'Better' Domestic Energy Advice in England? A Narrative Literature Review

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Executive summary

Public energy advice has long formed a key strategy of domestic energy saving policy, and is indeed required to be provided to householders enshrined in Articles 12 and 17 of the European Energy Directive. Domestic energy advice ('energy advice') here is defined as: "*Advice specific to householders' circumstances, with one or more of the following aims: achieving affordable warmth, improving energy efficiency, conserving energy and reducing carbon emissions*" (Darby, 2003a, p.8). Despite this definition, as far as the author is aware no clear definition of energy advice is broadly used, highlighting why this type of report is needed and indeed why the Energy Saving Trust is keen to engage further on this topic.

In this report, energy advice is regarded as both an active and passive method that can be delivered in multiple ways such as face-to-face, by phone, online, feedback and updates, and through more discrete methods. Advice can be participatory and led by the advisee or led in a more traditional method by the advisor. This report focusses specifically on the effect of domestic energy saving advice on energy efficiency upgrades and retrofitting, and behavioural changes in the home, rather than non-domestic energy use reduction (e.g. car use and renewable energy generation).

Much attention has been paid to methods of advice provision, and how this can be improved to increase and enhance uptake of domestic energy retrofitting or behaviour change schemes. One may ask: in this context, does advice work?. Generally, this report finds that evidence on the effectiveness of energy advice on energy saving outcomes is patchy, contested, and tends not to include indirect and/or qualitative measures in its appraisal. For these reasons, advice risks being avoided in the process of domestic energy policy implementation due to a lack of concrete outcomes, when in fact there is much evidence that finds advice effectiveness to be dependent on a wide range of factors and methods related to its content, source, and process.

As an output of the Energy-PIECES project, this report has the overarching aim of outlining current English energy advice practice, and how it can be improved and assessed based on the energy-related Social Sciences and Humanities (energy-SSH) literature and illustrative examples along three axes: content, source, and process. This is due to the broad nature of the definition of advice, and because of often context-dependent variations in outcomes. From this approach, the report aims to provide policy recommendations to improve domestic uptake rates of energy efficiency initiatives. To address this overarching aim, categorised based on the structure of Simcock et al. (2014), the report addresses the following objectives:

- Within 'Content' – this report underscores issues reported around an information deficit approach to advice provision, and highlights potential frames and tailoring mechanisms away from monetary depictions to promote uptake.

- Within 'Source' – this report evaluates appropriate source characteristics based on trustworthiness and expertise, and highlights the importance of considering these factors separately rather than as an individual characteristic.

- Within 'Process' – this report assesses current methods of advice provision and their merits, the relationship between energy advice and wider domestic energy efficiency policy, and between energy advice and the UK energy supply chain,

- Throughout – this report considers the impact of different housing tenure and group characteristics (e.g. demographics, fuel poverty, ability to pay) on different methods and approaches to energy advice.

Drawing on a broad review of the literature and illustrative examples, this report assesses current value of methods of advice provision in England. It also aims to provide and signpost to a broad base of literature on a large number of theoretical concepts that should be involved in the creation and appraisal of energy advice.

Current content structures of advice risk being less effective if constructed around monetary frames, rather than environmental, comfort, home improvement, or more social portrayals of reasons behind undertaking domestic energy saving. The characteristics of actors in energy advice provision highlight why the use of independent, non-profit organisations aiding both householders and those in the 'advice chain' (such as local contractors, community groups and local authorities) can be appropriate to engage householders. An overview of current methods of energy advice provision are also laid out, outlining benefits and drawbacks to recommend that a wider scope and number of advice methods are offered to address potential risks, focussing especially on wider engagement with householders to promote energy-saving activities.

In addition to this assessment, this review finds that energy advice as a discretionary policy should form part of a wider domestic energy policy mix, as a support tool to promote greater uptake of household energy efficiency rather than as a standalone method of changing behaviours in the absence of broader policy interventions. The current strategy in the absence of government-backed fiscal or regulatory drivers will result in a continuation

of the inertia we have seen in retrofit installations in England since the failure of the Green Deal. This will particularly impact able-to-pay owner-occupiers.

This review assesses the influence of a more integrated view of how energy advice is approached, offered, and valued. This is in terms of:

(1) The wider integration of 'the home' into advice, past a siloed singular approach to home retrofit to one that includes domestic energy advice within the home improvement supply chain;

(2) The inclusion and consideration of a wider group of formal and informal advisors into ideas of energy advice, such as installers in the supply chain or volunteering groups. Included, the idea of a centrally-funded information hub to oversee decentralised provision of advice while ensuring quality and consistency of energy advice;

(3) The quantification of energy advice as a difficult activity to undertake, often not valuing discrete effects or qualitative values associated with the action, which can distort both perceived value of advice and methods by which it is provided.

On the basis of our literature review and indeed from in-depth discussions with the Energy Saving Trust, we also provide the following recommendations:

Recommendations for energy advice providers

- Current approaches to providing advice should include multiple frames alongside one another (i.e. both monetary and non-monetary) to achieve greater interest in behavioural change programmes. Monetary frames should not be used in isolation.
- Other incentives to engage the public past drivers of self-interest alone can create a more appealing message to a broader spectrum of householders. These include altruistic drivers and non-monetary motivators such as environmental savings, comfort, and home improvement.
- Providing practice-based and know-how solutions (e.g. tangible methods and DIY) to householders over simple reasons for saving energy may provide more tangible and practical targets for households, as well as influencing social norms.
- Tailoring advice based on values and situation (socio-economic, current home ownership, fuel poverty) is vitally important to improve outcomes and energy scheme engagement.
- Before entering the advice sphere, potential energy advice providers should ensure that they consider levels of trustworthiness and expertise that advice providers needed to succeed.
- Energy advice providers should consider complementing low-involvement advice provision methods (e.g. websites and telephone advice centres) with high-involvement approaches (e.g. face-to-face and in-home audits) that engage communities at a local level especially for three key groups: vulnerable and fuel poor householders, early adopters of new technologies, and able-to-pay owner-occupiers. These groups require the greatest support and are more open to deeper retrofit options due to grant offerings, motivation, or available spending power.

Recommendations for the Energy Saving Trust

- Establish a knowledge bank of readings, in-house literature reviews and project assessments, and regular reviews of data held to ensure a legacy of energy advice evidence that exists past potential staff changes.
- Additionally, consider the creation of a project-independent energy-SSH academic steering group to systematically link experts to EST. This is to avoid EST reliance on personal academic contacts or project-specific actors to consider a wider and deeper evidence base in rationale for activities in the absence of such a steering group.
- Assess effectiveness of the EST website as an advice tool, and additionally aim to provide consistent measures of data that are not project-dependent to ensure reliability and consistency of data for further analysis and advice service improvement. This should also be thought of in the context of reassessing how energy advice is valued.
- Alongside the overall effectiveness of advice provision, a more in-depth process-driven assessment of the effect of different methods of advice provision, although difficult to assess, would provide a clearer picture of most effective methods and greater learning outcomes. In particular, a needs-based assessment of the effectiveness of different methods of advice provision would aid in creating an evidence-based advice strategy.

Recommendations for government policy makers, and funders of energy efficiency policies and advice[1]*:*

- Consider a reassessment of how energy advice is valued, to consider and appreciate both quantitative and non-quantifiable benefits and costs in energy advice funding models.
- Fund an information hub alongside the 'data warehouse' currently being developed across the UK to provide a more in-depth, flexible, and accessible provision of information to both householders and the supply chain and reduce barriers to data access.
- Promote and support the concept of a retrofit one-stop-shop where energy advice and support can be offered to householders through the energy efficiency, energy services, and home improvement

1 Although most recommendations to policy makers here are generic, specific recommendations for policy makers in England (BEIS) and Scotland (Scottish Government) are also added due to their differing approaches and priorities.

supply chains to simplify the process of home energy efficiency improvements for households.

- Consider funding projects on public engagement around decarbonising heat and new forms of generation in light of necessary heat provision changes.

- For the Scottish Government specifically, fund and ensure process-driven evaluation of publicly funded energy advice, including the assessment of different techniques of advice (e.g. home visits, telephone advice) to ensure consistency in approach and evidence-based learning outcomes rather than purely evaluating value for money.

- Despite its usefulness, engagement with English householders should move past the passive website provision to include more active forms of engagement, especially at a community level.

- In England, BEIS should provide greater funding to energy efficiency schemes, especially around retrofitting, and relocate advice as an assistance tool rather than existing in the absence of mandatory, enabling, exhortatory and consultative policies to promote domestic energy saving.

Recommendations for researchers[2]

- Further systematic research on the impacts of different framing techniques is needed to create advice that is more impactful upon household behaviour change, especially in the UK context.

- Categorisation and consideration of multiple groups when constructing energy advice experiments could aid in developing tailored approaches based on multiple individual and social predicators.

- Greater researcher interaction with governments and government departments such as BEIS is needed to promote knowledge exchange and greater application of findings from the literature into government policy.

2 Recommendations to researchers listed here are based not on knowledge gaps *per se*, but on salient topics discussed with stakeholders that they are interested in learning more about in the development of future energy advice policy. Multiple recommendations for further research based on existing knowledge gaps are presented within the text.

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List of acronyms and abbreviations	
ASHRAE	American Society for Heating, Refrigerating, and Air-conditioning Engineers
BAfA	German Federal Office for Economic Affairs and Export Control
BEIS	UK Government Department for Business, Energy & Industrial Strategy
BESN	Big Energy Savings Network
BM	Business model
BSI	British Standards Institution
CCC	Committee on Climate Change
CESP	Community Energy Saving Programme
CO2	Carbon dioxide
CSE	Centre for Sustainable Energy
DECC	Department of Energy and Climate Change
DWP	Department for Work and Pensions
ECO	Energy Company Obligation
EEAC	Energy Efficiency Advice Centre
EED	European Energy Directive
EHC	Each Home Counts review
Energy-SSH	Energy-related Social Sciences and Humanities
EPC	Energy performance certificate
ESCO	Energy Service Company
EST	Energy Saving Trust
ESTACs	Energy Saving Trust Advice Centres
EU	European Union
HEEPS	Home Energy Efficiency Programmes for Scotland
HEEPS:ABS	Home Energy Efficiency Programmes for Scotland: area-based schemes
HES	Home Energy Scotland
HESS	English Heat and Energy Saving Strategy
IEA	International Energy Agency
IHD	In-Home Display
IoT	Internet of Things
KfW	Kreditanstalt für Wiederaufbau (German state-owned development bank)
kWh	Kilowatt-hour
LA	Local Authority
NEA	National Energy Action
NEF	National Energy Foundation
NGO	Non-Governmental Organisation
NHS	National Health Service
Ofgem	Office of Gas and Electricity Markets
ONS	Office for National Statistics
PAS	Publicly Available Specification
SME	Small and Medium-sized Enterprise
SMIP	Smart Meter Implementation Program
UK	United Kingdom
WEMWBS	Warwick-Edinburgh Mental Well-being Scale

1. Introduction

1.1. Background context

To reach nationally mandated domestic energy reduction and fuel poverty targets, the UK government has historically had a range of energy efficiency policies and actions including domestic energy saving advice for the general public. Domestic energy advice ('energy advice') here is defined by Darby (2003a, p.8) as: "*Advice specific to householders' circumstances, with one or more of the following aims: achieving affordable warmth, improving energy efficiency, conserving energy and reducing carbon emissions*". Energy advice consists of more than just provision of general information, also including assistance information on how to undertake energy saving initiatives, what support is available, and an analysis of the expected costs and benefits of the intervention (Eyre et al., 2011) although not usually explicitly stated - energy advice does also traditionally include assistance on how to switch energy company and how to use new energy-saving technologies.

Despite such definitions and overviews, no single agreed definition of energy advice exists. From conversations with stakeholders, a set definition of the concept of energy advice seemed to be taken-for-granted to be uniform sector-wide. In this report, energy advice is regarded as both an active and passive method that can be delivered in multiple ways such as face-to-face, by phone, online, feedback and updates, and through more discrete methods. Advice can be participatory and led by the advisee or led in a more traditional method by the advisor. What all definitions have in common, however, is the shared aim of not providing information for its own sake, but with the goals set by the UK government around financial, fuel poverty, and carbon savings in mind. This report aims to provide a means to this end.

Following the 1992 Rio Earth Summit, the Energy Saving Trust (EST) was established to advise members of the public on energy efficiency investment, government-funded to provide advice until 2012 (Eyre et al., 2011). Over this time, energy efficiency policy and advice had not been as effective in reducing carbon emissions as expected, as seen with the Green Deal where very little uptake was achieved. Current energy efficiency upgrades are not occurring at a fast enough rate to meet the Clean Growth Strategy's targets (BEIS, 2017c; Rosenow et al., 2018). Questions to energy advice providers have been asked regarding the inherent rationale behind providing domestic energy advice, as well as the psychological and social effect of different messaging techniques on behaviours and actions. The development of new technologies and a changing policy landscape demand a fundamental reassessment of current practice, and its place in wider energy policy, as a method to promote greater public energy efficiency scheme uptake and domestic behaviour change.

1.2. Report aim and purpose

This report, the primary output from a seven-week secondment at EST, aims to assess current and best-practice methods for providing domestic energy advice to householders in England. Alongside this, a broader overview of the process of energy advice (through an intentionally divergent range of energy-SSH perspectives working in this space) aims to unpick tensions around issues with energy advice in its current state and the relationships that should exist for a more 'holistic' and 'influential' energy advice offering. Further, the integration of a broader range of actors into the advice offering, such as local community groups, Local Authorities (LAs), and the supply chain, should be considered due to their unique characteristics to engage householders.

Overall, a key takeaway from this report is to try to move away from ideas of a 'deficit mindset' (Besley and Nisbet, 2013; Simis et al., 2016), where the aim of advice is to correct public understanding of energy saving, and rather to a programme of support to take action alongside other incentives and government policy interventions. Despite this critique, there is value in assessing current and best-practice approaches to energy advice in its current form due to its perceived importance in policy circles and its consistent role as part of wider energy policy, and so evidence of pitfalls and best practice will be offered within this lens. On the basis of findings from this review and discussions with relevant stakeholders (from multiple groups, nations, and energy agencies), actionable recommendations are offered to a wide range of stakeholders including relevant government agencies and general energy advice providers, among other groups. Recommendations have been developed from both the content within the report, and through discussion with such stakeholders.

1.3. Approach

A narrative literature review of energy-SSH was conducted to understand and outline current energy advice provision, best practice examples and critiques of current approaches. Narrative literature reviews aim to review and collect evidence on the topics of discussion into a single document, rather than being a product of e.g. a single experiment, and as such this report does not contain new data. This approach was selected due to the broad scope of the report, and to provide a summary of research into multiple areas for the reader around specific themes and multiple research methods, rather than aiming to answer specific hypotheses as a meta-analysis would (Baumeister and Leary, 1997).

Literature from a broad range of disciplines researching energy use within social sciences were consulted, such as Social Psychology of decision-making and behaviours, Politics, Human Geography, Sociology, Sustainability Sciences, Behavioural Economics, and more general reviews of experimental evidence and meta-analyses.

Guidance was also taken from the energy policy masterclass that took place as part of the Energy-PIECES project in December 2018. Comments from the masterclass highlighted multiple research priorities around energy advice and helped to signpost areas of utmost importance in the literature. These included consideration of different householder groups such as fuel poor owner-occupiers in energy advice provision, questions around the relationship between energy advice and other domestic energy policies, as well as debates around the purpose of energy advice more broadly.

Alongside the narrative literature review, signposting from over 15 informal expert interviews and discussions with stakeholders aided to design the structure of the report. These stakeholders included individuals from EST, government agencies, Home Energy Scotland, and international energy agencies. These discussions, although neither transcribed nor used as direct evidence, helped to navigate the direction of the report and provided context to many of the theoretical concepts described below. International government-funded policy examples of advice from national governments (such as those of Denmark, Finland, France and Germany) were selected to illustrate evidence of potential schemes in real-world environments, building upon purely theoretical or experimental evidence.

This report aims to serve as a legacy document for organisations aiming to provide energy advice with a broad, yet in-depth, overview of the necessary considerations needed to provide domestic energy advice to householders in England. This is the reason behind the document's length. By providing a deep bed of literature across several topics, the report aims to underline the importance and usefulness of up-to-date energy advice theory and experimental evidence to shape policy and organisational direction in the aim of creating a more effective and evidence-based approach.

1.4. Report structure

This report is structured in the following way:

Section 2. Background: advice and energy saving

2.1. provides a brief overview of the history and variation of energy efficiency policy over the last 45 years.

2.2. provides a brief history of the Energy Saving Trust, both to give context to the rest of the report in terms of what energy advice has been offered, but also to show the positionality of EST in the last five years following funding cuts.

2.3. outlines what is current being offered to householders in terms of energy advice across the UK, with a particular focus on England.

Section 3. The future of energy advice

3.1. Why do we offer energy advice?

3.1.1. discusses the information deficit model, and the relationship between providing energy information to householders and domestic energy use reduction.

3.1.2. provides an overview of the experimental evidence around energy advice, and how in specific scenarios and by using certain methods energy advice can be a useful tool to alter behaviours and promote domestic energy efficiency upgrades.

3.2. Content-based considerations for a better energy advice method: This section aims to outline what content is appropriate when providing energy advice, and why.

3.2.1. lays out the experimental evidence documenting the effectiveness of monetary frames.

3.2.2. examines examples of non-monetary frames and assesses the impact of using multiple frames in energy advice.

3.2.3. outlines the literature on tailoring approaches to communication more generally, as well as in the specific case of energy advice.

3.2.4. examines other ways of developing energy advice content without necessarily using current conceptualisations, such as through combining energy advice as part of the wider home system, considering advising for energy sufficiency rather than energy efficiency, and providing skills rather than knowledge when advising householders on how to save energy.

3.3. Source: This section aims to assess which actors are appropriate to provide energy advice, and why.

3.3.1. Provides an overview of literature on trust and how it is created and destroyed, as well as providing an overview of the current trust landscape in England. Alongside this, the section aims to highlight which organisations are regarded as trustworthy in the literature, and why.

3.3.2. Explores the subtle difference in source suitability between trustworthiness and expertise.

3.3.3. Aims to provide an assessment based on past studies on which actors are most appropriate based on trustworthiness and expertise.

3.4. Process: This section outlines the process by which energy advice is delivered to householders, and how best to involve and engage householders.

3.4.1. Explores current and more traditional methods of energy advice such as telephone advice, web-based advice, or in-home visits.

3.4.2. Provides a brief overview of the literature on the effectiveness of feedback mechanisms as a new method of advising householders on energy consumption and how to save energy in the home.

3.4.3. Examines the relationship between energy advice and policy outlining the influence of different policy drivers on the effectiveness of advice.

3.4.4. assesses the need for greater integration of energy advice within the domestic supply chain.

Section 4. Conclusions

Section 5. Recommendations

This section offers actionable recommendations to a wide range of stakeholders involved in energy advice, such as EST, energy policy makers and funders, researchers, and anyone who aims to provide domestic energy advice to householders.

Appendix 1. Annotated Bibliography

An annotated list of useful readings when considering domestic energy advice is appended.

2. Background: advice and energy saving

In 2019, The UK government amended the Climate Change Act 2008 and has committed to achieving net-zero carbon dioxide emissions in the UK by 2050 (UK Parliament, 2008; UK Parliament, 2019). Energy saving is widely regarded as a cost-effective method to overcome the issues of the energy trilemma. Domestic energy use is a major contributor to UK greenhouse gas emissions, representing approximately 28% of total UK energy consumption in 2017 (BEIS, 2018b). Domestic energy efficiency improvements and retrofits can provide economic productivity, comfort, wellbeing, and energy security benefits, as well as reducing the incidence of fuel poverty (IEA, 2014).

Energy efficiency has therefore become a more important part of wider UK government energy policy and is recognised as vital to broader decarbonisation aims (Eyre et al., 2011; Committee on Climate Change, 2018b). Despite these broad opportunities, the UK housing stock is one of the least energy-efficient and oldest in Europe (Trotta, 2018). A series of energy reduction targets have been published to address this, including in the Department for Business, Energy, and Industrial Strategy (BEIS) Clean Growth Strategy 2017 (BEIS, 2017c). These targets include plans to reduce domestic emissions through the improvement of all home Energy Performance Certificates (EPCs) to Band C by 2035 "*where practical, cost-effective and affordable*" (BEIS, 2017c, p.13).

The Clean Growth Strategy also pushes for all fuel poor households to reach EPC Band C by 2030. The definition of fuel poverty in England employed by the UK government Committee on Fuel Poverty (2018) is 'Low Income, High Cost', and involves homes spending above the national median on energy bills ending up with residual income below the poverty line. Following a workshop with energy-SSH experts, Foulds and Robison (2017, p.19) find that energy poverty can be defined as "*not being able to pay for [...] energy supply in order to meet needs*", and can include the idea of not having sufficient energy to meet said needs.

In November 2018, BEIS stated it would launch an inquiry into the current approach to reaching national energy efficiency targets, highlighting current and future focus on this under-appreciated area of emissions reductions. Recent responses to this inquiry by National Energy Action (NEA) and the Committee on Climate Change (2018a), among others, have outlined that policy measures enacted to achieve the goals detailed above fall short.

Current household uptake rates of domestic retrofit remains low, and in recent years has dramatically dropped. Of the 24 million homes in the UK, only 30% have an estimated Energy Performance Certificate Band C or above (Rosenow et al., 2018). As Dixon and Eames (2013, p.500) outline, to reach the UK government's goal of 80% greenhouse gas emissions reductions by 2050, "*one building would need to be retrofitted every minute for the next 40 years at an estimated cost of £85 billion for homes alone*". Although domestic energy efficiency has improved over past decades, current rates of energy efficiency upgrades are not sufficient to achieve targets set by the fourth and fifth UK carbon budgets and will not be reached without concerted action (Committee on Climate Change, 2018a). Fuel poverty targets have also not been met, with BEIS finding that 2.55 million households (11% of all households) were in fuel poverty in 2016 (BEIS, 2018a).

This background section aims to outline the current position of energy advice as part of the wider energy policy landscape in the UK, and England more specifically. This background is brief and outlines the case, rather than being systematic. For a deeper review of UK government energy efficiency policy, Mallaburn and Eyre (2014) provide a deep and excellent outline and assessment over 40 years. In addition, Kivimaa and Martiskainen (2018) document the phases of energy efficiency policy in the UK, and how this has changed over the last 45 years following the applied use of theoretical concepts from energy transitions and niche development, clearly categorising phases of UK government energy efficiency policy and discussing future approaches. Kern et al. (2017) also outline the development of the energy policy mix in the UK and Finland, with the former being shown in an overview in Figure 1. Last, Eyre et al. (2011) provide an in-depth analysis and overview of EST approaches to engaging with the public on energy saving since its inception in 1992, and has been helpful to better understand the organisation and its changing role in providing energy advice from a historical perspective.

2.1. A brief history of English domestic energy saving policy in the face of climate change

There is a long history of energy efficiency policy in the UK. As Mallaburn and Eyre (2014) outline, the UK government has historically been a world leader on energy efficiency policy, having historically undertaken a multitude of energy efficiency programmes. Like Mallaburn and Eyre (2014), this brief overview will present UK government energy efficiency policy chronologically rather than thematically due to the impact of the political environment on energy efficiency policy. This historical overview of policy aims to briefly outline what the energy efficiency policy environment is in the modern-day, based on how it has developed. The UK government's approach has been divided into four phases of transitions by Kivimaa and Martiskainen (2018, p.84), as developed from Rotmans et al. (2001) and Safarzynska et al. (2012): (1) Predevelopment and Exploration; (2) Take-off; (3) Acceleration; and (4) Stabilisation[3].

Kivimaa and Martiskainen (2018) assign the predevelopment phase to 1970-1998, where an emerging policy focus on reducing building energy demand was originally triggered by the 1973 oil crisis. This led to the creation of the Department of Energy which launched its energy efficiency programme in late 1974 (Mallaburn and Eyre, 2014). In 1975, the 'Save It' energy campaign was launched, and in 1977 a 10-year government-run insulation programme was launched (Mallaburn and Eyre, 2014). 1976 saw the imposition of Part L1A 'Conservation of Fuel and Power in New Dwellings' as shown in Figure 1 (HM Government, 2014; Kern et al., 2017). Even in the 1970s, this approach was seen as very interventionist (Mallaburn and Eyre, 2014).

Following this emerging set of policies came a Conservative government in 1979 seeking to reduce state intervention in the role of markets. They believed in the influence of energy prices to reduce energy demand, enacting policy in this way (Mallaburn and Eyre, 2014; Kivimaa and Martiskainen, 2018). During the 1980s, a greater focus on energy efficiency under Energy Secretary Peter Walker led to a 'golden age' of energy efficiency, with 1986 being dubbed the year of energy efficiency (Owen, 1999; Mallaburn and Eyre, 2014). The next Conservative government reintroduced a free-market approach to energy policy, leading to funding cuts and the privatisation of the electricity industry in 1989. The 1989 Electricity Act was introduced, whose price control scheme had a large negative impact on energy efficiency (Mallaburn and Eyre, 2014). At this time, non-government intermediaries advocated for firmer policy interventions (Kivimaa and Martiskainen, 2018).

Between 1989 and 1998, the development of public climate concern – as demonstrated through the 1989 European Parliament elections where the Green Party received 15% of the vote, the 1992 EU Directives addressing energy efficiency and the 1994 UN Framework Convention on Climate Change – were the first signs of climate policy starting to influence energy efficiency policy (Mallaburn and Eyre, 2014; Kivimaa and Martiskainen, 2018). At this time, free-market approaches were favoured, however building regulations were strengthened.

3 See Kivimaa and Martiskainen (2018) for an in-depth outline of these four phases, and an excellent overview of the phases of development in the UK low-energy building niche in Appendix 1.

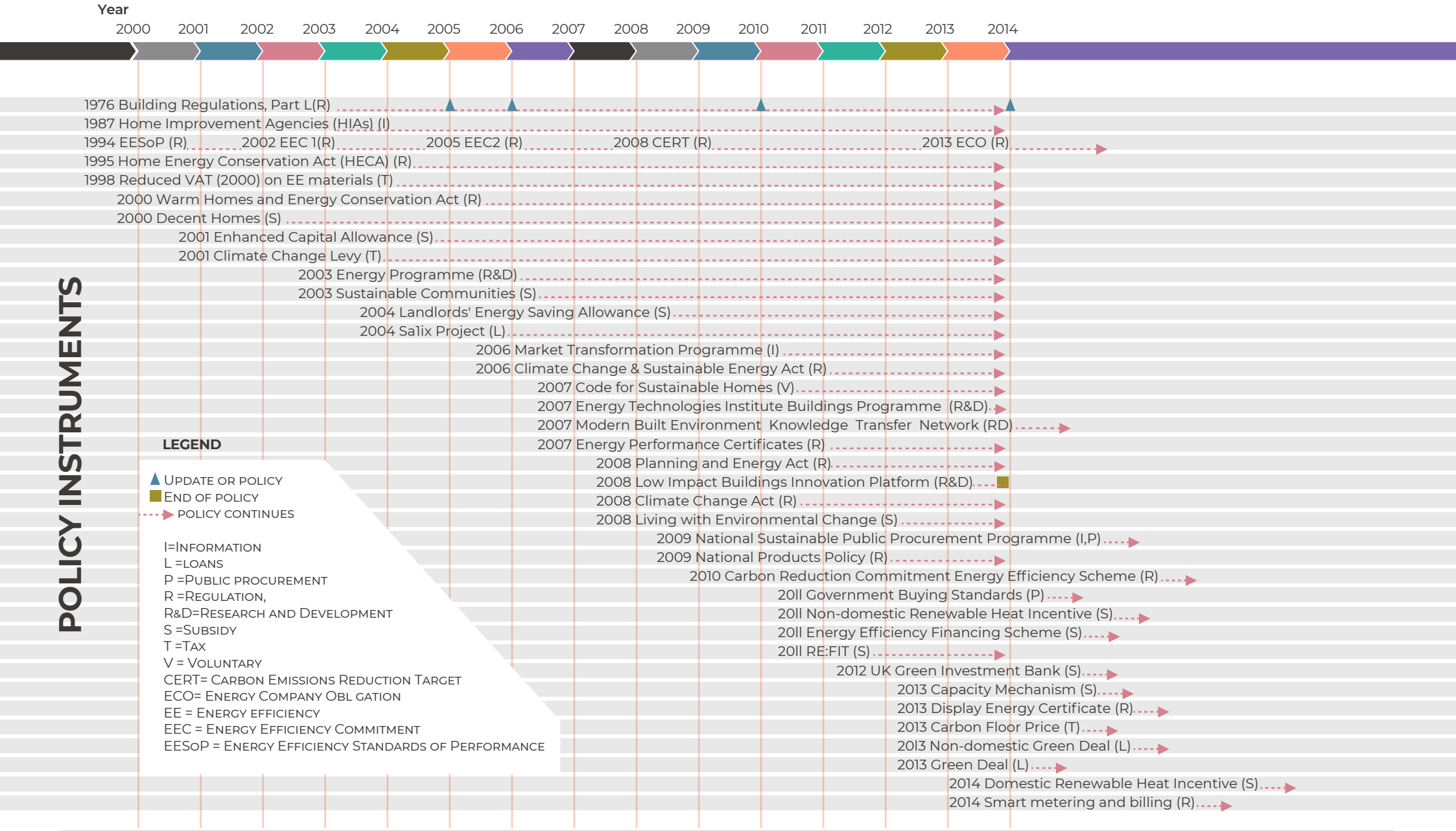

Figure 1. The development of the UK policy instruments for energy efficiency, 2000–2014. Reproduced from Kern et al. (2017, p.20). Image reproduced in accordance with the Creative Commons Attribution License CC BY 4.0. (Creative Commons, 2015).

According to Kivimaa and Martiskainen (2018), 'take-off', the next phase of the building energy efficiency policy transition, occurred between 1999 and 2008. Within this timeframe, early take-off (1999-2005) was punctuated with international climate agreements and nurturing of policy ideas for low-energy homes (Kivimaa and Martiskainen, 2018). This is clearly demonstrated in Figure 1, with a wide range of active policy interventions into the market epitomised through regulations, subsidies, taxes, and loans (Kern et al., 2017). Politically, pledges in the Labour Manifesto for a 20% reduction in CO2 emissions by 2010, past the 1997 Kyoto Protocol pledges, and a 1998 government consultation on a new climate change programme began to set the tone for a wide range of climate-based low-energy homes policy (Mallaburn and Eyre, 2014). New schemes were enacted through the Decent Homes Standard 2000, the Warm Homes and Energy Conservation Act 2000 and the Utilities Act 2000 (Kivimaa and Martiskainen, 2018), the latter giving power to government rather than OFGEM to set energy supplier obligation energy saving targets (Owen, 2006). These were implemented by energy utility companies through large-scale insulation subsidies and is understood as one of the largest-scale UK government energy efficiency policies alongside the 2005 condensing boiler regulation (Owen, 2006). In the later stage (2006-2008), 'shielding' and protection of current schemes was enacted, mainly through the zero-carbon new homes pledge in 2006 and the Climate Change Act 2008 (Kivimaa and Martiskainen, 2018). Additionally, the Department for Energy and Climate Change (DECC) was established in 2008.

Instead of the expected next step of 'Acceleration' in the transition to low-energy home policy in the UK, Kivimaa and Martiskainen document a 'backtracking phase' occurring over 2009-2016. This was brought on by the financial crisis, leading to austerity policies and a focus away from climate change issues (Gillard et al., 2017). Alongside this refocussing of issues, energy efficiency policies were diluted, reducing their impact. During the Coalition government elected in 2010, the zero-carbon definition was weakened, and many of the policies enacted in the 'take-off' phase were scrapped in 2015 before they could reach 'acceleration' (Kivimaa and Martiskainen, 2018). Government funding for the Carbon Trust and EST was removed in 2012.

In 2013, the Green Deal as a flagship UK government energy efficiency policy was launched to replace prior government-backed subsidy programmes for home energy retrofit through the use of loans (Kivimaa and Martiskainen, 2018). The Green Deal was deemed a failure and was defunded by government by 2015 (Rosenow and Eyre, 2016). Rosenow and Eyre (2016, p.2) assert that the Green Deal is "*probably the biggest failure in the history of UK energy efficiency policy*". Mallaburn and Eyre (2014) state that UK government, in the creation of the Green Deal as a policy that relies on market forces with neo-classical dogma, had not learned from the history of energy efficiency policy outlined above and detailed further by the authors cited in this section. In 2017, the Clean Growth Strategy set new targets for EPC ratings (BEIS, 2017c). However, a policy gap in this space remains following the failure of the Green Deal. The neo-classical dogma attached to this scheme continues to represent current government approaches to reducing the carbon intensity of UK homes.

2.2. Energy Saving Trust (EST): Background

UK government energy advice provision over the past four decades has been chronicled in depth by Mallaburn and Eyre (2014), Eyre et al. (2011), and Kivimaa and Martiskainen (2018)[4]. As Kivimaa and Martiskainen (2018) state, key intermediaries in the energy efficiency policy transition have been established since the 1970s. The Centre for Sustainable Energy (CSE) was originally established to undertake public retrofit projects starting in Bristol, including public energy advice (Centre for Sustainable Energy, 2009; Kivimaa and Martiskainen, 2018). When climate change concerns came to the fore with the 1992 Rio Earth Summit, a new intermediary, the Energy Saving Trust, was established to provide uptake of energy efficiency through advice and information schemes while also managing grant schemes (Eyre et al., 2011; Kivimaa and Martiskainen, 2018). As Eyre et al. (2011) outline, EST was established in a political environment marked by a government prioritisation of free-market approaches to energy efficiency, and with the goal of a liberalised and privatised energy market. EST was established as a public-private partnership and offers free and impartial advice to householders (Eyre et al., 2011).

EST's main goals are to shape behaviours, originally around energy efficiency and insulation. Their focus now includes waste and water use reduction, decarbonising transport, and household renewable energy generation advice (Energy Saving Trust, 2019). Eyre et al. (2011) outline the types of behaviours EST seek to change: (1) specific one-time behaviours (e.g. roof insulation); (2) decision making around appliance choices; (3) substitution (e.g. taking the bus rather than driving a car); and (4) routine behaviours (e.g. turning lights off when leaving a room).

EST is best known for its domestic energy efficiency and insulation advice. Until recently, EST has been the UK's largest provider of energy advice, but not the only source (Eyre et al., 2011). Historically, advice has been provided through a telephone service, and more recently primarily through a web platform in England (Eyre et al., 2011; Mallaburn and Eyre, 2014). The telephone service was administered through EST's network of telephone advice centres (ESTACs) (Eyre et al., 2011). These ESTACs were present across the UK, and were managed nationally, but operated at a more local level, usually by several LAs in collaboration (Hodson et al., 2009). Originally, EST's advice offering supported and strengthened existing patchy local provision of energy advice through these ESTACs. Increased funding led to full UK coverage by 1995 (Eyre et al., 2011). By 1998, 52 energy efficiency advice centres (EEACs) had been opened, run by EST and operated by the National Energy Foundation (NEF) (National Energy Foundation, 2014). In 2009-10, EST

4 Eyre, Flanagan and Double (2011) provide an evaluation and historical overview of EST in their book chapter. This section seeks to outline important developments that are relevant to the future of energy advice although this historical overview is by no means all-encompassing; for this, refer to Eyre et al. (2011).

received £62m in funding from DECC, which amounted to around two-thirds of its total funding levels (Carrington, 2011). Eyre et al. (2011) estimate EST's energy efficiency advice cost-effectiveness in 2007-8 of approximately £1 per tonne of CO2, and with associated savings benefits to consumers factored in this represents a positive cost-effectiveness of +£115/tCO2.

In 2012, government funding for EST as a support programme was cut during the gradual dilution and dismantling part of the 'backtracking phase' of the low-carbon home energy transition (Mallaburn and Eyre, 2014; Kivimaa and Martiskainen, 2018)[5]. Greater focus on market provision through the Green Deal was seen as a rationale for this, and EST has since had to bid for grants from DECC, and now BEIS. Since then, resources have reduced and activities have been scaled back (Mallaburn and Eyre, 2014; Kivimaa and Martiskainen, 2018).

2.3. Current energy advice provision in the UK

Across the UK, provision of energy efficiency policy and advice has been devolved, and thus Scotland, Wales and Northern Ireland each have different kinds of advice provision to England. Currently, EST in Scotland provides the broadest service by running Home Energy Scotland on behalf of the Scottish Government. This service provides online and telephone advice on domestic energy efficiency and renewable energy measures, access to grant funding and loans for measures, support and referrals for wider support to help fuel poor households, help with tariff switching and access to benefits/income advice, in-home advice visits for very vulnerable customers and for people considering complex renewable energy measures, and the integration of the database of EPCs for advice provision. In Scotland, five telephone advice centres provide this service alongside the EST website. In Wales, a similar telephone support programme is provided, however it is not as wide-ranging as in Scotland. Northern Irish energy advice is similar to this, however it is not provided by EST.

Since June 2018, official UK government-funded energy advice provision in England consists of 'Simple Energy Advice', a website and internet-based household energy calculator and planner. EST, among other organisations such as Citizens Advice, provide information for householders through their own free-to-use webpages on a non-statutory basis. Citizens Advice also have a more localised method of providing this advice through the local Citizens Advice network (Klein, 2015). Some LAs offer advice websites and other services, especially to fuel poor households (Lloyd, 2018). Energy companies follow a similar approach directly, or indirectly fund other organisations usually on a case-by-case basis. For example, npower (2019) fund Macmillan's Energy Advice Team, aimed specifically at advising householders with cancer to reduce energy bills. Alongside this, unofficial community-level advice is carried out by a patchwork of community organisations such as through 'Energy Cafés' (Martiskainen et al., 2018). Overall, energy advice in England is provided by a patchwork of different organisations with different priorities, audiences, and techniques. UK government-funded advice in England is generally reactive and low-involvement, rather than more proactive and high-involvement.

5 In Scotland, the telephone advice service continues to exist at a decentralised level, and EST in Scotland remains a government-funded organisation that administers national grant schemes.

3. The future of energy advice

3.1. Why do we offer advice?

Advice has often formed part of a broader energy efficiency initiative or policy (DECC, 2014b). In the last 20 years, a key part of domestic energy conservation initiatives has been information campaigns, and many experiments have been conducted to test their effectiveness (Delmas et al., 2013).

In recent decades, demand for energy advice has grown (Gardner and Stern, 2008). For instance, in a recent survey on the Green Deal, 48% of respondents stated they needed more information to act on energy efficiency upgrading (Howarth and Roberts, 2018). Whilst there are inevitable questions over whether or not further information would actually lead change in behaviour, the point here is that there clearly is a perceived inherent value (in this case from e.g. citizens) that is contributing to calls for energy advice.

Indeed, it is increasingly commonplace for energy advice to be embedded within formal policy instruments. The 2012 European Energy Directive (EED) mandates European nations to provide energy efficiency information and training to the public under Articles 12 and 17 (European Commission, 2012). As such, the UK government provided core funding to both the Carbon Trust and EST to offer energy saving advice to businesses and households until 2012 when funding was withdrawn (Mallaburn and Eyre, 2014). Many advice providers, such as those in Scotland, have also developed their methods of behaviour change past solely offering information in their advice (Darnton and Horne, 2013).

Advice in the context of domestic energy saving is generally regarded as a method by which information is provided to individuals with the aim of 'correcting' a specific non-rational or inefficient action resulting in unintended impacts such as the rebound effect (Sorrell et al., 2009), or assisting an individual or group to achieve goals more effectively. This approach is usually well-meaning, however presents challenges regarding assumptions of deficits, which we now discuss in the following sub-section.

3.1.1. *The 'Deficit Model' and domestic energy information*

A question often raised is why energy saving advice is funded by government, and whether it achieves the desired change being targeted, e.g. goals of greater update of energy efficiency technologies, behaviour change, social norm change, etc. Experts are expected to provide information and facts to the public to promote pro-environmental public behaviour (Maranta et al., 2003; Delmas and Lessem, 2014). This has been widely rationalised due to an asymmetry in information between the public and experts/policy makers in environmental actions including domestic energy use (Owens and Driffill, 2008; Ramos et al., 2015). Information asymmetry is further exacerbated when considering domestic energy activities due to the 'invisible' nature of energy use, as well as complicated and costly-to-obtain data (Gillingham et al., 2009; Ramos et al., 2015).

The complex nature of the energy efficiency offering for consumers is often described as a phenomenon that needs simplification through methods such as advice to be effectively interacted with (Wilson et al., 2014; Balta-Ozkan et al., 2013). The gap in energy efficiency due to, among other reasons, a lack of knowledge has been described as a market failure that must be corrected to ensure greater public uptake of efficiency projects (Jaffe and Stavins, 1994; Brown, 2001; Gillingham et al., 2009). In a literature review of public understandings of energy use and savings, Lesic et al. (2018) found four consistent findings across the studies reviewed, namely that:

1. the public overestimates the energy use of low-energy appliances, and underestimates high-energy appliances;

2. householders generally prefer energy conservation more than energy efficiency strategies;

3. householders do not possess information about savings accrued from energy-saving methods; and,

4. laypeople use heuristics to estimate appliance energy use, with accuracy often dependent on numeracy levels and pro-environmental attitudes.

Policy makers and communicators have long relied on the tenet that public attitudes and behaviours on a given topic, often lacking in accuracy and knowledge, can be corrected through the provision of information (Gross,

1994; Sturgis and Allum, 2004). Using the Information Deficit approach in the context of an ever-complexifying domestic energy sector could be perceived as useful to policy makers due to the straightforward nature of the solutions proffered (Owens and Driffill, 2008). There has been much debate in the energy-SSH and environmental-SSH literatures regarding the "*flawed*" nature of solely information-based approaches to environmental and sustainability advice campaigns to alter behaviour (Owens, 2000, p.1141; Burgess et al., 1998). As Stern highlights:

> "*The history of informational programs for residential energy conservation, recycling, and the use of mass transit shows clearly that the most typical result of simply presenting people with information on the benefits of proenvironmental behaviors is that the behavior does not change.*"
>
> (Stern, 1999, p.467)

More generally, the Information Deficit approach assumes linearity between cause and effect: that solving a barrier specifically (here, lack of information) will correct individual decision making in spite of other potential barriers and would act in isolation (Burgess et al., 1998; Owens, 2000). It has been argued that communicators, scientists, and policy makers assuming or extrapolating public knowledge deficits have led to the development of a "*deficit mindset*", disconnected from influence of social structures (Besley and Nisbet, 2013; Simis et al., 2016, p.405).

Despite this assessment, studies have consistently shown the importance of knowledge in determining attitudes and outcomes (Sturgis and Allum, 2004). The use of mental models has been successful in mapping and addressing public knowledge gaps to tackle sub-optimal decision making for decades (Morgan et al., 2002; Bruine de Bruin and Bostrom, 2013). Indeed, some recent studies have attempted to use mental models in electricity understandings and energy information provision (Chisik, 2011; Gabe-Thomas et al., 2016). Gabe-Thomas et al. (2016) find that UK participants tended to group appliances based on activities (e.g. entertainment), and location (e.g. bathroom), rather than considering energy consumption itself as a grouping factor. This example shows the potential for behaviour change messages aimed at activities in the home, rather than energy consumption itself, and the importance of 'mapping' both expert and public understandings.

Lack of knowledge of risks and/or solutions is widely regarded as a barrier to public environmental action (Blake, 1999; Kollmuss and Agyeman, 2002; Lorenzoni et al., 2007) and reducing household energy consumption more precisely (Steg, 2008; Cotton et al., 2016). Conversely, increased knowledge can crystallise and strengthen attitudes (Petty et al., 1995; Bidwell, 2016). Despite this, several studies have found that increasing only knowledge does not translate into reductions in energy consumption (Kollmuss and Agyeman, 2002; Owens and Driffill, 2008). Overall, knowledge provides an important *part* of the overall picture of behaviours and understandings around energy saving as part of cognitive, affective, and behavioural elements (Lorenzoni et al., 2007; Owens and Driffill, 2008). Information on its own is not sufficient to alter behaviours adequately, and the extent of the impact of advice provision as a method to tackle knowledge gaps and behavioural inaction is contested.

3.1.2. *Impact of energy advice on domestic energy consumption*

Evidence on effectiveness of information provision on domestic energy consumption levels has been inconclusive and often contradictory (Delmas et al., 2013). Asensio and Delmas (2016) find variance in effectiveness based on information frames, ranging from no long-term change to an 8-10% decrease in energy use over 100 days. In another review, Abrahamse et al. (2005) find that information interventions had little to no effect on public energy consumption. Conversely, Abrahamse et al. (2007) find a 5.1% decrease in energy use among households exposed to a knowledge-based intervention, alongside increased energy conservation knowledge. In a literature review of experimental evidence, Fischer (2008) finds that multiple feedback methods provide energy-saving benefits, ranging from 1.1-20% saving, with an average overall saving of between 5 and 12%.

Aydin et al. (2018) found that among Dutch residents, information provision reduced consumption of electricity by an average of 20% compared to the control group. Iwafune et al. (2017) found that giving homeowners home energy reports reduced Japanese winter energy consumption by 3.7% in 2015/16, and a 9.8% reduction in space heating in this time although summer energy savings were not significant. Overall, Delmas et al.'s (2013) meta-analysis of 156 published trials of information strategies' effects on conservation behaviour from 1975 – 2012 found that individual energy consumption reduced by on average 7.4%. The Scottish Government-funded energy advice service, Home Energy Scotland, attributes annual estimated lifetime savings of £82.5 million to its energy advice network. Similarly, Finnish utilities reduced domestic energy consumption by 2.5% from the use of advice, communication and feedback between 2011 and 2012 (Ulla Suomi and Motiva Oy, 2014). Despite this wealth of information, measuring the true effectiveness of advice in isolation outside of experimental studies (i.e. the evaluation of advice initiatives at the national-scale) is difficult due to its dependence on social, policy and economic contexts. Evidence is also inconclusive on the long-term effects of energy advice, and therefore could be exaggerated (Buchanan et al., 2015). According to Attari et al. (2010) and Dietz et al. (2009), information provision is needed as one part of a wider intervention to overcome all barriers to reducing household energy consumption. Delmas and Grant (2014) find that the effectiveness of information strategies depends on the method and context. Asensio and Delmas (2016) show that energy information provision techniques vary across cases, and for a wide range of reasons.

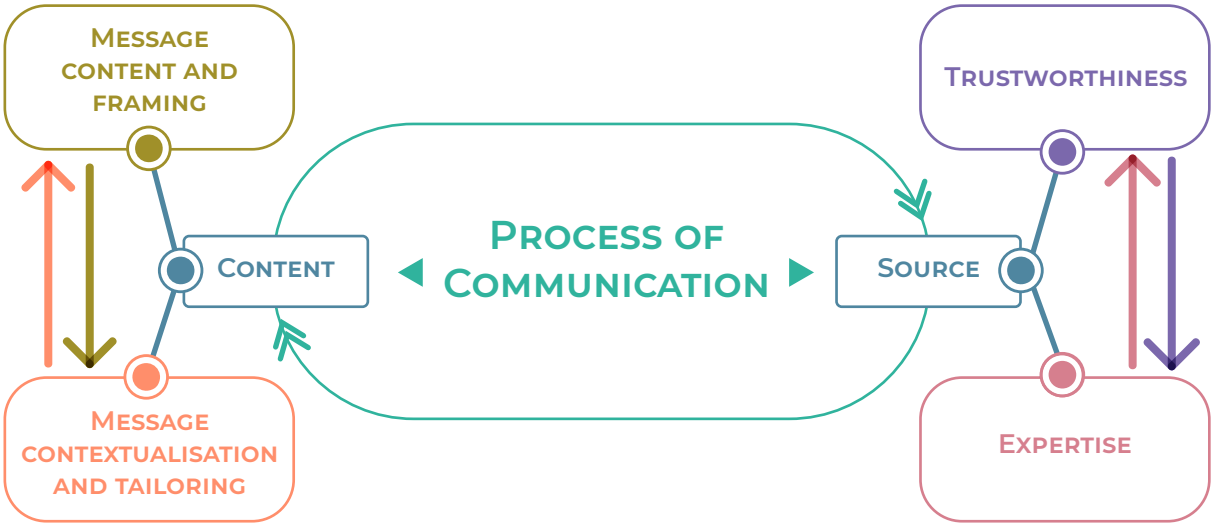

Figure 2. The linkages between factors analysed by Simcock et al. (2014). Adapted from Fig. 2 on page 462, Simcock et al. (2014, p.462).

Following Simcock et al. (2014), assessing information provision through the lens of 'content'[6], 'source'[7], and 'process'[8] through which information is communicated provides a useful division of the various considerations needed. This is organised incrementally: starting with the message, then messenger characteristics, then perhaps most importantly *how* advice is disseminated. As shown in Figure 2, Simcock et al. (2014) determine the 'process' of communication the integral part of the overall information reception. An application of the concept to the specific segmented recipients of energy advice is important, namely: (1) Landlords and tenants; (2) Self-funding/ Able-to-pay owner-occupiers; (3) Fuel poor owner-occupiers; (4) Social housing. Each group has its own characteristics and faces differing challenges and needs. This must be considered in wider provision of energy advice.

3.2. Content-based considerations for a better energy advice method

Contextualising information for householders is an important part of the overall advice process (Simcock et al., 2014). The information messages contain can influence their effectiveness on public behaviours. One consideration involves message framing, a method of highlighting particular facets of a given message to focus public attention (Chong and Druckman, 2007). Framing can be defined in this review as: "*the perceptual lenses, worldviews or underlying assumptions that guide communal interpretation and definition of particular issues*" (Miller, 2000, p.212). Framing is generally used because of varying individual priorities, values, and abilities among householders, and has become of particular interest in social sciences as a method of addressing environmental issues (Gamson and Modigliani, 1989; Miller, 2000; Hulme, 2008; Frederiks et al., 2015). Often, these frames are divided in terms of their appeal to self-interest or altruism (De Dominicis et al., 2017). Alongside framing, message tailoring and targeting has been discussed as a more effective solution to traditional generic top-down messaging strategies (see Boomsma et al., 2016 for an overview), and its merits will be discussed below. New, less-considered holistic methods of energy advice past solely energy efficiency can also offer an idea of best practice around energy advice provision and therefore are considered as part of a wider assessment of the effectiveness of different energy advice content strategies.

6 'Content' here includes message framing strategies, considerations over complexity and tailoring of information.

7 'Source' here refers to the trustworthiness and expertise of the information provider.

8 Here, 'process' refers to techniques by which information is communicated, consistency of information messaging, decentralised methods of information provision, and the relationship between energy advice and broader domestic energy policy.

3.2.1. *Monetary framing*

Historically, a common method of energy advice framing involves communicating financial savings from installing measures (pecuniary incentives) (Hayes and Cone, 1981; Eyre et al., 2011). Providing details of financial savings has been found to result in greater understanding of relevance of savings to personal energy behaviours and context (Owens and Driffill, 2008; Hargreaves et al., 2010; Simcock et al., 2014). Generally, providing energy use advice in the context of money spent or saved rather than 'invisible' and difficult-to-understand measures such as kWh or CO2 emissions have resulted in a predominant use of this frame in current energy advice (Chatterton, 2011; Hargreaves et al., 2010). Since energy use reduction results in cost savings this is a natural connection to make; as long as savings outweigh costs this will appeal to individuals' self-interest (Hutton and McNeill, 1981; Steinhorst et al., 2015). This section aims to evaluate the effectiveness of using monetary framing to elicit energy use behaviour change or domestic efficiency upgrades.

A recent study by Steinhorst et al. (2015) finds that using a monetary frame as a method to save electricity has a positive impact, at a similar effect size to environmental frames. Despite this finding, other studies have found that pecuniary framing strategies can have no effect, or even increase domestic energy use and ambivalence rather than decrease it (Bolderdijk et al., 2013; Delmas et al., 2013; Schwartz et al., 2015). In a meta-analytic review, Deci et al. (1999) find that financial incentivisation as intrinsic motivation can actually reduce motivation to act. It is suggested by Dogan et al. (2014) that the contradictory findings between studies may be explained by whether participants consider the savings potential worthwhile. Spence et al. (2014, p.24) find that provision of savings potentials and feedback in monetary units can be a risk due to the perception that savings are "*not worth it*". Special attention must also be paid to the gain/loss framing (prospect theory) of any message as impacts of householder intervention will likely differ, as evidenced by similar pro-environmental behaviour change initiatives such as coffee cup waste reduction techniques (Poortinga and Whitaker, 2018). Here, a gain/loss framing technique refers to the concept of prospect theory, that people are more likely to aim to avoid paying a charge on something or overpaying (loss) rather than aiming to receive a discount (gain) (Kahneman and Tversky, 2013). Little research in this area exists in the context of energy saving and more must be conducted according to Green and Peloza (2014).

Steinhorst et al. (2015) find no positive environmental spillover effects present when using a monetary frame. Environmental spillover refers to the knock-on impact of pro-environmental behaviour on other environmentally-minded actions (Thøgersen, 1999). Asensio and Delmas (2016) find no significant net energy saving in homes 100 days after a monetary-savings-frame intervention. This has been echoed in findings by Steinhorst and Klöckner (2018), that providing advice in a monetary frame has no effect on long-term behaviour. van Middelkoop et al. (2017) also warn that demographic and individual differences may also mediate the effectiveness of financial information provision. Overall, multiple authors including McMakin et al. (2002), Spence et al. (2014), and Asensio and Delmas (2015) warn against solely appealing to self-interest and financial benefits, instead arguing that additionally appealing to a broader range of non-financial interests can be more effective in achieving greater domestic energy savings. This review highlights that although monetary incentivisation can have some impact, focus on other frames and incentives should also be considered to provide a more enticing form of energy advice to a wider group with differing interests and priorities.

3.2.2. *Non-monetary framing*

Rosenow and Eyre (2016, p.142) reflect on the failings of the UK Green Deal. They found a failure in engagement: "*we need to focus on what consumers actually want*". This has been found to be more than just financial motivation: alongside provision of financial information of energy schemes, there is a broad consensus among the research community for the provision of non-monetary information (Frederiks et al., 2015; Rosenow and Eyre, 2016). Non-monetary frames can be either aimed at self-interest or altruism (see De Dominicis et al., 2017). This section outlines a non-exhaustive list of non-monetary frames to elicit domestic energy behaviour or efficiency changes. The non-monetary frames selected here are among the most common and researched, rather than an outline of all frames possible.

The most commonly used non-monetary frame in energy saving advice involves appealing to environmental attitudes, beliefs, and values (see Spence et al., 2014; Abrahamse and Shwom, 2018). Here, environmental framing has found to have more of an impact on behavioural intentions than monetary framing (Schwartz et al., 2015). Xu et al. (2015) observed a more positive reaction to environmental frames from US residents than economic frames, albeit mediated by political ideology and climate concern. Similarly, Steinhorst and Klöckner (2018) find that only environmental, rather than monetary, framing has a positive impact on pro-environmental intrinsic motivation among German respondents. Despite this commonly-used frame, several studies and meta-analyses (Brandon and Lewis, 1999; Fischer, 2008; Steinhorst et al., 2015) have found no difference in the impact of environmentally framed information on energy saving behaviours compared to monetary frames, and Steinhorst and Klöckner (2018) find no influence on long-term behavioural change either. Van Der Werff and Steg (2018) show mixed findings on the impact of emphasising the positive environmental effects of pro-environmental behaviour on spillover to other behaviours, finding some effectiveness in some of their studies, and no effect in others. Spence et al. (2014) advocate for the combination of both environmental and cost frames in engagement with householders on energy saving. Despite this, the authors note that this may be difficult to achieve and potentially counterproductive due to the contradictory values of the self-interest (cost) and altruism (environment) frames (Corner and Randall, 2011). This issue is generally worth considering when aiming to combine message frames.

As sub-optimal EPC homes increase in-home vulnerability to climate risks, especially among the elderly, climate adaptation strategies have begun to consider domestic efficiency changes as more than solely traditional climate mitigation strategies (Abrahamson et al., 2009). Alongside research assessing the impact of health frames on climate change communication techniques, some research has therefore focussed on health frames to communicate the impacts of energy saving (Myers et al., 2012). Asensio and Delmas (2015) found that, in a study of 118 Los Angeles residents over eight months, using a public health frame in informational messages reduced average domestic energy use by 8.2%, compared to an energy use increase of 3.8% among a monetary treatment group. From a personal perspective, employing a "*perceived susceptibility to [...] climate change*" frame (i.e. personal health risk) reduced self-reported energy consumption among a U.S. sample in 2008 (Semenza et al., 2011, p.10). This frame relates to the theoretical risk of climate change impacts (e.g. heatwaves and cold snaps) targeted at the general public, rather than currently at-risk individuals experiencing these risks. Less information exists on the impact of these frames on currently at-risk groups. Carrico et al. (2018) find that using a health frame may inhibit environmental spillover effects, perhaps due to the lack of realisation that individuals are partaking in pro-environmental behaviours in the first place (Van Der Werff and Steg, 2018). In the context of tackling climate change, a mixed-methods study on UK residents undertaken by Whitmarsh and Corner (2017, p.125) found quite mixed results of a health frame: some participants saw the link between "'*dirty*'" fuel sources or energy-inefficient homes and negative health outcomes, while some older participants were sceptical about current air pollution effects based on past experience of perceived worse conditions. Despite some promising findings, more research must be conducted in this area to assess the impact of both personal and societal health frames on domestic energy use in the UK context.

Another non-monetary messaging frame that has been found to influence domestic energy saving behaviour involves the use of comfort. Comfort here, defined by the American Society for Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE), applies to thermal comfort, as well as noise levels, visual characteristics, psychological comfort, ergonomics, and air quality levels (Huebner, Cooper and Jones, 2013). At a fundamental level, one goal of energy use is for greater comfort (Stern, 2000). Comfort has been a long-used method of attracting consumers: U.S. ESCOs have integrated householder comfort into comprehensive energy efficiency solutions since the 1990s (Vine et al., 1999). Aune et al. (2016) find that living in comfort and convenience are thought of as social norms, regardless of energy saving among Norwegian households. In a Swiss sample, Banfi et al. (2008) find that comfort benefits are valued highly by consumers in assessments of willingness to pay.

Generally, energy efficiency schemes such as the Warm Front in England have resulted in more thermally comfortable homes. The risk of these schemes is that rebound effects result in no overall energy saving, especially in fuel poor households (Hong et al., 2009). Pro-environmental action has often been associated with risk of reduced comfort (see Bardsley et al., 2019). Loss of comfort as a result of environmental behaviour change was generally not positively viewed in a study of Devon residents (Barr et al., 2005). This finding is broadly generalisable, and so means that a comfort frame should be integrated into all domestic energy consumption reduction strategies (Frederiks et al., 2015). In a study of Irish households, comfort gains were regarded as more important to an energy efficiency measure decision than environmental considerations, with 66% of grant applicants referring to comfort as a rationale for the application (Aravena et al., 2016). Similarly, Cole et al. (2018) find comfort ranked third in perceived benefits of energy efficiency upgrades in a study of U.S. households. Some EST evidence from 2016 shows that all social groups value warmth highly, with respondents on lower incomes more likely to value greater warmth with the same energy bill over simple cost reductions (Energy Saving Trust, 2016). Despite these studies, limited experimental evidence on the direct attribution of comfort to reduced energy consumption exists, especially in the context of England. This should be consistently measured.

One final frame requiring attention involves viewing energy saving, especially energy efficiency, as a 'home improvement'. As Wilson et al. (2015) posit, a focus on home improvements rather than efficiency improvements, and homes rather than houses, could overcome current limitations of applied behavioural research in finding answers to energy saving barriers. Maller and Horne (2011, p.59) assert that "*home improvement, environmental performance and household practice rarely occur together in social enquiry*". Wilson et al. (2018) assess that one of the main failures of the Green Deal was in omitting emphasis on potential improvements in home tensions that energy efficiency upgrades could solve through home renovation. The authors outline tensions in domestic lived experience as including issues around physical use of space and representation of identity in the home that can serve as the rationale for considering home improvement. This frame may be more effective among certain population segmentations, such as self-funding owner-occupiers, rather than tenants or fuel poor owner-occupiers (Wilson et al., 2015). The rise of 'eco-chic' and fashionable sustainability could potentially provide a frame that taps into current trends, including social norms and aesthetic desires, as seen in Sweden (Buser and Carlsson, 2017). To the author's knowledge, little to no data exist on the impact of a 'home improvement' message frame on either overall energy consumption or motivation.

Overall, different frames can have varying impacts on household pro-environmental behaviour. Despite this wealth of literature, more contextual and consistent studies must be undertaken to better understand the effect of varying message frames on domestic energy saving. A key consideration here is that the effectiveness of different pro-environmental behaviour frames and incentives are very dependent on the specific type of behaviour, as assessed by Moser et al. (2016). Additionally, the incorporation, recognition, and comparison of variance in effectiveness of advice frames between home ownership groups, demographic groups, housing types, income groups, and group social status should take place in future experiments such as those described above: not to consider this risks overlooking opportunities and pitfalls to future advice framing.

Message content framing must therefore be considered when planning energy advice. Alongside monetary frames, non-monetary frames have value as energy is not just construed in financial terms; often a single focus on the former approach is found to be counterproductive. The particularly interesting, yet under-researched, frames of 'comfort' and 'home improvement' could offer novel ways of viewing energy efficiency past recent binary self-interest vs. altruism 'money vs. environment' framing debates. Multiple frames should be used ensure a more effective roll-out, however further experimentation is needed. Despite this amount of previous research into energy advice content, it must be made clear that both theoretical and experimental research on most effective methods of message framing is far from concluded. As Andor and Fels (2018, p.186) state: "*We are surprised at how little we know… It seems surprising that an intervention such as labelling is applied worldwide but there is little knowledge about the actual impact*".

Assumptions that correcting, or simply focussing, on specific frames may be construed as a form of 'deficit mindset', a one-way process outlined above that has been heavily warned against in much of the literature (Simis et al., 2016). To begin to avoid this, accounting for and incorporating public opinion, situation, and behaviour in advice and knowledge can be effective (Dilling and Lemos, 2011), and can start to be achieved through more tailored messaging in the aim of co-producing knowledge.

3.2.3. *Message tailoring and personalisation*

Despite the wealth of literature on different content frames, the debate on the most effective frame in the literature is not conclusive. According to Xu et al. (2015), among others, one reason behind this contestation is due to 'individual predictors'; namely personal factors that influence motivational variation, resulting in disparities in advice content reception and final energy saving behaviour (see Figure 3; Frederiks et al., 2015).

As stated by Brandsma and Blasch (2019) in a study on Dutch customers of green energy provider Qurrent, despite no significant variance in frame of feedback message on effectiveness (energy, money, environment), the authors found differences in effectiveness based on individual characteristics. On the subject of individual differences, Spence et al. conclude:

> "*The implication is that different people are likely to perceive communications on energy reductions in quite different ways from each other. There is therefore unlikely to be a simple message that can effectively engage everyone.*"
>
> (Spence et al., 2014, p.24)

The patchwork of varying characteristics influencing advice reception and domestic energy priorities (Frederiks et al., 2015), even within frames, highlights the importance of tailored approaches to energy advice from a theoretical perspective (Dietz et al., 2009). Tailored and personalised information provision involves collecting data on an individual, and offering personalised solutions to address their issues based on the data collected (Abrahamse et al., 2007). Communication with different socio-demographic groups requires a varied approach, as they interact differently with the energy system. For example, in a Dutch study, an increase in household income by one percent led to an 11% increase in electricity usage (Brounen et al., 2012). In the UK, households residing in an apartment are 21% likelier to undertake habitual energy-saving activities, but 15% less likely to retrofit their property (Trotta, 2018). Trotta (2018) also found that residents in a detached house were 9% more likely to undertake retrofitting than households in a terraced house. Trotta (2018) puts forward two reasons for these differences: first, that detached houses tend to be larger and have greater heating demands, thus prioritising retrofitting; second, those living in apartments tend to also be from lower-income groups. Regarding gender, women are more likely to theoretically enrol in an energy-saving program based on a comfort message than men (Cole et al., 2018). Often, everyday practices in the home and cultural norms are different between genders, and should not be ignored (Tjørring, 2016). These examples serve to emphasise the importance of considering individual and situational predictors in energy advice, and that this can only be achieved through a tailored approach. Personal values can also shape individual message interest and overall message effectiveness. Environmentalists were more willing (over 60% agree) to accept comfort level reductions than non-environmentalists (less than 25% agree) (Barr et al., 2005). This example, part of a wider literature base on the influence of motivations and different values on pro-environmental decision-making, underlines the importance of considering personal values in energy interactions and broader advice (see De Groot and Steg, 2010 for a broader overview of the literature and assessment). Indeed, Fischer (2008) states that, based on the author's model, tailored information based on values and motivations is needed.

Tailored content provided to different home ownership groups such as fuel poor owner-occupiers, able-to-pay owner-occupiers, landlords, and social housing could also provide benefits due to different priorities and capabilities (Trotta, 2018). For example, in a review by Sardianou (2007), multiple studies have shown that tenants in a rented property tend to invest less in energy efficiency than owner-occupiers in general. Even within the rental market, Phillips (2012) finds that landlords' willingness to pay for insulation upgrades is found to only be at 50-70% of tenants' comparative willingness to pay. Preferred methods of efficiency also vary between the two groups (Phillips, 2012). This example of split incentives highlights the uniqueness of every retrofit efficiency proposition in the private rented sector, which accounts for just over 20% of all UK dwellings as of 2017 (Wilson et al., 2014; MHCLG, 2018). Owner-occupied homes accounted for approximately 63% of all UK dwellings, and within this group 7.7% were classed as fuel poor in 2016 (BEIS, 2018a; MHCLG, 2018). UK fuel poor homes tend to be of below average housing stock quality (Oreszczyn et al., 2006). This influences the extent of retrofit needed to reach certain EPC targets and thus potential retrofit cost levels, and potential health priorities (Heyman et al., 2005). In social housing, Elsharkawy and Rutherford (2018) assess that

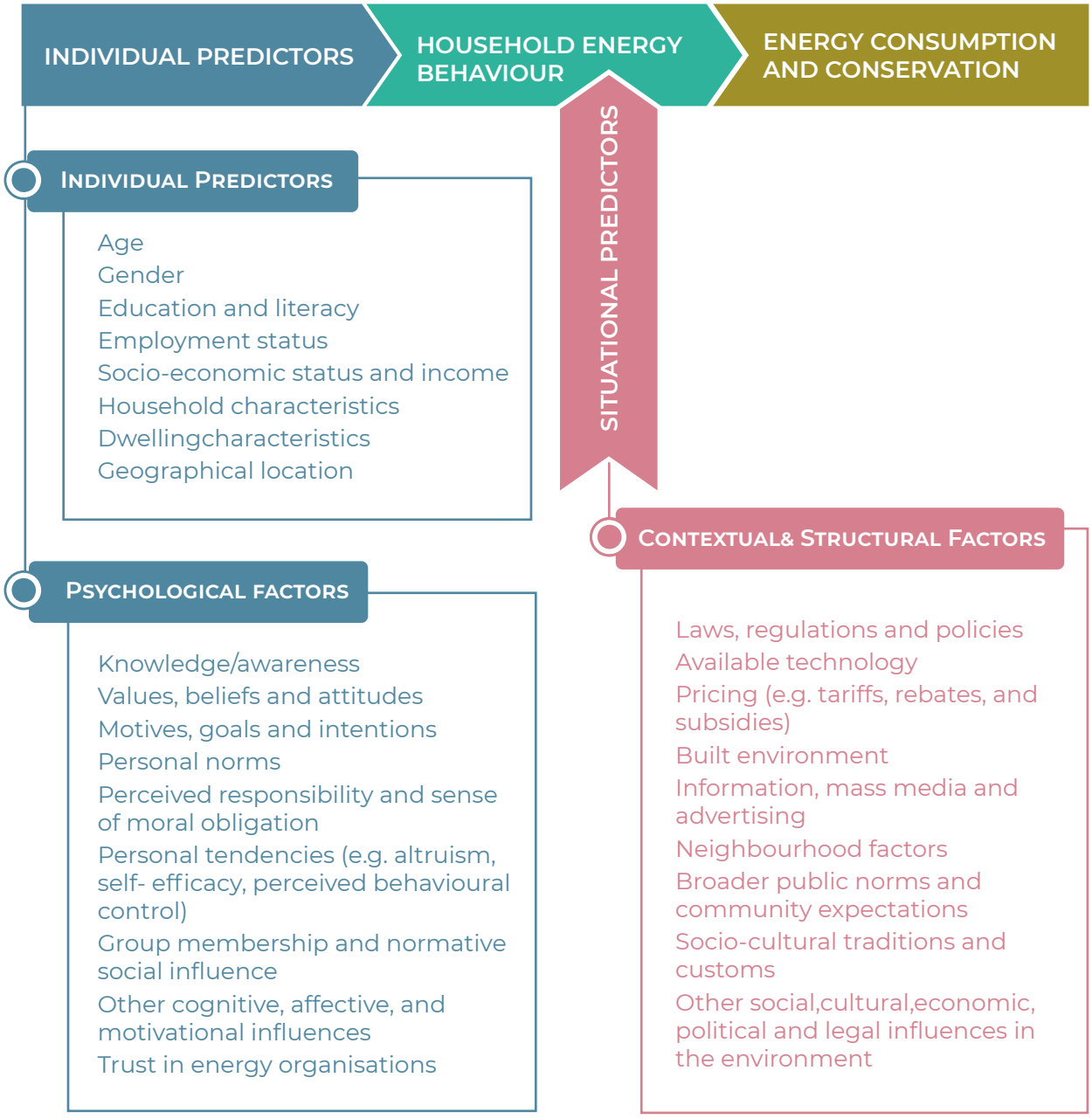

Figure 3. Integrative conceptualisation of the varied individual and social factors influencing domestic energy consumption and saving. Adapted from Frederiks, Stenner and Hobman (2015, p.577). Image reproduced in accordance with the Creative Commons Attribution License CC BY 4.0. (Creative Commons, 2015).

the characteristics of the area studied determined that locals thought that tailored advice was crucial, but that tailoring may not have the necessary impact on carbon reductions due to other social or financial constraining factors. Limited research was found comparing groups explicitly within one study to identify differences in responses to different tailored content around energy advice, and this topic must be explored further.

Overall, research supports the effectiveness of a more tailored approach. Tailored approaches to providing energy advice have been more successful than generic messages (Rimer and Kreuter, 2006), and are also less likely to be ignored than generic messaging tactics in the context of a range of areas including electric vehicle advice and energy saving (Al-Ubaydli and Lee, 2011; Nicolson et al., 2017; Bent and Kmetty, 2017). Targeted messaging has been found to be more effective than large-scale generic information campaigns, especially in the short-term, in a range of different areas such as health (Noar, 2006). In the context of energy, it is argued that advice should be tailored to specific personal contexts (Simcock et al., 2014). A wider assessment of these considerations can be found in the study by Bent and Kmetty (2017). A study on energy feedback in the UK found a significant improvement in lowering home temperatures among those who received a tailored textual messages with action prompts, compared to those who did not (Mogles et al., 2017). Using tailored information in conjunction with goal setting and

tailored feedback reduced energy use by an average 5.1% in Dutch households, compared to the control group increase of 0.7% (Abrahamse et al., 2007).

Some evidence exists of theoretical concepts of tailoring entering energy advice programmes. In Scotland, the use of the ISM model (Individual, Social, and Material) begins to address some of these areas seen in Figure 3 (Darnton and Horne, 2013). The ISM model acts as a practical tool to map and assess the unique characteristics of each policy and approach to promoting energy efficiency upgrades and behaviour change, as well as stakeholder considerations. However, more depth and granularity in individual stakeholder group reactions is required to provide more effective advice on a personal context, as highlighted above (see Frederiks et al., 2015).

Despite a consensus of the importance of tailoring over traditional generic methods of communication, and some evidence of tailoring being effective in reducing domestic energy consumption, Büchs et al. (2018) show that research has also found little long-term impact of personalised information provision (Darby, 2006; Hargreaves et al., 2013; Allcott and Rogers, 2014). This finding resonates with Abrahamse et al.'s (2005) suggestion that tailored messaging needs to be regular and consistent to avoid drop-offs in message salience and impact. Tailoring advice is an expensive task, and can be less cost-effective than more generic advice (Dowd and Hobman, 2013). Further research on the influence of tailored messaging on domestic energy saving needs to be undertaken, particularly in conjunction with new technologies and additionally experiments on the impact of tailored messaging approaches on specific group energy saving responses. Tailored messaging should be viewed and assessed along multiple different axes, including a wide range of individual predictors such as housing tenure type, housing stock, income, and values alongside social predictors, as conceptualised by Frederiks et al. (2015) in Figure 3.

3.2.4. *Invisible energy advice*

If the overall goal of domestic energy advice is to reduce energy use in the home, as well as to positively influence behaviours, social norms, and home experience (among other factors), new findings suggest that highlighting energy efficiency/behaviours in isolation rather than general home improvement works may be less productive than a more holistic approach to home efficiency improvements (Brown et al., 2019). Especially with the risk of the paradox that increased efficiency could increase actual energy use through the rebound effect (Herring, 2006), a more holistic approach may be necessary. The deep, embedded nature of energy practices in social activities and position within society, wider than purely environmental and monetary considerations (Waitt et al., 2016), demands its consideration in wider domestic energy saving support programmes.

Recent work by Shove (2018) has suggested that a shift in focus is needed, away from the current model of energy efficiency that sustains current and past practices of energy use, towards advice about broader domestic ways of life that are consistent with the necessary reductions in demand required to meet emissions targets. It may therefore be necessary to consider a shift in the communication of energy reduction away from the output (e.g. energy efficiency installation), towards a more holistic offering of outcomes to homeowners around e.g. home living. If a broad aim of an energy advice service is to improve quality of life, then this will likely incorporate more than pure efficiency measures in homeowner interaction in the domestic space (Wilson et al., 2014). Alongside this, the interconnected nature of energy use and saving to other non-energy activities and services both domestically and externally – e.g. health, fuel poverty, and other lived experiences such as changes in familial and personal life that shape interaction – suggest greater regard for these factors and a wider provision of non-energy advice and sociocultural applications of energy saving could have broader energy-saving impacts (Tjørring and Gausset, 2019). In a review of the literature, Waitt et al. (2016) reveal a broad advocation for behaviour change conducted through citizen-focussed schemes, rather than knowledge provision alone. Overall, when offering energy advice, incorporating sociocultural meanings of home alongside more technical appraisals of retrofit energy saving needs to be reflected in policy to ensure broader individual applicability and potential uptake (Tjørring and Gausset, 2019).

Alongside this broader view of energy advice in the domestic setting, some authors suggest energy advice should appreciate the difference between the communication of energy efficiency and energy sufficiency. Energy sufficiency, defined by Sorrell et al. (2018, p.8) as "*reductions in the consumption of energy services, that have the aim of reducing the energy use and environmental impacts associated with those services*", pushes for further integration of efficiency upgrades and behavioural advice interventions. Recent research advocates for a combined approach to avoid possible rebound effects and to promote more effective use of domestic interventions (Sorrell et al., 2018). Not predicting rebound effects as part of efficiency upgrades is problematic due to lower savings being achieved than expected, potentially having a knock-on effect of householder disappointment and risk of reduced willingness to engage with future energy-saving opportunities (Webber et al., 2015). This rebound effect exists due to an increasing disconnect, where engineering innovation ignores the social context in which the innovation occurs, resulting in inaccurate or contradictory results (Jones and Jones, 2016).

Galassi and Madlener (2017) underline householders' priority of increasing comfort created through rebound effects following efficiency upgrades. This suggests that comfort, as well as financial and carbon savings, should be considered in calculating expected results from energy efficiency upgrade policy. This is especially true when evaluating the effectiveness of energy efficiency policy, including advice, on fuel poor households where take-back rates will inevitably be greater (Herring and Roy, 2007). Thomas et al. (2018) among others state that a broader focus of energy advice to provide behavioural support, integrated into the recommendation for more structural and social norm changes over a longer time period, can result in greater savings than solely providing persuasive advice on methods of making homes more efficient, regardless of framing or tailoring methods. This

can include methods such as altering and using social norms, comparing energy reduction levels to neighbours, or individual goal-setting around energy reduction targets (Abrahamse et al., 2007; Allcott, 2011; Gillingham and Tsvetanov, 2018). These methods have been found to be effective in reducing domestic energy use above and beyond solely structural changes to homes.

When aiming to bridge public information gaps, a question that is often raised is the relationship between knowledge and understanding: namely, just because knowledge is provided, and even received, this may not translate into the individual understanding and practical application of the information provided. Burchell et al. (2015) argue to move past solely contemplating ideas of information provision and factual knowledge, and to support 'know-how'; promoting more practical skills, advice and experience. Royston (2014) highlights that, despite commendable work commissioned by the Energy Saving Trust on online advice about heat wastage for example (Changeworks, 2015), a focus on the experiential and performative (rather than solely cognitive understandings of energy savings) could be more effective in increasing further engagement in domestic energy systems. This approach could increase 'know-how' in householders as well as more traditional energy knowledge. Recent work around the creation of an Information Hub in the UK has proposed including content including DIY guides, however the provision of this advice will still be remote and less effective compared to engaged in-home interaction with householders (Royston, 2014; Gupta et al., 2018).

3.3. Source

Alongside the actual content of any given message in influencing and engaging stakeholders around energy saving, who is providing the information is an important factor to consider. Social trust in communicators has long been seen as almost more important in influencing outcomes than the actual content of the message itself (Wynne, 1991).(Wynne, 1991). Bord and O'Connor (1990) see this as the facts behind the facts; namely the characteristics about the organisation providing information (e.g. trust). Many authors have aimed to categorise trust (Renn and Levine, 1991; Poortinga and Pidgeon, 2003; Löfstedt, 2005). As Lucas et al. (2015) state, there is no agreed definition of trust within the social sciences. In this review, according to Simcock et al. (2014), the two most important considerations for an appropriate source selection to ensure energy advice uptake involve factors that are broadly grouped into trustworthiness, and expertise (or competence) (see Breakwell, 2000). These are the two most commonly chosen categories among authors, and so source suitability will be assessed in these terms. It must also be considered that both *Content* and *Process* will both have influence on, and be influenced by, perceptions of trustworthiness and expertise.

3.3.1. *Trustworthiness*

When considering the effectiveness of any advice method, trustworthiness of the advisor mediates the effect of the message once it is received by the public (Irwin and Wynne, 1996). Trust is vitally important in the effectiveness of policy and communications techniques (Löfstedt, 2005). Trust can often determine the impact of a given message technique: trusted actors tend to be more successful with top-down messaging such as unidirectional energy advice than non-trusted actors (Löfstedt, 2005). In the context of energy, people will naturally gravitate first towards actors they trust, regardless of expertise (Brown et al., 2014). This highlights the importance of not only being an expert advisor, but also public perceptions of reliability, honesty, transparency, and fairness as characteristics of an effective source of energy advice. There is a general recognition among energy policy makers and advice services that trustworthiness and honesty is important, although this tends not to be founded in a great amount of theory or evidence.

Trust is difficult to build, is a time-consuming process, and is easy to destroy (Slovic, 1993). Slovic (1993, p.8-12) suggests that this occurs for four main reasons: (1) Trust-destroying events are more visible than positive events; (2) Negative events carry more weight than positive ones; (3) Sources of negative news are regarded as more credible than positive news sources; (4) distrust perpetuates and reinforces distrust.

Despite a broad literature on trust and communication more generally, scant empirical work on trust in energy advice exists. A literature review conducted by Darby (1999) found that trust-building was an influential factor in the success of advice provision. More fundamentally, a review by Organ et al. (2013) finds that trust in government, businesses and community influences likelihood to interact with domestic energy improvements, with higher trust linked to greater motivation to act. Trust was also found by Forum for the Future to be vitally important in ensuring a positive experience of energy saving installation measures in the aim of continued householder involvement in efficiency initiatives (Ross, 2011). Trust can generally be enhanced in the context of energy use through high-level customer service, both reactive and proactive kinds of service, and by relieving perceived risks, particularly financial risks and loss (Stenner et al., 2017). Wilson et al. (2017) outline that trustworthiness of organisations involved in energy-saving initiatives is becoming more important due to changing technologies. Due to the more intrusive nature of smart home technologies, for example, concerns about privacy and data handling can harm uptake (Harms, 2015). Indeed, Wilson et al. (2017) find that improving trustworthiness and focussing on security and privacy was not enough of a priority of the smart home technology industry in the smart meter roll-out, and this is one reason behind recent roll-out troubles (Balta-Ozkan et al., 2014; Sovacool et al., 2017).

According to Simcock et al. (2014), trustworthiness is determined not necessarily by social distance, but more importantly by advisor motives, especially in terms of financial interests. Respondents were particularly sensitive to and wary of privatised companies in

this respect. Privatisation and, in recent years, rising energy bills alongside perceived poor energy company performance have increased distrust in long-established energy providers. A distinct public worry has emerged about their relationship with energy companies as profit-making organisations and whether they have the public's interest at heart (see Bailey and Hodgson, 2018). This is indicative in the Which? (2018) survey on best and worst UK energy companies, with none of the Big Six energy companies scoring higher than 58% satisfaction. In the same Which? (2018) study, the picture for newer energy companies is mixed, with first-placed Octopus Energy scoring 80%, and Solarplicity in last place on 44%. This low trustworthiness and satisfaction has been found to affect perceptions and uptake of smart meter devices, showing tangible negative effect on outcomes (Hoenkamp et al., 2011; Buchanan et al., 2016). Stenner et al. (2017) find that only 18% of Australian respondents who distrusted energy companies were likely to subscribe to direct load control programs. Similarly, respondents in a 2016 study highlighted a deep distrust in energy companies, usually the only or most common organisation with which the public interact on energy issues (Evensen et al., 2018). This can have knock-on effects on trust in the overall system, hindering interaction and credibility of more trusted actors. Respondents assigned the greatest responsibility to energy companies to drive the energy transition; ideas of fairness, procedural justice and honesty were very important to allow acceptance of schemes and cost increases that may need to occur to achieve transitions (Evensen et al., 2018). This evidence of low trustworthiness highlights that, in the UK, direct energy advice from energy companies such as British Gas is likely to be viewed as not useful or as part of an ulterior motive (Simcock et al., 2014; Bailey and Hodgson, 2018). Limited and transparent involvement between third-party energy advisors and energy companies, or a specific selection of more trusted actors, could overcome limitations of effectiveness due to lack of trust.

The UK government is perceived and expected to be largely responsible for overall energy transitions. Trust in governmental behaviour was more strongly linked to acceptance of added costs than purely factual knowledge about costs and benefits (Evensen et al., 2018). Despite this, 23% of UK respondents did not trust the national government 'at all' to transform the UK's energy system towards cleaner forms of energy (Steentjes et al., 2017). In terms of policy, the centralised nature of the Green Deal was cited as a reason behind its failure in 2015 in Birmingham as it failed to gain trust of local householders due to the one-size-fits-all approach (Localise West Midlands, 2014). Despite this general distrust of central government and its agencies, a clear distinction must be made between perceptions of the UK government and devolved governments and agencies such as the Scottish government, which are not the focus of this review.

Local governments are regarded as vital to the roll-out of new, high-level energy supply and demand systems change in multiple areas including district heating (Bush et al., 2016). Knowledge of local community is cited as an important trust-creating attribute by Darby (1999). Despite this, trust in local government is variable, often politically driven and very context-dependent, particularly in England (Fudge et al., 2016). Some local governments have previously collaborated with corporations, such as Merton Council and B&Q. This partnership aimed to achieve greater trust among participants and higher uptake of efficiency initiatives, as the Cabinet Office Behavioural Insights Team (2011) outline. This approach resonates with Mallaburn and Eyre's (2014) findings that for domestic energy interventions, local delivery is more effective. Solutions to issues with the UK Green Deal point towards greater decentralisation of policy and advice provision due to greater trust in local actors in Birmingham, for example (Watson, 2014). Generally, local government, among other decentralised institutions, can aid in engaging the public on energy and increasing public trust (Bergman and Foxon, 2018).

Non-governmental organisations and arms-length independent authorities tend to be the most trusted source of information for the UK public (see Cabinet Office Behavioural Insights Team, 2011). Current models of energy advice provision rely on independent actors such as Energy Saving Trust and Citizens Advice to provide advice. As Sovacool et al. (2017) suggest, a wider range of points of contact outside purely governmental organisations may help to reduce distrust, resistance, and ambivalence to both advice and scheme uptake. Mallaburn and Eyre (2014) find evidence that community groups, local institutions and businesses are more widely trusted than central government and energy companies. Researchers have advocated for engaging with community organisations in the role of "*trusted intermediaries*" to enhance the reach of certain schemes, particularly when interacting with fuel poor groups (Rugkåsa et al., 2007; Reeves, 2016, p.2). The importance of trust in local community groups has been well-established in the context of renewable energy projects (see Walker et al., 2010). Alongside these local characteristics, non-commercial project characteristics are also regarded as enhancing trustworthiness and authenticity of these projects (Burchell et al., 2014). Fornara et al. (2016) find that trusted local networks, including family and friends, can persuade individuals to undertake energy saving measures. Using both independent and local organisations as intermediaries of energy advice could be a method of overcoming low levels of trustworthiness in more centralised government entities.

However, risks exist in the way information is provided and the rigour of message content communicated by third parties. As Simpson et al. (2016) find, discrepancies between predicted and actual savings from energy installations can create trust-destroying events, and be very negative to future advice acceptance. Quality assurance is needed to ensure that contractors and front-line energy actors interacting with householders must be properly trained and monitored to do the right thing, as well as successfully installing an efficiency upgrade. These groups, often as the sole face-to-face contact with householders, can help to build trust through effective and helpful support (Wilson et al., 2015). However, distrust in installers will result in lower likelihood of domestic energy technology adoption (Owen et al., 2014). Contractors and installers are often distrusted due to past scandals, negative experiences, and a perceived culture of poor ability or lack of care from installers (Brown et al., 2014).

Despite the evidence for trust-building being a useful activity, it must not be viewed as a panacea or a sure-fire solution to improving the effectiveness of advice to

householders. As Tjørring and Gausset (2019) find among Danish retrofitters, despite trust in advisors, not all schemes were undertaken, influenced heavily by social factors that often temper uptake of schemes (e.g. age of homes, social relations and social status). Trust in each entity described above as providers of energy advice is constantly changing and is also affected by content and process in its creation (Simcock et al., 2014). Trust here in the short-term also mediates the effectiveness of the message, regardless of content or process (Slovic, 1993). In this way, it is important to continually monitor trustworthiness and seek to promote it, as the general trust in specific actors (e.g. national government; energy companies) may differ in the future, complicating the appropriate choice of source of advice and policy over time as well as the effectiveness of any advice programme.

3.3.2. *Expertise*

Although often grouped together with trustworthiness/honesty, expertise is seen by Simcock et al. (2014) as a different, yet important consideration when deciding upon energy advice source selection. Expertise is seen by Simcock et al. (2014) and by study subjects as being related to the competence of the advice provider, irrelevant of honesty. Qualified experts are deemed able to "*communicate detailed, specialised information*" (Simcock et al., 2014, p.5-6), and thus their specialist knowledge and expertise enables them to contextualise and tailor their advice to individual problems.

Often, experts were viewed as 'blue collar' workers, such as technicians and official websites (Simcock et al., 2014). The supply chain, as the delivery mechanism of retrofit upgrades and traditionally seen as experts, fits this bill although suffers somewhat from trust issues (Simpson et al., 2016). PAS 2035: 2019 (hereon PAS 2035), a new code of practice approved by the British Standards Institution (BSI), sets a new standard in terms of *who* can provide advice within the supply chain. This aims to conjoin both trustworthiness and expertise around the delivery of efficiency upgrades (see Simcock et al., 2014). Following the approach outlined by Brown (2018) and using a trusted singular service within the entire business model may therefore address the BSI's approach and ground it in the findings from academic research.

Scientists and experts are often regarded as the most relied-upon information source more generally, usually because of a underlying social belief in expertise and to shift cognitive load despite mistrust (Ajzen, 1991; Stern, 1992; Fornara et al., 2016). The public often additionally relies on informal expertise in the provision of useful information, especially through peers with personal experience to provide contextualised expertise or barriers in a range of areas including energy-saving advice through subjective norms (Claudy et al., 2011; Michelsen and Madlener, 2012; Simcock et al., 2014). Other groups with expertise such as local councils and LAs may be perceived as having reduced capability due to austerity measures, the consistent need for upkeep of partnerships, and ever-changing rules and regulations (Morris et al., 2017).

Recent work to establish and promote expertise among local communities has been put forward and tested at a small-scale. One example involves the 'Energy Champions' scheme promoted by Bristol Energy Network, which trains local people in all neighbourhoods of Bristol to start projects and audit community energy use (Bristol Energy Network, 2019). Indeed, ideas like this have been taken up by larger energy companies such as British Gas, which ran an Energy Champions scheme in partnership with National Energy Action as part of the Community Action Partnership that ran from 2014-2016 in specific local areas such as Liverpool, Manchester, and Northamptonshire (NEA, 2019). Another approach as part of the English Heat and Energy Saving Strategy (HESS) involved the Community Energy Saving Programme (CESP), where between 2009 and 2012 Nottingham's Aspley ward received funding to undertake energy-efficient retrofit in social housing, although advice was not adequately given to improve householder knowledge and was seen as a missed opportunity (Elsharkawy and Rutherford, 2018). Additionally, community-run 'Energy Cafés' or 'Energy Shops' have been employed by local community groups as a method of offering energy advice to householders and especially the fuel poor (Martiskainen et al., 2018); this approach is recorded as having a similar impact to home visits on behaviour change outcomes (Martiskainen and Speciale, 2016). Other attempts to include local actors include community energy projects that often incorporate energy efficiency as part of a wider portfolio, outlined in great detail by Seyfang et al. (2013)..

3.3.3. *Who should provide advice?*

The growing number of actors providing energy advice such as community groups, LAs, energy hubs, energy companies, installers, central agencies, central advisors such as EST and Citizens Advice, cooperatives, different types of advisors will continue to coexist in this space (Citizens Advice, 2015). Despite these groups' importance, the "*balkani[s]ed landscape*" of energy retrofit and advice can mean that the number of actors in this space, including community groups and LAs, manufacturers, contractors and installers, act as a barrier to retrofit-seeking due to a lack of complete market knowledge (Risholt and Berker, 2013; Galvin and Sunikka-Blank, 2014; de Wilde and Spaargaren, 2019, p.363). Some work has previously been conducted by Citizens Advice (2015) and Which? (2015) to outline what local provision of energy advice could look like in the UK at a more practical level. Citizens Advice (2015) recommend the provision of advice through local offices and centres that are delivered, monitored and managed through a national framework. Despite this conclusion, more empirical evidence here to support recommendations offered by these organisations is needed.

Overall, for messages to be accepted and effectively understood, an advice service must be both trustworthy and regarded as an expert (Simcock et al., 2014). Organisations that are seen not to be making undue

profits from people and are independent from central UK government are likely to be regarded as trustworthy and acting in the public interest, and perceptions of expertise often rely on qualification and a record of service (Büchs et al., 2012; Simcock et al., 2014; Reeves, 2016). A range of entities operating at the local level such as LAs and other non-governmental organisations could fit the profile of both a trusted and expert advisor, especially as these groups often have the most direct and face-to-face interaction with householders (Morris et al., 2017; de Wilde and Spaargaren, 2019). Citizens Advice (2015) argue for a devolved approach at LA level to reach targets. This is additionally advocated for by respondents in research from Morris et al. (2017) due to LAs being organisations of trust. Best-practice local energy initiatives in Germany and the Netherlands, as outlined by Hoppe et al. (2015), show that trust in local community actors is important to achieve energy-saving goals in these two nations. Indeed, Citizens Advice (2015) refer to existing area-based schemes such as HEEPS:ABS in Scotland and the Arbed scheme in Wales as a potential starting point for greater local energy advice provision and public engagement. The continued involvement of local groups as intermediaries in the provision of energy advice is seen as an important and effective method of interaction and engagement with householders and communities and so should be included in any advice provision going forward (Seyfang et al., 2013; Which?, 2015; Citizens Advice, 2015; Frick et al., 2017).

Local advice providers are also well-placed to engage community groups, similar to Energy Champions schemes, could help to promote advice to more households as a form of network intervention (see Bale et al., 2013). Frick et al. (2017) add that energy-saving motivation could be increased through interaction with social groups that are trusted in the community, and operate outside of the business-side of energy saving. Gamification with peers may also be incorporated into this technique (Wemyss et al., 2018). Questions remain here as to the exact relationship between official and unofficial advice and support: At what level is this provided? Is this a formal (LA) or informal (community actor) link?

However, without continued financial and knowledge-related support to maintain and develop expertise there is a risk that the effectiveness of these local actors as advice providers may be rather ephemeral in the longer-term (Walker, 2008; Seyfang et al., 2014). Rydin and Turcu (2019) find that community groups are often quite fragile, and their longevity is reliant on their ability to engage the community, the strength of networks, and leadership. Here, coherence and planned consistent strategy is key to promote the robustness and influence of community energy programmes, as outlined by Seyfang et al. (2014). Historically, funding streams like the Big Energy Savings Network (BESN) have provided funding to local community groups (BEIS, 2017a), however UK government energy policy and the funding environment for these groups has been very inconsistent (Uyarra et al., 2016). Rydin and Turcu (2019) find that a lack of policy consistency has heavily impacted many local urban energy projects, often resulting in closure. Consistency in funding and consistent policy support could therefore help community groups thrive in this space (Bergman and Foxon, 2018). Alongside this, regular monitoring and evaluation has been deemed helpful to ensuring consistency and improved local group advice provision (Seyfang et al., 2014).

To ensure an effective conjunction of both trustworthiness (provided through community and not-for-profit groups) and expertise (through officially assigned or accredited organisations), advice and expertise could be provided by central or regional services through techniques such as offering white-label advice products and services, which local actors can use with householders. Something similar to this has already been offered by OVO energy company (OVO Energy, 2014). OVO's White Paper aimed to provide all community groups with a toolkit to establish groups and greater access to services that would make these groups successful, especially around microgeneration. White-labelling advice products and services could also be of use to LAs alongside the provision of data and assessment of advice techniques to achieve energy use reduction targets (Citizens Advice, 2015). However, this approach has a heavy focus on expertise-building rather than trustworthiness (i.e. 'doing the right thing') This can risk knock-on effects on trust in centralised energy advice providers (Löfstedt, 2005), and thus requires regular monitoring and assessment to ensure keeping with codes of practice. Other risks related to the non-monetary fragility of local community energy actors may require more official actors with expertise and access to business models in this space (Pearce and Cooper, 2013).

As recommended as part of the Each Home Counts Review, an information hub that provides organisations, householders, and third-party groups with a wider standards framework and advice centre could be a way to achieve this goal (Bonfield, 2016). Problematically, the enforcement of future requirements in BSI's PAS 2035 would mean that community groups and EST advisors alike, under these rules, will not be fully compliant to provide advice due to the need for qualifications to provide said support. These qualifications can be attained by all with training, however for local community groups especially this presents a resource and time cost that may act as a barrier to entry to volunteering and providing community-level energy advice, already seen as an issue with regard to barriers associated with PAS 2030 (Watson, 2014).

Businesses are often regarded as expert, but not necessarily as trustworthy (Simcock et al., 2014). One potential method to circumvent this problem is through a simplification of interaction using Brown's (2018) five key archetypes of retrofit business models. Here, Brown (2018, p.1512) recommends that a successful advice and energy-saving business model provision will contain "*a simplified customer interface with a single expert point of contact*", and avoiding past failures by using more trusted local sources.

In the context of both business and non-profit advice provision, care must be taken to extricate trustworthiness and expertise: just because an organisation is regarded as expert, this does not mean it is trustworthy, and vice versa. There are clear benefits of involving local community groups and LAs in the provision, of energy advice, but as Mallaburn and Eyre (2014, p.36) state: "*People, when faced with a choice of technology options, need unbiased advice on which one to choose and why. This is clearly a role of government*".

Indeed, the UK government can fund these initiatives, however arms-length organisations may be more suited to delivering the initiative as a one-stop-shop for energy advice. Boza-Kiss and Bertoldi (2018) provide an evaluation of one-stop-shops throughout Europe that highlight characteristics needed for an effective one-stop-shop. In France, government-backed one-stop-shops operated at the local level (PRIS) were established in 2013 (Ministry of the Environment Energy and Sea, 2017), and could provide a model to be followed. The proposed Information Hub discussed in the Each Home Counts review alongside a broader data warehouse (Bonfield, 2016), could be a potential method of reaching the goal of a UK one-stop-shop for energy advice. This approach could adequately integrate both local community actors, LAs, and businesses into offering impartial, free advice and community engagement, as seen in nations such as Denmark and France (Economidou et al., 2016; Ministry of the Environment Energy and Sea, 2017; Cludius et al., 2018; Brown et al., 2018).

3.4. Process

The third lens through which energy advice can be assessed involves the process by which messages are communicated to the relevant stakeholders (Simcock et al., 2014). Simcock et al. (2014) assess the difference between top-down and more interactive modes of communication: this has been a long-argued issue linked to the information deficit model previously described. The aim of improving the process of energy advice is to increase overall public understanding of domestic energy saving, interaction with energy saving initiatives, and broader involvement with the energy system.

3.4.1. *Current advice techniques: towards a best-practice model*

Current and traditional advice techniques have often followed a linear one-way top-down approach, where householders are advised by a central organisation on methods to save energy in the home. This technique can have an impact in reducing carbon emissions, but is often dependent on the method by which the information is provided (Abrahamse et al., 2007; Steg, 2008). The most common and widespread methods of advising householders on energy saving generally involves websites and phone-based advice, and has been the traditional model of widespread advice provision in the UK since the inception of a public energy advice service (Eyre et al., 2011). Alongside this, other methods such as proactive and reactive email and face-to-face meetings at events and town halls are common, as seen historically in England and currently in Scotland (Eyre et al., 2011; Scottish Government, 2018). Current English provision of advice revolves primarily around a web-based strategy rather than a phone service. With newer technologies such as smart meters and Internet of Things (IoT) devices, the near-real-time use of home energy data in advice has been gaining importance for some time (Cabinet Office Behavioural Insights Team, 2011).

Web-based interventions such as webpages tend to be comparatively inexpensive and simple to organise. The internet is often one of the first places people tend to search for information (Novikova et al., 2011). However, due to the low-involvement approach of this advice technique, it is less likely to be effective in changing behaviours and achieving carbon savings than more involved forms of advice provision (Delmas et al., 2013; Steinhorst and Klöckner, 2018). This is especially true for more vulnerable groups such as fuel poor owner-occupiers (Middlemiss et al., 2018). Further, the often generic nature of mass media web-based advice is less effective than tailored approaches, and this approach can be seen as the most emblematic example of one-way communication of energy saving information (Atterson et al., 2018). Despite this assertion, the websites of many energy saving advice providers, such as those in Sweden[9], offer online simulators to self-assess and personalise advice based on home characteristics (Gyberg and Palm, 2009).

Drawbacks to consider to a solely web-based approach include the risk of not achieving total population coverage: not all householders are internet users due to age (Office for National Statistics, 2018), many prefer other interaction methods (Wallace et al., 2010), and a some householders classed as fuel poor or rural and may not be able to find the information online due to cost or location constraints (Middlemiss et al., 2018). Overall, ONS classed 10% of the UK adult population as 'internet non-users' in 2018 (Office for National Statistics, 2018). Further, there is also a risk of a specific official website being 'drowned out' when searching for advice online, as many different sources exist in the UK and globally (Kjeang et al., 2017). Without prerequisite knowledge of specific official actors, a web-based approach in isolation could backfire due to low trust in internet-based information and information overload, restricting energy saving behaviours (Jacoby, 1984; Adjei et al., 2010; Novikova et al., 2011). The success of low-involvement impersonalised webpages is also predicated on the expectation that people will seek out the webpage, which is not guaranteed, and for specific issues householders have been found to be more interested in phone calls over webpage interaction (Darby and Liddell, 2016).

Nudge is another method of inexpensively shifting public behaviours in a low-involvement way. Nudging aims to change habits through altering choice architecture, and has been recently applied to energy saving and uptake of energy audits (Thaler and Sunstein, 2008; Cabinet Office Behavioural Insights Team, 2011; Gillingham and Tsvetanov, 2018). A review of nudge-like experiments on domestic energy saving conducted by Andor and Fels (2018, p.178) highlight four main methods used, namely: "*social comparison*, *commitment devices*, *goal setting*, *and labeling*". All of these were found to be effective in reducing overall domestic energy

9 Those described by Gyberg and Palm (2009) are Fortum.se and Energiadgivningen.se.

consumption, although the most effective was social comparison. However, effect sizes of all methods were large, and few to no studies on the other nudge-based methods, especially goal setting, have been conducted in the UK (Andor and Fels, 2018). Nudge, however, is not a panacea: Allcott and Kessler (2019) find that 34% of natural gas customers in upstate New York would prefer not to be nudged, even if the nudge was free. Further, the authors argue that social welfare benefits of nudging, and overall social value above simple behavioural change, are overstated. Allmark and Tod (2014) state that nudge as part of a wider toolkit to solve old-age fuel poverty risks is more appropriate. General, and more energy-specific, questions regarding the ethics of nudging certain groups have also been considered as potential drawbacks (Allmark and Tod, 2014).

The mandatory issuance of EPCs to most residential properties in the UK since 2008 has offered a general, yet easily understandable, method of visualising domestic energy use (Taranu and Verbeeck, 2018). The EPC aims to serve as a method of informing and motivating householders to energy efficiency improvement (Taranu and Verbeeck, 2018). As Taranu and Verbeeck outline, much research has been conducted to assess the effectiveness of EPCs in reducing energy demand, and limited success has been found in creating behavioural change or greater installation uptake (Christensen et al., 2014; Wade and Eyre, 2015).

Historically, a phone advice service has been a key method of household advice provision (Eyre et al., 2011). This method tends to be presented as a one-stop shop for advice (Dahlbom et al., 2009). A phone advice service may cater to a different demographic than web-based advice; according to Eyre et al. (2011), 65% of phone advice service callers are over 50 years old. Given older age groups' higher level of home ownership and ability to effect change in the home, energy advice tends to interact with an older demographic more generally. The effectiveness of phone-based advice is heavily dependent on training (see Darby, 2003). Recent high-level training by Home Energy Scotland and the creation of the idea of a 'customer journey' long seen as a standard in energy advice highlights the effectiveness of this approach: of 33,322 unique customer calls to Scottish advice centres regarding the Scottish Government Fuel Poverty Home Energy Efficiency Programmes for Scotland (HEEPS) in the year 2016-17, around 90% of callers took up offers of help (Scottish Government, 2018). Alongside well-trained staff to answer questions (see 3.3.2. Expertise), trustworthy and ethical telephone practices are important (Simcock et al., 2014). Risks present themselves in the modern age due to negative connotations of cold-calling because of issues around nuisance calls that have persisted in recent years (Ofcom, 2018), making a reactive phone service (where individuals call an advisor) more likely to be effective than a proactive service unless previous interaction has taken place. Telephone helplines are also often regarded as more expensive and time-consuming than online advice provision. Similar to online services, telephone advice has traditionally struggled to cover difficult-to-reach households (Darby, 2003b), and are assessed by Baker et al. (2019) as being insufficient to provide effective support to more vulnerable households. While this analysis of telephone advice and its potential benefits and costs should be considered, the number of regular phone users and callers is generally reducing in favour of more online interaction: this has been seen in Scotland and Sweden (Kjeang et al., 2017). These changing priorities and expectations suggest that novel methods that understand the difference between purely reactive web- and phone-based methods and more proactive methods, and the importance of tailored and personalised approaches rather than simple information provision should be considered, especially towards methods that are more interactive (e.g. in-person visits) for certain vulnerable groups (Baker et al., 2019).

In discussion with experts on energy advice, face-to-face home visits are regarded as the 'gold standard' of advice provision. This involves a trained and certified expert visiting a home and identifying appropriate retrofit options in a tailored approach based on the individual characteristics of the home (Tjørring and Gausset, 2019). This method resolves some issues arising from more reactive and low-involvement approaches such as a phone service and webpages respectively, as advice from trained home visit assessors are independent of householder understanding of home energy and could therefore identify more problems or opportunities than those solely perceived by untrained householders (Tjørring and Gausset, 2019). Organisations that provide this service often claim that the complexity of the lived experience and of specific home efficiency needs require this level of in-depth service (Atterson et al., 2018).

Alongside workshops, home visits were found to be successful in engaging local residents on energy saving techniques (Gupta et al., 2018). Face-to-face interactions were also found to increase trust in energy actors, and build confidence to interact in the energy system and domestic efficiency more widely to achieve individual household goals (Bailey and Hodgson, 2018). More specifically, home visits are often regarded as a method of providing effective actionable advice particularly for fuel poor and rural homes who may not take advantage of existing information offers. Using this approach, success in overcoming these barriers has been seen in Scotland with the HES Homecare scheme (Wade et al., 2019). Home visits can also be effective when assisting early adopters when the supply chain or social norms are not fully developed to provide greater information and support, and among those who are willing to pay for a more in-depth assessment, although more research needs to be conducted to assess its true impact on these groups.

Some evidence has shown mixed or low levels of effectiveness from home visits. Abrahamse et al.'s (2005) review of home energy visits found that despite an expectation of more in-depth advice and support for householders, results on their effectiveness were inconsistent. In a review of the RE:NEW home energy visit programme in London found that home visits had no significant effect on pro-environmental behaviours, and did not reduce barriers around cavity wall and loft insulation installation (Revell, 2014).

Face-to-face home visits that offer advice are costly, resource-intensive and time-consuming (Gupta et al., 2018). They are also heavily dependent on the effectiveness of intermediaries to properly engage with households and deliver advice, which can easily backfire when low trustworthiness or expertise are present in-home advisors, much like other forms of advice presented above. Alongside a problem of trust, a risk of

home visits is that language and measures used in generating reports may be too technical for householders to understand and subsequently use (see Gupta et al., 2018).

Based on experimental inconsistency in results, novel and different methods of energy advice and support are required, alongside greater monitoring of current activities. Additionally, experimental research on different advice provision methods must be done in collaboration with policy makers to be able to fully assess the impact of advice techniques. This is an area for future research that does not currently exist in England due to the lack of provision of some of these types of advice methods at a national level.

3.4.2. *The role of feedback in future energy advice*

Traditional methods of energy advice, particularly websites and phone calls, risk a one-way communication process that does not fully involve or engage individuals around energy saving (Simcock et al., 2014). Recent methods, including nudge-type interventions discussed above, have been used and considered to create internet-based high-involvement strategies aimed at creating behaviour change. These kinds of interventions aim to increase public openness and awareness for domestic efficiency upgrades that are more involved than non-tailored or reactive methods traditionally used (Cabinet Office Behavioural Insights Team, 2011; Andor and Fels, 2018; Gillingham and Tsvetanov, 2018). Such other examples include feedback. Here energy feedback refers to both household information on energy consumption, and broader energy advice. Feedback is seen in a modern view as provided to households through devices such as IHDs, thermal imaging, and more generally smart homes and involves the provision of data and advice based on specific household energy use characteristics. Feedback in this manner is regarded as a two-way interaction of information and advice that offers the ability to provide tailored information through monitoring domestic energy practices. Feedback has been a long-used method of attempting to change behaviours, dating back to the 1970s (Hazas et al., 2011). The goals of feedback are to increase householders' visibility, controllability and the perceived ability to change energy use, which programme developers believe will alter behaviour and reduce overall energy consumption (Darby, 2006; Faruqui et al., 2010; Foulds et al., 2017). One particular driver of feedback, still advocated for today, is to complement efficiency upgrades to avoid problems related to the rebound effect: lower actual savings compared to expected savings of efficiency installations (Elsharkawy and Rutherford, 2018).

The assessment of feedback, presented below, is by no means an exhaustive list but seeks to outline its role, examples, how it fits into future communication strategies, and considerations and caveats of this approach. A fuller review of the evidence on methods and effectiveness of energy feedback on domestic energy use discussed in this section has been conducted by Webborn (2019) in a review of the evidence for the Smart Energy Research Lab.

Fischer (2008, p.79) outlines four key qualities that feedback must have to be effective from international studies, namely: (1) Feedback should be given frequently and over a long time; (2) Feedback provides an appliance-specific breakdown; (3) Feedback is presented in a clear and appealing way; (4) Feedback uses computerised and interactive tools. Overall, feedback has been found to reduce energy consumption, however the effect size of this change varies across studies, with Delmas et al. (2013) finding reductions ranging from an average of 11% for real-time feedback, to 11.5% for social comparisons, to 8.5% for individual usage feedback. In a literature review, Darby (2006) found a saving of between 5-15% for direct feedback, and 0-10% reduction from indirect feedback. Mogles et al. (2017) find that UK households found feedback to be helpful and displayed increased energy literacy, as well as reducing gas consumption.

This variation, however, and the difference between rigorous and less rigorous tests highlight the inconsistency of findings. Positive findings shown here should be taken with caution due to the unreliability of study results (Delmas et al., 2013): as Khosrowpour et al. (2018) argue about Delmas et al.'s (2013) findings, methodological inconsistencies in approach between studies in the meta-analysis exist. Overall, Khosrowpour et al. (2018) state there is a need for more comparative testing of different and intersecting feedback methods to provide concrete assessments of feedback as a method to reduce domestic energy consumption.

With technology developing to allow for greater data management, increased ability to roll-out tailored feedback to more households has become possible (Mogles et al., 2017). According to Buchanan et al. (2018), methods to deliver this feedback include through In-Home Displays (IHDs) (Hargreaves et al., 2010), visual energy feedback (e.g. through thermal imaging) (Pahl et al., 2016; Spence et al., 2018), tailored action prompts (Mogles et al., 2017), and combined feedback with wider communication and social norms (Abrahamse et al., 2007). These more interactive methods can increase engagement with household energy advice, compared to more traditional methods (Fischer, 2008), and should be considered in wider advice provision. However, feedback generally and technologies specifically are not free from critique and pitfalls. Burchell et al. (2016) assess the effectiveness of IHDs, finding that general engagement with IHDs dictates effectiveness of feedback. IHDs display both real-time information about overall energy use, and past energy use trends (Burchell et al., 2016). Alongside this, gender disparity in IHD engagement was reported, with men more likely to interact with IHDs than women in some studies (Hargreaves et al., 2010), but the reverse was found in others (Burchell et al., 2016). Several reports including from BEIS (2017b) and Hodges et al. (2018) also assert that content and approach of feedback may also be dependent on household characteristics, such as home ownership, fuel poverty, and household income and priorities and so require specific appropriate tailored feedback interventions, but Britton (2016) highlights opportunities for engagement that arise for these groups through more appropriate specified feedback.

Hargreaves et al. (2013) highlight a number of risks associated with feedback from IHDs, namely disappointment

at low levels of savings, family power disputes around who engages with the scheme in the household, and the risk of IHDs fading into the background, or not being clearly visible. Consistent engagement over time and long-term effectiveness are also debatable, with little evidence for long-term change found (van Houwelingen and van Raaij, 1989; Hargreaves et al., 2013). Current IHD feedback methods also do not provide an appliance-specific breakdown, a quality that Fischer (2008) describes as a necessary attribute for successful feedback. This means that less clarity on what exactly is using energy can be offered in this way, limiting the usefulness of the information to householders to make appropriate changes (Weiss et al., 2012).

Within this technological view, critiques and assessment of feedback have emerged that are summarised in Buchanan et al. (2018). These have come in two main areas, namely as the testing of new findings and technologies to improve feedback as a method of energy consumption reduction (see Herrmann et al., 2018; Revell and Stanton, 2018; Gupta et al., 2018; Spence et al., 2018), and in the form of critique of the focus on practices of feedback in isolation, aiming to highlight how engagement, participation and policy feedback, broader than simple transactional feedback methods can result in greater, broader, and more effective forms of feedback and energy consumption reduction (Darby, 2003b; Bull and Janda, 2018; Robison and Foulds, 2018; Hargreaves, 2018). Recent evidence on IHD uptake, has highlighted the importance of positive public perception of such devices and trust in the system to create buy-in and roll-out success (Balta-Ozkan et al., 2014; Buchanan et al., 2016; Sovacool et al., 2017). Positive stories about smart meters, such as those outlined in interviews by Smart Energy GB on the effects of smart meters on energy-saving behaviour change, could encourage greater uptake (Smart Energy GB, 2018).

Overall, feedback can provide opportunities for more tailored, up-to-date, and easily understandable advice provision than simple communication of advice, while remaining widespread if enacted through technologies such as IHDs. In addition, feedback can complement existing and future advice schemes, including goal setting and tailored communications (Abrahamse et al., 2007). Indeed, this is a broader goal of UK government energy efficiency policy as seen during the UK Smart Meter Implementation Program (SMIP) (Sovacool et al., 2017). As observed by Burchell et al. (2016), the use of more proactive applications alongside technologies such as IHDs rather than reactive websites may prove a more effective method of providing feedback than use of one sole technique. In an EST evaluation of their Smart Meter Advisory Project, prompts through emails were found to be effective in increasing Scottish participant usage in spikes (Energy Saving Trust, 2014). However, "*beyond energy feedback*", broader application of feedback into social structures with the aim of altering social norms and increasing agency ahead of future energy transitions should be undertaken (Hargreaves, 2018, p.332), alongside correct use of appropriate feedback methods to specific demographic and housing groups (BEIS, 2017b). A particular focus on "*practice feedback*" (p.335) (positioning energy feedback within a broader understanding of social practices), "*policy feedback*" (p.336) (considering the impact of energy feedback on energy policy), and "*speculative design*" (p.338) is offered based on recent literature (Hargreaves, 2018). In this way, a more holistic view of energy feedback past solely carbon or financial savings may be more appropriate and effective when considering the wider role of energy advice and its relationship with the broader domestic lived experience and social norms around energy (Hargreaves, 2018; Shove, 2018).

3.4.3. *The relationship between energy advice and energy policy*

This section aims to provide an overview of the relationship between English advice and other elements of domestic energy policy, as well as provide an assessment of how current structures of policy influence both the effectiveness of advice provision, and of overall emissions reduction. Measuring the impact of energy advice specifically and detaching results from the external context is very difficult due to the specificity of research conducted, research gaps, and the unique social background to every assessment that exists. UK government energy efficiency policy exists primarily to achieve carbon reduction targets and to reduce fuel poverty levels. In policy, this has been most recently addressed through the 2017 BEIS Clean Growth Strategy (2017c) and the Fuel Poverty Strategy 2015 (HM Government, 2015). Alongside these aims, a wide range of other benefits are documented by the IEA (2014) including benefits regarding energy supply, health and wellbeing, comfort, financial savings and government public budget impacts.

As outlined by Gardner and Stern (1996), four key policy interventions can be undertaken: (1) government laws; (2) regulations and incentives; (3) programmes of education; (4) moral, religious and/or ethical appeals. Parag and Darby (2009, p.3990) additionally outline that, in government-consumer relations information and advice is a discretionary policy, compared to mandatory (regulation), enabling (grants and rebates) exhortatory (campaigns) and consultative policies. In their assessment back in 2009, they state:

> "*Current energy policies and regulations fail to narrow the perception–action gap significantly for energy users [...] and as a result the messages about the need to reduce energy demand are unfocussed. This vagueness, in turn, leaves energy consumers without psychological, social or economic motivation to reduce their demand. Furthermore, the weight given to the market in delivering demand reduction implies that consumers do not need to act but to react to market signals. Hence, our analysis suggests that more attention should be given to the government–consumer dyad with a view to more explicit treatment of the politics of carbon reduction, rather than treating citizens primarily as consumers who response only to price signals.*"
>
> (Parag and Darby, 2009, p.3991)

In practice, UK government-funded information and advice offered to consumers around energy saving has long been part of a wider legislative policy more generally since the 1970s. A broader discussion of historical energy efficiency policies in the UK is discussed in Section 2. The recent roll-out and free-market approach of the Green Deal and ECO programmes in the UK has limited the amount of publicly-funded advice offered (Mallaburn and Eyre, 2014).

According to the CCC, the current UK government policy package around energy efficiency is not adequate to meet longer-term climate ambitions, especially in the context of incentivising able-to-pay households and social housing (Committee on Climate Change, 2018b). This is primarily due to lack of funding for policies as seen with the Green Deal, which reduced financial incentive to partake (Rosenow and Eyre, 2016). Other reasons include recent funding cuts to information providers (Kern et al., 2017). Following the Coalition government's 2013 decision to move away from 'green' environmental policy and the liberalisation of energy markets, a shift in focus to energy bill prices has reduced incentives for efficiency as government has become less willing to fund schemes ideologically through raising energy bill costs (Kern et al., 2017), predicted by Eyre (1998). The current expectation of a public reliance on price signals to act reveals a problematic inertia which could hinder the ability to reach government-set targets such as "*as many homes as possible at EPC C by 2035*" (p.13) set in the Clean Growth Strategy 2017 (BEIS, 2017c).

Across Europe, UK government and particularly English investment in energy efficiency policy has in recent years been comparatively low, with insulation rates falling through the floor last year (E3G, 2018). When viewed as a proportion of total energy bill cost, the UK has one of the lowest proportions of bills going to taxes and levies among the European energy frontrunners (Heptonstall and Gross, 2018). This limits national ability to roll-out broader efficiency schemes covering all kinds of legislation outlined by Gardner and Stern (1996) needed to promote wider domestic retrofit and behaviour change.

A lack of consistent policy, alongside insufficient funding for projects, has also resulted in not meeting ambitious policy targets around energy efficiency and fuel poverty. Kern et al.'s (2017) assessment of UK government energy efficiency policy additionally shows an inconsistency in long-term strategy, in terms of who is responsible, who is implementing programmes, and shifting political ideologies. The Committee on Climate Change (2016) has argued that a consistent longer-term policy strategy is needed to promote enticing policies that lead to greater uptake. Kern et al. (2017) assess that the UK energy policy mix can be viewed as incoherent, particularly in the context of contradictory policy goals such as legally binding targets around fuel poverty reduction and overall domestic energy use reduction. Indeed, the IEA (2007) has long warned that mixing societal goals into overall energy efficiency policy can limit the impact of cost-efficient environmental policy. Despite general UK government inertia, a significant churn and inconsistency in domestic energy policy has led to an unstable policy environment in the English context, which Kern et al. (2017) argue has stifled innovation and reduced corporate desire to be involved in this sector, lowering overall household retrofit levels. A more stable energy efficiency policy, as witnessed in France for example (Ministry of the Environment Energy and Sea, 2017), could be more effective in ensuring adequate domestic efficiency improvements in line with targets.

A much-discussed solution to some of these problems involves the creation of a well-funded and considered energy efficiency policy mix. Elsharkawy and Rutherford (2018) note that individual policy tools (e.g. only regulation, or only advice) in isolation of other tools have thus far not been effective in reaching bold climate targets around housing efficiency, and that a wider policy mix incorporating these four elements should exist, combining elements of bottom-up (informational) and top-down (laws, regulation, or subsidies) policy to ensure greater and longer-term energy consumption reduction in the UK housing stock. This is echoed by a note written by the Parliamentary Office of Science and Technology, assessing that a mix of non-regulatory and regulatory policies shows greater effectiveness than single policies at increasing behaviour change around energy use, although regulations are more restrictive in nature than non-regulatory approaches (POST Report 417, 2012). As an example, Denmark's policy mix for incentivising domestic retrofit includes (1) Monetary measures (e.g. tax deductions); (2) building regulations regarding retrofitting requirements; (3) Voluntary obligations from industry, such as energy company obligations; (4) Certificates such as EPCs, although these policies have not been found to be particularly successful (Gram-Hanssen et al., 2018).

Another potential method of promoting energy efficiency upgrades involves lowering costs of capital to finance energy efficiency upgrades (Brown et al., 2019). Schröder et al. (2011), comparing the UK government and German approach to energy efficiency policy, highlight that comparative generosity and exacting nature of the German approach has resulted in greater take-up in Germany than the UK, despite the same emissions targets. The authors note that this means the UK will have to achieve these targets from a much lower base, signalling that measures should be implemented soon but will have to be much more effective than both the current approach and the current German approach to catch up. As Brown et al. (2019) find, the reduction in capital costs through sources such as state investment banks are vital to public interest in domestic retrofit, and so the German approach can be a potential avenue to follow regarding financing. Despite this statement, Brown et al. (2019) highlight that low capital costs are important, but depend upon a range of other factors including how, what and by whom finance offerings on retrofit options are given and so financial mechanisms alone will also not be the solution on their own.

Advice as part of this policy mix alongside regulation, enabling grants and rebates can be an effective method to promote energy efficiency uptake (Gardner and Stern, 1996; Parag and Darby, 2009). Indeed, Studer and Rieder (2019) found that advice, alongside subsidy offers, meant generally increased effectiveness when complementing one another rather than as single isolated methods. The aim of advice in a policy mix is to support all householders in taking action and complementing existing incentives, rather than acting as the main approach to incentivise despite widespread UK government budget cuts to advice providers in recent years (Kern et al., 2017).

Informational campaigns aimed at changing social norms alongside traditional behaviour change could also have an impact. As a respondent replied in Fylan et al. (2016, p.195) "*Make energy efficiency normal*".

For fuel poor consumers, Elsharkawy and Rutherford (2018) suggest less of a focus on informational programmes due to this group's reduced desire to receive general feedback, and attempts to solve more structural economic and social issues around households and energy may be more effective. As Middlemiss et al. (2018) recommend for policy tackling energy poverty, energy advisors to provide visits to homes can be part of the bigger picture of energy efficiency policy. Currently, as Reeves (2016) documents, UK policy does not enhance energy advice for the fuel poor because of the lack of grants for more substantial domestic energy efficiency improvements. Offering subsidies or at least incentivising loans alongside effective long-term best-practice advice in this manner may also push able-to-pay owner-occupiers to consider upgrades (Brown, 2018). Current regulations to mandate landlords to improve EPCs could be an effective measure to reduce split incentive risks but need to be tied in with advice to ease the process of becoming compliant and correct potential imperfect information barriers (Patrick and Bright, 2016; Trotta et al., 2018; Janda et al., 2018).

Another method to overcome current shortcomings with energy efficiency policy may involve Middlemiss et al.'s (2018) recommendation for greater integration of policies across different areas due to the domestic experience often being a point of intersecting influences. Carbon savings, health problems, fuel poverty, mental health, and climate adaptation are just some of the myriad issues that could be addressed through better linked-up domestic policy. Further, current structures of energy advice services employed in Scotland by HES create a network of referral services to treat a broader range of problems, such as NHS referral to mitigate home health risks, and DWP referral and benefits check to ensure fuel poor households receive the correct entitlements (Wade et al., 2019). Holistically, the often siloed nature of energy efficiency policy, separate from wider public considerations about home retrofit that relate to everyday life (Gram-Hanssen, 2014), reduces its impact. Solving this, however, remains difficult: what is proposed by Wilson et al. (2015) is that policy support 'bundling' together of efficiency measures into other types of renovations, especially in the able-to-pay owner-occupier and landlord sector. Potential policy steps as seen in Scotland to make energy efficiency a national infrastructure priority with financial backing, also advocated by Bergman and Foxon (2018) for the UK as a whole to take up, could shape multiple government department foci around this issue. This would aim to solve multiple issues related to inefficient homes, and could be delivered at a devolved level to ensure effectiveness (Webb, 2017).

Alongside the relationship between energy advice and wider domestic energy policy, a broader question related to funding of advice schemes as part of wider energy efficiency policy involves how we measure, assess, and monitor advice effectiveness. Darby (2003b, p.1217) argues that when taking a purely behaviourist view, disregarding a constructivist view of knowledge construction, assessing the effectiveness of advice provision for example resembles a "*black box approach*" and focusses on inputs and outputs rather than considering individual ideas of meaning and subjective knowledge. Additionally, tacit knowledge or know-how is not often assessed, or regarded as a potential benefit of providing energy advice (Royston, 2014; Burchell et al., 2015). A primarily quantitative focus on overall cost and carbon reduction as primary outcomes above other benefits of energy advice can be counterproductive when setting advice service targets, as these goals do not fully align with public priorities around energy saving (Simcock et al., 2014; Robison and Foulds, 2018; Shove, 2018), especially among fuel poor and low-income households (Boomsma et al., 2017). As previously stated, energy advice offers more benefits and risks to individuals than purely energy-saving characteristics. One example of wider measures that could be used to monitor and appraise advice involves mental health and wellbeing, which has been measured using the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Tennant et al., 2007). This has been considered by the Scottish government within its review of recent evidence around fuel poverty in 2017 (Scottish Government, 2017). It is important to state that although energy advice, by not including more discrete, indirect or qualitative measures, is not correctly valued, there is a wider argument that it cannot ever be fully valued due to its broad scope and multiple indirect and unquantifiable impacts. This was already documented in the context of Energy Efficiency Advice Centres in Scotland by Goepfert (2006) in 2006, however little has been done to integrate this into wider policy and advice evaluation. Despite this assertion, policy makers require quantifiable measures when considering funding schemes, and no current solution to this dilemma truly exists. In this way, research should be commissioned by BEIS to more holistically assess the value of energy advice, which would better inform future funding models and central goals of advice as a service in a broader situated context than purely energy saving.

3.4.4. *Energy advice in the supply chain*

This section seeks to establish how the supply chain can influence energy efficiency upgrades by providing advice, what processes are in place to ensure the quality of advice and potential drawbacks of current approaches, and how the role of one-stop-shops and government-led frameworks have been found to be effective in other European nations. Historically, links between energy advisors such as EST and the supply chain have been used to ensure good and improving practice, and to use the supply chain as another method of communicating advice to householders (Eyre et al., 2011). The influence of the supply chain in providing energy advice is large and commonplace (see Owen et al., 2014). Here, the supply chain includes installers, contractors, and product manufacturers among others (de Wilde and Spaargaren, 2019).

The development and integration of supply chains, alongside consumer demand, have long been seen as the proof of successful energy efficiency policy (Rosenow and Eyre, 2013; Brown et al., 2019). This target is sought-after

because a wide range of issues within the supply chain are regarded as contributing to wider energy efficiency upgrade market failure (Rosenow and Eyre, 2013). Broadly, these problems include inconsistent quality of work, skills and training. Most importantly, supply chain problems include inadequate information provision and advice to help customers understand and make a decision on energy efficiency upgrades, as seen during the Green Deal (DECC, 2014a). However, the concept of a single supply chain is problematic, as multiple groups exist for different measures that operate in very different ways. These three supply chains can be broadly defined as: (1) Energy efficiency installers such as insulation installers of ECO; (2) Energy services such as boiler installers with a specific task; (3) Home improvement, such as builders and architects. Assessing the knowledge and structures of how energy advice is given from the supply chain in this defined way is therefore important to consider as part of the overall energy advice package.

In 2016, the Committee on Climate Change (2016) advocated for clear energy efficiency policies that can improve skills and supply chains. Further, Galvin and Sunikka-Blank (2017, p.380) recommend that policy focussed on the supply chain, "*business sub-sectors*" that provide and install retrofits, is needed. Previous disastrous experience of poor advice given by assessors during the Green Deal roll-out (DECC, 2014a) shows the importance of engaging to improve how the supply chain advises customers. Historically, supply chains have not had a great incentive to provide advice, and certainly not impartial advice at that. Trust in this market is important to individual interaction with energy retrofitting (de Wilde and Spaargaren, 2019). Trust should be assessed in the context of the broadly defined three supply chains that exist when considering energy efficiency, described above. Within the supply chain, it has been advocated that more trusted advice and training for the entire chain could resolve the risk of poor or unintegrated energy advice into different forms of home improvement (Bergman and Eyre, 2011; Wilson et al., 2018). Much research has been conducted, and continues to be undertaken, on how advice fits into the supply chain (Mahapatra et al., 2011; Revell and Stanton, 2017). Research has also been conducted on how to radically reshape the current supply chain, with one rationale for this approach being that it could improve energy advice provision.

One such proposal is put forward by Genovese et al. (2013). That authors state that current configurations of the supply chain around energy efficiency outline a fractured and complex, centralised power system that does not embrace supply chain localisation: the 'Power-House' supply chain configuration (Genovese et al., 2013, p.33). Risks arising from a fractured supply chain due to conflicting international regulations on products and services additionally complicate the picture (Genovese et al., 2013). Genovese et al. (2013) put forward two new models to avoid the risks of this 'Power House' configuration, with the aim of LAs being a facilitator in the supply chain rather than the middle man, involving SMEs more and pushing for greater localised provision of the supply chain overall.

Brown (2018, p.1512) also assesses that certain types of domestic retrofit business models could reap benefits in promoting larger-scale and deeper retrofits in the UK context: (1) "A *value proposition focussed primarily upon aesthetics, comfort, health and well-being and includes guaranteed rather than estimated energy performance savings*"; (2) "*An integrated and industrialised supply chain providing a comprehensive whole-house approach*"; (3) "A *simplified customer interface with a single expert point of contact*"; (4) "A *financial model that includes a low-cost financing mechanism integral to the offering*"; and (5) "*Coordinated governance of these four components through an integrated BM*". Assessing the knowledge and structures of how energy advice is given from the supply chain in this defined way is therefore important to consider as part of the overall energy advice package, and has recently been considered as part of the Each Home Counts review (Bonfield, 2016).

Integrating energy advice into the home improvement sector could provide a new method of promoting wider renovation alongside more general home improvements. Wilson et al. (2018) argue that efficiency improvements should be bundled in to wider home renovation and targeted specifically at householders aiming to renovate. Wilson et al. (2013) find that householders are three times more likely to include efficiency improvements to their home as part of a wider renovation project, and only one in ten households considering renovation are only planning on improving efficiency. Last year, 47% of all homeowners who accessed the Houzz website planned to renovate their home, and in 2017 57% of homeowners renovated, at a median cost of £15,000 each (Houzz, 2018). A survey conducted by Hiscox in 2018 also highlights a stark increase in home improvement over moving home in the last five years, stating that home adaptation was regarded as a new norm (Hannah, 2018). This highlights the capacity for efficiency add-ons to existing projects to motivate householders, especially able-to-pay owner-occupiers, to integrate efficiency retrofits into wider upgrades that are commonly sought. Similarly, Gooding and Gul (2017) recommend greater integration of retrofit works into projects such as bathroom or kitchen upgrades, and integration of tradespeople from different areas. As yet, incentives are not present for this integration to occur, and government assistance is deemed to be required by industry professionals to ensure this occurs (Gooding and Gul, 2017). Integrated whole-house retrofits could address many more of the wider issues of home living, past purely financial or carbon savings, while still delivering these with a simplified consumer interaction (Brown et al., 2017). Here, energy efficiency upgrades could be provided and advised upon by the home improvement segmentation of the supply chain in conjunction with larger projects such as kitchen or bathroom installations. This segmentation of the supply chain could therefore benefit from a framework of energy advice to aid energy installation integration into other areas of the home supply chain.

The latest policy action to reform the way the supply chain for energy efficiency works is PAS 2035. PAS 2035, as a new code of practice from the BSI, is designed particularly to address quality issues around energy efficiency, and more generally aims to provide a much clearer and more effective process for retrofit, from advice through to specification and installation. PAS 2035 also seeks to standardise and improve quality of advice from installers when retrofitting properties. Within this, a requirement of qualifications such as a minimum level of City and Guilds 6176 Energy Awareness, and a higher-level SQA

Level 3 Award in Energy Efficiency Measures for Older and Traditional Buildings for high-risk buildings in England aims to regulate those offering advice. This may also aim to force a sector-wide reskill around low-carbon housing as undertaken around retraining gas heating engineers on condensing boiler technology in 2003, as Bergman and Eyre (2011) outline as a necessary step towards low-carbon retrofitting. This BEIS-sponsored specification primarily seeks to address some of the findings from the Each Home Counts review and recommendation that a "*Quality Mark for domestic retrofit supported by an industry Code of Conduct, a Consumer Charter and a framework of technical standards for retrofit*" be established (British Standards Institution, 2018, p.i).

Supply chain obstacles have long been viewed as a barrier to greater interaction with efficiency upgrades, and setting high-level standards may be a way to ease the process by delivering flexibility to overcome problems and retrofit homes more broadly (Patterson, 2016). An improvement in minimum knowledge through supply chain actor training has long been advocated, including recently by Gooding and Gul (2017). Further, the imposition of standards in this manner have been put forward as a potential way of getting the supply chain to innovate and improve (Webb, 2017). In this way PAS 2035 could be a future mechanism to promote the quality of the home improvement design and advice, while integrating elements of energy advice into a more general market. However, this approach relies on the assumption that standards of energy advice provided are consistent, accurate, and impartial, and more can be done to complement this code of practice in the form of an information hub as outlined in the Each Home Counts review (Bonfield, 2016).

Current processes of interaction between households and the supply chain are not trusting (Bonfield, 2016), and low trust in supply chain actors has been found to negatively impact on willingness to undertake efficiency retrofits (Oxera, 2006; Owen et al., 2014). The aim of PAS 2035, to ensure a certain minimum level of expertise amongst all members of the supply chain to provide the advice, may be effective in reducing incorrect advice: Reliable advice at the point of installation has long been lacking (Rosenow and Eyre, 2013), and so this approach aims to address this challenge as progress has been limited and not uniform through similar past approaches (Fylan et al., 2016). This is similar to the German model involving certified installers and loan/grant organisations KfW and BAfA, where in-home comprehensive assessments are standardised for all households and partially funded by the state (Schröder et al., 2011; Stieß and Dunkelberg, 2013).

However, because PAS 2035 can only point to existing standards, a 'catch-22' emerges as no standard for energy advice exists currently. To ensure advice is included within the standard, the best available proxies for an advice standard were used until new advice standards are created. This has as yet not been undertaken. Problematically, there is also no UK government-selected entity that has been chosen to ensure the consistency and accuracy of advice delivered by the supply chain, and the Each Home Counts review calls for an organisation that is a central and independent source of advice to undertake this activity (Bonfield, 2016).

Further, addressing expertise disparities in this manner may not solve issues around trustworthiness alone (Simcock et al., 2014). As explored above, the subtle but important difference between trustworthiness (or honesty), and expertise may not resolve wider feelings of distrust in the sector without engaging with householders alongside the supply chain, rather than apart from it (see Löfstedt, 2005 for examples). This distrust, especially when coupled with experience of a poor installation, can reduce future perceived benefits of new energy technologies, limiting the influence of engagement schemes (Owen et al., 2014). Feser and Runst (2016) also argue that the similar German approach has not been as successful as expected, and that information asymmetries still existed between the consultant providing advice as part of the supply chain and the householder.

One further potential issue with the introduction of PAS 2035 is that the blanket requirement for specific qualifications could make a host of organisations providing energy advice non-compliant. By shifting the meaning of 'expert', PAS 2035 could act as a barrier to a wide range of community organisations offering accredited energy advice under the quality mark to households. This could also devalue their advice compared to those meeting PAS2035 requirements, even if these organisations are delivering consistent quality of advice. In addition, for SMEs and local non-profit or volunteering organisations, PAS 2030 was already regarded as a burdensome and expensive activity that put in place barriers to entry for installers, with cost of obtaining PAS 2030 potentially reaching £2000 and several days' worth of training (Watson, 2014). PAS 2035, additional to PAS 2030 as a more stringent standard, could be more burdensome to comply with for a supply chain made up largely of SMEs, and a supply chain traditionally less inclined or able to innovate (O'Keeffe et al., 2016). As Patterson (2016) states in a study on Welsh retrofit programmes and local supply chains, local actors in the supply chain offering advice could provide continuity and local knowledge to householders, and contextualise and localise measures for their specific area to improve reach and increase the number of installations. To ensure this, support and consideration regarding compliance issues for local actors and PAS 2035 should be considered through engagement with advisors and installers, which would aid the implementation of policy rather than the approach that risks blocking SMEs from partaking in the market (Owen et al., 2014). Alongside unconsidered SMEs and community groups, national energy advice offerings such as the EST website or Citizens Advice could also face the risk of being non-compliant. Work to engage stakeholders across the supply chain and ensure that this approach can improve the current system rather than increasing barriers to reputable organisations should be considered. Despite these risks, PAS 2035 serves as a useful mechanism to drive up the quality of energy advice, in line with some of the recommendations of the Each Home Counts review.

Comprehensive energy advice is delivered by a one-stop-shop in Denmark (BedreBolig), which refers householders on to local tradespeople and aims to integrate them into the supply chain more broadly to simplify the process of retrofitting for homeowners (Economidou et al., 2016; Cludius et al., 2018). This could provide a potential solution to advice integration in this manner; the simplification of the customer journey is

generally seen as an effective method to increase household uptake of domestic retrofit (Brown et al., 2019). The idea of one-stop shops has been historically considered as a solution to current issues around supply chain advice provision, and indeed within the supply chain architects could be regarded as a one-stop-shop, offering design, advice, and implementation. These could also be administered at the local level (Brown et al., 2018). In specific supply chains such as boilers, the regulatory framework is so developed that British Gas has become a form of one-stop-shop, providing the advice, assessment, and installation. Because regulatory frameworks are not as developed in other energy efficiency supply chain areas, this cannot be undertaken more widely without further regulatory intervention.

A recommendation arising from the Each Home Counts Review (Bonfield, 2016) highlighted the potential for an information hub to provide advice as a one-stop-shop to suppliers of efficiency as well as consumers. This could be a useful approach, however it must consider altering current top-down, short-term and policy-related information strategies that dominate the energy efficiency retrofit landscape (see Brown et al., 2017). A limited knowledge and resource hub for SMEs and local groups dictates that the existence of an advice one-stop-shop could make the supply chain much more resourceful so that businesses and households can take advantage of a supplier and installer network, which has been advocated for in past studies (Gooding and Gul, 2017). Here, similar to the Danish example, a centralised system could take the form of advice on who to trust. This is being built by TrustMark in the form of a list of registered TrustMark members currently abiding by the Quality Mark (EHC) Framework. Alongside this, a broader remit for an individual point of contact would provide specific advice on measures one can take.

This latter approach was recommended by the Each Home Counts review as the Information Hub, providing support to householders and a consistent and impartial advice framework in which advisors can act. EST has put together a more concrete outline of the vision of an Information Hub, and how it can be delivered. To achieve this professionalised supply chain, Webb (2017) outlines that energy services adapted to all different housing sectors such as able-to-pay owner-occupiers, fuel poor owner-occupiers, landlords, or social housing must be considered. O'Keeffe et al. (2016) recommend in an assessment of supply chains and the Green Deal that this interaction between the supply chain and the householder is important and should not be forgotten when developing policy or advice strategies. Brown et al. (2019) assert that the customer journey is key, and this is mainly mediated by the organisation at the point of sale with the household in the supply chain. Additionally, targeted advice around market transformation avenues and innovation (e.g. specific developing technologies) could help to integrate energy-saving advice into non-traditional efficiency supply chains (O'Keeffe et al., 2016), aiding consumers to consider retrofitting as part of home improvement through additional personal innovation (Galvin and Sunikka-Blank, 2014).

A final consideration in assessing the effectiveness of the supply chain providing and receiving energy advice and support involves *who* this approach benefits. The target market for an upgraded and integrated supply chain is mainly the able-to-pay owner-occupier housing stock (Wilson et al., 2018). This is due to this group's ability to pay for and demand for general home improvements, which precipitates the potential for including retrofitting into the overall picture of home improvement that remains as a market-led finance mechanism (Brown, 2018). In the context of fuel poor households, a consideration for new configuration and integration of the local supply chain may aid these groups in accessing funding and appropriate supply chain actors needed to achieve retrofit improvements (Genovese et al., 2013). Similarly, social housing can benefit from an altered approach to the supply chain that prioritises local actors and SMEs. Landlords, similar to able-to-pay owner-occupiers, tend to be able to afford the retrofit and home improvement costs, however suffer from the split incentives dilemma (Sorrell et al., 2004). This tends to require more forceful compliance-based approaches such as the Minimum Energy Efficiency Standard 2018 (Trotta et al., 2018). This form of policy can signal widespread change to the supply chain and precipitate any change that may have to occur at this level (Citizens Advice, 2016). Alongside this, however, a timely and targeted advice provision and supply chain navigation aid as seen in Denmark could promote simpler and more cost-effective achievements of these standards, resulting in greater compliance levels (Cludius et al., 2018). Overall, consideration of advice in the domestic energy supply chain could be effective across all consumer household groups, however will most likely be of highest relevance to able-to-pay owner-occupiers, followed by landlords.

4. Conclusions

This report aims to outline current English energy advice practice. The report also aims to show how English energy advice can be improved and assessed based on the energy-SSH literature and illustrative examples along three axes – Content, Source, and Process – to provide policy recommendations to improve domestic uptake rates of energy efficiency initiatives.

Overall, energy advice as a method to engage householders to reduce domestic energy demand does have a role to play in overall domestic energy saving policy due to the democratic nature of society and the importance of behavioural implications outlined above. However, the content, messenger, and process by which this advice is given suggest that a more effective method of energy advice could be offered compared to the current provision in England (Simcock et al., 2014).

If advice provision is considered in status quo, then content should include non-price frames such as health and comfort alongside standard environmental or monetary messages and be tailored to the household receiving advice to be the most contextually useful. Models such as Figure 3 adapted from Frederiks et al. (2015) can serve as an overview of all different individual and social factors to consider when constructing energy advice content for householders. When considering the messenger providing this information, it is key to assess both the trustworthiness of the organisation as well as its expertise. Community energy initiatives, local groups and SMEs, and local and regional government offer advice provision techniques and chains of advice that both complicate and add to the overall picture of advice provision and should be considered as potential actors in energy advice, whether formally or informally. Additionally, decentralised advice has been successful in different nations as well as Scotland, but questions remain at what scale this could operate in England, and this will depend on politics and experimental evidence. Among traditional processes of energy advice, personal and proactive interaction will always be more effective than reactive interaction, however prove relatively more expensive to roll-out. With new technologies such as smart meters providing more opportunities for feedback, a mixed-method approach could prove the most effective, as seen in studies such as Abrahamse et al. (2007), among others.

Generally, the impact of energy advice is difficult to measure or value due to the conditionality and case-specific nature of advice, as well as current measures of advice evaluation. The impact of advice is, to some extent, dependent on the current domestic energy policy landscape. This results in two main conclusions: first, that broader concepts should be considered in the valuation of advice, past solely target-driven CO2 or financial savings, and to consider both quantifiable (e.g. health; mental health; comfort) and unquantifiable (e.g. social norm change; confidence boosting; know-how; energy system understanding) to ensure a fairer and more realistic evaluation of energy advice, and second, that energy policy consistency and long-term strategy would create a more stable foundation upon which energy advice could be assessed. An approach which readjusts expectations, rather than aiming to fully understand the impact of energy advice, may be more appropriate, as over- or under-expectations of advice value can have unintended consequences.

The integration of energy advice and energy-saving initiatives into a wider portfolio of domestic improvement could aid in avoiding the siloed nature of energy advice outside of social considerations and create a more holistic approach. As Galvin and Sunikka-Blank (2017, p.385) summarise, "*retrofits must be good for people and for the environment*". This approach could integrate energy saving retrofit into ideas of home renovation, and reposition energy retrofit as part of a holistic home system aimed at broader outcomes rather than being thought of as an upgrade in isolation. This would be especially impactful for able-to-pay owner-occupiers, where the majority currently perceive little incentive to invest in energy retrofit other than potential cost savings.

Additionally, a more holistic view of the entire business model of the energy retrofit supply chain including advice as outlined by Brown (2018, p.1512) could reap benefits in promoting larger-scale and deeper retrofits in the UK using a business model such as those suggested by Genovese et al. (2013) and Brown (2018). One fundamental question to be asked with regard to this is: who is advice for? Advice in its current meaning is primarily aimed at members of the public on matters relating to energy use as an end user rather than wider ideas around energy advice for prosumers and professionals. A reconceptualization of who energy advice is provided for, and what kinds of energy advice are offered, could broaden the base of knowledge and strengthen the role of the supply chain in advising consumers and installing more generally, in line with the recent development of the Each Home Counts review recommendation for an information hub and data warehouse for both end-consumers and industry.

However, there is currently a much greater opportunity to promote energy-saving practices and upgrades aside from solely considering a more traditional method of energy advice provision. This method, while difficult to value, approaches energy saving from a deficit mindset approach: that there is a linear cause and effect between the advice provided and household decision-making based on a lack of public understanding. Alongside individual barriers to energy saving, accounting for social barriers and structures is crucial to wider uptake of energy saving initiatives. This change could be seen through changing aims of what energy advisors do: instead of providing advice solely on best methods of reducing energy use, advisors should support householders through the process of reducing energy demand (Royston, 2014; Waitt et al., 2016). This paradigm shift could help resolve deep underlying tensions that exist

past knowledge deficits alone that influence public reluctance to improve domestic energy efficiency.

Energy advice as a discretionary policy must be seen as a complement to wider forms of mandatory, enabling, exhortatory and consultative policies such as grants, subsidies, rebates, or regulations (Parag and Darby, 2009; Kern, Kivimaa and Martiskainen, 2017; Brown et al., 2019). Currently, particularly in the context of able-to-pay owner-occupiers, a policy vacuum exists that does not incentivise this group to undertake energy-saving techniques due to lack of financing. Here, energy advice exists more as a measure to *persuade*, rather than to *inform* and *support*, and will not be effective without regulatory or fiscal measures afforded from government alongside advice.

Finally, consideration to different groups must be undertaken with energy advice and wider domestic energy policy. One-size-fits-all, low-cost and isolated approaches are unlikely to engage all segments of householders. Considering the impact and methods of advice on fuel poor, able-to-pay owner-occupiers, landlords, and social housing is extremely important to wider engagement and scheme uptake and should be integrated into every policy appraisal and advice method.

5. Recommendations

For energy advice providers

- Current approaches to providing advice should include multiple frames alongside one another (i.e. both monetary and non-monetary) to achieve greater interest in behavioural change programmes. Monetary frames should not be used in isolation.
- Other incentives to engage the public past drivers of self-interest alone can create a more appealing message to a broader spectrum of householders. These include altruistic drivers and non-monetary motivators such as environmental savings, comfort, and home improvement.
- Providing practice-based and know-how solutions (e.g. tangible methods and DIY) to householders over simple reasons for saving energy may provide more tangible and practical targets for households, as well as influencing social norms.
- Tailoring advice based on values and situation (socio-economic, current home ownership, fuel poverty) is vitally important to improve outcomes and energy scheme engagement.
- Before entering the advice sphere, potential energy advice providers should ensure that they consider levels of trustworthiness and expertise that advice providers needed to succeed.
- Energy advice providers should consider complementing low-involvement advice provision methods (e.g. websites and telephone advice centres) with high-involvement approaches (e.g. face-to-face and in-home audits) that engage communities at a local level especially for three key groups: vulnerable and fuel poor householders, early adopters of new technologies, and able-to-pay owner-occupiers. These groups require the greatest support and are more open to deeper retrofit options due to grant offerings, motivation, or available spending power.

For the Energy Saving Trust

- Establish a knowledge bank of readings, in-house literature reviews and project assessments, and regular reviews of data held to ensure a legacy of energy advice evidence that exists past potential staff changes.
- Additionally, consider the creation of a project-independent energy-SSH academic steering group to systematically link experts to EST. This is to avoid EST reliance on personal academic contacts or project-specific actors to consider a wider and deeper evidence base in rationale for activities in the absence of such a steering group.
- Assess effectiveness of the EST website as an advice tool, and additionally aim to provide consistent measures of data that are not project-dependent to ensure reliability and consistency of data for further analysis and advice service improvement. This should also be thought of in the context of reassessing how energy advice is valued.
- Alongside the overall effectiveness of advice provision, a more in-depth process-driven assessment of the effect of different methods of advice provision, although difficult to assess, would provide a clearer picture of most effective methods and greater learning outcomes. In particular, a needs-based assessment of the effectiveness of different methods of advice provision would aid in creating an evidence-based advice strategy.

For government policy makers, and funders of energy efficiency policies and advice[10]:

- Consider a reassessment of how energy advice is valued, to consider and appreciate both quantitative and non-quantifiable benefits and costs in energy advice funding models.
- Fund an information hub alongside the 'data warehouse' currently being developed across the UK to provide a more in-depth, flexible, and accessible provision of information to both householders and the supply chain and reduce barriers to data access.
- Promote and support the concept of a retrofit one-stop-shop where energy advice and support can be offered to householders through the energy efficiency, energy services, and home improvement supply chains to simplify the process of home energy efficiency improvements for households.
- Consider funding projects on public engagement around decarbonising heat and new forms of generation in light of necessary heat provision changes.
- For the Scottish Government specifically, fund and ensure process-driven evaluation of publicly funded energy advice, including the assessment of different techniques of advice (e.g. home visits, telephone advice) to ensure consistency in approach and evidence-based learning outcomes rather than purely evaluating value for money.

10 Although most recommendations to policy makers here are generic, specific recommendations for policy makers in England (BEIS) and Scotland (Scottish Government) are also added due to their differing approaches and priorities.

- Despite its usefulness, engagement with English householders should move past the passive website provision to include more active forms of engagement, especially at a community level.

- In England, BEIS should provide greater funding to energy efficiency schemes, especially around retrofitting, and relocate advice as an assistance tool rather than existing in the absence of mandatory, enabling, exhortatory and consultative policies to promote domestic energy saving.

For researchers[11]

- Further systematic research on the impacts of different framing techniques is needed to create advice that is more impactful upon household behaviour change, especially in the UK context.

- Categorisation and consideration of multiple groups when constructing energy advice experiments could aid in developing tailored approaches based on multiple individual and social predicators.

- Greater researcher interaction with governments and government departments such as BEIS is needed to promote knowledge exchange and greater application of findings from the literature into government policy.

11 Recommendations to researchers listed here are based not on knowledge gaps *per se*, but on salient topics discussed with stakeholders that they are interested in learning more about in the development of future energy advice policy. Multiple recommendations for further research based on existing knowledge gaps are presented within the text.

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8. Appendix 1 – Annotated bibliography

Brown, D., Sorrell, S. and Kivimaa, P., 2019. Worth the risk? An evaluation of alternative finance mechanisms for residential retrofit. *Energy Policy*, 128, pp.418–430.

Exploring issues related to financing retrofit schemes in the UK, the authors present a detailed picture of finance mechanisms using a range of international and UK examples. Using a qualitative approach of interviews and secondary data, the authors find and analyse the key components of six key archetypes of finance mechanisms for residential retrofit, namely: public loan or credit enhancement, on bill financing or repayment, property assessed clean energy, green mortgage, energy services agreement, community financing. To do this, the authors have created a framework to understand these mechanisms, namely through capital, financial instruments, project performance, point of sale, security and underwriting, repayment channel. The authors argue that a lack of access to low cost capital in the UK is stalling current rates of residential retrofit. Alongside this, the authors argue that offering broader home improvement incentives as part of a package of works, and a simplified customer journey would aid in achieving greater uptake levels as seen in the success of schemes like PACE and KfW. The authors note that financial mechanisms on their own are unlikely to drive whole-house retrofit, and so should be viewed as part of a wider strategy taking into account all elements of the framework outlined above.

Darby, S., 1999. Energy advice - what is it worth? In: *ECEEE Summer Study Conference Proceedings*. Stockholm, Sweden: European Council for an Energy Efficient Economy.

This report offers a broad overview of energy advice, alongside an assessment of its value. Surveying energy practitioners from a range of organisations, this study finds that practices of consumer data collection from practitioners for analysis are inadequate for formal evaluation. Darby also outlines the different modes of advice giving: opportunistic, energy-efficiency-led, client-led, and research led. The author argues that the opportunistic and client-led mode of advice giving are more effective and tailored to householders' situations and desires. An assessment of feedback is provided using past studies, finding that feedback is most effective when combined with other advice methods, such as general information, comparison to past energy use, and simple, well-designed brochures. Darby concludes that feedback should be a larger part of energy advice programmes to raise awareness and to provide evaluative data for practitioners. Despite the age of the report, many of the findings and conclusions remain relevant in the present day.

Delmas, M.A., Fischlein, M. and Asensio, O.I., 2013. Information strategies and energy conservation behavior: A meta-analysis of experimental studies from 1975 to 2012. *Energy Policy*, 61, pp.729–739.

The authors conduct a broad-reaching meta-analysis to evaluate the quantitative impact of information strategies on energy savings, assessing 156 published field trials over almost 40 years. The authors find that electricity consumption was on average reduced by 7.4% with information strategies, although different methods of advice and message content has an influence on energy saving behaviour. Findings are tempered by study quality, however: 'high quality' studies with statistical controls such as weather, demographics, or a control group only had average reductions of 1.99%, whereas 'low quality' studies without statistical controls reported higher average savings of 9.57%. Information strategies built around monetary savings increased participant energy use, due to the 'licensing effect'. The authors argue that an informational approach built around non-monetary frames can be effective in reducing household energy use.

Eyre, N., Flanagan, B. and Double, K., 2011. Engaging people in saving energy on a large scale: Lessons from the programmes of the Energy Saving Trust in the UK. In: L. Whitmarsh, S. O'Neill and I. Lorenzoni, eds., *Engaging the Public with Climate Change: Behaviour Change and Communication*. Routledge, p.141.

The authors provide a historical overview of the establishment and activities of the Energy Saving Trust, from the years before its founding in 1992 to 2011. The authors describe the original mission of EST and highlight a range of activities and advice methods undertaken over an almost 20-year period. The authors also provide some context for the evaluation of the impact of the service EST provided in 2007-8, using data provided by EST. Here, the authors provide key statistical data showing an annual cost-effectiveness of £1.5t/CO2. A discussion of the different methods by which EST engages the public on energy saving are offered, including consumer marketing; energy advice; the involvement of ESTACs, local authorities and community; the supply chain, or the

energy efficiency industry. The authors argue that all of these groups and advice methods have a role to play, through different information dissemination methods.

Foulds, C. and Robison, R., 2017. *The* SHAPE ENERGY *Lexicon - interpreting energy-related social sciences and humanities terminology*. Cambridge: SHAPE ENERGY.

This lexicon seeks to outline and highlight differences in use of energy-related words based on a workshop with a range of researchers in energy-related fields. This is undertaken through engagement with an interdisciplinary group of leading energy researchers from across Europe. The authors seek to emphasise the broad way in which energy-related words are understood and acted upon, and that there is often no single agreed or perceived definition for energy-related terms. It is argued that this multitude of understanding of a single term emphasises the multiple possible solutions to the same problem, with different approaches and targets. The authors find, for example, that 'energy efficiency' as a term is regarded by scholars as: "(*energy out*) *[divided by]* (*energy in*)" (p.13); being about technology or behaviour; meaning getting the same, or more, for less; a relative concept; a solution that raises questions of its true impact. The lexicon additionally includes multiple definitions for other energy-related words such as: energy behaviour; energy consumer; energy engagement; energy poverty; energy policy.

Frederiks, E., Stenner, K. and Hobman, E., 2015. The Socio-Demographic and Psychological Predictors of Residential Energy Consumption: A Comprehensive Review. *Energies*, 8(1), pp.573–609.

This review of research and theory into individual determinants of energy consumption provides a detailed overview into the wide range of both socio-demographic and psychological factors that influence decision-making in this context. The authors present a conceptualisation of factors that influence decision-making in a clear manner for policy makers. The authors recommend that a systematic and consistent framework is used to better predict how householders will behave in relation to new policies and interventions. Understanding the uniqueness of each householder will aid policy makers in identifying appropriate and targeted messages, as well as offering tailored and effective messaging strategies. Key findings from the comprehensive literature review undertaken include: inconsistent support for age and gender differences in energy consumption; a relationship between education and increased knowledge of energy issues; employment status may indirectly impact energy consumption; energy consumption increases with household income, but could be mediated by capacity to pay for energy efficiency products; dwelling size, home ownership, and stage of family cycle all have an impact on energy consumption and propensity to invest in energy-saving initiatives. This article also contains a rich repository of peer-reviewed scientific evidence and theory on behaviour change strategies and demographic differences that influence engagement in energy saving and general energy use characteristics that should be referred to when considering energy advice programmes.

Galvin, R. and Sunikka-Blank, M., 2017. Ten questions concerning sustainable domestic thermal retrofit policy research. *Building and Environment*, 118, pp.377–388.

Based on six years of research, the authors pose and answer ten questions related to domestic thermal retrofit policy in the aim of raising rates of home heating energy savings. Based on a large literature base and clearly laid out, these questions include topics of the debate between deep and incremental retrofit approaches; how energy efficiency can deal with gender issues; the relationship between qualitative research and retrofit policy recommendations; and the relevance of the rebound effect to thermal retrofit policy. The authors find that a focus on one-off, deep retrofit as the only option are counterproductive to energy and climate goals as most initiatives are piecemeal. Alongside this, the authors argue for more nuanced policies that account for and engage better with different kinds of households e.g. socio-demographics. Further assertions from the authors involve the important place that qualitative research methods have, and should have, in retrofit research, and that paths already trodden by savvy retrofitters are not often trodden when creating new retrofit policy.

Kivimaa, P. and Martiskainen, M., 2018. Dynamics of policy change and intermediation: The arduous transition towards low-energy homes in the United Kingdom. *Energy Research and Social Science*, 44, pp.83–99.

The authors provide an overview 45 years of transition towards low-energy homes, outlining UK government policy over this time period and categorising various eras in the context of the low-energy home transition. Included in this is the documentation of 'backtracking' occurring in the low-energy homes policy space from around 2009. Currently, the authors argue, we are in this phase highlighted by a U-turn in government policy in this space and a lighter touch on engagement. The authors additionally analyse the dynamics between intermediary organisations and policy, and outline the changing role and existence of intermediaries influencing low-energy homes policy in the UK. Transition Intermediaries here could be: a government-initiated agency, like CCC or EST; charity or social enterprise, such as Friends of the Earth or NEA; Member organisations such as ACE or the UK Green Building Council; or public-private networks such as the Sustainable Buildings Task Group or the Zero Carbon Hub. The authors find that these intermediaries have occasionally affected the development of policy in this space, where piloting new projects has led to policy acknowledgement. Despite some examples here, the authors also point to many instances where intermediary activities did not result in policy changes.

Lesic, V., de Bruin, W.B., Davis, M.C., Krishnamurti, T. and Azevedo, I.M., 2018. Consumers' perceptions of energy use and energy savings: A literature review. *Environmental Research Letters*, 13(3), p.033004.

This literature review outlines key findings related to how people understand and perceive their energy use and methods of saving energy, providing and reviewing data from 14 empirical studies on consumer perceptions of energy use and savings. The authors find that consumers: have consistent misinterpretations of energy use; prefer curtailment strategies over efficiency; lack information about electricity savings of given strategies; use heuristics to assess energy use of specific appliances that are mediated by numeracy levels and pro-environmental attitudes. The authors recommend that future research focus on the effectiveness of feedback methods can correct misperceptions found in the literature, but need to be presented in an understandable way. The authors also promote the use of tailored feedback in reducing domestic energy use.

Mallaburn, P.S. and Eyre, N., 2014. Lessons from energy efficiency policy and programmes in the UK from 1973 to 2013. *Energy Efficiency*, 7(1), pp.23–41.

Mallaburn and Eyre provide a wide-ranging and in-depth political overview of the fluctuating energy efficiency policy landscape over a 40-year period using an intuitive timeline approach. This was undertaken through a literature review of government documents and other official publications. Detailing the historic development of energy efficiency policy in the UK, the authors find that the UK has led the way on energy efficiency policy, with a generally strong legacy in climate and environmental policy. The aim of this article, published in 2014, is to assess whether the Green Deal would be a success based on historical precedent and learnings from this legacy. The authors conclude that the Green Deal approach relies heavily on the role of markets, and despite outlining some innovative elements of the policy argue that the heavy focus on overcoming financial barriers to energy efficiency ignore the other factors restricting uptake including disruption and long-term risk on properties. Mallaburn and Eyre (2014: 39) conclude, characterising UK energy efficiency policy as "*at best, confused and at worst, in danger of unravelling*".

Middlemiss, L., Gillard, R., Pellicer, V. and Straver, K., 2018. Plugging the Gap Between Energy Policy and the Lived Experience of Energy Poverty: Five Principles for a Multidisciplinary Approach. In: *Advancing Energy Policy*. Cham: Palgrave Macmillan, pp.15–29.

In this book chapter, the authors outline the reasons behind the validity of a multidisciplinary approach to designing and critiquing energy poverty policy. The authors put forward five key elements that should be considered when designing energy policy that addresses the energy poor. These are: aiming for joined-up policy approaches; building momentum through networks and partnerships; expecting the unexpected; holistic measures of progress; that policy should go ahead and move forward with policy through risk taking. Overall, the authors conclude that an understanding of the lived experience of the fuel poor is vital to reach an equitable future that recent policies have aimed for. Further, the authors advocate for the use of qualitative research methods and contextual understanding can improve understanding of lived experiences.

Mourik, R., Jeuken, Y., De Zeeuw, M., Uitdenbogerd, D., Van Summeren, L., Wilhite, H., Robison, R., Heidenreich, S., Blahová, M., Pidoux, B., Kern-Gillars, T., Arrobbio, O., Sonetti, G., Throndsen, W., Fox, E., Nikolaev, A., Radulov, L., Sari, R., Sumpf, P. and Balint, L., 2017. *Energy Efficiency and Using Less: A Social Sciences and Humanities Annotated Bibliography*. Cambridge: SHAPE ENERGY.

This annotated bibliography provides an extensive and deep outline of the literature available around a wide range of energy-SSH topics. Research areas range from behaviour change literature, to findings on energy users and cost distributions. The energy topics span the four main project areas of the SHAPE-ENERGY project, namely: energy efficiency and using less; competitive, secure, low-carbon energy supply; energy system optimisation and smart technologies; transport sector decarbonisation. This annotated bibliography can serve as an excellent starting point and signpost to a literature review on a range of energy topics, and can be useful as a teaching resource on social sciences and humanities energy efficiency research.

Royston, S., 2014. Dragon-breath and snow-melt: Know-how, experience and heat flows in the home. *Energy Research and Social Science*, 2, pp.148–158.

Using quotes from various sources such as web forums and advice sites, Royston outlines the conceptual difference between knowledge and know-how as a more practical concept than theoretical knowledge. This article seeks to evaluate how know-how and experiential learning is used in regulating energy consumption. Additionally, Royston outlines what can develop know-how, namely changes in life course, changes in material arrangements, and changes in shared understandings. Royston argues that thermal management is not only about statistics provision, but also about know-how and experience of the system to enable successful interaction. Here, know-how occurs through two main dynamics: negotiation with material and social arrangements, and; the embedding of know-how within the body and mind, where sensory and physical experiences are fundamental.

Simcock, N., MacGregor, S., Catney, P., Dobson, A., Ormerod, M., Robinson, Z., Ross, S., Royston, S. and Marie Hall, S., 2014. Factors influencing perceptions of domestic energy information: Content, source and process. *Energy Policy*, 65, pp.455–464.

Based on a multi-method case study approach involving households in the UK, the authors outline important factors to be considered when developing

domestic energy information campaigns, namely content, source, and process. Most importantly, the authors argue that the process by which information is communicated is vital to its effectiveness: without greater public interaction, top-down messaging approaches will continue to not reach expected levels of effectiveness. This method requires information exchange and active involvement, the opposite of the passive user assumed in knowledge-deficit models. Recommendations for policy here involve promoting discussions and experience around energy saving, likely to require government's financial investment. Further, any policy strategy is more likely to succeed when it holistically accounts for all factors highlighted in the article due to the interconnected nature of the factors.

Sorrell, S., Gatersleben, B. and Druckman, A., 2018. Energy sufficiency and rebound effects Concept paper. ECEEE *concept paper*.

In this concept paper, the authors outline that reframing domestic energy saving in the concept of energy sufficiency rather than energy efficiency are more appropriate partly due to rebound effects that have led to lower-than-expected CO2 savings as a result of domestic retrofitting. The authors find: rebound effect from energy efficiency improvements are large and should be taken into account by policy; it is wrong to conclude that rebound effects are undesirable; consumers can limit the effects of the rebound effect by reducing consumption; energy sufficiency actions are linked to indirect rebound effects due to re-spending cost savings; moral licensing can act as an added area of the rebound effect; voluntary 'downshifting' should reduce household consumption. An evaluation of the impact of carbon pricing finds that their preferred approach involves an economy-wide initiative with revenue recycling that takes into account border carbon adjustments to include the carbon cost of traded goods.

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‘Better’ domestic energy advice in England? A narrative literature review

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