet the challenges of energy efficiency and fuel poverty. In contrast, the physical measures which will be required to meet these challenges will be increasingly expensive, and there is a need for more intensive support to households beyond the physical measures in order to maximise the energy saving gains from these measures and to provide the more holistic support (such as advice on behaviour change and benefit and tariff checks) which is often needed to lift households out of fuel poverty.

There is currently a complex delivery landscape, with multiple schemes, many overlapping, some short term and often subject to significant changes. This makes it challenging and uncertain for those involved in delivery, but also confusing for consumers.

The Scotland-specific schemes appear to have been effective in countering much of the central-Scotland bias apparent in delivery of the UK-wide supplier obligations. However, the data from current schemes highlights the risk of a bias in the delivery of solid wall insulation towards the bigger urban areas, particularly in the central belt.

[251] The Housing (Scotland) Act 2001 requires the Scottish Government to eradicate fuel poverty in Scotland, as far as reasonably practicable, by November 2016.
[252] The Climate Change (Scotland) Act 2009 sets in statute the Scottish Government's economic strategy target to reduce Scotland's emissions of greenhouse gases by 42% by 2020 and by 80% by 2050.
[253] Scottish Government, 2015. Scottish House Condition Survey 2014: Key Findings

The devolution settlement provides an opportunity to simplify the delivery landscape and provide a stable, long-term, strategic and equitable approach. This approach will need to address a number of key challenges, as described below.

Key challenges for future energy efficiency and fuel poverty schemes

5.1.1 Striking the balance between energy efficiency and fuel poverty

There are synergies between improving energy efficiency and addressing fuel poverty but there can be conflict between the two, since the most cost-effective approach to addressing energy efficiency will not be the most cost-effective means of addressing fuel poverty. The combination adopted in Scotland of large-scale area-based delivery, alongside nationally available targeted support for fuel poor households, represents a sensible approach but striking the right balance between the two, and ensuring that both are of sufficient scale to meet the stated ambitions, will remain a constant challenge for policymakers.

5.1.2 Funding

Scotland has, historically, been successful in leveraging a disproportionate share of UK-wide energy efficiency and fuel poverty funding, relative to the number of households in the country. However, this may no longer be possible following the devolution settlement. Public funding is increasingly scarce, and the public funds available now and in the future on their own will be far from sufficient to address the scale of the challenge. Householders themselves will increasingly need to take responsibility for improving the energy efficiency of their homes.

5.1.3 Consumer demand

Consumer demand for insulation and other energy efficiency measures is low. With increasingly constrained funding meaning fewer grants and subsidies are available, generating the consumer demand necessary to deliver on the new National Infrastructure Priority will require radical new approaches to drive consumer awareness and interest in improving energy efficiency.

5.1.4 Behaviour change

Driving consumer demand for energy efficiency measures will not be sufficient on its own. How people use energy following such interventions is complex and not well understood, but it is clear that the potential energy efficiency benefits are rarely fully realised because of a lack of awareness and understanding (e.g. how to effectively use heating controls or the electricity from microgeneration) or because of other behavioural responses (such as the rebound and prebound effects).

5.1.5 Dealing with hard-to-treat properties

The research suggests that the remaining opportunities for basic insulation measures such as loft and cavity wall insulation are increasingly limited. There appears to remain some significant potential for cavity wall insulation, although realising some of this is likely to require overcoming maintenance issues or physical obstacles, as well as overcoming the barrier of multiple ownership in flats and tenements. Given the cost-effectiveness of cavity wall insulation, there would appear to be a strong case for further research into the true remaining potential for this measure in Scotland. Notwithstanding that, there is a need for an increasing focus on measures such as solid wall insulation. Such measures are far more expensive and disruptive, further exacerbating the issues of consumer demand and funding constraints. In addition, there is concern that solid wall insulation may be physically damaging for some older properties.

5.1.6 Rurality

Scheme design needs to better account for the impacts of rurality, particularly the higher risk of fuel poverty in rural areas. Delivering interventions in rural areas tends to be more expensive so a greater focus on rural areas will increase the overall costs of delivery. Nevertheless, the greater prevalence of fuel poverty in rural areas necessitates such a focus and there is, therefore, a need to develop the supply chain across the whole country in order to manage costs, whilst at the same time ensuring that interventions are of the requisite quality.

5.1.7 Understanding 'real world' impacts

The data used to inform policy and scheme development is modelled and there are significant differences between modelled and actual energy consumption. This is exacerbated in Scotland by its diversity of geography, climate and housing stock, which does not lend itself well to standard modelling. The more non-standard the home and household is, the greater the likely difference between modelled and actual consumption data, and as energy inefficient and fuel poor households tend to be further from the standards, it is vital for future schemes and policies to be informed by a better understanding of how energy is used and the 'real world' impacts of energy efficiency and fuel poverty interventions.

5.1.8 Effectively targeting the fuel poor

Targeting of the fuel poor is currently based on proxies (benefits) and, for those schemes not administered by central Government, based on benefits checks rather than centrally held data. Relying on benefits checks increases the complexity and expense of scheme delivery. Perhaps more significantly, however, receipt of benefits is often a poor proxy for fuel poverty and there is a need to develop more effective ways of targeting fuel poor households.

Recommendations

1. Scottish Government should develop a long-term approach to addressing energy efficiency and fuel poverty, including long term funding commitments to schemes. This needs to be based on a clear vision of what the housing stock will look like in the future in order to meet the targets which have been set. This will give the confidence necessary for the supply chain to develop and to allow potential recipients, whether homeowners, private landlords or housing associations, to plan. It will be crucial to carefully plan for any transition periods between schemes, e.g. following the devolution settlement, in order to avoid undermining the supply chain.

2. There is a need for continued, and increasing public funding, to match the scale of the stated ambition. The case for investing in energy efficiency as an infrastructure priority has now been clearly made, highlighting its benefits in terms of the sustainability of energy infrastructure, carbon emissions, health and wellbeing. Energy efficiency investments have also been shown to provide value for money, comparable to other major infrastructure investments, even without quantifying many of the key social benefits of energy efficiency measures.

3. Public funding must also be accountable. There is a need, therefore, to: ensure robust quality assurance processes are in place for all aspects of delivery, without undermining the ability of the supply chain to develop in rural areas; and ensure effective monitoring and evaluation of schemes takes place. The latter is addressed in recommendation 17 and in appendix A.

4. Given the acute challenge of eradicating fuel poverty and the November 2016 target of eradicating fuel poverty, Scottish Government should give renewed consideration to moving away from universal payment of the Winter Fuel Payment. Models exist for similar smaller

programmes (the Cold Weather Payment group and the Warm Home Discount group) which would enable better targeting of this very significant source of funding on those who are most vulnerable[254].

5. There is also scope for refinements to the eligibility criteria for Cold Weather Payments in order to take better account of Scottish climatic conditions, e.g. island households facing strong winds but relatively warm temperatures are currently not eligible.

6. This review has found substantial and significant evidence that living in poorly maintained, energy inefficient homes is a contributing factor to householders experiencing respiratory illnesses and other related conditions. In addition, the economic and wider regeneration benefits of schemes, particularly those involving solid wall insulation, is increasingly apparent. Scottish Government should consider opportunities for greater integration between energy efficiency funding and the funding for health, public health, social care, economic development and regeneration.

7. There are also opportunities for increased integration in the delivery of public services, particularly those involved in frontline health and social care making referrals to energy efficiency and fuel poverty schemes. We understand that this is currently the subject of a study being undertaken by Scottish Government, in conjunction with the Fuel Poverty Forum and a range of stakeholders. In addition, Citizens Advice England and Wales will be launching a pilot housing and health referral service, taking forward new NICE guidelines on excess winter deaths and researching the public health case for better energy standards.

8. Research is needed to establish the true remaining potential for cavity wall insulation in Scotland, taking into account: the unreliability of simple visual inspection and householder recall; the physical barriers to installation such as access difficulties or unsuitable wall construction; and the proportion of this potential which is in flatted properties which would need agreement from multiple property owners.

9. Research is needed into the appropriate measures for different types of hard-to-treat properties, and how the costs of treating such properties might be reduced. There is concern that solid wall insulation may cause long-term harm to building fabric in some types of construction, as well as concerns about the impacts on breathability, ventilation and associated health impacts. There may be significant learning available simply from studying the impacts and experience of solid wall installations carried out to date.

10. A major marketing and communications campaign is needed to promote awareness and understanding of the benefits of energy efficiency measures and energy efficient behaviour, drawing on the experience of countries such as Germany, where previous such campaigns have been undertaken.

11. Even with improved marketing and communications, it is hard to envisage how the necessary consumer demand can be driven in the absence of regulation. The Scottish Government's proposal for regulating minimum standards of energy performance in existing private homes needs to be taken forward. In addition, consideration should be given to how further use can be

[254] It should be noted that Citizens Advice Scotland support ongoing universal payment of the Winter Fuel Payment. In addition to avoiding the known risks associated with selectivity, Citizens Advice Scotland believe a more universal approach within the target populations is the most effective and efficient means of achieving the desired outcome: maximising the incomes of low income and vulnerable households for help with their heating costs during the winter months. See the following publication for further details: http://www.cas.org.uk/system/files/publications/designing_a_social_security_system_for_scotland_-_winter_fuel_and_cold_weather_payments.pdf

made of the provisions of the Tenement Act to overcome ‘blockers’ to measures being installed in flats.

12. Regulation, and any use of legislation like the Tenements Act, needs to be accompanied by attractive loan finance for those that are able to pay. The ‘pay-as-you-save’ principle embodied within the Green Deal is a solid one. However, the finance package on offer needs to be competitive with mainstream finance offers available, up-front assessment costs need to be avoided, flexibility for early repayment without penalty needs to be included and the overall scheme needs to be kept as simple as possible so that there is clarity for consumers.

13. There is a need to increase the levels of advice and support which are provided alongside the delivery of measures, e.g. raising awareness and understanding of energy use to support behaviour change, providing tariff checks and benefits checks. The aim should be to move towards not just a ‘whole house’ approach, which has been shown to be more cost-effective than single measures, but, a ‘whole-household’ approach, i.e. combinations of physical measures, plus advice and support for behaviour change alongside other forms of financial assistance such as tariff and benefits checks. The National Infrastructure Priority, if pursued in isolation, will not achieve the desired impact in terms of carbon emissions, energy savings or fuel poverty.

14. The installation of smart meters in all homes and businesses by 2020 represents a significant opportunity to engage with households. Given the pressures associated with meeting the delivery target, it is not realistic to expect the energy companies to include any significant advice and support alongside smart meter installations. However, at the very least:

    a. an advice leaflet should be provided to every household receiving a smart meter, containing referral details for other forms of energy efficiency and fuel poverty support; and

    b. a mechanism should be established to provide support to those who have gas appliances condemned during their gas smart meter installations.

15. There is a need for future schemes to include a more nuanced consideration of likely actual energy consumption and expenditure, and be able to provide appropriate solutions where this is likely to be significantly different from the norm. An understanding of how this can be achieved will be enhanced by more effective evaluation and monitoring of scheme interventions, but in the shorter term, consideration should be given to simple modifications to the eligibility criteria to account for this. For example, having broader eligibility criteria for those in off-gas areas (particularly those using electric heating), those with higher than standard levels of occupancy and those on low incomes (those on low incomes may not always be claiming the benefits that would otherwise make them eligible). Consideration should also be given to the potential to include those in receipt of tax credits within the eligibility criteria, in order to better support the working fuel poor.

16. With the costs, benefits, and appropriateness of different energy efficiency measures varying significantly across different dwelling and household types, and across different geographies and socio-economic groups, there is a need for more individual engagement with householders. There is some evidence from schemes such as BESN and the CCF that increasing the involvement of grassroots and community organisations, alongside local authorities, in the delivery of schemes (particularly in engaging householders and making referrals to the delivery bodies) could help to achieve this and help to better target those who are most vulnerable, although care will be needed to avoid developing complex referral pathways and customer journeys.

17. Scottish Government should work with the Department for Work & Pensions and HMRC to find the means to share their benefits/tax credits data with those responsible for scheme delivery, which would make the targeting of schemes far simpler and more cost-effective. However, benefits checks should continue to form part of scheme delivery, as such checks can generate significant increases in income for individual households who are not claiming the benefits they are entitled to.

18. Independent formal evaluation needs to be built into the design and management of all schemes in order to achieve a cycle of continuous improvement, to build an understanding of the impact of different energy efficiency and fuel poverty interventions and to help build the business case for investment in energy efficiency. The previous absence of formal evaluation from many Scotland-specific schemes represents a significant missed opportunity. A proposed approach to improving monitoring and evaluation is provided in appendix A.

19. Evaluation should include monitoring of actual behaviour and energy use. This will be important in generating a better understanding of how different energy efficiency interventions impact on different socio-economic groups and in different housing types and geographies, including the scale of rebound and prebound effects.

20. Future schemes need to make provision for repair and maintenance, which might otherwise prevent energy efficiency interventions from taking place.

21. Consideration should be given as to whether further capacity building measures are needed for local authorities to ensure effective delivery of energy efficiency schemes across the country.

Appendix A: Improving monitoring and evaluation

This review of energy efficiency and fuel poverty schemes has highlighted that very little formal evaluation of schemes is undertaken in Scotland. Stakeholders and workshop participants suggested two reasons for this:

1. evaluation can be expensive, therefore absorbing money which could otherwise be used to deliver measures; and

2. internal and informal evaluation and subsequent programme refinements are inherent parts of the current system, underpinned by formal stakeholder bodies such as the Fuel Poverty Forum.

In relation to the first point, the costs of evaluation would not need to be more than a very small percentage (probably less than 1% of the budget of the main schemes) of the overall costs of the schemes. Weighed against this cost would be a significant number of potential benefits, as discussed here.

In relation to the second point, this research has found evidence that the internal and informal evaluation which is currently undertaken has been utilised to develop and improve schemes (see section 3.1.21). However, independent evaluation would at the very least confirm that internal processes were effective, that all stakeholder views were being captured and that learning from schemes was being maximised. It is unlikely that in the absence of systematic approaches to monitoring and evaluation that all such learning is being captured and this will be increasingly important as the energy efficiency and fuel poverty challenges become ever greater.

The two main aims of Scottish Government programmes are to address fuel poverty and reduce climate change emissions. Individual schemes have other aims and sub-objectives, whether this be promoting particular types of measures or ensuring equitable geographic spread of delivery. Formal monitoring and evaluation would allow assessments to be made of the extent to which these aims and objectives are being delivered, thereby providing a measure of accountability for the funding. The current absence of formal monitoring and evaluation means that it is not possible to assess with confidence the real impact of different interventions on different households, either in terms of energy costs and fuel poverty, or in terms of reduced climate change emissions.

This research has highlighted significant gaps in our current understanding of the 'real world' impacts of energy efficiency and fuel poverty interventions. Ongoing efforts are needed to build this understanding in order to improve and refine approaches to the modelling of energy use and emissions and to improve and refine the design and targeting of schemes. Formal evaluation and monitoring could play a significant role in this.

Finally, the research has highlighted evidence of the significant wider potential benefits of energy efficiency interventions. Formal evaluation and monitoring could play a significant role in helping to build the evidence base in this area, allowing, over the longer term, greater integration with other policy areas such as health, public health, economic development and regeneration.

The following actions provide an outline of a potential approach to improving the monitoring and evaluation of future schemes in Scotland.

Action	Justification	Comment
All schemes to have clearly stated aims, objectives, outputs and outcomes against which they can be evaluated. Use could be made of conceptual frameworks such as Theories of Change to understand and articulate the intended outcomes from each scheme and how they will be achieved.	Stating clear aims, objectives, outputs and outcomes allows for clear accountability of funding and provides the basis for evaluation.	Using conceptual frameworks such as Theories of Change are useful not only for the purposes of evaluation but also for scheme planning and design.
Independent formative evaluation to be commissioned alongside all energy efficiency and fuel poverty schemes.	To allow for ongoing refinements and improvements in the design and delivery of schemes and to understand the full range of impacts of the schemes.	Would require quantitative (see below) and qualitative (e.g. beneficiary and stakeholder interviews) elements to generate a clear understanding of scheme process and impacts.
Simple count of measures delivered, by location and target group, including cost per measure	To understand what is delivered, i.e. outputs.	Already in place for most SG programmes
Access before / after real consumer fuel use data from c.5% of all beneficiaries under each programme	To understand impacts of interventions / to inform targeting of future sub-programmes / to understand links between passport benefits and fuel poverty in practice / to understand gaps between modelled and real emissions	Energy use data could be secured from householders or, with householder permission, from suppliers. Interviews with beneficiaries will be needed to interpret data
Record and publish detailed data on issues raised by consumers calling HES helpline and results of assistance	To understand issues raised which may require new solutions, e.g. advice on minimum standards, connections to district heating	This data may already exist but is not published

Appendix B: Bibliography

Notes on approach to the literature review

- 'Grey' literature was time-limited to the last 10 years unless it covered material or issues not covered substantially elsewhere. Academic literature was not time-limited.
- Annual publications and any that have subsequently been updated, aside from Government publications, were excluded.
- Position papers, responses to consultations, and presentations were generally excluded unless they relate to planned or proposed schemes.
- Paid-for publications (aside from journal papers) were generally excluded.
- 'Environmental' includes technical studies on the basis that the primary goal of these is to inform emissions reduction, unless they explicitly focus on evaluating other aspects of technologies such as providing affordable warmth or influencing behaviour change.
- The 'General / Other' category in the bibliography was added to make reports that did not fit under one specific category easier to find – e.g. scheme / programme reviews.
- The scope of literature is deliberately broad and includes some reports from areas not directly addressed by the review, for example district heating and renewable energy.

The literature reviewed explored the following key areas identified by CAS:

Environmental

- The differences between modelled and actual emissions savings from households, particularly those in fuel poverty and those in rural and island areas.
- The effectiveness and appropriateness of different energy efficiency measures for reducing demand from households in different geographic locations and socio-economic groups.
- Evidence of potential conflicts between improving energy efficiency and fuel poverty, e.g. fuel switching to cheaper but higher carbon energy tariffs.

Health

- Evidence of households self-rationing and self-disconnecting, and how well (or otherwise) evidence of these behaviours has been captured by fuel poverty schemes.
- The relationship between excess winter deaths and fuel poverty.
- Whether modern air-tight buildings are necessarily better for occupants with respiratory problems.

Social

- The relative benefits of standard energy efficiency measures to households in different geographic locations and socio-economic groups.

- The extent of the 'rebound effect' across households in different geographic locations and socio-economic groups, and the implications for future policy making.
- The extent to which the problem of poor maintenance is contributing to household energy demand, health inequalities, and fuel poverty.

Economic

- The impact of planned and proposed changes to funding, at different levels of devolution, on future capacities for delivering energy efficiency and fuel poverty schemes.
- The potential for schemes to be better designed to deliver improved levels of wider social and economic benefits, e.g. through reducing demand on the NHS.
- The impact of schemes on supporting economic regeneration through providing income streams for local businesses, particularly in rural and deprived areas.

Health

Adshead, F., & Thorpe, A., 2007. The role of the Government in public health: A national perspective. *Public Health*, 121, pp. 835-839.

Age Scotland, 2012. At home with Scotland's older people: Facts and figures 2011-12. Available at: http://www.ageuk.org.uk/Documents/EN-GB-SC/Policy/2011%20At%20Home%20With%20Scotland's%20Older%20People%20-%20%20web%20PDF%20hi-res.pdf?dtrk=true

Age Scotland, 2011. Looking Ahead: 2011-2016: Age Scotland's five year public policy agenda. Available at: http://www.ageuk.org.uk/Documents/EN-GB-SC/Policy/Looking%20Ahead%2044%20pp%20A4.pdf?dtrk=true

Annesi-Maesano, I., Lundbäck, B., & Viegi, G., 2014. Respiratory epidemiology. 1st ed. Sheffield: European Respiratory Society.

Becker, R., Goldberger, I. & Paciuk, M., 2007. Improving energy performance of school buildings while ensuring indoor air quality ventilation. Building and Environment. 42 (9), pp.3261-3276.

Bernstein, J., Alexis, N., Bacchus, H., Bernstein, I., Fritz, P., Horner, E., Li, N., Mason, S., Nel, A., Oullette, J., Reijula, K., Reponen, T., Seltzer, J., Smith, A. & Tarlo, S., 2008. The health effects of nonindustrial indoor air pollution. Journal of Allergy and Clinical Immunology. 121 (3), pp.585-591.

Bornehag, C., Blomquist, G., Gyntelberg, F., Järvholm, B., Malmberg, P., Nordvall L., Nielsen A., Pershagen G., & Sundell J., 2001. Dampness in Buildings and Health. Nordic Interdisciplinary Review of the Scientific Evidence on Associations between Exposure to "Dampness" in Buildings and Health Effects (NORDDAMP). Indoor Air. 11 (2), pp.72-86.

Burgess, S., Propper, C. and Rigg, J., 2004. The Impact of Low-Income on Child Health: Evidence from a Birth Cohort: ALSPAC Study Team, University of Bristol, Available from: http://www.bristol.ac.uk/cmpo/publications/papers/2004/wp98.pdf

CASD, 2010. A Select Review of Literature on the Relationship Between Housing and Health. Communities Analytical Services Division, Scottish Government. Available at: www.apho.org.uk/resource/view.aspx?RID=99182

Commission on Housing and Wellbeing, 2015. A blueprint for Scotland's future. June 2015. Available at: http://housingandwellbeing.org/

De Vries, R. and Blane, D., 2013. Fuel poverty and the health of older people: the role of local climate: Journal of Public Health, 35, (3), pp. 361-366. Available from: http://jpubhealth.oxfordjournals.org/content/35/3/361

Douglas, M., Thomson, H., & Gaughan, M., 2003. Health Impact Assessment of Housing Improvements: A Guide. Public Health Institute of Scotland, Glasgow.

EAS, 2015. Fuel Poverty and Health: Increased Winter Mortality. Energy Action Scotland. Available from: http://www.eas.org.uk/page.php?id=2306

EAS, 2012. The relationship between Fuel Poverty and Heath: A discussion paper. Energy Action Scotland. Available at: http://www.theclaymoreproject.com/uploads/associate/365/file/Health%20Documents/Full%20Document.pdf

EAS, n.d. Fuel Poverty and Health. Energy Action Scotland. Available from: http://www.eas.org.uk/key_issues_fuel_poverty_and_health.php

EnergyStar, n.d. Mechanical Ventilation. Environmental Protection Agency, USA. Available at: https://www.energystar.gov/ia/new_homes/features/MechVent_062906.pdf

EST, 2014. Cold, draughty, mouldy, damp: What the UK public think about their homes. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/organisations/news/cold-draughty-mouldy-damp-what-uk-public-think-about-their-homes

Fischbacher, C., 2014. Identifying 'deprived individuals': The Scottish Public Health Observatory, Jan 2014. Available from: http://www.scotpho.org.uk/downloads/scotphoreports/scotpho140109-simd-identifyingdeprivedindividuals.pdf

Fisk, W., Lei-Gomez, Q. and Mendell, M., 2007. Meta-analyses of the associations of respiratory health effects with dampness and mould in homes. Indoor Air. 17 (4), pp.284-296.

Geddes, I., Bloomer, E., Allen, J. and Goldblatt, P., 2011. The health impacts of cold homes and fuel poverty: Friends of the Earth and the Marmot Review Team, Available from: http://www.foe.co.uk/sites/default/files/downloads/cold_homes_health.pdf

George, M., Graham, C., & Lennard, L., 2013. The Energy Penalty: Disabled People and Fuel Poverty. University of Leicester, report for the Eaga Charitable Trust. Available at: https://www2.le.ac.uk/departments/law/research/cces/documents/the-energy-penalty-disability-and-fuel-poverty-pdf

GoWell, 2012. Housing Improvements, Housing Quality and Psychosocial Benefits from the Home. Glasgow Community Health and Wellbeing Research and Learning Programme, February 2012. Available at: http://www.gowellonline.com/assets/0000/0559/Briefing_Paper_17.pdf

Grant, C., Hunter, C., Flannigan, B. and Bravery, A., 1989. The moisture requirements of moulds isolated from domestic dwellings, International Biodeterioration 24, 4, 259-289. Available from: http://www.sciencedirect.com/science/article/pii/026530368990002X

Healy, J. D., 2003. Excess winter mortality in Europe: a cross country analysis identifying key risk factors: Journal of Epidemiology and Community Health, 57, 784-789. Available from: http://jech.bmj.com/content/57/10/784.short

Howden-Chapman, P., Viggers, H., Chapman, R., O'Sullivan, K., & Barnard, L. T., Lloyd, B., 2012. Tackling cold housing and fuel poverty in New Zealand: A review of policies, research and health impacts: Energy Policy 49, 134–142. Available from: http://www.sciencedirect.com/science/article/pii/S0301421511007336

Hulin, M., Simoni, M., Viegi, G., & Annesi-Maesano, I., 2012. Respiratory health and indoor air pollutants based on quantitative exposure assessments. European Respiratory Journal. 40 (4), pp.1033-1045.

Isola, D., Kimber, I., Sarlo, K., Lalko, J., & Sipes, I., 2008. Chemical respiratory allergy and occupational asthma: what are the key areas of uncertainty? Journal of Applied Toxicology. 28 (3), pp.249-253.

James, J., 2005. Emissions of Volatile Organic Compounds from Several Green and Non-Green Building Materials: A Comparison. Indoor and Built Environment. 14 (1). pp.69-74.

Jochelson K., 2007. The role of the Government in public health: A national perspective. *Public Health*, 121, pp. 1149-1155.

Johnson, L., Ciaccio, C., Barnes, C., Kennedy, K., Forrest, E., Gard, L., Pacheco, F., Dowling, P., & Portnoy, J., 2009. Low-cost interventions improve indoor air quality and children's health. Allergy and Asthma Proceedings. 30 (4), pp.377-385.

Jones, A.P., 1999. Indoor air quality and health. Atmospheric Environment. 33 (28), pp. 4535–4564.

Kamendere, E., Zogla, G., Kamenders, A., Ikaunieks, J., & Rochas, C., 2015. Analysis of Mechanical Ventilation System with Heat Recovery in Renovated Apartment Buildings. Energy Procedia. 72, pp.27-33.

Kim, K., Jahan, S., & Kabir, E., 2013. A review on human health perspective of air pollution with respect to allergies and asthma. Environment International. 59, pp.41-52.

Kingman, D., 2014. Excess winter deaths not related to fuel poverty, BBC research suggests: Intergenerational Foundation, UK. Available from: http://www.if.org.uk/archives/4807/excess-winter-deaths-not-related-to-fuel-poverty-bbc-research-suggests

Lee, C., Haghighat, F., & Ghaly, W., 2005. A study on VOC source and sink behaviour in porous building materials - analytical model development and assessment. Indoor Air. 15 (3), pp.183-196.

Liddell, C. and Morris, C., 2010. Fuel poverty and human health: A review of recent evidence: Energy Policy 38, pp. 2987-2997. Available from: http://www.sciencedirect.com/science/article/pii/S0301421510000625

McConalogue, D., Kierans, C. and Moran, A., 2015. The hidden practices and experiences of healthcare practitioners dealing with fuel poverty: Journal of Public Health, May 11, 2015. Available from: http://jpubhealth.oxfordjournals.org/content/early/2015/05/11/pubmed.fdv059.abstract

McGill, G., Qin, M. and Oyedele, L., 2014. A Case Study Investigation of Indoor Air Quality in UK Passivhaus Dwellings. Energy Procedia, 62, pp.190-199.

Mendell, M., Mirer, A., Cheung, K., Tong, M., & Douwes, J., 2011. Respiratory and Allergic Health Effects of Dampness, Mold, and Dampness-Related Agents: A Review of the Epidemiologic Evidence. Environ Health Perspect. 119 (6), pp.748-756.

Missia, D., Demetriou, E., Michael, N., Tolis, E., & Bartzis, J., 2010. Indoor exposure from building materials: A field study. Atmospheric Environment. 44 (35), pp.4388-4395.

Murphy, P., & Hart, N., 2009. Who benefits from home mechanical ventilation? Clinical Medicine, Journal of the Royal College of Physicians, April 2009, Vol. 9, (2), pp. 160-163.

Nandasena, S., Wickremasinghe, A., & Sathiakumar, N., 2012. Respiratory health status of children from two different air pollution exposure settings of Sri Lanka: A cross-sectional study. American Journal of Industrial Medicine. 55 (12), pp.1137-1145.

Niachou, K., Hassid, S., Santamouris, M., & Livada, I., 2008. Experimental performance investigation of natural, mechanical and hybrid ventilation in urban environment. Building and Environment. 43 (8), pp.1373-1382.

Nicolaou, N., Siddique, N. & Custovic, A., 2005. Allergic disease in urban and rural populations: increasing prevalence with increasing urbanization. Allergy. 60 (11), pp.1357-1360.

Niven, R.M., Fletcher, A.M., Pickering, A.C., Custovic, A., Sivour, J.B., Preece, A.R., Oldham, L.A., & Francis, H.C., 1999. Attempting to control mite allergens with mechanical ventilation and dehumidification in British houses. Journal of Allergy and Clinical Immunology, Vol. 103, (5), 1999, pp. 756-762.

Norbäck, D., Björnsson, E., Janson, C., Palmgren, U., & Boman, G., 1999. Current asthma and biochemical signs of inflammation in relation to building dampness in dwellings. The International Journal of Tuberculosis and Lung Disease. 3 (5), pp. 368-376.

Osborne, H., 2014. Debt and mental health must be taken seriously – Citizens Advice: The Guardian 10th Oct 2014. Available from: http://www.theguardian.com/money/2014/oct/10/lenders-responsibly-borrowers-mental-health?CMP=twt_gu

Osanyintola, O., & Simonson, C., 2006. Moisture buffering capacity of hygroscopic building materials: Experimental facilities and energy impact. Energy and Buildings. 38 (10), pp.1270-1282.

Park, J., Schleiff, P., Attfield, M., Cox-Ganser, J., & Kreiss, K., 2004. Building-related respiratory symptoms can be predicted with semi-quantitative indices of exposure to dampness and mold. Indoor Air. 14 (6), pp.425-433.

Perez-Padilla, R., Schilmann, A, Riojas-Rodriguez, H., 2010. Respiratory health effects of indoor air pollution. The International Journal of Tuberculosis and Lung Disease. 14 (9), pp. 1079-1086.

Public Health England, 2014. Local action on health inequalities: fuel poverty and cold home-related health problems. Health Equity Evidence Review 7: September 2014.

RCPUK, 2006. Fuel Poverty and Health. Faculty of Health of the Royal Colleges of Physicians of the United Kingdom. Available at: http://www.fph.org.uk/uploads/bs_fuel_poverty.pdf

SAMH, 2014. Worried sick: Experiences of poverty and mental health across Scotland. Scottish Association for Mental Health, March 2014. Available from: http://www.samh.org.uk/mental-health-information/know-where-to-go/worried-sick-experiences-of-poverty-and-mental-health-across-scotland

SFHA, 2012. Supporting Older People to Live at Home. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/supporting-older-people-to-live-at-home

Simonson, C., Salonvaara, M., & Ojanen, T., 2002. The effect of structures on indoor humidity - possibility to improve comfort and perceived air quality. Indoor Air. 12 (4), pp.243-251.

Shortt, N., & Rugkasa, J., 2007. *"The walls were so damp and cold"* fuel poverty and ill health in Northern Ireland: Results from a housing intervention. Health & Place, Vol. 13, (1), 2007, pp. 99-110.

Snell, C., 2013. Fuel poverty and disabled people: the impact of policy change. Report for the Eaga Charitable Trust. Available at: http://www.eagacharitabletrust.org/index.php/projects/item/fuel-poverty-and-disabled-people-the-impact-of-policy-change

Srinivasan, S., O'Fallon, L., & Dearry, A., 2003. Creating Healthy Communities, Healthy Homes, Healthy People: Initiating a Research Agenda on the Built Environment and Public Health. American Journal of Public Health. 93 (9), pp.1446-1450.

Sundell, J., Levin, H., Nazaroff, W.W., Cain, W.S., Fisk, W.J., Grimsrud, D.T., Gyntelberg, Y.L., Persily, A.K., Pickering, A.C., Samet, J.M., Spengler, J.D., Taylor, S.T., & Weschler, C.J., 2001. Ventilation rates and health: multidisciplinary review of the scientific literature. Indoor Air, Vol. 21, (3), 2011, pp. 191-204.

Taske, N., Taylor,L., Mulvihill, C., & Doyle, N., 2005. Housing and public health: a review of reviews of interventions for improving health. Evidence Briefing the National Institute for Health and Care Excellence (NICE), UK.

Teedon, P.L., Gillespie, M., Lindsay, K., & Baker, K.J., 2014. Parental perceptions of the impacts the built environment has on young children's health: a qualitative examination and lay assessment amongst residents in four Scottish communities. Health and Place, 28 (2014), pp. 50-57.

Teedon, P., Lindsay, K., Gillespie, M., & Baker, K., 2012. Engaging for public health – investigation of resident perception on health. Environmental Determinants of Public Health in Scotland (EDPHiS) Project report.

Teller-Elsberg, J., Sovacool, B., Smith, T., & Laine, E., 2016. Fuel poverty, excess winter deaths, and energy costs in Vermont: Burdensome for whom? Energy Policy, Vol. 90, 2016, pp. 81-91.

Uhde, E., & Salthammer, T., 2007. Impact of reaction products from building materials and furnishings on indoor air quality—A review of recent advances in indoor chemistry. Atmospheric Environment. 41 (15), pp.3111-3128.

Vaneckova, P., Beggsa, P., de Deara, R. and McCracken, K., 2008. Effect of temperature on mortality during the six warmer months in Sydney, Australia, between 1993 and 2004: Environmental Research 108, 3, 361-369. Available from: http://www.sciencedirect.com/science/article/pii/S0013935108001588

Walker, J., Mitchell, R., Petticrew, M., & Platt, S., 2008. The effects on health of a publicly funded domestic heating programme: a prospective controlled study. Journal of Epidemiology & Community Health, 2009, 63, pp. 12-17.

Welch, L., 1991. Severity of health effects associated with building-related illness. Environ Health Perspect. 95, pp. 67-69.

WHO, 1990. Indoor Environment: Health Aspects of Air Quality, Thermal Environment, Light and Noise. World Health Organisation. Available from: http://whqlibdoc.who.int/hq/1990/WHO_EHE_RUD_90.2.pdf

Wilkinson, D., 1999. Poor Housing and Ill Health: A summary of Research Evidence. Scottish Government. Available at: http://www.scotland.gov.uk/Resource/Doc/156479/0042008.pdf

Wilkinson, P., Smith, K., Joffe, M. and Haines, A., 2007. A global perspective on energy: health effects and injustices: The Lancet 370, 965–978.

Wolkoff, P. et al., 1997. Are We Measuring the Relevant Indoor Pollutants?. Indoor Air. 7 (2), pp.92-106.

Zuraimi, M., Tham, K., Chew, F., & Ooi, P., 2007. The effect of ventilation strategies of child care centers on indoor air quality and respiratory health of children in Singapore. Indoor Air. 17 (4), pp.317-327.

Social

Baker, K.J., Griffiths, P., Teedon, P., & Thomson, C., 2011. Delivering climate change through behaviour change: the work of civil society organisations. Northern European Social Science Conference, Stockholm, June 2011.

Baker, W., 2011. Off-gas consumers: Information on households without mains gas heating. Consumer Focus. Available from: http://www.consumerfocus.org.uk/files/2011/10/Off-gas-consumers.pdf

Barnes, M., Butt, S., Tomaszewski, W., 2008. The Dynamics of Bad Housing: The Impact of Bad Housing on the Living Standards of Children. The NatCen Study, National Centre for Social Research, London.

Boerstra, A., 2010. Personal control in future thermal comfort standards? Proceedings of the Network for Comfort and Energy Use in Buildings (NCEUB) Conference, Adapting to Change: New Thinking on Comfort, Windsor, April 2010.

Bonini, S.M.J., & Oppenheim, J.M., 2008. Helping 'green' products grow. The McKinsey Quarterly, October 2008.

Brunner, K-M., Spitzer, M. and Christaneli, A., 2012. Experiencing fuel poverty. Coping strategies of low-income households in Vienna/Austria: Energy Policy 49, 53-59. Available from: http://www.sciencedirect.com/science/article/pii/S0301421511009748

Buzar, S., 2007. The 'hidden' geographies of energy poverty in post-socialism: Between institutions and households: Geoforum, 38 (2) 224-240.

Cambridge Econometrics, 2015. Assessing the Employment and Social Impact of Energy Efficiency: Final Report. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/CE_EE_Jobs_main%2018Nov2015.pdf

Campanera, J.M.,Higgins,P.,2011.Qualityoflifeinurban-classified andrural- classified Englishlocalauthorityareas.Environ.andPlan.A43,683–702.

Carbon Trust, 2015. Low carbon behaviour change: The £300 million opportunity. Available at: http://www.carbontrust.com/resources/reports/advice/low-carbon-behaviour-change/

Centre for Sustainable Energy and National Energy Action, 2005. 'Warm Zones Evaluation: Final Report'. Available at: http://www.warmzones.co.uk/050301%20-%20Warm%20Zones%20Evaluation%20Final%20Report.pdf

Chanfreau, J., Barnes, M., Tomaszewski, W., Philo, D., Hall, J., & Tipping, S., 2011. Growing Up in Scotland: Change in early childhood and the impact of significant events: Edinburgh: Scottish Government. Available from: http://www.scotland.gov.uk/Publications/2011/05/25092325/0

Chitnis, M., Sorrell., S., Druckman, A., Firth, S.K., & Jackson, J., 2014. Who rebounds most? Estimating direct and indirect rebound effects for different UK socio-economic groups. Ecological Economics, 106, 2014, pp. 12-32.

Cloke, P., Milbourne, P., Thomas, C.,1997 .Living lives in different ways? Deprivation, marginalization and changing lifestyles in rural England. Trans. Inst. Br. Geogr. 22, 210–230.

CLS, 2015. Case study: Community living room and kitchen. Communities Living Sustainably. Avilable at: http://www.communitieslivingsustainably.org.uk/wp-content/uploads/2015/11/Granby-Toxteth-Community-Living-Room-v2.pdf

CLS, 2015. Case study: Communities living sustainably in Dorset. Communities Living Sustainably. Available at: http://www.communitieslivingsustainably.org.uk/wp-content/uploads/2015/06/CLS-in-Dorset-Community-Renewable-Energy1.pdf

CLS, 2015. Manor House PACT Home Energy Advice. Communities Living Sustainably. Available at: http://www.communitieslivingsustainably.org.uk/wp-content/uploads/2015/06/Manor-House-PACT-Home-Energy-Advice1.pdf

Consumer Focus, 2011. Off-gas consumers. Available at: http://www.consumerfocus.org.uk/files/2011/10/Off-gas-consumers.pdf

CSE, 2014. Beyond average consumption: Development of a framework for assessing impact of policy proposals on different consumer groups. Updated report to Ofgem, March 2014. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2014/06/cse_14_beyond_average_consumption_report_to_ofgem_march_2014_update.pdf

Cullenward, D. and Koomey, J. C., 2016. A critique of Saunders' 'historical evidence of energy efficiency rebound in 30 US sectors'. Technological Forecasting & Social Change. 103, 203-213.

Druckman, A., Chitnis, M., Sorrell, S., & Jackson, T., 2011. Missing carbon reductions? Exploring rebound and backfire effects in UK households. Energy Policy, Vol. 39, (6), pp. 3572-3581.

Druckman, A, Jackson,T, 2008 Household energy consumption in the UK: A highly geographically and socio-economically disaggregated model. Energy Policy 36, 3177-3192.

Dubois, U., 2012. From targeting to implementation: The role of identification of fuel poor households. Energy Policy 49, 107–115. Available from: http://www.sciencedirect.com/science/article/pii/S0301421511009852

EAS, 2006. Energising Fuel Direct. Energy Action Scotland. Available at: http://www.theclaymoreproject.com/uploads/associate/365/file/EAS%20Publications/Energising_Fuel_Direct.pdf

EAS, 2004. Self Disconnection Survey Report. Energy Action Scotland. Available at: http://www.theclaymoreproject.com/uploads/associate/365/file/EAS%20Publications/SelfDisconnection_survey_report.pdf

Ec-linc, n.d. Energy Check for Low Income Households. Available at: http://www.changeworks.org.uk/sites/default/files/Energy_Check_for_Low_Income_Households_%28EC-LINC%29.pdf

EEA, 2013. Achieving energy efficiency through behaviour change: what does it take? European Environment Agency. Available at: http://www.communitieslivingsustainably.org.uk/wp-content/uploads/2015/05/Achieving-energy-efficiency-through-behaviour-change1.pdf

EST, 2010. Energy in the Home: A selection of insights into consumer behaviour. Energy Saving Trust presentation to the Scottish Government, 28th June 2010.

Darby S., 2010. Smart metering: what potential for householder engagement? *Building Res. & Info*., 38, pp 442–457.

Defra, 2008. Changing Behaviour. Available at: http://www.defra.gov.uk/sustainable/government/what/priority/changing-behaviour.htm

Defra, 2008. A Framework for Pro-environmental Behaviours.

Department of Trade and Industry, 2003. Energy – its impact on the environment and society. Annex 3a.

Department for Work and Pensions. 2009. Incentives to save for retirement: Understanding perceptions and behaviour.

DfT, 2010. Behaviour Change: What Works for Transport? Think Piece project. Available at http://www.dft.gov.uk/pgr/scienceresearch/social/behaviour-changes/

EST, 2009. Aberdeen City Council: A Case Study of Community Heating. CE 65. London: Energy Savings Trust

Faruqui, A., Sergici, S., & Sharif A., 2010. The impact of informational feedback on energy consumption: A survey of the experimental evidence. *Energy*, 35, pp.1598–1608

Fell, D. and King, G., 2012. Domestic energy use study: to understand why comparable households use different amounts of energy: A report to the Department for Energy and Climate Change. Brook Lyndhurst. DECC, London. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65599/6919-domestic-energy-use-study.pdf

Frontczak, M., Andersen R.V., & Wargocki, P., 2010. Questionnaire survey on factors influencing comfort with indoor environmental quality in Danish housing. Building and Environment, 50, pp. 56-64.

Galvin, R. And Sunikka-Blank, M., 2016. Quantification of (p)rebound effects in retrofit policies – Why does it matter? Energy, 95, pp. 415-424.

Galvin, R., 2015. The rebound effect, gender and social justice: A case study in Germany. Energy Policy, Vol. 86, 2015, pp. 759-769.

Galvin, R., 2014. Estimating broad-brush rebound effects for household energy consumption in the EU 28 countries and Norway: some policy implications of Odysee data. Energy Policy, 73, 2014, pp.323-332.

Gordon, D, Adelman, L, Ashworth, K, Bradshaw, J, Levitas, R, Middleton, S, Pantazis, C, Patsios, D, Payne, S, Townsend, P and Williams, J., 2000. Poverty and Social Exclusion in Britain. Research Report. Joseph Rowntree Foundation, York.

Green, M., 2007. Voices of people experiencing poverty in Scotland. Everyone matters?: Poverty Alliance, Joseph Rowntree Foundation: UK.

Greening L.A., Greene, D.L., & Difiglio, C., 2000. Energy efficiency and consumption — the rebound effect — a survey. *Energy Policy*, 28, pp. 389-401.

Grevisse, F. and Brynart, M., 2011. *Energy poverty in Europe: Towards a more global understanding*: Sustainable Energy Service SCRL, Brussels.

Gill, Z.M., Tierney, M.J., Pegg, I.M., & Allan, N., 2010. Low-energy dwellings: the contribution of behaviours to actual performance, *Building Research & Information*, 38, pp. 491 — 508.

Hamilton, I.G., Steadman, P.J., Bruhns, H.R., Summerfield, A.J., & Lowe, R., 2013. Energy efficiency in the British housing stock: energy demand and the Homes Energy Efficiency Database. Energy Policy, Vol. 60, (2013), pp. 462-480.

Herring, H. and Roy, R., 2007. Technological innovation, energy efficient design and the rebound effect: Technovation 27, (4) 194-203, Available from: http://www.sciencedirect.com/science/article/pii/S016649720600112X

Heyman, A., 2015. Sustainable Sunderland: Report from Residents' Questionnaire. Available at: http://www.communitieslivingsustainably.org.uk/wp-content/uploads/2015/03/Sustainable-Sunderland-Survey-Report-FINAL.pdf

Hubbub, 2016. Mapping the Reality: Summary of Research Findings.

Hunn, N., 2013. Smart metering is fcuked. WiFore Consulting. Available at: http://www.nickhunn.com/wp-content/uploads/downloads/2013/11/Smart-Metering-is-FCUKED.pdf

Jackson T. 2005. SDRN Briefing Note One: Motivating Sustainable Consumption. Sustainable Development Research Network publication. Available at: www.sd-research.org.uk/wp-content/uploads/sdrnbriefing1motivatingsustainableconsumption_001.pdf

Jaffee, S. R.; Hanscombe, K. B.; Haworth, C. M.; Davis, O. S. and Plomin, R., 2012. Chaotic homes and children's disruptive behavior: a longitudinal cross-lagged twin study: Energy Policy 40, 132-142. Available from: http://www.sciencedirect.com/science/article/pii/S0301421511007336

Jenkins, K., McCauley, D., Heffron, R. and Stephan, H. 2014. Energy justice, a whole system approach. http://www.researchgate.net/profile/Darren_Mccauley/publication/274084170_Energy_Justice_a_Whole_Systems_Approach/links/5515e6e80cf2b5d6a0ec5d61.pdf

Jones, R.V., & Lomas, K.J., 2015. Determinants of high electrical energy demand in UK homes: Socio-economic and dwelling characteristics. Energy and Buildings, Vol. 101, 15 August, pp. 24-34.

Jones, R.V., Fuertes, A., & Lomas, K.J., 2015. The socio-economic, dwelling and appliance related factors affecting electricity consumption in domestic buildings. Renewable and Sustainable Energy Reviews, Vo. 43, (2015), pp. 901-917.

JRF, 2015. Monitoring Poverty and Social Exclusion in Scotland. Joseph Rowntree Foundation, March 2015. Available at: http://www.jrf.org.uk/publications/monitoring-poverty-and-social-exclusion-scotland-2015

Lally P., Cornelia H.M., Jaarsveld, V., Potts H.W.W., & Wardle J., 2010. How are habits formed: Modelling habit formation in the real world. European Journal of Social Psychology. October 2010. 40 (6), pp. 998-1009.

Langlois-Bertrand, S., Benhaddadi, M., Jegen, M., & Pineau, P-O., 2015. Political-institutional barriers to energy efficiency. Energy Strategy Reviews, Vol. 8, 2015, pp. 30-38.

Love, J., 2011. Mapping the impact of changes in occupant heating behaviour on space heating energy use as a result of UK domestic retrofit. UCL Energy Institute, London.
Martiskainen M. 2007. Affecting Consumer Behaviour on Energy Demand. Final Report to EdF Energy, Sussex Energy Group, Brighton

Madlener, M., & Hauertmann, M., 2011. Rebound Effects in German Residential Heating: Do Ownership and Income Matter? FCN Working Paper no. 2/2011, Energy Research Centre, RWTH-Aachen University.

Meyers R.J., Williams, E.D., & Matthews, H.S., 2010. Scoping the potential of monitoring and control technologies to reduce energy use in homes. *Energy and Buildings*, 42, pp.563–569.

Middlemiss, L., & Gillard, R., 2015. Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor: Energy Research and Social Science, 6, pp.146-154. Available from: http://www.sciencedirect.com/science/article/pii/S2214629615000213

Monk, S., Tang, C., & Whitehead, C., 2011. What does the literature tell us about the social and economic impact of housing? Report to the Communities Analytical Services Division, Scottish Government. Available at: http://www.scotland.gov.uk/Resource/Doc/313646/0099448.pdf

Ofgem, 2015. Retail Energy Markets in 2015. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/retail_energy_markets_in_2015_report_0.pdf

Ofgem, 2015. Insights paper on households with electric and other non-gas heating. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/insights_paper_on_households_with_electric_and_other_non-gas_heating_1.pdf

Ofgem, 2014. Understanding the consumer experience of dynamically teleswitched (DTS) meters and tariffs. Report for Ofgem. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2014/11/understanding_the_customer_experience_of_dts_meters_and_tariffs_final_version_0.pdf

Ofgem, 2014. Warm Home Discount – Energy Advice: Consumer Experiences. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2014/11/warm_home_discount_energy_advice_consumer_experiences_final_0.pdf

Ofgem, 2014. Community Energy Grid Connections: Working group report to the Secretary of State. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/insights_paper_on_households_with_electric_and_other_non-gas_heating_1.pdf

Ofgem, 2014. Complaints to Energy Companies. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2014/11/warm_home_discount_energy_advice_consumer_experiences_final_0.pdf

Ofgem, 2014. Green tariffs: additionality and messaging. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2014/06/gt_messaging_summary_final_0.pdf

Ofgem, 2011. What can behavioural economics say about GB energy consumers? Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2011/03/behavioural_economics_gbenergy_1.pdf

O'Sullivan, K.C., Howden-Chapman, P.L., & Fougere, G., 2011. Making the connection: The relationship between fuel poverty, electricyt disconnection, and prepayment meters. Energy Policy, Vol 39, (2), 2011, pp. 733-741.

Pantazis, C., Gordon, D. and Levitas, R., 2010. Poverty and social exclusion in Britain. The millennium survey: Studies in Poverty, Inequality and Social exclusion 2nd Edition, University of Bristol, The Policy Press.

Peffer, T., Pritoni, M., Meier, A., Aragon, C., & Perry, D., 2011. How people use thermostats in homes: A review. Building and Environment. 46 (12), pp.2529-2541.

Pleace, N., 2015. Crisis, At What Cost? An estimation of the financial costs of single homelessness in the UK. Centre for Housing Policy, University of York, July 2015.

Preston, I., Banks, N., Hargreaves, K., Kazmierczak, A., Lucas, K., Mayne, R., Downing, C., & Street, R., 2014. Climate Change and Social Justice: An Evidence Review. Joseph Rowntree Foundation. Available at: http://www.communitieslivingsustainably.org.uk/wp-content/uploads/2014/06/JRF-Climate-Change-Social-Justice-full-report.pdf

Roberts, D., Vera-Toscano, E., & Phimister, E., 2015. Fuel poverty in the UK: Is there a difference between rural and urban areas? Energy Policy, 87, (2015), pp.216-223.

Roberts, S., 2008. Energy, equity and the future of the fuel poor: Energy Policy 36, 4471-4474, Available from: http://www.sciencedirect.com/science/article/pii/S0301421508004679

Royston, S., 2014. Behind cold doors: The chilling reality for children in poverty: The Children's Society, Available from: http://www.childrenssociety.org.uk/sites/default/files/tcs/behind_cold_doors_-_final.pdf

Saunders, H. D., 2013. Historical evidence for energy efficiency rebound in 30 US sectors and a toolkit for rebound analysis. Technical Forescasting & Scoial Change 80, 1317-1330.
Scottish Government, 2009. SEABS 08: The Scottish Environmental Attitudes and Behaviours Survey 2008. Scottish Government Social Research, Edinburgh. Available at: http://www.scotland.gov.uk/Publications/2009/08/03100422/0

Schleich, J., Mills, B., & Dütschke, E., 2014. A brighter future? Quantifying the rebound effect in energy efficient lighting. Energy Policy, Vol. 72, 2014, pp. 35-42.

Scottish Government, 2013. Scottish Neighbourhood Statistics, Scottish Index of Multiple Deprivation, Interactive Mapping: Available from: http://www.sns.gov.uk/Simd/Simd.aspx accessed January 2013

Scottish Government, 2010. 10 Key Messages About Behaviour Change.

Scottish Government, 2011. International Review of Behaviour Change Initiatives.

Scottish Government, 2011. Review of the Climate Challenge Fund.

SDC, 2010. The Future is Local. Sustainable Development Commission, July 2010. Available at: http://www.sd-commission.org.uk/presslist.php/112/empowering-communities-to-lead-local-improvement-works-is-the-best-way-to-tackle-climate-change-and-

SFHA, 2010. Making Places Work. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/making-places-work

Sorrell, S., 2009. Jevons' paradox revisited: the evidence for backfire from improved energy efficiency: Energy Policy, 37 (4). 1456-1569. ISSN 0301-4215.

Sorrell, S., 2007. The Rebound Effect: an assessment of the evidence for economy-wide savings from energy efficiency. UK Energy Research Centre. Available at: http://www.ukerc.ac.uk/programmes/technology-and-policy-assessment/the-rebound-effect-report.html

Stephens, M., Blenkinsopp, J., & Gibb, K., 2015. The Devolution of Housing Benefit and Social Security: Rebalancing Housing Subsidies in Scotland. Available at: http://scotland.shelter.org.uk/professional_resources/policy_library/policy_library_folder/the_devolution_of_housing_benefit_and_social_security_rebalancing_housing_subsidies_in_scotland

Stern, P.C., Young, O.R., & Druckman, D., 1992. Global environmental change: Understanding the human dimensions. National Academy Press, Washington, D.C.

Summerfield, A.J., Lowe, R.J., Bruhns, H.R., Caeiro, J.R., Steadman, J.P., & Oreszcyn, T., 2007. Milton Keynes Energy Park revisited: changes in temperatures and energy usage. Energy and Buildings, 37, (7), (2007), pp. 783-791.

Thomson, H., and Snell, C., 2013. Quantifying the prevalence of fuel poverty across the European Union: Energy Policy 52, 563-572, Available from: http://www.sciencedirect.com/science/article/pii/S0301421512008671

Tingey, M., Hawkey, D., & Webb, J., 2014. Local Engagement in UK Energy Systems A Pilot Study of Current Activities and Future Impact with the Energy Technologies Institute.

Turner, K., 2012. Rebound effects from increased energy efficiency: a time to pause and reflect: Stirling Economics Discussion Paper, 2012-15. Stirling Management School, Available from: http://hdl.handle.net/1893/8950

Walker, G. and Day, R., 2012. Fuel poverty as injustice: integrating distribution, recognition and procedure in the struggle for affordable warmth: Energy Policy 49, October 2012, 69-75.

Walton, M., 2012. Social and Economic Benefits of Community Energy. National Trust publication. Available at: http://www.communitieslivingsustainably.org.uk/wp-content/uploads/2014/06/Report_-Social-and-Economic-Benefits-of-Community-Energy.pdf

Wang, Z., Han, B., Lu, M., 2016. Measurement of energy rebound effect in households: Evidence from residential electricity consumption in Beijing, China. Renewable and Sustainable Energy Reviews, 58, 852-661.

Watts, B., Fitzpatrick, S., Bramley, G. and Watkins, D., 2014. Welfare sanctions and conditionality in the UK: Joseph Rowntree Foundation, Available from: http://www.jrf.org.uk/sites/files/jrf/Welfare-conditionality-UK-Summary.pdf

Wei, S., Buswell, R., & Loveday, D., 2010. Probabilistic modelling of human adaptive behaviour in non-airconditioned buildings. Proceedings of the Network for Comfort and Energy Use in Buildings (NCEUB) Conference, Adapting to Change: New Thinking on Comfort, Windsor, April 2010

White, T.A., 2011. *Climate Change Communications: understanding people's perceptions and evaluating the effectiveness of interventions*. PhD Thesis. Institute of Energy and Sustainable Development (IESD), De Montfort University, UK.

Willis, R.M., Stewart, R.A., Panuwatwanich, K., Jones, S., & Kyriakides A., 2010. Alarming visual display monitors affecting shower end use water and energy conservation in Australian residential households. *Resources, Conservation and Recycling*, 54, pp.1117–1127

Wood, & G., & Newborough, M., 2007. Energy-use information transfer for intelligent homes: Enabling energy conservation with central and local displays. *Energy and Buildings*, 39, pp.495-503.

Wyatt, P., 2013. A dwelling-level investigation into the physical and scoio-economic drivers of domestic energy consumption in England. Energy Policy, Vol. 60, (2013), pp. 540-549.

Ueno, T., Sano, F., Saeki, O., & Tsuji, K., 2005. Effectiveness of an energy-consumption information system on energy savings in residential houses based on monitored data. *Applied Energy*, 83, pp.166–183

Environmental

AEA Technology. 2011. The AEA Scottish Microgeneration Index. Available at: http://www.aeat.com/cms/assets/Documents/The-AEA-Scottish-Microgeneration-Index.pdf

AECOM, 2013. Study into the Potential for Deep Geothermal Energy in Scotland: Volume 1. Scottish Government publication. Available at: http://www.scotland.gov.uk/Resource/0043/00437977.pdf

Allen, S.R., Hammond, G.P., & McManus, M.C., 2008. Prospects for and barriers to domestic micro-generation: A United Kingdom perspective. *Applied Energy*, 85, pp. 528-544

Audenaert, A., Briffaerts, K. and Engels, L., 2011. Practical versus theoretical domestic energy consumption for space heating: Energy Policy 39, 5219-5227. Available from: http://www.sciencedirect.com/science/article/pii/S0301421511004289

Baker K.J., & Rylatt, M., 2008. Improving the prediction of UK domestic energy demand using annual consumption data. Applied Energy, 85, pp. 475-482.

Baker, K., 2007. Sustainable Cities: Determining indicators of domestic energy consumption: PhD thesis: De Montfort University, Leicester. Available from: https://www.dora.dmu.ac.uk/handle/2086/4118

Baster, M.E, 2011. Modelling the Performance of Air Source Heat Pumps. University of Strathclyde, Glasgow. Available at: http://www.esru.strath.ac.uk/Documents/MSc_2011/Baster.pdf

BGS, 2013. Heat energy beneath Glasgow. British Geological Survey. Available at: http://www.bgs.ac.uk/research/energy/geothermal/heatEnergyGlasgow.html

Boardman, B., Darby, S., Killip, M., Jardine, C. J., Palmer, J. and Sinden, G., 2005. 40% House. Environmental Change Institute, Oxford University Press. Available from: http://www.eci.ox.ac.uk/research/energy/downloads/40house/40house.pdf

Boardman, B., 2007. Home truths: A low carbon strategy to reduce UK Housing emissions by 80% by 2050: Environmental Change Institute, Oxford University Press. Available from: http://www.eci.ox.ac.uk/research/energy/downloads/boardman07-hometruths.pdf

Bothwell, K., Saich, M., & Mallion, P., 2011. Retrofit of existing housing in the United Kingdom: the carbon reduction possibilities. Architecture and Sustainable Development, Proceedings of the Passive and Low Energy Architecture (PLEA) Conference, Louvain-la-Neuve, Belgium, July 2011.

Bouzarovski, S., Petrova, S. and Sarlamanov, R., 2012. Energy poverty in the EU: a critical prospective: Energy Policy 49, 76-82. Available from: http://www.sciencedirect.com/science/article/pii/S0301421512000584

Brady, B., 2013. Rising energy bills force bleak choice on families - eat or heat: The Independent, Available from: http://www.independent.co.uk/news/uk/politics/rising-energy-bills-force-bleak-choice-on-families--eat-or-heat-8439823.html

BRE, 2015. Product characteristics database: Boilers. Buildings Research Establishment, Watford, UK. Available from: http://www.ncm-pcdb.org.uk/sap/pcdbsearchresults.jsp?btnSubmit=Search&type=0&mainType=2&heatPumpType=0&emitterType=0&mvType=0&fuel=1&brand=&model=&modelQualifier=&instantaneous=0&integrated=-1&pid=26&modelQualifier

BRE, 2012. Standard Assessment Procedure 2012. Buildings Research Establishment, Watford, UK. Available from: http://www.bre.co.uk/sap2012/page.jsp?id=2759

BRE, 2011. The Passivhaus Standard. Building Research Establishment, UK. Available at: http://www.passivhaus.org.uk/standard.jsp?id=122

BRE, 2002. Thermal Insulation: Avoiding Risks. BRE Report 262, Building Research Establishment, Watford, UK. Available at: http://www.decc.gov.uk/en/content/cms/meeting_energy/microgen/ashps/ashps.aspx

Buchanan, K., Banks, N., Preston, I., & Russo, R., 2016. The British public's perception of the UK smart metering initiative: Threats and opportunities. Energy Policy, 91, 2016, pp. 87-97.

Changeworks, 2014. Guide to Insulating Hard-to-Treat Cavities (HTTCs). Available at: http://www.changeworks.org.uk/sites/default/files/Guide_to_Insulating_Hard_to_Treat_Cavities_2014.pdf

Changeworks, 2012. Solid Wall Insulation in Scotland. Available at: http://www.changeworks.org.uk/sites/default/files/Solid_Wall_Insulation_in_Scotland.pdf

Changeworks, 2010. Street by street, house by house: Area-based retrofit for low carbon homes: Best approaches for Scotland. Report for WWF Scotland. Available at: http://www.changeworks.org.uk/sites/default/files/Street_by_street_house_by_house.pdf

Changeworks, 2009. Renewable Heritage: A guide to microgeneration in traditional and historic homes. Available at: http://www.changeworks.org.uk/sites/default/files/Renewable_Heritage.pdf

Changeworks, 2008. Energy Heritage: A guide to improving energy efficiency in traditional and historic homes. Available at: http://www.changeworks.org.uk/sites/default/files/Energy_Heritage.pdf

Church, E.S., 2012. A Proof of Concept Study Investigating the Application of a Geographical Information System in Determining Geothermal Potential in Abandoned Mine Workings in Glasgow. Glasgow Caledonian University, Scotland.

CICStart, 2013. The Green Deal and Sustainable Refurbishment of Traditional Buildings. Conference held at Glasgow Caledonian University on 29th Feb 2012. Details at: http://www.cicstart.org/events/events/212,481/Conference--The-Green-Deal-and-Sustainable-Refurbishment-of-Traditional-Buildings.html

Danish Energy Authority, 2005. Heat Supply in Denmark. Available at: http://193.88.185.141/Graphics/Publikationer/Forsyning_UK/Heat_supply_in_Denmark/pdf/varmeforsyning_uk.pdf

Dresner, S., & Ekins, P., 2004. Economic Instruments for a Socially Neutral National Home Energy Efficiency Programme. Policy Studies Institute, London, UK.

Druckman, A., & Jackson, T., 2008. Household energy consumption in the UK: A highly geographically and socio-economically disaggregated model. Energy Policy, Vol. 36, (8), pp. 3177-3192.

EAS, 2007. Living with a Warm Home and a Carbon Footprint. Energy Action Scotland. Available at: http://www.theclaymoreproject.com/uploads/associate/365/file/EAS%20Publications/Manifesto2007_living_with_warm_home.pdf

Element Energy, 2008. Numbers of Microgeneration Units Installed in England, Wales, Scotland, and Northern Ireland. Report to BERR. Available at: http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file49151.pdf

EST, 2014. City of Wakefield Metropolitan District Council Home Energy Conservation Act: Further Report 2012-2013. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/organisations/sites/default/files/wakefield-heca-further-report-march-2013.pdf

EST, 2014. Green communities case study – Hyde farm. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/organisations/reports/green-communities-case-study-hyde-farm

EST, 2014. Green communities case study – St Mary's Church. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/organisations/reports/green-communities-case-study-st-marys-church

EST, 2014. Green communities case study – Sadberge Energy Saving Project. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/organisations/reports/green-communities-case-study-sadberge-energy-saving-project

EST, 2014. Green communities case study – Davyhulme Energy Saving Project. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/organisations/reports/green-communities-case-study-davyhulme

EST, 2014. Green communities case study – Cotteridge friends meeting house. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/organisations/reports/green-communities-case-study-cotteridge-friends-meeting-house

EST, 2014. Green communities case study – Linlithgow Climate Challenge. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/organisations/reports/green-communities-case-study-linlithgow-climate-challenge

EST, 2011. Ground source heat pumps. Available at: http://www.energysavingtrust.org.uk/scotland/Generate-your-own-energy/Ground-source-heat-pumps?gclid=CMW05JXTmqwCFYEZ4QodRV03Og

EST, 2011. Hydroelectricity. Available at: http://www.energysavingtrust.org.uk/Generate-your-own-energy/Hydroelectricity

EST, 2010. Getting Warmer: A Field Trial of Heat Pumps. Energy Saving Trust publication. Available at: http://www.energysavingtrust.org.uk/content/download/1801485/4898250/version/9/file/Getting_warmer_a_field_trial_of_heat_pumps_report.pdf

European Commission, 2010. Evaluation of the Communication Plan on Energy-Climate Change. The Evaluation Partnership (TEP), London.

European Union, 2010. Energy Performance of Buildings (EPBD) Directive. European Union Directive 2002/91/EC, and as amended in 2010/31/EU.

ExHA, 2015. A Warm Homes Act for Scotland – October 2015. Existing Homes Alliance. Available at: http://existinghomesalliancescotland.co.uk/wp-content/uploads/2015/10/A-Warm-Homes-Act-for-Scotland_ExHAS_FINAL.pdf

ExHA, 2015. No one in Scotland living in a hard-to-heat, draughty home by 2025. Existing Homes Alliance. Available at: http://existinghomesalliancescotland.co.uk/wp-content/uploads/2015/10/EXHAS_jointstatement_Oct15.pdf

ExHA, 2015. Existing Homes Alliance calls for energy efficiency to be national infrastructure project in 2016. Existing Homes Alliance. Available at: http://existinghomesalliancescotland.co.uk/policy/existing-homes-alliance-calls-for-energy-efficiency-to-be-natioinal-infrastructure-project-in-2016out-policy-asks-for-2016/

ExHA, 2015. A minimum energy performance standard for existing private homes. Existing Homes Alliance. Available at: http://existinghomesalliancescotland.co.uk/wp-content/uploads/2015/11/ExHAS-regulation-briefing_Nov2015.pdf

ExHA, 2014. Do we need a new housing Condition Standard? Existing Homes Alliance. Available at: http://existinghomesalliancescotland.co.uk/policy/do-we-need-a-new-housing-condition-standard/

Goodall, C., 2014. Actual energy savings from efficiency measures only half of what is officially claimed. Carbon Commentary. Available at: http://www.carboncommentary.com/2014/01/18/3368

Haas, R., Resch. G., Panzer, C., Busch, S., Ragwitz, M., & Held, A., 2011. Efficiency and effectiveness of promotion systems for electricity generation from renewable energy sources e Lessons from EU countries, *Energy*, 36, pp. 2186-2193.

Hawkey, D., 2014. District Heating in the UK: Prospects for a Third National Programme. Science and Technology Studies, 27 (3): 68-89.

Iwaszkiewicz, C., Christofides, J., Wright, W., Thompson, R., Connaughton, J., Hayes-Lewin, B., & Newey, R., 2010. Study on hard to fill cavity walls in domestic dwellings in Great Britain. Report for the Department of Energy and Climate Change. Ref: CESA EE0211. Available at: http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/saving_energy/analysis/788-hard-to-fill-cavity-walls-domestic.pdf

Jenkins, D., 2010. The value of retrofitting carbon-saving measures into fuel poor social housing. Energy Policy 38, (2), pp. 832-839. Available from: http://www.sciencedirect.com/science/article/pii/S0301421509007770

John Gilbert Architects, 2013. PassivTEN: Upgrading Glasgow's Tenements to PassivHaus standard. John Gilbert Architects, Glasgow. Available at: http://www.johngilbert.co.uk/files/130128RPT_PassivTEN_NoAppendix_v4_web.pdf

Kavgic, M., Mumovic, D., Summerfield, A., Stevanovic, Z., & Ecim-Djuric, O., 2013. Uncertainty and modelling energy consumption: Sensitivity analysis for a city-scale domestic energy model. Energy and Buildings, Vol. 60, May 2013, pp. 1-11.

Kelly S., 2011. Do homes that are more energy efficient consume less energy?: A structural equation model of the English residential sector, *Energy*, 36, pp. 5610-5620.

Kingspan Ltd, 2016. 6 Benefits of building to the Passivhaus Standard. Available at: http://blog.kingspaninsulation.co.uk/6-benefits-building-passivhaus-standard/

Kraljevska, E., 2014. Estimated Benefits of Achieving Passivhaus and Net Zero Energy Standards in the Region of Waterloo Residential Sector and the Barriers and Drivers to Achieve Them. Masters thesis, University of Waterloo, Canada.

Lomas, K.J., 2010. Carbon reduction in existing buildings: a transdisciplinary approach, *Building Res & Info.*, 38, pp. 1–11.

Lowe, R.J., & Johnston, D.K., 1997. Mechanical ventilation with heat recovery in local authority, low rise housing: Final report on the Derwentside field trial. CeBE Report no.6 Centre for the Built Environment, Leeds Metropolitan University, Leeds, UK, 1997.

Macintosh, A., & Steemers, K., 2005. Ventilation strategies for urban housing: lessons from a PoE case study. Building Research & Information, Vol. 33, (1), 2005, pp. 17-31.

Majcen, D., Itard, L. and Visscher, H., 2013. Actual and theoretical gas consumption in Dutch dwellings: What causes the differences?: Energy Policy 61, 460–471.

Martin, M., 2015. The application of a large scale open water source heat pump and thermal store within an existing combined heat and power (CHP) and district heating system. Feasibility study for Aberdeen Heat and Power, funded by Scottish Government Local Energy Challenge Fund.

Martiskainen, M., 2007. Affecting consumer behaviour on energy demand: Sussex Energy Group, University of Sussex, Available from: https://www.sussex.ac.uk/webteam/gateway/file.php?name=seg-consumer-behaviour-final-report.pdf&site=264

National Insulation Association, n.d. Case Studies. Available at: http://www.nia-uk.org/consumer/understanding-insulation/case-studies/

New Scientist, 2013. How heat from trains and sewers can warm our homes. 5th December 2013. Elsevier, London.

Oladokun, M.G., & Odesola, I.A., 2015. Household energy consumption and carbon emissions for sustainable cities – A critical review of modelling approaches. International Journal of Sustainable Built Environment. Vol 4, (2), December 2015, pp. 231-247.

Roaf, S., Fuentes, M., & Thomas-Rees, S., 2012. Ecohouse. Forth Edition. Routledge.

Roaf, S., Crichton, D. & Nicol, F., 2009. Adapting buildings and cities for climate change. 2nd ed. Amsterdam: Architectural Press.

Roaf, S., Baker, K.J., & Peacock, A., 2008. Evidence on Hard to Treat Properties. Scottish Government.

Sanders, C., & Phillipson, M., 2006. Review of Differences between Measured and Theoretical Energy Savings for Insulation Measures. Report for the Energy Saving Trust.

Scottish Building Standards Agency, 2005. Review of Guidance on Energy and Environment. Available at: http://www.scotland.gov.uk/Resource/Doc/217736/0096692.pdf

Scottish Government, 2013. A Low Carbon Building Strategy for Scotland (The Sullivan Report) – 2013 update.

Scottish Government, 2012. Fuel Poverty Evidence Review: Defining, Measuring and Analysing Fuel Poverty in Scotland. Available at: http://www.gov.scot/resource/0039/00398798.pdf

Scottish Government, 2010, DEMScot 2: Scotland's Housing Carbon Model The extensions. http://www.scotland.gov.uk/Resource/Doc/1035/0103828.pdf

Stephens E. 2011. The Potential for Exploiting Geothermal Energy in Scotland. Available at: http://www.st-andrews.ac.uk/~wes/research/Geothermal_overview.html

Scottish Government, 2009, Modelling Greenhouse Gas Emissions from Scottish Housing: Final Report, p47. http://www.scotland.gov.uk/Publications/2009/10/08143041/0

Scottish Government, 2008. Scottish Hydropower Resource Study.

Scottish Government, 2007. A Low Carbon Building Strategy for Scotland (The Sullivan Report).

STBA, 2012. Responsible Retrofit of Traditional Buildings: A Report on Existing Guidance and Research with Recommendations. Sustainable Traditional Buildings Alliance. Available at: http://www.spab.org.uk/downloads/STBA%20RESPONSIBLE-RETROFIT.pdf

Ürge-Vorsatz, D., Tirado Herrero, S., 2012. Building synergies between climate change mitigation and energy poverty alleviation: Energy Policy, 49, October 2012, Pages 83-90.

USA Department of Energy. Heat Pump Systems. Available at: http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12610

Washan, P., Stenning, J. and Goodman, M., 2014. Building the future: The economic and fiscal impacts of making homes more energy efficient: Cambridge Econometrics, Verco, Available from: http://www.energybillrevolution.org/wp-content/uploads/2014/10/Building-the-Future-The-Economic-and-Fiscal-impacts-of-making-homes-energy-efficient.pdf

Webb, J., 2015. Improvising innovation in UK urban district heating: the convergence of social and environmental agendas in Aberdeen. Energy Policy.

Williams J. 2010. The deployment of decentralised energy systems as part of the housing growth programme in the UK. Energy Policy, 38, pp.7604–7613.

Wiltshire, R., Jangsten, O., Williams, J., & Aguilio-Rullan, A., 2009. Community Heating and Combined Heat and Power. Buildings Research Establishment / NHBC Foundation. Available at: http://www.communitieslivingsustainably.org.uk/wp-content/uploads/2012/05/Community-Heating.pdf

Wright, A., 2008. What is the relationship between built form and energy use in dwellings?: Energy Policy 36, (2008) 4544-4547.

WPZ, 2011. Test Results of Air to Water Heat Pumps based on EN 14511. Wärmpumpen-Testzenstrum. Published by the Interstaatliche Hochschule für Technik Buchs, Switzerland. Available at: http://www.ntb.ch/fileadmin/Institute/IES/pdf/PruefResLW110620_Eng.pdf

Economic

Agrella, P. and Bogetoft, P., 2005. Economic and environmental efficiency of district heating plants: Energy Policy 33, 10 1351-1362. Available from: http://www.sciencedirect.com/science/article/pii/S0301421503003793

Anderson, W., White, V. and Finney, A., 2012. Coping with low incomes and cold homes: Energy Policy, Vol 49, February 2012, pp. 40-52. Available from: http://www.sciencedirect.com/science/article/pii/S0301421512000055

Archard, D., Washan, P., Stenning, J., & Summerton, P., 2014. Economic impact of energy efficiency investment in Scotland. Verco and Cambridge Econometrics report for Consumer Futures Scotland. Available at: http://webarchive.nationalarchives.gov.uk/20140728011208/http://www.consumerfutures.org.uk/files/2014/03/Economic-impact-of-energy-efficiency-investment-in-Scotland.pdf

Bachelor, 2013. Why the Green Deal could make your home a hard sell. The Guardian, 27th January 2013. Available at: http://www.theguardian.com/money/2013/jan/27/green-deal-home-hard-sell

Baker, K.J., & Mould, R., 2015. Study shows rural fuel poor pay more than urban equivalents. Energy Review, Energy Action Scotland, Winter 2015.

Bale, C., Bush, R., Hawkey, D., & Webb, J., 2014. Valuation of passive provision for heat network investments. Chapter 6 in A.Brown and M. Robertson (eds) The Economics of Infrastructure. Newcastle/Leeds: iBuild https://research.ncl.ac.uk/ibuild/outputs/9940_iBuild_report_print_version%20WEB.pdf

Butler, P., 2013. Heat or eat? Or take out a loan, do both, and hope for the best?: The Guardian, Available from: http://www.theguardian.com/society/2013/oct/01/heat-eat-loan-liverpool

Cambridge Econometrics, 2015. Assessing the Employment and Social Impact of Energy Efficiency. Final Report. November 2015. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/CE_EE_Jobs_main%2018Nov2015.pdf

CBI, 2014. Homes for Growth. Available at: http://www.cbi.org.uk/media-centre/press-releases/2014/09/uk-housing-shortage-is-costing-consumers-%C2%A34bn-each-year-cbi-report/

Changeworks, 2014. Guide to Identifying Eligible Households for the Home Heating Cost Reduction Obligation (HHCRO). Available at: http://www.changeworks.org.uk/sites/default/files/Guide_to_HHCRO_Sept13.pdf

CFS, 2013. Changed Lives: The real cost of high fuel bills: The impact of rising energy prices on struggling households in Scotland. Consumer Focus Scotland. Available at: http://webarchive.nationalarchives.gov.uk/20140728011208/http://www.consumerfutures.org.uk/files/2013/05/Changed-lives.pdf

COSLA, 2015. Energy Efficiency Funding for Housing. Available at: http://www.cosla.gov.uk/documents?tid=&search=energy&month=0&year=0

CRSP, 2013. A Minimum Income Standard for Remote Rural Scotland. Report for Scottish Federation of Housing Associations by the Centre for Research in Social Policy, Loughborough University. Available at: http://www.sfha.co.uk/sfha/publications/a-minimum-income-standard-for-remote-rural-scotland-july-2013

Davies, G., Woods, P., 2009. The potential and costs of district heating networks: Pöyry Energy Consulting on behalf of DECC. Available from: http://webarchive.nationalarchives.gov.uk/20121205174605/http:/decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/distributed%20energy%20heat/1467-potential-costs-district-heating-network.pdf

DCLG, 2011. Cost of building to the Code for Sustainable Homes: updated cost review, Dept for Communities and Local Govt. http://www.communities.gov.uk/documents/planningandbuilding/pdf/1972728.pdf

DECC, 2015. Annual Domestic Energy Bills 2015. Department of Energy and Climate Change, HMSO, London.

DECC, 2014. Annual Fuel Poverty Statistics Report, 2014. Department of Energy and Climate Change, HMSO, London.

DECC, 2014. Domestic Energy Price Indices, 2014. Department of Energy and Climate Change, HMSO, London.

DECC, 2012. How the Green Deal will reflect the in-situ performance of energy efficiency measures: Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48407/5505-how-the-green-deal-will-reflect-the-insitu-perfor.pdf

DECC, 2012. District Heating – Heat Metering Cost Benefit Analysis: Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48389/5462-district-heating--heat-metering-cost-benefit-anal.pdf

DECC, 2011. *The Green Deal and Energy Company Obligation – Consultation Document*. Available at: http://www.decc.gov.uk/assets/decc/11/consultation/green-deal/3607-green-deal-energy-company-ob-cons.pdf

DECC, 2011. Evaluation of the Community Energy Saving Programme. Available at: http://www.decc.gov.uk/assets/decc/11/funding-support/3342-evaluation-of-the-community-energy-saving-programm.pdf

Dresner, S, Ekins, P, 2004 Economic instruments for a Socially Neutral national home Energy Efficiency Programme. Policy Studies Institute London, UK.

EAS, 2011. The Cost of Affordable Warmth. Energy Action Scotland, January 2009. Available at: http://www.theclaymoreproject.com/uploads/associate/365/file/EAS%20Publications/Cost_Affordable_Warmth_FINAL_VERSION.pdf

EC, 2010. An Energy policy for Customers. Commission Staff Working Paper. European Commission, 11.11.2010. Brussels.

ECEC, 2012. Edinburgh Community Energy Cooperative Renewable Energy Development and Financing Report. Available at: http://www.changeworks.org.uk/sites/default/files/Edinburgh_Community_Energy_Co-operative_Report.pdf

EST, 2008. Towards a long term strategy for reducing carbon dioxide emissions from our housing stock.

Faulk, A., 2015. Funding Energy Efficiency in Scotland's Existing Homes – Learning from Housing Associations' Experience. Report for the Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/funding-energy-efficiency-in-scotlands-existing-homes

Frontier Economics, 2015. Energy efficiency: An infrastructure priority. Report for Citizens Advice, Energy Bill Revolution, Energy Saving Trust, Kingfisher Plc and MIMA.

González-Equino, M., 2015. Energy poverty: An overview: Renewable and Sustainable Energy Reviews 47, 377-385 Available from: http://www.sciencedirect.com/science/article/pii/S1364032115001586

Goodacre, C., Sharples, S., & Smith, S., 2002. Integrating energy efficiency with the social agenda in sustainability. Energy and Buildings, Vol. 34, (1), 2002, pp. 53-61.

Goodall, C., 2012. The Energy Company Obligation: a pittance that will worsen the finances of the most poor. Carbon Commentary, 3rd January 2012. Available at: http://www.carboncommentary.com/2012/01/03/2230

Grevisse, F. and Brynart, M., 2011. Energy poverty in Europe: Towards a more global understanding: Sustainable Energy Service SCRL, Brussels.

Grubb, M. J., 1990. Energy efficiency and economic fallacies: Energy Policy 18, 783–785. Available from: http://www.researchgate.net/publication/4945574_Communication_Energy_efficiency_and_economic_fallacies

Hawkey, D., & Webb, J., 2014. District Energy Development in Liberalised Markets: situating UK heat network development in comparison with Dutch and Norwegian Cases. Technology Analysis and Strategic Management.

Hawkey, D., & Webb, J., 2014. Coordinating heat network development under uncertainty: nascent heat networks in two British cities, Paper presented at RC-UK International Workshop: Sustainable Heating Provisions and Cities, Edinburgh, October 2014.

Healy, J. D. and Clinch, J. P., 2002. Fuel poverty in Europe: A cross country analysis using a new composite measurement: Environmental Studies Research Series, University College Dublin.

Heinrich M., & Neuhoff, K., 2006. Choosing to save. University of Cambridge publication. Available at: http://www.eprg.group.cam.ac.uk/wp-content/uploads/2008/11/eprg0630.pdf

Hills, J., 2012. Getting the measure of Fuel Poverty: DECC, Case Report 72 March 2012, Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48297/4662-getting-measure-fuel-pov-final-hills-rpt.pdf

Hirsch, D., Preston, I. and White, V., 2011. Understanding fuel expenditure: Fuel poverty and spending on fuel: Consumer Focus, Available from: http://www.cse.org.uk/downloads/reports-and-publications/fuel-poverty/understanding-fuel-expenditure.pdf

Ipsos Mori, 2012. Consumers' views of price comparison guides and tariff structures. Report for Ofgem. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2012/10/consumers%27-views-of-price-comparison-guides-and-tariff-structures_1.pdf

Jackson, T., 2009. Prosperity without Growth. Sustainable Development Commission, UK. Available at: http://www.sd-commission.org.uk/data/files/publications/prosperity_without_growth_report.pdf

Jarvis, S., Jenkins, S.P., 1997. Low income dynamics in 1990s Britain. Fisc. Stud. 18, 123–142.

Jenkins, S.P.,Rigg, J., 2001. The Dynamics of Poverty in Britain. Department of Work and Pensions, HMSO, Research Report No157.

Jones, C., 2010 .Less and less favoured? Britain's regions in the energy crunch. Environ. Plan. A 42, 3006–3022.

Kabir M.R., Rooke, B., Dassanayake, G.D.M., & Fleck, B.A., 2012. Comparative life cycle energy, emission, and economic analysis of 100 kW nameplate wind power generation, *Renewable Energy*, 37, pp. 133-141

McKay, H., 2006. Environmental, economic, social and political drivers for increasing use of woodfuel as a renewable resource in Britain. Biomass and Bioenergy, Vol. 30, (4), 2006, pp. 308-315.

Monahan, J., & Powell, J.C., 2011. A comparison of the energy and carbon implications of new systems of energy provision in new build housing in the UK, *Energy Policy*, 39, pp. 290–298.

Monbiot, G., 2012. The green deal is a useless, middle-class subsidy. The Guardian, 13th January 2012. AvAilable at: http://www.guardian.co.uk/environment/georgemonbiot/2012/jan/13/green-deal

Mould, R., Baker, K.J., & Emmanuel, R., 2014. Behind the Definition of Fuel Poverty: Understanding differences between the Fuel Spend of Rural and Urban Homes. Queens Political Review, Vol. II, 2014, Issue 2, pp. 7-24.

Ofgem, 2010. Review of suppliers' approaches to debt management and prevention. Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2011/03/behavioural_economics_gbenergy_1.pdf

Palmer, G., MacInnes, T. and Kenway, P., 2008. Cold and Poor: An analysis of the link between fuel poverty and low income: New Policy Institute. Available from: http://www.poverty.org.uk/reports/fuel%20poverty.pdf

Phimister, E., Upward, R., Vera-Toscano, E., 2000. The dynamics of low incomes in rural areas. Reg. Stud. 34 (5), 407–417.

Phimister, E., Vera-Toscano, E., Roberts, D.,2015. The dynamics of energy poverty: evidence from Spain. Econ. Energy Environ. Policy 4, 153–166.

Preston, I., White, V., Backlaws, K., & Hirsh, D., 2014. Fuel and poverty: A Rapid Evidence Assessment for the Joseph Rowntree Foundation. Available at: https://www.cse.org.uk/downloads/reports-and-publications/fuel-poverty/Fuel_and_poverty_review_June2014.pdf

Poulter, S., 2013. The 25 year 'green deal' loans that could prevent you selling your house. The Daily Mail, 14th September 2013. Available at: http://www.dailymail.co.uk/news/article-2420496/The-25-year-green-deal-loans-prevent-selling-house.html

Power, A., 2008. Does demolition or refurbishment of old and inefficient homes help to increase our environmental, social and economic viability? Energy Policy, Vol. 36, (12), 2008, pp. 4487-4501.

Ridge, T. and Wright, S., 2011. Understanding inequality, poverty and wealth: The Press and the Social Policy Association.

Scottish Government, 2013. Scottish Index of Multiple Deprivation. Scottish Government. Available at: http://www.scotland.gov.uk/Topics/Statistics/SIMD

Scottish Government, Communities Analytical Services (Housing Statistics), 2011. New House Building in Scotland. Data available at http://www.scotland.gov.uk/Topics/Statistics/Browse/Housing-Regeneration/HSfS/NewBuild

Scottish Government, 2008. Economic Strategy. March 2015. Available at: http://www.gov.scot/Publications/2015/03/5984

SFHA, 2014. Cause for Concern? Early impacts of benefit sanctions on housing associations and cooperatives in Scotland. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/cause-for-concern-sfha-report-on-sanctaions

SFHA, 2014. The Real Cost of the Bedroom Tax. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/the-real-cost-of-the-bedroom-tax

SFHA, 2013. Welfare Rights and Wrongs: A Good Practice Guide. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/the-real-cost-of-the-bedroom-tax

SFHA, 2013. Preparing for Welfare Reform: Rural Housing Associations. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/preparing-for-welfare-reform-rural-housing-associations

SFHA, 2012. Preparing for Housing Benefit Spending: Busting the Myths. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/housing-benefit-spending-busting-the-myths

SFHA, 2012. The Impact of Welfare Reform on Housing Associations and Cooperatives in Scotland. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/the-impact-of-welfare-reform-on-housing-associations-and-co-operatives-in-scotland

SFHA, 2012. Preparing for Welfare Reform. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/preparing-for-welfare-reform

SFHA, 2012. CIHS/SFHA Discussion Paper – Devolving Housing Benefit. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/cihssfha-discussion-paper-devolving-housing-benefit

SFHA, 2011. Welfare Reform Impact Assessment Report. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/welfare-reform-impact-assessment-report

SFHA, 2009. Beating the Crunch. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/beating-the-crunch

Shelter, 2015. The Economic Impact of Investment in Affordable Housing. Available at: http://scotland.shelter.org.uk/__data/assets/pdf_file/0009/1218609/Economic_impact_of_housing_investment.pdf/_nocache?utm_source=Adestra&utm_medium=email&utm_campaign=2642

Shelter Scotland, 2015. Affordable Housing Need in Scotland: Final Report – September 2015. Sheffield Hallam University, St Andrews University, and the University of Sheffield, report for Shelter Scotland, Chartered Institute of Housing Scotland, and the Scottish Federation of Housing Associations. Available at: http://www.cih.org/resources/PDF/Scotland%20Policy%20Pdfs/Affordable%20Housing,%20Supply%20and%20Planning/7909_Final_Housing_Needs_Research%20scotland%202015.pdf

Stevens, A., 1999. Climbing out of poverty. Falling back in: measuring the persistence of poverty over multiple spells. J. Hum. Res. 3,557–588.

Snodin, H.M., 2008. Fuel Poverty in Great Britain, Germany, Denmark and Spain - relation to grid charging and renewable energy. Report for Highlands and Islands Enterprise. Available at: http://www.hi-energy.org.uk/Downloads/General%20Documents/Report%20on%20Fuel%20Poverty%20in%20Relation%20to%20Grid%20Charging%20and%20Renewable%20Generation.pdf

Tadeu, S.F., Alexandre, R.F., Tadeu, A.J.B., Antunes, C.H., Simoes, N.A.V., & da Silva, P.P., 2016. A comparison between cost optimality and return on investment for energy retrofit in buildings: A real options perspective. Sustainable Cities and Society, Vol. 21, February 2016, pp. 12-25.

Toke, D. and Fragaki, A., 2008. Do liberalised electricity markets help or hinder CHP and district heating? The case of the UK: Energy Policy 36, 1448-1456, Available from: http://www.sciencedirect.com/science/article/pii/S0301421507005745

Watts, C., Jentsch, M.F., & James, P.A.B., 2011. Implications of Energy Performance Certificates for the UK domestic building stock – Feedback from a Southampton homeowner survey. CIBSE Technical Symposium, De Montfort University, Leicester, UK – 6th and 7th September 2011.

WWF Scotland, 2012. Mind the Gap: Funding Home energy efficiency to deliver Scotland's climate change and fuel poverty targets. Available at: http://assets.wwf.org.uk/downloads/fuel_poverty_funding_3__2_.pdf

General / Other

AEA Technology, 2011. A study into the recovery of heat from power generation in Scotland. Available at: www.scotland.gov.uk/Resource/Doc/362183/0122534.pdf,

Allan, G., Eromenko, I., McGregor, P., & Swales, K., 2011. The regional electricity generation mix in Scotland: A portfolio selection approach incorporating marine technologies, *Energy Policy*, 39, pp. 6–22

Alacho, 2014. A Guide to Good Practice in Partnership Working Between Scottish Councils and RSLs. Association of Local Authority Chief Housing Officers. Available at: http://alacho.org/what-we-do/reports/

Alacho, 2014. An analysis of the capacity of Scottish local authorities to fund new housing supply. Available at: http://alacho.org/what-we-do/reports/

Alcock, P., 2006. Understanding Poverty: Palgrave MacMillan Houndslow, England.

Baker, K.J., Emmanuel, R., & Phillipson, M., 2014. Review of the Energy Assistance Package. Report for the Scottish Government. Available at: http://www.scotland.gov.uk/Topics/BuiltEnvironment/Housing/warmhomes/fuelpoverty

Boardman, B., 2012. Fuel poverty synthesis: Lessons learnt, actions needed: Energy Policy 49, 143–148. Available from: http://fuelpoverty.eu/resources/fuel-poverty-synthesis-lessons-learnt-actions-needed/

Boardman, B., 2010. Fixing fuel poverty: challenges and solutions. Earthscan.

Boardman, B. 1991. Fuel Poverty: From Cold Homes to Affordable Warmth: London: Belhaven Press.

Bouzarovski, S., Petrova, S., Tirado-Herrero, S., 2014. From Fuel Poverty to Energy Vulnerability: The importance of Services, Needs and Practices SPRU Working Paper Series December 2014 University of Sussex.

Britnell, J., & Dixon, T., 2011. Retrofitting in the private residential and commercial property sectors – survey findings. Retrofit 2050 Working Paper. Oxford Institute for Sustainable Development (OISD), Oxford Brookes University.

CASD, 2010. A Thematic Review of Literature on the Relationships Between Housing, Neighbourhoods and Schools. Communities Analytical Services Division, Scottish Government. Available at: www.gov.scot/resource/doc/1125/0104564.doc

Castellani, B., 2014. Complexity and the failure of quantitative social science. Discover Society November 2014. Available from: http://discoversociety.org/2014/11/04/focus-complexity-and-the-failure-of-quantitative-social-science/?utm_content=buffer0def5&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

Changeworks, 2015. Changeworks' Position on Future Approaches to Tackling Fuel Poverty. Available at: http://www.changeworks.org.uk/sites/default/files/Changeworks%20Position%20on%20Fuel%20Poverty.pdf

Changeworks, 2015. Changeworks Fuel Poverty Conference Report, November 2015. Available at: http://www.changeworks.org.uk/sites/default/files/Changeworks_Fuel_Poverty_Conference_Report_2015.pdf

Changeworks, 2014. Maximising Benefits from PV: A Guide for Social Landlords. Available at: http://www.changeworks.org.uk/sites/default/files/eaga_Fuel_Poverty_PV_Guide_for_Social_Landlords_0.pdf

Christie Commission, 2011. Report on the Future Delivery of Public Services. Scottish Government.

CIH, 2014. Warm Homes, Better Lives: Investing in energy efficiency now for future generations. Chartered Institute of Housing. Available at: http://www.cih.org/resources/PDF/Policy%20free%20download%20pdfs/1fuelpovertyreportorbitcih.pdf

Clarke, P., 2014. Report on project for small area estimation of fuel poverty in Scotland. Office of National Statistics (ONS) Methodology Advisory Service. July 2014. Available from: http://www.gov.scot/Resource/0045/00457007.pdf

Communities Scotland, 2005. Housing and Disrepair in Scotland: Analysis of the 2002 Scottish House Condition Survey.

COSLA, 2014. Energy Policy and Programmes. Available at: http://www.cosla.gov.uk/documents?tid=&search=energy&month=0&year=0

COSLA, 2013 Home Energy Efficiency Programme: Area Based Schemes. Available at: http://www.cosla.gov.uk/documents?tid=&search=energy&month=0&year=0

COSLA, 2013 Home Energy Efficiency Programme for Scotland: Area Based Schemes. Available at: http://www.cosla.gov.uk/documents?page=1&tid=&search=energy&month=0&year=0

COSLA, 2013. Energy Efficiency. Available at: http://www.cosla.gov.uk/documents?page=1&tid=&search=energy&month=0&year=0

COSLA, 2013. Energy Efficiency in Housing. Available at: http://www.cosla.gov.uk/documents?page=1&tid=&search=energy&month=0&year=0

CSE, 2005. Warm Zones Evaluation: Final Report. Centre for Sustainable Energy and National Energy Action. Available at: http://www.warmzones.co.uk/050301%20-%20Warm%20Zones%20Evaluation%20Final%20Report.pdf

Danish Energy Authority, 2005. Heat Supply in Denmark. Available at: http://193.88.185.141/Graphics/Publikationer/Forsyning_UK/Heat_supply_in_Denmark/pdf/varmeforsyning_uk.pdf

DCLG, 2013. Laying the foundations: a housing strategy for England. Available at: https://www.gov.uk/government/publications/laying-the-foundations-a-housing-strategy-for-england--2

DCLG, 2012. Making energy performance certificate and related data publicly available - Privacy Impact Assessment. Available at: http://www.communities.gov.uk/documents/planningandbuilding/pdf/2121715.pdf

DECC, 2015. Assessment of the Performance, Characteristics and Cost of UK Heat Networks. Department for Energy and Climate Change, Westminster, UK.

DECC, 2015. Household Energy Efficiency National Statistics. Department for Energy and Climate Change, December 2015.

DECC, 2013. Areas and types of properties off the gas grid. Special feature – NEED analysis. Department of Energy and Climate Change, HMSO, London.

DECC, 2011. Evaluation of the Community Energy Saving Programme. Available at: http://www.decc.gov.uk/assets/decc/11/funding-support/3342-evaluation-of-the-community-energy-saving-programm.pdf

DECC, 2011. Making Better Use of Energy Performance Data - Privacy Impact Assessment. Available at: http://www.decc.gov.uk/assets/decc/legislation/energybill/1000-energy-bill-2011-ia-performance-privacy-i.pdf

DSD, 2011. Warmer Healthier Homes A New Fuel Poverty Strategy for Northern Ireland. Department for Social Development, Northern Ireland.

EAS, 2015. Reaching the Target to End Fuel Poverty by 2016 – One year milestone: A Second Report by Energy Action Scotland. Energy Action Scotland publication, available at: http://www.theclaymoreproject.com/uploads/associate/365/file/EAS%20Publications/Reaching%20Target%20seminar%202015%20report.pdf

EAS, 2014. Reaching the Target to End Fuel Poverty by 2016. A Report by Energy Action Scotland. Energy Action Scotland publication, available at: http://www.theclaymoreproject.com/uploads/associate/365/file/EAS%20Publications/Reaching%20Target%20seminar%202015%20report.pdf

EAS, 2011. A Scottish Perspective on the Green Deal and Energy Company Obligation. Report from a seminar organised by Energy Action Scotland and Consumer Focus Scotland, 15th February 2011. Available at: http://www.theclaymoreproject.com/uploads/associate/365/file/EAS%20Publications/Summary%20Report%20EAS%20CFS.pdf

EAS, 2006. Best Practice in Fuel Poverty Schemes. Energy Action Scotland. Available at: http://www.theclaymoreproject.com/uploads/associate/365/file/EAS%20Publications/Best_practice_in_fuel_poverty_report.pdf

Emmanuel R, Baker K. 2012. Carbon Management in the Built Environment. Routledge.

EPEE, 2014. European Fuel Poverty and Energy Efficiency. Intelligent Energy Europe. Available from: https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/epee_european_fuel_poverty_and_energy_efficiency_en.pdf

EST, 2014. Our Calculations. Energy Saving Trust. Available at: http://www.energysavingtrust.org.uk/content/our-calculations

EST, 2011. The applicability of district heating in new dwellings: The Energy Saving Trust. Practical Guidance. Available from: http://www.energysavingtrust.org.uk/Publications2/Housing-professionals/Heating-systems/The-applicability-of-district-heating-for-new-dwellings

European Commission, 2010. Commission Staff Working Paper: An Energy Policy for Consumers. European Commission, Brussels.

European Parliament, 2008. Legislative resolution of 18 June 2008 on the proposal for a directive of the European Parliament and of the Council amending Directive 2003/54/EC concerning common rules for the internal market in electricity. Official Journal of the European Union, C 286 E/106.

Everwarm, 2015. Our Projects. Available at: http://www.everwarmgroup.com/our-projects.php

Hawkey, D., Webb, J., Lovell, H., McCrone, D., Tingey, M., & Winskel, M., 2016. Sustainable Urban Energy Policy: Heat and the City Abingdon: Routledge.

Hawkey, D., & Webb, J., 2014. Wyndford Estate District Heating – draft Case Study for DH Delivery Structures Guidance, Scottish Futures Trust.

Hawkey, D., & Webb, J., D., 2014. District energy development in liberalised markets: situating UK heat network development in comparison with Dutch and Norwegian case studies, Technology Analysis & Strategic Management. Available from: http://www.heatandthecity.org.uk/__data/assets/pdf_file/0007/160657/Hawkey_and_Webb_District_Energy_Development_2014.pdf

Hawkey, D., Webb, J., & WInskel, M., 2013, Organisation and governance of urban energy systems: district heating and cooling in the UK. Journal of Cleaner Production, 50, 22-31. Available from: http://www.sciencedirect.com/science/article/pii/S0959652612006099

Hawkey, D., Webb, J., & Winskel, M., 2013 Organisation and Governance of Urban Energy Systems: District Heating and Cooling in the UK. Journal of Cleaner Production Volume 50, 22–31 Special Issue on Sustainable Urban Transformation.

Hawkey, D., & Webb, J., 2012. Multi Level Governance of Sociotechnical Innovation: The Case of District Heating in the UK Paper presented at Jean Monnet International Workshop: The Governance of Innovation and Socio-Technical Systems in Europe: New Trends, New Challenge, CBS, March 2012

Hawkey, D., 2012. District Heating in the UK: A Technological Innovation Systems Analysis. Environmental Innovation and Societal Transitions Volume 5, pp 19-32.

Hawkey, D., & Webb, J., 2011. Case Study – District Heating in Bergen.

Healy, J.D., Clinch, J.P., 2004. Quantifying the severity of fuel poverty, its relationship with poor housing and reasons for non-investment in energy-saving measures in Ireland. Energy Policy 32, 207–220.

Heat Network Partnership for Scotland (HNPS), 2015. HNP projects map: Resource Efficient Scotland, Available from: http://www.districtheatingscotland.com/hnp-projects-map

Heindl, P., 2014. Measuring fuel poverty: general considerations and application to German data. SOEP Papers on Multidisciplinary Panel Data Research 632, Berlin.

Herring H. 2009. National building stocks: addressing energy consumption or decarbonization? *Building Res. & Info*, 37, pp. 192–195.

Highland Council, 2011. Heat Mapping, Final Report. Available at: http://www.highland.gov.uk/NR/rdonlyres/37863E11-66C1-4F35-9C5C-CFF71FD9BC5B/0/110511_HighlandHeatMap_FinalReport_FINAL_RED_forWebsite.pdf

Household, I., & Musatescu, V., 2012. Fuel Poverty: Draft assessment report: December 2012. Improving Energy Efficiency in Low-Income Households and Communities in Romania project. Report for the United Nations Development Programme. Available at: http://www.undp.ro/libraries/projects/EE/Assesment%20Report%20on%20Fuel%20Poverty%20-%20DRAFT(1).pdf

Huby, M., Cinderby, S., White, P., de Bruin, A., 2009. Measuring in equality in rural England: the effects of changing spatial resolution. Environ. Plan. A 41, 3023–3037.

IMechE, 2011. Scottish Energy 2020? Institution of Mechanical Engineers, London, UK. Available at: http://www.imeche.org/docs/default-source/2011-press-releases/IMechE_Scottish_Energy_Report.pdf?sfvrsn=0

Legendre, B., & Ricci, O., 2013. Measuring fuel poverty in France: which households are the most vulnerable? Research Report 2013-05-12, Chaire Modélisation prospective au service du développement durable. 2013, pp.27 - Les Cahiers de la Chaire. Available from: https://hal-mines-paristech.archives-ouvertes.fr/hal-01135294/

Liddell, C., Morris, C., McKenzie, S.J.P., Rae, G., 2012. Measuring and monitoring fuel poverty in the UK: national and regional perspectives. Energy Policy 38, 27–32.

Liddell, C., Morris, C., McKenzie, P. and Rae, G., 2011. Defining fuel poverty in Northern Ireland, a preliminary review: Department for Social Development Northern Ireland: Available from: http://eprints.ulster.ac.uk/19994/

Lister, R., 2004. Poverty. Polity Press.

MacKay D. 2011. Sustainable Energy Without the Hot Air.

MacInnnes, T., Aldridge, H., Bushe, S., Tinson, A. and Born, T., 2014. Monitoring poverty and social exclusion 2014: Joseph Rowntree Foundation, Available from: http://www.jrf.org.uk/publications/monitoring-poverty-and-social-exclusion-2014

Moore, R., 2012. Definitions of Fuel Poverty: Implications for policy: Energy Policy 49, 19-26. Available from: http://www.sciencedirect.com/science/article/pii/S0301421512000833

NHS Health Scotland, n.d. Fuel Poverty. Available at: http://www.widgetlibrary.knowledge.scot.nhs.uk/media/WidgetFiles/1010550/Fuel%20Poverty%20Summary.pdf

Nussbaumer, P., Bazilian, M. and Modi, V., 2012. Measuring energy poverty: Focusing on what matters: Renewable and Sustainable Energy Reviews, 16, 231-243, Available from: http://www.sciencedirect.com/science/article/pii/S1364032111003972

Office of Energy and Sustainable Development, City of Berkley, n.d. 'Residential Energy Conservation Ordinance'. Available at: http://www.ci.berkeley.ca.us/ContentDisplay.aspx?id=16030

Office of Fair Trading, 2011. Off-Grid Energy: An OFT market study. HMSO, London, October 2011. OFT1380.

Ofgem, 2015. Energy Companies Obligation (ECO): Available from: https://www.ofgem.gov.uk/environmental-programmes/energy-companies-obligation-eco

Ofgem, 2014. Energy Company Obligation – measures: Available from: https://www.ofgem.gov.uk/ofgem-publications/83100/energycompaniesobligation-measures.pdf

Ofgem, 2013. The final report pf the Carbon Emissions reduction Target (CERT) 2008-2012: Available from: https://www.ofgem.gov.uk/ofgem-publications/58425/certfinalreport2013300413.pdf

Ofgem, 2013. The final report of the Community Energy Saving Programme (CESP) 2009-2012: Available from: https://www.ofgem.gov.uk/ofgem-publications/58763/cesp-final-report-2013final-300413.pdf

Ofgem, 2008. A review of the Energy Efficiency Commitment 2005-2008: Available from: https://www.ofgem.gov.uk/ofgem-publications/58735/annual-report-2008-final.pdf accessed October 2014

Ofgem, 2005. A review of the Energy Efficiency Commitment 2002-2005: Available from: https://www.ofgem.gov.uk/ofgem-publications/58585/11254-18105.pdf accessed October 2014

Ofgem, 2003. A review of the Energy Efficiency Standards of Performance 1994 – 2002: Available from: https://www.ofgem.gov.uk/ofgem-publications/58653/4211-eesopreportjuly03.pdf

Palmer, J. and Cooper, I., 2011. Great Britain's housing energy fact file: DECC, Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48195/3224-great-britains-housing-energy-fact-file-2011.pdf

Poverty Alliance, n.d. EPIC Briefing No. 14: Rural Poverty. Available at: http://povertyalliance.org/userfiles/files/briefings/EPIC_BriefingNo14.pdf

Price, C. W., Brazier, K. and Wang, W., 2012. Objective and subjective measures of fuel poverty: Energy Policy 49, October 2012, 33-39.

Raizada, 2012. Renewables and District Heating: Eastern Europe Keeps It Warm, Available from: http://www.renewableenergyworld.com/rea/news/article/2012/09/renewables-and-district-heating

Ren C, Ng E Y-Y, Katzschner L. 2011. Urban climatic map studies: a review. *Int. J. Climatol.* 31, pp. 2213–2233.

RICS, 2014. Building a Better Scotland. The RICS Scottish Housing Commission Report. Royal Institution of Chartered Surveyors. July 2014. Available at: http://www.rics.org/uk/about-rics/what-we-do/influencing-policy/influencing-activity/thought-leadership-papers/the-rics-scottish-housing-commission-report-building-a-better-scotland/

Rosenow, J., 2012. Energy Savings Obligations in the UK – a history of change: Energy Policy 49, pp. 373–382.

Rosenow, J., Platt, R. and Flanagan, B., 2013. Fuel poverty and energy efficiency obligations – A critical assessment of the supplier obligation in the UK: Energy Policy 62, 1194–1203.

RSPB Scotland, WWF Scotland and FoE Scotland, February 2006. The Power of Scotland: Cutting Carbon with Scotland's Renewable Energy

Rutter, P. and Keirstead, J., 2012, A brief history and the possible future of urban energy systems: Energy Policy 50, 72-80. Available from: http://www.sciencedirect.com/science/article/pii/S0301421512002777

Scott, J., Baker, K.J., & Reid, S., 2011. Improving Energy Efficiency in the Housing Sector in Scotland: Exploring the Role of Regulation. Report for Consumer Focus Scotland.

Scottish Council for Development and Industry, 2009. The future of electricity generation in Scotland. Report prepared by Wood Mackenzie for SCDI, 9 December 2008

Scottish Government. 2016. Energy in Scotland. Available at: http://www.gov.scot/Resource/0049/00493362.pdf

Scottish Government, 2015. National Infrastructure Investment Plan. December 2015.

Scottish Government, 2015. Heat Policy Statement. Towards Decarbonising Heat: Maximising the Opportunities for Scotland. Available at: http://www.gov.scot/Resource/0047/00478997.pdf

Scottish Government, 2014. Scottish Housing Event. Outputs from the Scottish Housing Event, November 18th 2014, Edinburgh. Available at: http://www.gov.scot/Topics/Built-Environment/Housing/reform/housing-event

Scottish Government, 2013. Outline Heat Vision. Scottish Government, January 2013. Available at: http://www.scotland.gov.uk/Resource/0041/00413386.pdf

Scottish Government, 2013. District Heating Action Plan: Response to the Expert Commission on District Heating. Scottish Government, May 2013. Available at: http://www.scotland.gov.uk/Resource/0042/00423849.pdf

Scottish Government, 2013. Low Carbon Scotland: Meeting the Emissions Reduction Targets 2013-2027: The Second Report on Proposals and Policies (RPP2). Available at: http://www.gov.scot/Publications/2013/06/6387

Scottish Government, 2012. Scottish Government Urban/Rural Classification, 2011-2012: Available from: http://www.scotland.gov.uk/Topics/Statistics/About/Methodology/UrbanRuralClassification/Urban-Rural-Classification-2011-12

Scottish Government, 2011. Update to the Renewable Heat Action Plan. Available at: http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-sources/19185/Heat/RHUpdate11

Scottish Government, 2011. Homes Fit for the 21st Century: The Scottish Government's Strategy and Action Plan for Housing in the Next Decade: 2011-2020. Available at: http://www.gov.scot/Resource/Doc/340696/0112970.pdf

Scottish Government, 2011. Low Carbon Scotland: Meeting the Emissions Reduction Targets 2010-2022: The Report on Proposals and Policies (RPP1). Available at: http://scotland.gov.uk/Publications/2011/03/21114235/0

Scottish Government, 2010. Home Energy Schemes 2009-10: Energy Assistance Package and Home Insulation Scheme: End Year Report.

Scottish Government, 2010. Summary in differences in UK fuel poverty methodologies: Available from: http://www.scotland.gov.uk/Topics/Statistics/SHCS/UKfuelpoverty

Scottish Government, 2010. Housing: Fresh Thinking, New Ideas. Available at: http://www.gov.scot/resource/doc/312740/0098899.pdf

Scottish Government, 2009. Use and Understanding of the ScottishGovernment Urban Rural Classification. Scottish Government, Edinburgh, August 2009.

Scottish Government. 2007. Biomass Action Plan. http://www.scotland.gov.uk/Publications/2007/03/12095912/0

Scottish Government, 2002. The Scottish Fuel Poverty Statement. Available from: http://www.scotland.gov.uk/Resource/Doc/46951/0031675.pdf

Scottish Renewables (n.d.). Microgeneration in Older Housing. Available at: http://www.changeworks.org.uk/uploads/David%20Cameron.pdf

Sefton, T., 2002. Targeting fuel poverty in England: is the Government getting warm? Fisc. Stud. 23, 369–399.

SFHA, 2013. A Housing Report for Scotland. Scottish Federation of Housing Associations. Available at: http://www.sfha.co.uk/sfha/publications/a-housing-report-for-scotland

SFPF, 2015. Fuel Poverty and Poverty Briefing Note. Scottish Fuel Poverty Forum. Available at: http://www.gov.scot/Topics/Built-Environment/Housing/warmhomes/fuelpoverty/ScottishFuelPovertyForum/briefingnote

SFPF, 2014. Final Report on the Review of the Scottish Government's Fuel Poverty Strategy. Scottish Fuel Poverty Forum. Available at: http://www.gov.scot/Topics/Built-Environment/Housing/warmhomes/fuelpoverty/ScottishFuelPovertyForum/final-report

Shelter, 2011. Housing investment Part 2: The role of housing in building local economic growth. Available at: http://england.shelter.org.uk/professional_resources/policy_and_research/policy_library/policy_library_folder/housing_investment_part_2

Shelter, 2011. Housing investment part 1: The role of housing in building local economic growth. http://england.shelter.org.uk/professional_resources/policy_and_research/policy_library/policy_library_folder/research_briefing_housing_investment_part_1

Simcock, N., & Walker, G., 2015. Fuel Poverty Policy and Non-Heating Energy Uses. DEMAND Centre Working Paper 16, Lancaster University, April 2015. Available at: http://www.demand.ac.uk/wp-content/uploads/2016/01/working-paper-16-Walker.pdf

Swider, D.J., Beurskens, L., Davidson, S., Twidell, J., Pyrko, J., Prüggler, W., Auer, H., Vertin, K., & Skema, R., 2008. Conditions and costs for renewables electricity grid connection: Examples in Europe. Renewable Energy, 33, pp. 1832-1842.

Tirado-Herrero, S., Bouzarovski, S., 2014. Energy transitions and regional inequalities in energy poverty trends: exploring the eu energy divide conference paper. United States Association for Energy Economics (USAEE) Research Paper Series, Working Paper 14-193.

Tirado Herrero, S., & Urge-Vorsatz, D., 2012. Trapped in the heat: A post-communist type of fuel poverty: Energy Policy 49, October 2012, pp. 60 – 68.

Tirado Herrero, S., & Ürge-Vorsatz, D., 2010. Fuel Poverty in Hungary: A first assessment. Central European University, Hungary.

Walker, R., Thomson, H., & Liddell, C., 2013. Fuel Poverty 1991-2012: Commemorating 21 years of action, policy and research. University of Ulster & University of York. Available from: http://fuelpoverty.eu/wp-content/uploads/2013/03/Fuel-poverty-anniversary-booklet.pdf

Walker, R., McKenzie, P., Liddell, C., Morris, C., 2012. Area-based targeting of fuel poverty in Northern Ireland: an evidence-based approach. Appl. Geogr. 2012 (34), 639–649.

Wang, K., Wang, Y-X., Li, K. and Wei, Y-M., 2015. Energy poverty in China: An index based comprehensive evaluation: Energy Policy 47, 308-323. Available from: http://www.sciencedirect.com/science/article/pii/S136403211500194X

Webb, J., 2015. Improvising innovation in UK urban district heating: the convergence of social and environmental agendas in Aberdeen. Energy Policy, 78: 265–272. Available from: http://www.sciencedirect.com/science/article/pii/S0301421514006685

Webb, J., & Hawkey, D., 2014. Aberdeen Heat and Power Ltd – draft Case Study for DH Delivery Structures Guidance, Scottish Futures Trust.

Webb, J., 2013. "If it hasn't been done in Aberdeen, it's not worth doing": governing change in urban energy in a northern UK city. Paper presented at LATTS, Universite de Paris-Est International Workshop on *Urban Energy Governances North and South*, Paris, September 2013

Webb, J., Wiltshire, R., King, M., &, Banks, N., 2013, Research into barriers to deployment of district heating networks, UK Government Department of Energy & Climate Change, London URN 13D/073. Available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191542/Barriers_to_deployment_of_district_heating_networks_2204.pdf

Webb, J., 2012. Enabling Urban Energy? Governance of Innovation in Two UK Cities Paper presented at International Workshop: From Networked to Post-Networked Urbanism: New Infrastructure Configurations, Autun, France, July 2012.

Webb, J., 2012 Climate change and society: the chimera of behavior change technologies. Sociology, 46 (1) 109-125, Available from: http://soc.sagepub.com/content/46/1/109

Weber, C., & Shah, N., 2011. Optimisation based design of a district energy system for an eco-town in the United Kingdom, Energy, 36, pp. 1292-1308.

Welsh Assembly Government, 2010. Fuel Poverty Strategy 2010. Welsh Assembly Government. Available at: http://gov.wales/docs/desh/publications/100723fuelpovertystrategyen.pdf

White, V., Roberts, S., & Preston, I., 2012. Beyond average consumption, Development of a framework for assessing impacts of policy proposals on different consumer groups, Centre for Sustainable Energy, Ofgem.

Whyley, C., & Callender, C., 1997. Fuel poverty in Europe: evidence from the European Household Panel Survey. National Energy Action, Newcastle upon Tyne.

Williams J. 2010. The deployment of decentralised energy systems as part of the housing growth programme in the UK. Energy Policy, 38, pp.7604–7613.

Wiltshire, R., King, M., Webb, J., & Banks, N., 2013. Research into barriers to deployment of district heating networks, UK Government Department of Energy and Climate Change, London: URN 13D/073.

Scheme reviews

CERT

Ofgem, 2009. Carbon Emissions Reduction Target (CERT) 2008-2011 Supplier Guidance - Version 2, https://www.ofgem.gov.uk/sites/default/files/docs/2008/02/cert-supplier-guidance_0.pdf

Ofgem, 2013. The final report of the Carbon Emissions Reduction Target (CERT) 2008-2012, https://www.ofgem.gov.uk/sites/default/files/docs/2013/05/cert_finalreport2013_300413_0.pdf

Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/350722/CERT_CESP_Evaluation_FINAL_Report.pdf

CESP

Ofgem, 2013. The final report of the Community Energy Saving Programme (CESP) 2009-2012, https://www.ofgem.gov.uk/sites/default/files/docs/2013/05/cesp-final-report-2013_final-300413_0.pdf

Ipsos MORI, CAG Consultants and BRE, 2014. Evaluation of the Carbon Emissions Reduction Target and Community Energy Saving Programme, for DECC, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/350722/CERT_CESP_Evaluation_FINAL_Report.pdf

ECO

DECC, 2014. Summary of findings of research with households that received ECO-funded installations in September 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/388692/ECO_Customer_Journey_Research_Report_-_FINAL_PUBLISHED.pdf

CSE, 2014. The ECO: an evaluation of year 1, for Energy UK, https://www.cse.org.uk/downloads/reports-and-publications/policy/eco_evaluation_final_april_2014.pdf

DECC, 2015. Household Energy Efficiency National Statistics, Headline Release, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486705/Headline_Release_-_Exec_Summary_-_HEE_stats_17_Dec_Final_2_.pdf

Ofgem, 2015. Energy Companies Obligation Final Report, https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/eco_final_report_0.pdf

Green Deal

Government website providing overview of Green Deal https://www.gov.uk/green-deal-energy-saving-measures/overview

DECC, Domestic Green Deal and Energy Company Obligation in Great Britain, Headline Report, Statistical release, November 2015, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/477288/Headline_Release_-_GD___ECO_in_GB_19_Nov_Final.pdf

DECC overview of Government policy on household energy https://www.gov.uk/government/publications/2010-to-2015-government-policy-household-energy/2010-to-2015-government-policy-household-energy

https://www.gov.uk/government/news/green-deal-finance-company-funding-to-end

Government press release, 2015, Green Deal Finance Company Funding to End https://www.gov.uk/government/news/green-deal-finance-company-funding-to-end

DECC, 2014, Domestic Green Deal, Energy Company Obligation and Insulation Levels in Great Britain, Quarterly report https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/294343/Quarterly_Statistical_Release_-_GD_ECO_and_insulation_levels_in_Great_Britain_-_20_March_2014.pdf

DECC, 2012, Final Stage Impact Assessment for the Green Deal, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42984/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf

Green Deal Oversight and Registration Body website http://gdorb.decc.gov.uk/

House of Commons Energy and Climate Change Committee, 2014, Green Deal, a watching brief, Third report of session 2014-15, http://www.parliament.uk/business/committees/committees-a-z/commons-select/energy-and-climate-change-committee/inquiries/parliament-2010/green-deal-watching-brief-2/

Information on expenditure on marketing Green Deal http://www.greenwisebusiness.co.uk/news/government-to-spend-29m-on-marketing-green-deal-3673.aspx#.Vp4SsVIdo1o

Big Energy Saving Network

Sheffield Hallam University, 2015. Evaluation of the Big Energy Saving Network: Final Report, for DECC, https://www.gov.uk/government/publications/evaluation-of-the-big-energy-saving-network-final-report

HIS

CAG Consultants, 2010. Review of area-based energy efficiency initiatives in Scotland: Final report, for Consumer Focus Scotland

EST, 2013. Home Energy Programmes Summary Report 2009/2013, http://www.energysavingtrust.org.uk/domestic/sites/default/files/Getting%20Support%20-%20Programme%20statistics%20-%20PDF%20-%20HE%20Summary%20Report%202009%20-%20LC%20-%20July%202014.pdf

EST, 2013. Home Energy Programmes Detailed Report 2009/2013 (Excel), http://www.energysavingtrust.org.uk/sites/default/files/Home%20Energy%20Programmes%20Detailed%20Report%2020092013.xlsx

EAP

Glasgow Caledonian University, 2013. Review of the Energy Assistance Package. http://www.gov.scot/Topics/Built-Environment/Housing/warmhomes/fuelpoverty/Energy-Assistance-Package-Review-Report

EAS

Energy Saving Trust, 2014. Home Energy Efficiency Programmes for Scotland: Summary Delivery Report 2013/14. http://www.energysavingtrust.org.uk/home-energy-efficiency-programmes

Boiler Scrappage Scheme

Energy Saving Trust, 2014. Home Energy Efficiency Programmes for Scotland: Summary Delivery Report 2013/14. http://www.energysavingtrust.org.uk/home-energy-efficiency-programmes

HEEPS: ABS

Scottish Government, 2013. Home Energy Efficiency Programmes For Scotland - Area Based Schemes 2013-14: Programme Guidance On Scheme Design And Delivery, http://www.gov.scot/Resource/0042/00426982.pdf

Scottish Government, 2014. Home Energy Efficiency Programmes For Scotland - Area Based Schemes 2014-15: Programme Guidance On Scheme Design And Delivery

Scottish Government, 2014. Home Energy Efficiency Programmes For Scotland Summary Delivery Report 2013/14, http://www.gov.scot/Resource/0046/00466702.pdf

HEEPS: Cashback

http://www.energysavingtrust.org.uk/heeps-cashback-statistics

Green Homes Cashback

http://www.energysavingtrust.org.uk/green-homes-cashback-statistics

HEEPS: Loans Scheme

http://www.energysavingtrust.org.uk/heeps-loan-scheme

http://news.scotland.gov.uk/News/Over-100-million-to-fight-fuel-poverty-1831.aspx

https://www.citizensadvice.org.uk/scotland/consumer/energy/energy-supply/get-help-paying-your-bills/grants-and-schemes-to-help-you-save-money-on-energy-bills-s/#HEEPS:_Loan_scheme

HEEPS: Warmer Homes Scotland

http://www.energysavingtrust.org.uk/heeps-warmer-homes-scotland-scheme

SEEP

Scottish Government, 2016. Scotland's Energy Efficiency Programme Pilot Projects Pathfinder Fund, http://www.gov.scot/Resource/0049/00492710.pdf

CCF

Changeworks, 2015. Review of the Climate Challenge Fund, for Scottish Government Social Research, http://www.gov.scot/Resource/0048/00489046.pdf

Brook Lyndhurst and Ecometrica, 2011. Review of the Climate Challenge Fund, for Scottish Government Social Research, http://www.gov.scot/Resource/Doc/352709/0118663.pdf

Warm Home Discount

Ofgem, 2015. Warm Home Discount: Annual Report 2014/15, https://www.ofgem.gov.uk/publications-and-updates/warm-home-discount-annual-report-scheme-year-4

Winter Fuel Payments

DWP statistics https://www.gov.uk/government/collections/winter-fuel-payments-caseload-and-household-figures

Citizens Advice Scotland, 2015. Designing a Social Security System for Scotland: Winter Fuel and Cold Weather Payments, http://www.cas.org.uk/publications/designing-social-security-system-scotland-winter-fuel-and-cold-weather-payments

Cold Weather Payments

DWP statistics https://www.gov.uk/government/statistics/cold-weather-payments-28-to-31-march-2015

CSE, 2015. Energy tariff options for consumers in vulnerable situations, for Citizens Advice, https://www.citizensadvice.org.uk/Global/CitizensAdvice/essential%20services%20publications/tariff-options-for-vulnerable-consumers-May2015.pdf

Citizens Advice Scotland, 2015. Designing a Social Security System for Scotland: Winter Fuel and Cold Weather Payments, http://www.cas.org.uk/publications/designing-social-security-system-scotland-winter-fuel-and-cold-weather-payments

FiTs

The Government's overview of FiTs: https://www.gov.uk/feed-in-tariffs/overview

DECC, 2015. Performance and Impact of the Feed-in Tariff Scheme: Review of Evidence Final Report, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/456181/FIT_Evidence_Review.pdf

EST's online information on FiTs: http://www.energysavingtrust.org.uk/domestic/feed-tariff-scheme

DECC summary of policy on low carbon technologies: https://www.gov.uk/government/publications/2010-to-2015-government-policy-low-carbon-technologies/2010-to-2015-government-policy-low-carbon-technologies#appendix-8-feed-in-tariffs-scheme

DECC, 2015. Sub regional Feed in Tariffs statistics, https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics

RHPP

Special Feature - Renewable Heat Premium Payment Scheme (available on DECC website; no author or date provided) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/386859/RHPP.pdf

DECC, 2015. Evaluation of the Renewable Heat Premium Payment Scheme Phase 2 https://www.gov.uk/government/publications/evaluation-of-the-renewable-heat-premium-payment-scheme-phase-two

AECOM, 2013. Analysis of customer data from phase one of the renewable heat premium payments (RHPP) scheme, for DECC https://www.gov.uk/government/publications/analysis-of-customer-data-from-phase-one-of-the-renewable-heat-premium-payments-rhpp-scheme

CAG Consultants, 2013. Interim evaluation of the RHPP Phase 1.

RHI

Ofgem, 2014. The first 10,000 Domestic Renewable Heat Incentive accreditations, https://www.ofgem.gov.uk/publications-and-updates/first-10000-domestic-renewable-heat-incentive-accreditations

Ofgem, 2015. Domestic RHI Quarterly report, May 2015, https://www.ofgem.gov.uk/sites/default/files/docs/2015/05/es309_drhiquarterlyupdate_issue4_web_0.pdf

Ofgem, 2014. Factsheet: A Metering and Monitoring Service Package (MMSP) for Domestic RHI https://www.ofgem.gov.uk/sites/default/files/docs/2014/02/drhi_factsheet_mmspfordrhi_v1_1_oct_2014_web.pdf

DECC, 2013. Domestic RHI impact statement, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211978/Domestic_RHI_Impact_Assessment.pdf

Parliament UK, Renewable Heat Incentive Scheme: Written question – 20573, December 2015, http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2015-12-17/20573/

DECC, 2014. Evaluation of the Renewable Heat Incentive: Interim report from Waves 1-4 of the domestic RHI census of accredited applicants, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/375710/Publication_-_full_report.pdf

Home Energy Scotland Renewables Loans

EST Scotland website: http://www.energysavingtrust.org.uk/home-energy-scotland-renewables-loan-scheme

Energy Saving Trust, 2015. Home Energy Scotland renewables loan scheme – FAQs Issue 12, http://www.energysavingtrust.org.uk/domestic/sites/default/files/HESRL%20FAQs%20v12.pdf

CARES

http://www.gov.scot/Publications/2014/08/2228

https://www.mygov.scot/community-and-renewable-energy-scheme-cares-local-energy-challenge-fund/

Scottish Government, 2014. The Community And Renewable Energy Scheme: Overview of Support, http://www.gov.scot/Resource/0045/00457861.pdf

Appendix C: Mapping

Figure C.1: Intervention rate (number of measures installed per household) for cavity wall insulation at datazone level

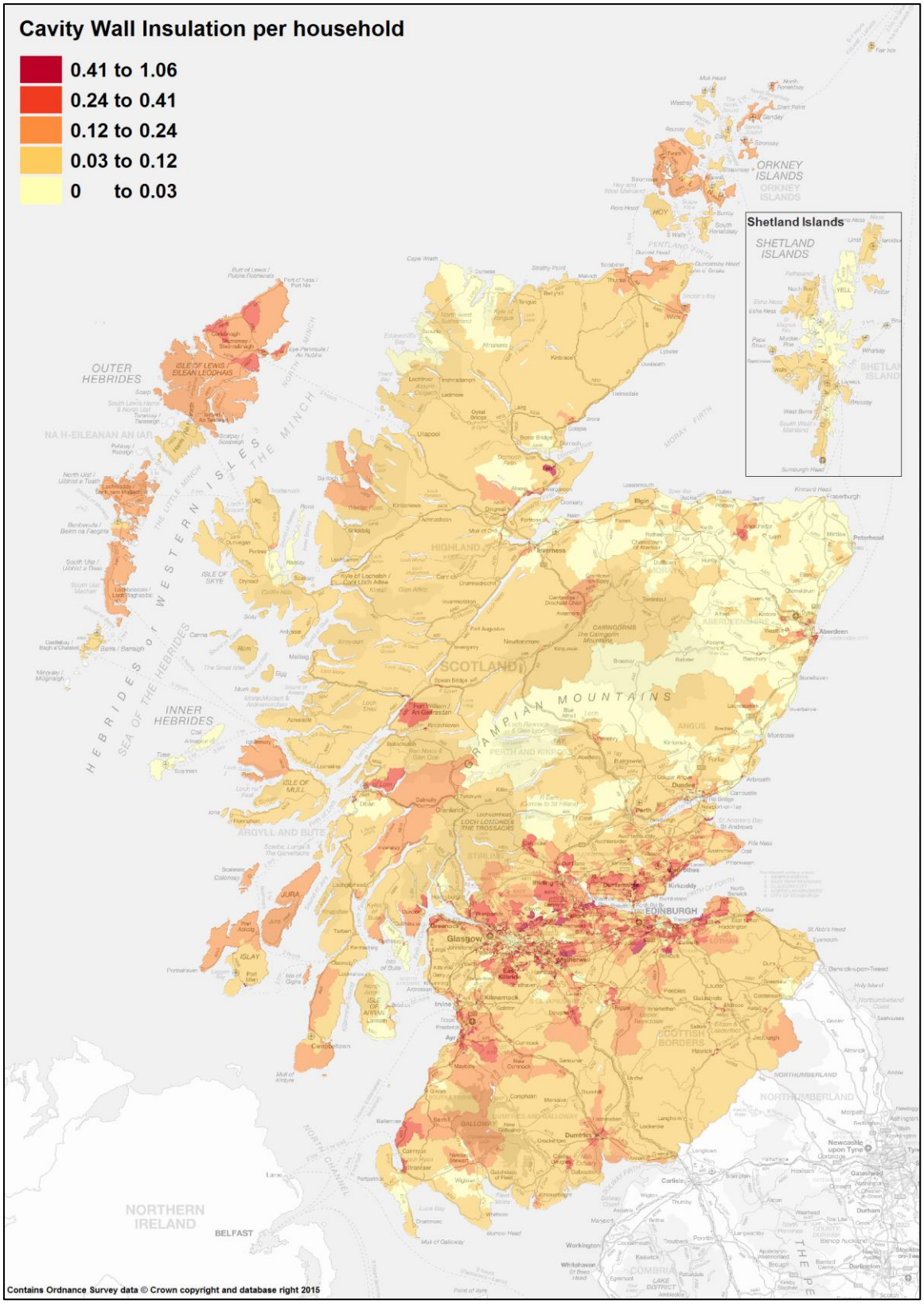
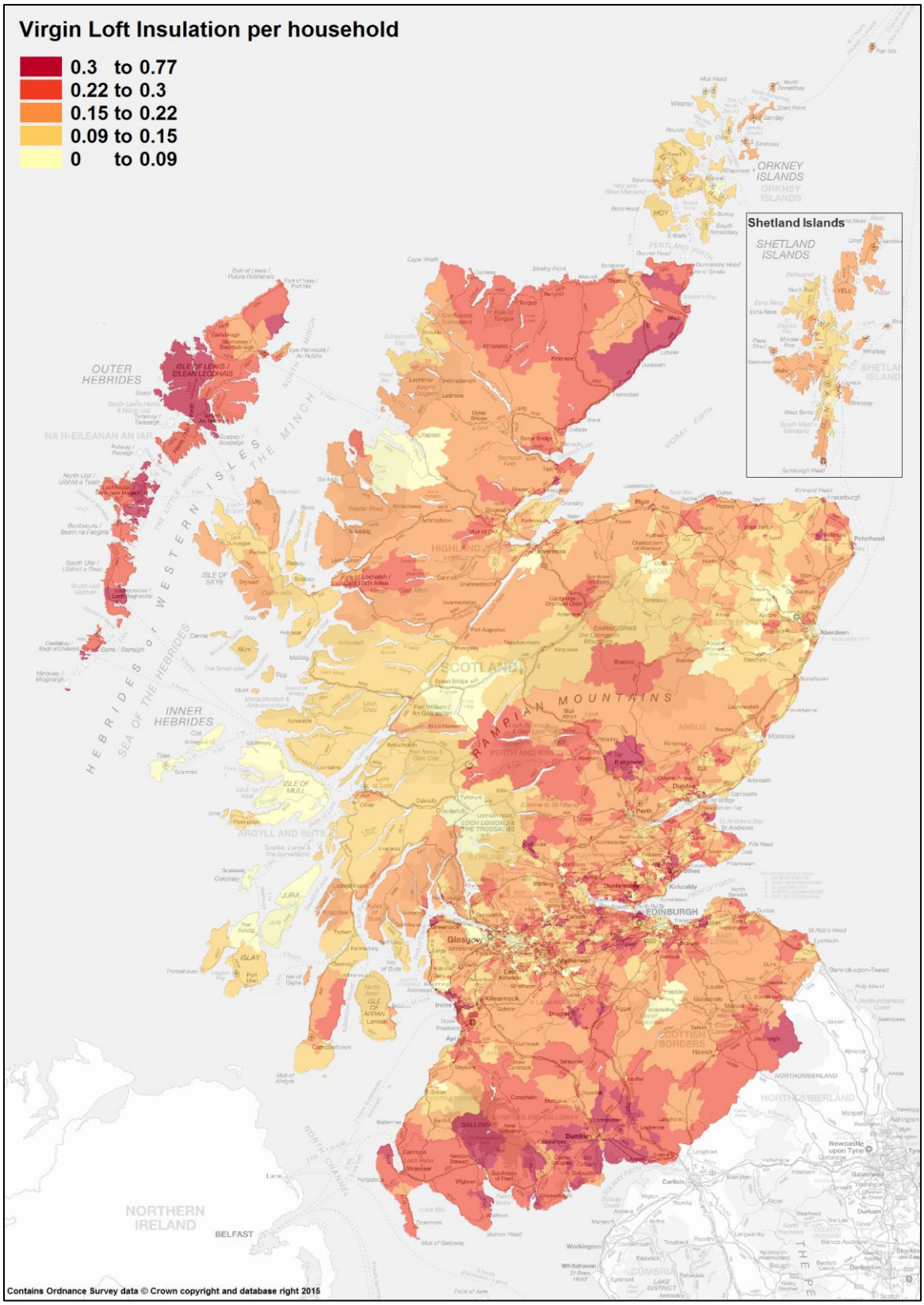
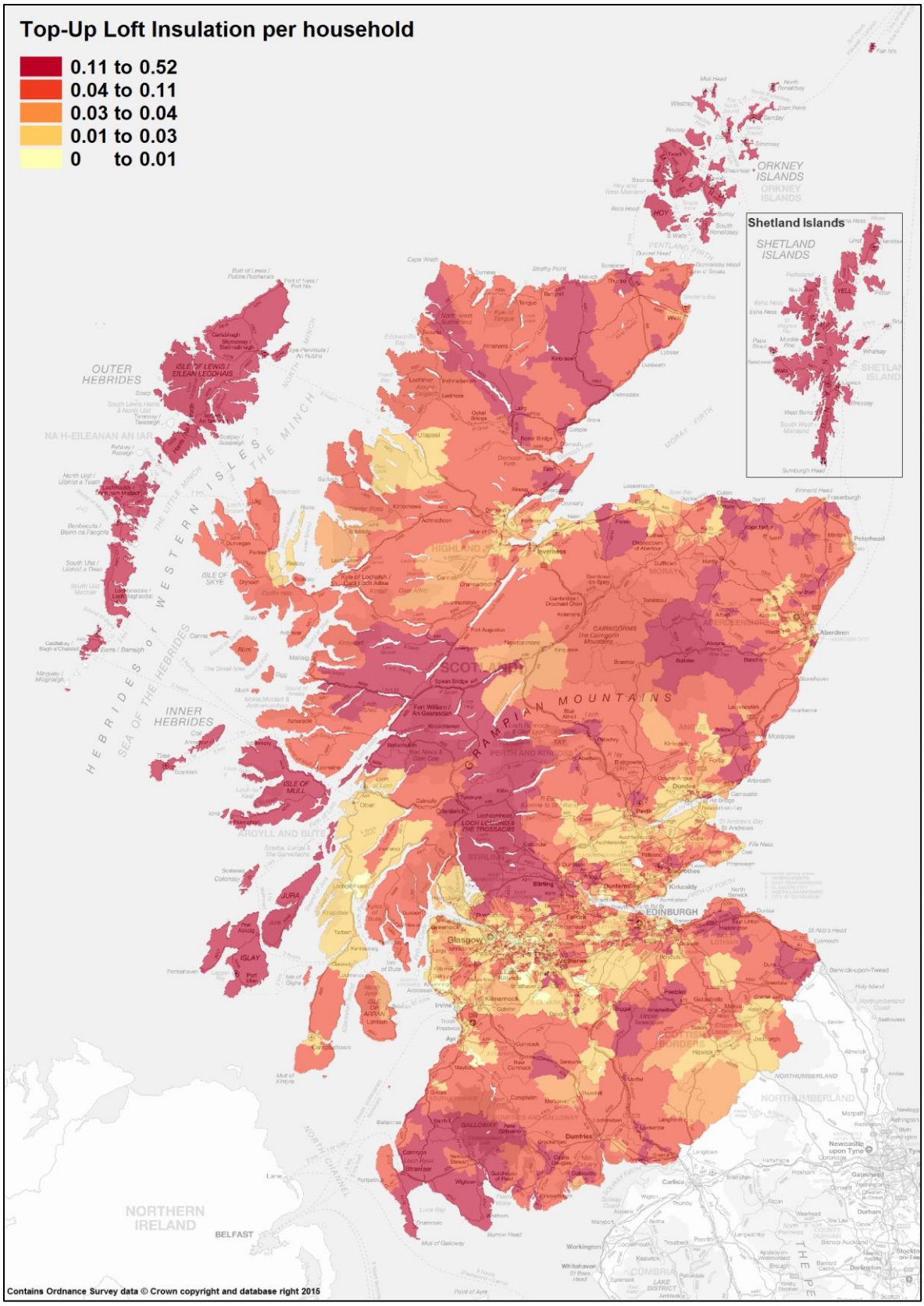


Figure 0.2: Intervention rate (number of measures installed per household) for virgin loft insulation[255] at datazone level



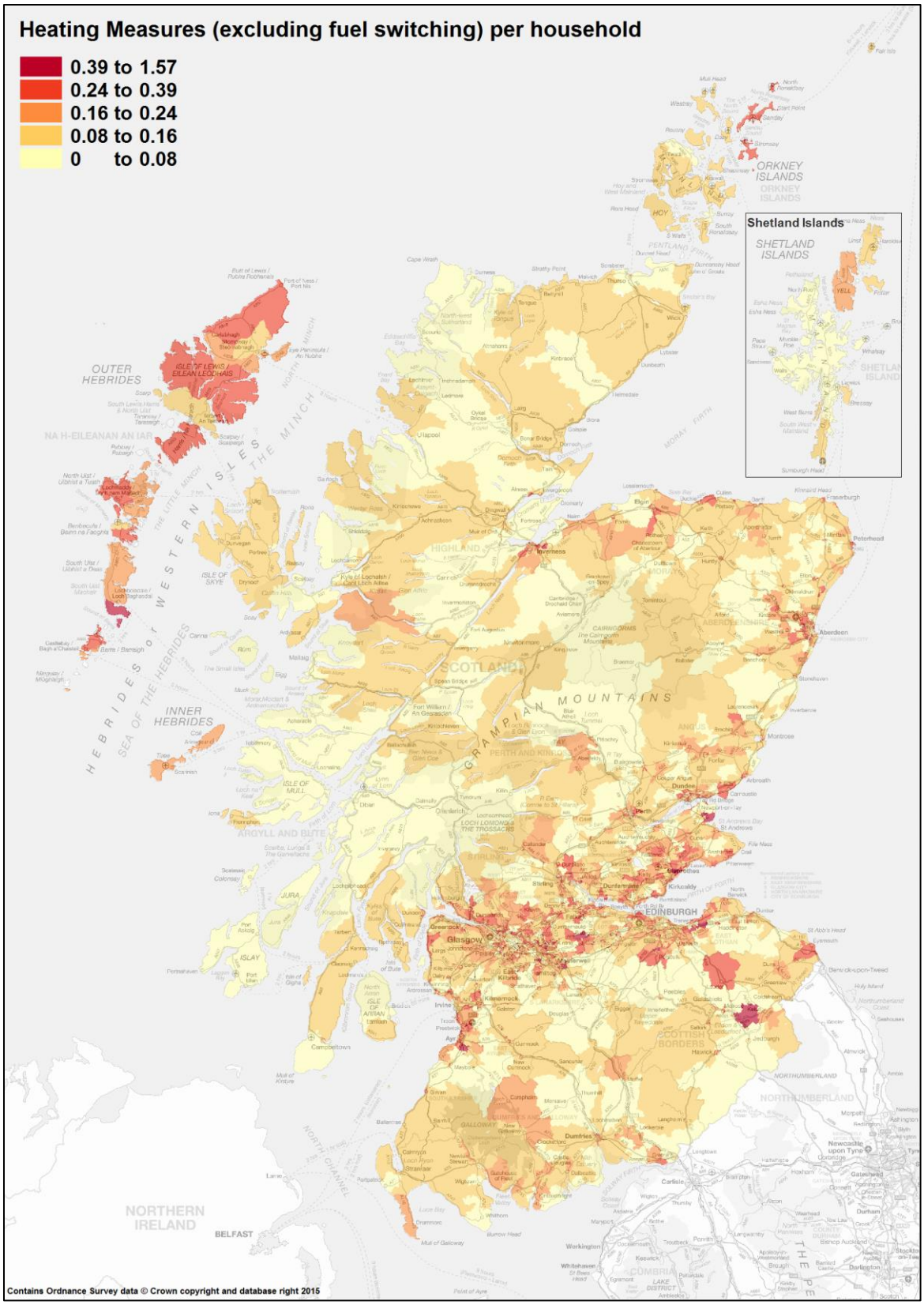
[255] Virgin loft insulation includes any installation of loft insulation with a starting depth of 0-60mm.

Figure 0.3: Intervention rate (number of measures installed per household) for top-up loft insulation[256] at datazone level



[256] Top-up loft insulation includes any installation of loft insulation with a starting depth of more than 60mm.

Figure 0.4: Intervention rate (number of measures installed per household) for heating measures[257] at datazone level



[257] Includes replacements boilers, heating controls and other heating system upgrades

Figure 0.5: Intervention rate (number of measures per household) for fuel switching at datazone level

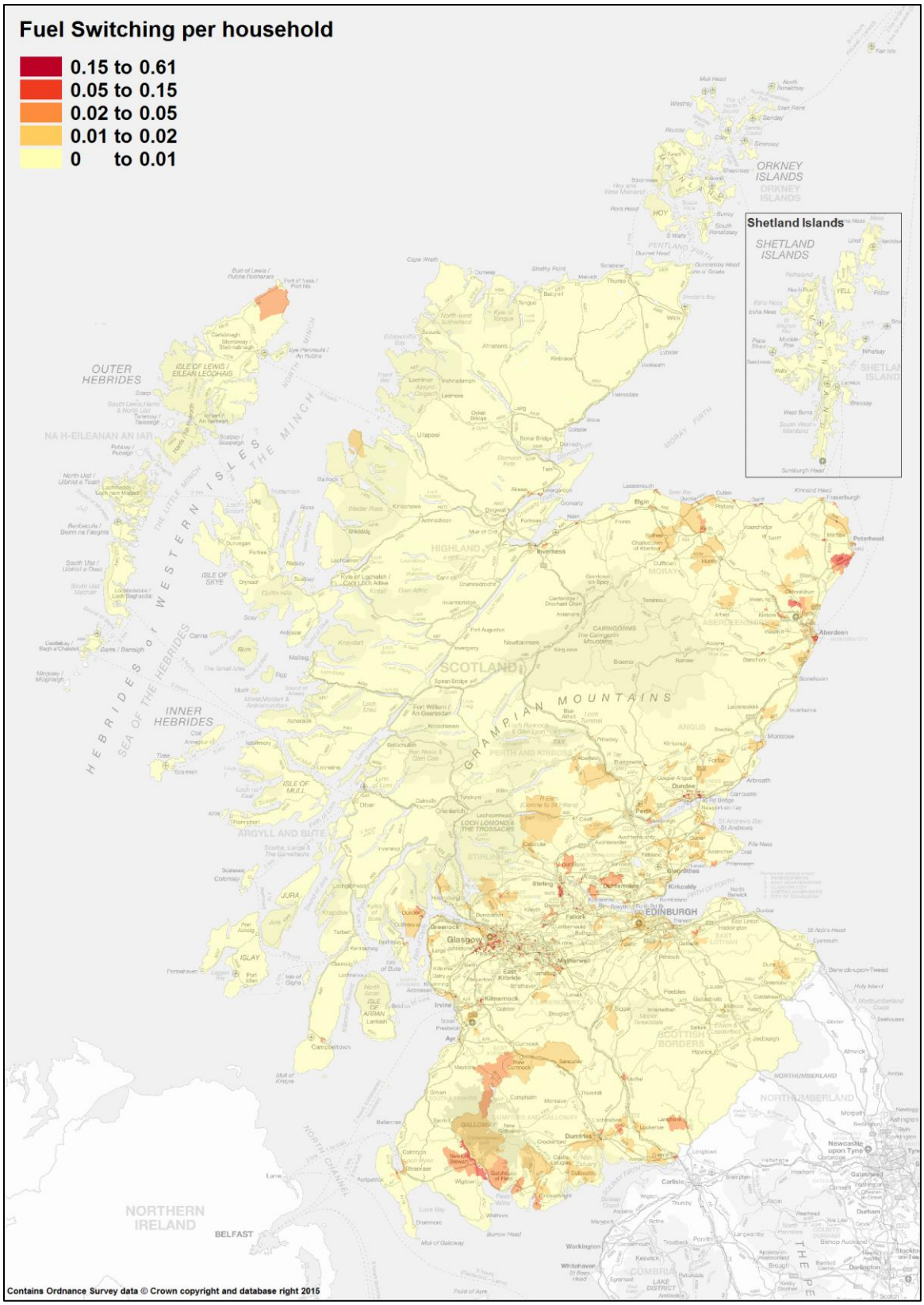


Figure 0.6: Intervention rate (number of measures per household) for solid wall insulation at datazone level

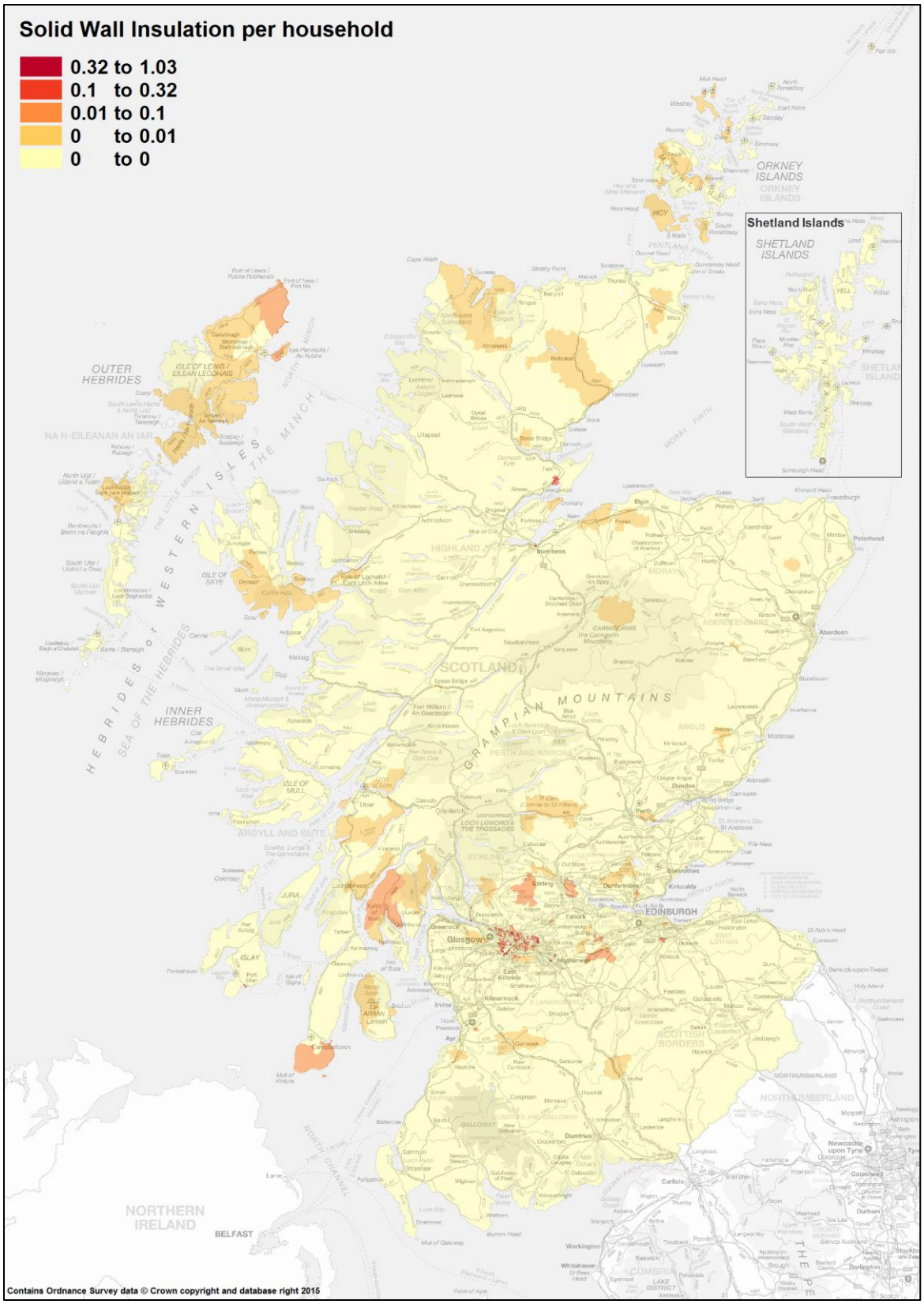


Figure 0.7: Intervention rate (number of measures per household) for all measures at datazone level, Argyll & Bute

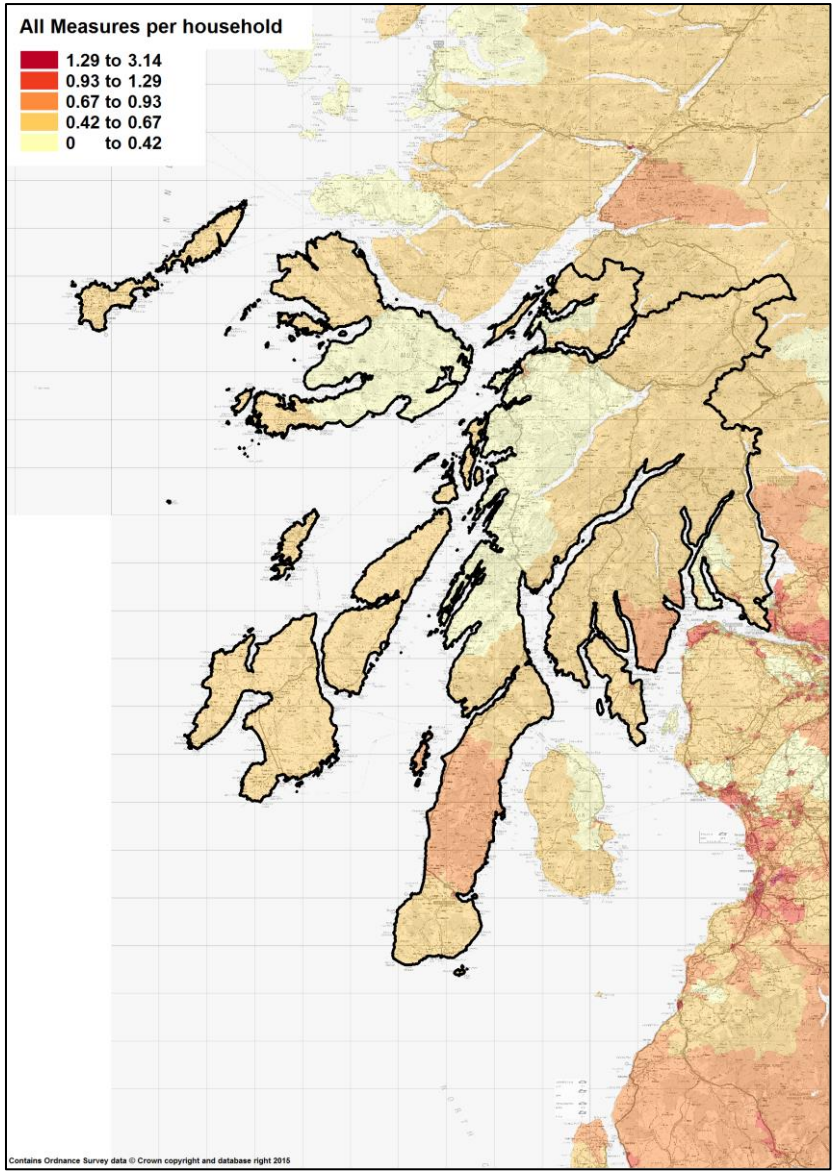


Figure C.8: Intervention rate (number of measures per household) for all measures at datazone level, Eilean Siar

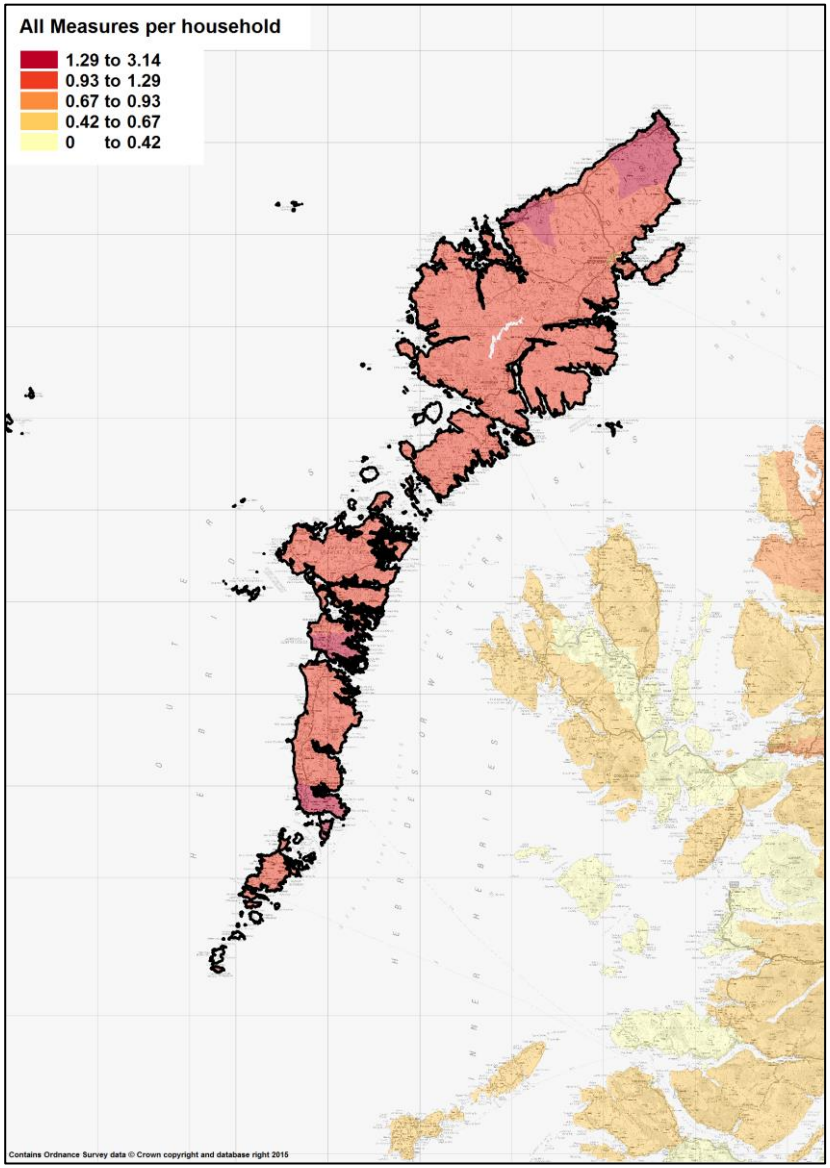


Figure 0.8: Intervention rate (number of measures per household) for all measures at datazone level, Shetland

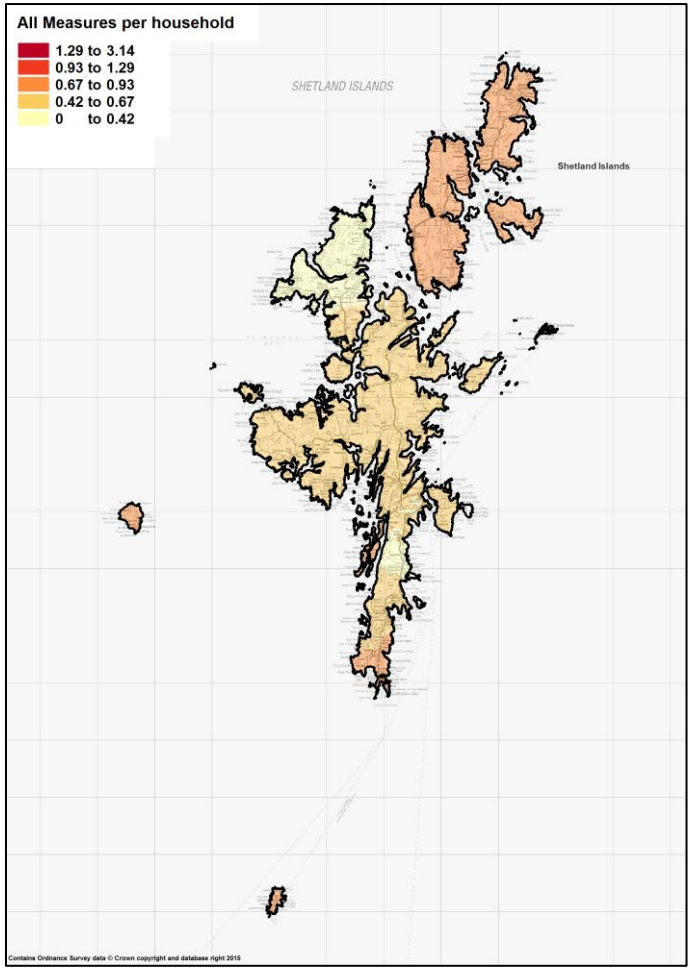
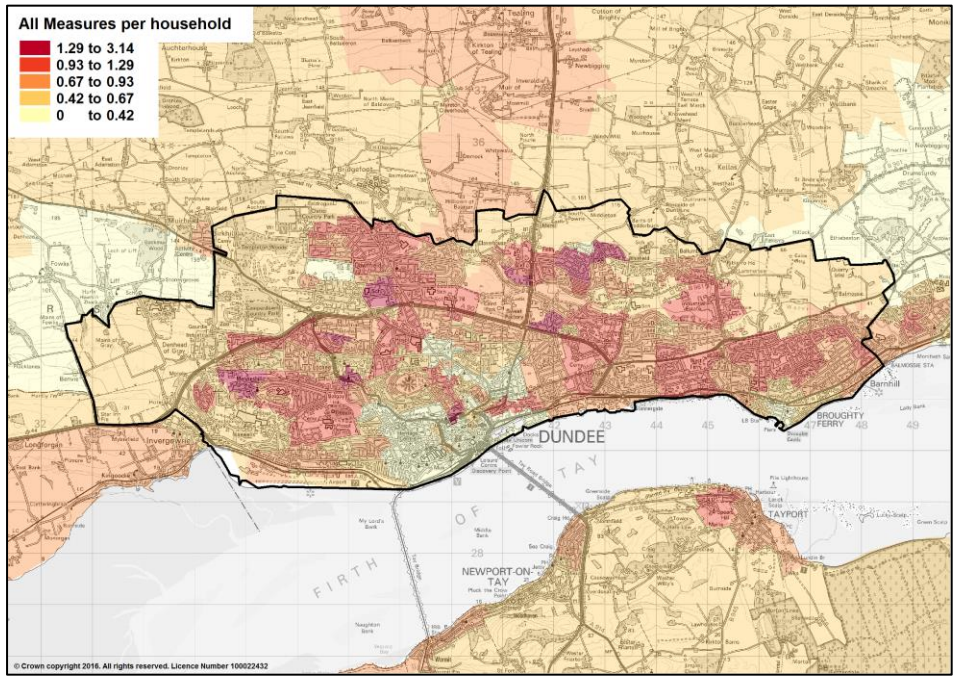


Figure C.8: Intervention rate (number of measures per household) for all measures at datazone level, Dundee City



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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E-mail: ConsumerFuturesUnit@cas.org.uk

Twitter: @CFUcas

Web: www.cas.org.uk

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Produced by The Scottish Association of Citizens Advice Bureaux
Citizens Advice Scotland (Scottish charity number SC016637)
Spectrum House, 2 Powderhall Road, Edinburgh EH7 4GB
Tel: 0131 550 1000

Consumer Futures Unit

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