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Reframing policy for the energy efficiency challenge: insights from housing retrofits in the United Kingdom

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Abstract

This paper examines the challenges associated with stimulating large-scale investment in energy efficiency and demand management measures, using residential energy efficiency-improving retrofits in the UK as a case study. We consider how issues of energy policy, consumer choice and financial systems intersect, drawing on recent literature including energy policy documents and research reports, and on interviews with stakeholders from the finance sector, energy efficiency practitioners and more. We suggest that following the withdrawal of the Green Deal, there is a need to reconsider the framing of policy for household energy efficiency improvements, moving beyond addressing barriers and market failure. We examine three potential aspects of a new policy framing: *energy efficiency as infrastructure; new business and financing models for energy efficiency provision; and decentralised financing institutions for energy efficiency investment.*

This would require a long-term commitment from government on energy efficiency, and a need to ensure that projects are attractive and investable from both householders and investors' perspectives. We conclude that there are important roles for government in any large scale initiative for energy efficient retrofitting of UK homes, even if the mechanisms are market based. These include signalling long-term policy consistency and reducing risks for financial investment, and supporting industry innovators and decentralised actors.

Keywords

energy efficiency; energy policy; green finance; demand side management (DSM); infrastructure

1 Introduction

There is widespread agreement that improving the efficiency of provision of energy services is an important contributor to meeting the ambitious climate change mitigation goals in the Paris Agreement and broader sustainability goals, including addressing fuel poverty. However, compared to the depth of analysis and range of policy measures aimed at

promoting innovation and investment in low carbon energy supply technologies, there has been relatively little attention paid to understanding incentives for stimulating innovation and investment aimed at improving energy efficiency and reducing end-use energy demand [1]. In particular, there is a challenge associated with promoting investment in household energy efficiency improvements, both for new build and for retrofit. The dominant policy framing of this challenge in the UK and other industrialised countries has focussed on the role of energy policy to address market failures or barriers to the take-up of energy efficiency measures [2,3]. For example, the UK government's Clean Growth Strategy talks about the need to "build the market for energy efficiency" [4] (p. 77). However, attempts to create incentives to address these market failures and barriers have not so far attracted the levels of investment needed to deliver an ambitious scale of household energy efficiency improvement. Indeed, the previous UK flagship energy efficiency policy, the Green Deal, failed to attract householders or investors in large numbers, and was withdrawn after a short period of implementation [12,13]. Reviews of decades of energy efficiency policy in the UK [5] and internationally [6] raise doubts about the efficacy of a neo-classical economic framing and emphasise the need to take into account the range of systemic factors affecting household and investor decision-making.

In this paper, we argue that this lack of policy effectiveness points to the need for a more systemic framing of energy efficiency investment challenges and how these could be overcome. Drawing on interviews with stakeholders from the policy and investment communities, we illustrate three aspects of a more systemic policy framing: *energy efficiency as infrastructure*; *new business and financing models for energy efficiency provision*; and *decentralised financing institutions for energy efficiency investment*. This contributes to a small but growing academic literature examining how energy finance can be reoriented towards low carbon investments, though this literature has mostly focussed on renewable energy investment [7–12]. Whilst efforts to promote standardising how energy efficiency projects are developed, documented and measured, such as the Investor Confidence Project [13], are important to enabling investment, we argue that a more systemic policy framing is also needed to promote significant levels of investment in household energy efficiency.

Combining evidence from academic and policy literatures with insights from interviews with actors and experts on UK energy efficiency policy, we identify three key concerns relating to stimulating low carbon investment: that incentives resulting from a 'market failure' framing do not necessarily create attractive investment opportunities from the perspective of investors; that a lack of coherence and consistency in policy fails to deliver a stable environment, and creates uncertainty that hinders private sector investment; and that an overly centralised financial system fails to stimulate more diverse and decentralised investment opportunities. This leads to three implications for energy policy: the need for policy to create a clear direction for implementation; the challenge of linking finance to projects; and the scale of the domestic retrofit challenge. The paper is structured as follows. Section 2 reviews the dominant policy framing of measures to promote investment in energy efficiency by households and how this has influenced UK household energy

efficiency policy development, which we argue demonstrates these concerns. In Section 3, we outline the methods of this study, drawing on expert stakeholder interviews and review of recent reports and policy documents. In Sections 4, 5 and 6, we describe three potential aspects of a more systemic framing for policy makers and industry stakeholders: *energy efficiency as infrastructure*; *new business and financing models for energy efficiency provision*; and *decentralised financing institutions for energy efficiency investment*, and discuss how attention to these aspects could help to address the above concerns for energy efficiency investment. Section 7 presents our conclusions.

2 Linking energy efficiency to finance – policy and literature review

2.1 Reorienting finance towards energy efficiency

In recent years, questions of climate change and sustainable development have raised issues about the nature of global finance, with growing recognition that the finance system needs to be reshaped, as it “remains disconnected from the long-term needs of the real economy” [14](p 1) . For example, the Global Commission on the Economy and Climate argue that the financial system has to be transformed if it is to deliver the scale and quality of investment needed in order to ‘green’ the system [15], including making significant investments in energy efficiency in buildings, energy and transportation. Meeting the Paris agreement targets requires significant scaling up of the take-up of energy efficiency measures around the world. Circumstances and institutions vary from country to country, and our focus is on the UK, where energy efficiency policy is heavily market oriented. Nonetheless, we suggest some of the lessons in this paper are applicable in other contexts too: the scale of the task requires participation of private finance in most countries, as in the current global economic climate, public funds are limited.

The dominant policy framing in the UK in relation to energy efficiency has been to address market failures or barriers to the take-up of energy efficiency measures [2,3]. One taxonomy [16] identifies a number of barriers, including: having a higher technical or financial risk than other investments; lack of perfect information of energy efficiency opportunities; hidden costs through utility reduction or additional costs; lack of access to capital; split incentives, as between landlords and tenants; and bounded rationality, due to limited time or capacity. Similarly, at EU level, ‘market barriers and failures’ to energy efficiency investment include a lack of information and high perceived risk by both users and financiers; and the lack of financial convention of cash flows from saving energy in an ‘asset-based culture’ [17]. Barriers specifically affecting the residential sector include small project size with high upfront costs and long payback periods; split incentives between landlords and tenants; lack of contractors; and lack of support for holistic retrofits (ibid.). These barriers are reflected in the impact assessments for energy efficiency policies in the UK, including the Green Deal [18]. Current risk-based capital budgeting practices favouring short-term returns on investment have also been identified as a barrier to energy efficiency investments [19].

Solutions to overcoming these barriers have focussed on promoting new financing instruments for energy efficiency [17] and an adaptive policy design to address specific

barriers to low-carbon innovation along the innovation cycle for particular technologies [12]. Whilst these prescriptions are important, we argue that they do not provide a positive policy framing for attracting significant levels of investment needed for energy efficiency measures, nor the basis for coherent and consistent policy development in this area. A new policy framing is important because the current framing, based on addressing market barriers and failures, often does not resonate with how either household or financial actors frame the energy efficiency challenge. For example, NGOs in the energy efficiency field in the US have drawn on market transformation and collective action frames to enable coordination by highlighting how efficiency can be framed in a way that appeals to householders, industry and government priorities, while still being rooted in a market-based discourse [20].

The global role of the finance sector is key as climate change mitigation action has come to be associated with private profitable business [21], with policymakers looking to the private sector to fund the transition to a low-carbon economy [22]. However, [23] suggest that an impasse has emerged, with policymakers hoping that financial markets will mobilise capital into low-carbon investments, while market actors have no incentive to do so without credible action towards longer-term, stable policies.

It is in this context that the academic literature has begun to research institutional and cultural challenges associated with reorienting the global financial system towards sustainable and low carbon investments. Structural constraints have been identified as delaying increases in investment in renewable energy supply in the UK [8,9] and throughout OECD countries [24], including immaturity of asset classes, lack of liquidity of long-term investments, short-term drivers pressuring fund managers and lack of secondary market vehicles.

Energy efficiency measures are especially relevant to questions of finance, as deploying them is capital intensive and requires upfront investment, be it from household savings, business equity or debt finance, often with the aim of reduced energy bills or increased revenue in the future [25]. To illustrate the scale of capital in the UK alone, estimates of the potential social impact of the Green Deal and ECO showed costs of £10 billion in installation and £17.3 billion total costs, with benefits totalling £25.6 billion, including £15 billion in energy savings and £3.5 billion in comfort benefits [18]. The G20 Energy Efficiency Task Group has argued that energy efficiency financing is a mechanism that could accelerate the growth of energy efficiency business models, enabling scaling up of energy efficiency investments for projects that don't have easy access to the necessary capital [26].

However, financial investors and energy efficiency practitioners have qualitatively different perspectives, the former underestimating the savings potential of energy efficiency, and overestimating its risk, due to simplistic or conservative risk analysis; and the latter lacking the financial expertise to make the case for it [19]. Linking finance to projects is therefore not trivial; it is this gap and the role of government and policy within it that we seek to address. It has been argued that it is incumbent on engineers, facility managers and professional organisations to translate energy efficiency analysis into financial risk

management language [19]. We disagree, and suggest this is unrealistic for household level investment. Instead, we argue for reframing energy efficiency policy in a positive way to encourage the further development of new business and financing models for energy efficiency investments at a household level.

2.2 UK household energy efficiency policy

An international review of policies for energy efficiency suggests “policies should be kept in place for a decade or more in order to ensure an orderly development of energy efficiency markets” [6](p 571) while standards, targets and incentives be revised periodically.

UK energy efficiency policy, though, has a record of inconsistent policy, and is currently in a state of flux, not least as the UK negotiates ‘Brexit’ from the European Union. At the high level, the UK government remains committed to addressing the energy ‘trilemma’ – meeting climate change targets, ensuring security of energy supply and maintaining affordability of energy for households and businesses. In addition, following the 2015 general election, a renewed emphasis has been placed on developing an industrial strategy, including “securing the industrial opportunities for the UK economy of energy innovation” [27](p 89). However, the issue of affordability of energy has been high on the political agenda for years. In August 2017, the UK government commissioned an independent review examining how to “best minimise the costs of energy consistent with the overarching objectives”, to report by October 2017 [28]. The resulting review argued, from an economic perspective, that “avoiding detailed intervention is the key to keeping costs down” [29](p xiv) and that energy efficiency objectives should not be confused with fuel poverty objectives, which should be addressed through general welfare payments. However, others have argued in response that this approach plays down the key roles that technology and energy efficiency policies have played in bringing energy costs down [30,31].

Domestic retrofitting is significant in UK’s energy efficiency and climate change mitigation policy: In 2015, 23% of UK carbon emissions came from the domestic sector [32]. Domestic emissions are predominantly from space and water heating [33], due to the majority of residential buildings being constructed before 1980, and a slow rate of replacement of buildings [34]. However, climate policy discussions in the UK lack a systemic focus on demand [35], despite a long-argued need to tackle demand, rather than “decarbonis[e] an ever-increasing energy supply” [36](p 1). In 2012, the previous UK Coalition government produced an Energy Efficiency Strategy with a “mission to seize the energy efficiency opportunity” [2], which recognised the importance of linking financing opportunities to energy demand. The main household energy efficiency measure was the Green Deal, which aimed to provide a novel way of financing energy efficiency improvements. However, this scheme was discontinued in 2016, after only around 20,000 home energy improvements were funded between 2013-2015 [37]. We discuss the reasons for this failure and lessons to be learned in Section 5.1. The remaining measures are the Energy Company Obligation (ECO) which is an obligation on suppliers to improve energy efficiency for poorer households, and a roll-out of smart meters (to be offered) to every home by 2020, which aims to stimulate a transition to a smart energy system [38]. Improvements in energy

efficiency of household appliances have largely been driven in recent years by the implementation of European Union (EU) Directives, and it is not clear how the UK government intends to continue progress in this area, after the UK leaves the EU in 2019.

At time of writing, there is still no clear successor to the Green Deal, although the UK government has committed to developing a replacement. In October 2017, the UK Government published its Clean Growth Strategy [4], setting out a framework for further measures to meet carbon reduction targets out to 2032, whilst minimising costs and maximising social and economic benefits. While it does not give detailed policies, it calls for evidence, including “incentives and other levers that could encourage homeowners to invest in energy efficiency improvements” [4](p 77). However, the dominant framing is still in terms of “building the market for energy efficiency” (*ibid.*). This raises the question of whether this framing neglects important aspects of the challenge, particularly from investors’ perspective.

3 Methods

To explore these issues, we undertook a review of policy documents and research reports on the challenges of financing housing energy efficiency improvements in the UK, focusing on potential policy and financial insights which could help connect finance and energy efficiency, and ways to move beyond the framing of barriers and market failures as the main reasons for government intervention. This literature review began with prominent recent government documents such as the Clean Growth Strategy and the Industrial Strategy [4,27], reports from the Department for Business, Energy & Industrial Strategy (BEIS), and from academic papers which reviewed policy [5,6]. We further included academic literature familiar from our previous work in this area and papers from literature searches for terms including “energy efficiency”, “UK” and “investment”. This was followed up with semi-structured stakeholder interviews, which in turn led to a second review of further recent relevant reports and documents that interviewees alerted us to. We did not do a formal coding for inclusion of documents, but selected those most relevant to our focus on drivers and barriers to energy efficiency investment.

A total of 12 expert interviews were undertaken between March and July 2017¹ with UK-based stakeholders from the finance and banking sectors, policy researchers and experts, consultants, analysts and practitioners in energy efficiency, and local authority workers. These stakeholders were identified as they were experts in this area, including some occupying senior positions, and covering a range of perspectives. The stakeholders were selected through recommendations from colleagues and peers, and as members of organisations known to the authors. We cannot definitively state that we reached theoretical saturation, but we heard similar answers multiple times, and believe that a larger number of interviewees would have resulted in considerable overlap and repetition.

¹ For context, the interviews took place after the 2016 ‘Brexit’ vote, and after the publication of the government’s 2017 Industrial Strategy Green Paper [27], but before the publication of the 2017 Clean Growth Strategy [4].

Further, we found that there was a fairly small pool of people with interest and expertise in finance and energy efficiency, and this limited potential interviewees; indeed, several recommendations of potential interviewees were for authors of some of the reports and papers we reviewed.

A set of interview questions was developed to investigate investment options for energy efficiency, policy and regulatory drivers, and financial institutions, tools and business models. Interviewees were also asked about attitudes towards financing energy efficiency in their respective sectors. The questions were informed by the literature review, for example the critiques of the Green Deal led us to seek out interviewees' attitudes towards it and what policy instruments might replace it (see section 5). Similarly, the contrast between the German public development bank KfW and the UK Green Investment Bank, and the notion of a civic energy sector, led us to ask about the role of national and local institutions (see Section 6). The list of interviewees is in Table 1, and the list of guiding questions is in Appendix 1.

From the literature and interviews, we identified three key aspects around which documents and stakeholders proposed reframing policy relating to financing domestic energy efficiency: *energy efficiency as infrastructure*, *new business and financing models for energy efficiency provision* and *decentralised financing institutions for energy efficiency investment*. The first of these was a recurring theme from our initial literature review, which we found promising, and interviewees were asked specifically about the framing of energy efficiency as infrastructure. The second and third were identified as the most common other themes in the interviews and literature. In the following sections, we discuss how these aspects can inform policy and action challenges of linking available finance to energy efficiency projects needing financing.

4 Energy efficiency as infrastructure

Investing in energy efficiency in housing requires a long-term perspective, is relatively capital-intensive and brings social as well as private benefits. Some policy analysts therefore argue that this should be considered as a type of infrastructure investment, comparable to national investments in transport or energy supply infrastructure [39–41]. This relates to both to the time it would take to retrofit millions of homes, and to the high expenditure per household this would entail, requiring potentially long-term loans for homeowners. This is in line with the long-term nature of other sustainability related issues, and the idea of a transition to a low-carbon economy. However, the challenge arises of linking finance to projects, such as creating long-term finance mechanisms appropriate for homeowners.

In this section, we examine the implications for finance and policy of considering aggregated energy efficiency measures in homes as an infrastructure problem. We then discuss the role of pensions, as an example of an institutional investor, in terms of the supply of finance for investment in energy efficiency.

4.1 The case for framing energy efficiency as infrastructure

It has been argued that domestic energy efficiency, when suitably aggregated, could be seen as an infrastructure issue with investment priority in the EU [39] and UK contexts [40,41]. These authors argue that domestic energy efficiency investments fit the broad definition of infrastructure as capital investments in physical structures, which bring significant systemic benefits. Such investments free up capacity in the energy system; this is done via demand rather than supply, but that does not change the economic (or energy savings) outcomes. Moreover they save money through avoided investments in energy infrastructure. This logic has already been successfully used in ‘least cost investment’ requirements, for example in the US, where many states require supply-side investments to be tested against demand-side options before permits (e.g., for power plants or transmission lines) can be issued [42,43]. We would add that this approach highlights, and is appropriate for, the large scale of investment needed to improve domestic energy efficiency in the UK.

A retrofit company director (#11) argued that “that is exactly how government should see the whole energy network and energy conservation – as an infrastructure issue. Yes, and they should be investing in it in the same way because it’s in the public interest”.

This reframing would require the government to intervene in order to reward the social benefits of these investments. Its role would be both to lead with a strategy and to provide capital spending where an investment gap now exists. Even where infrastructure is privately financed, the UK National Infrastructure Commission has argued that government roles can include long-term commitment to securing patient capital, providing support or insurance to reduce risk, and creating reliable funding streams to ensure projects are financeable [44], all roles with advantages for energy efficiency. There is strong support for the infrastructure approach from business and local authorities [40], and potentially from public opinion, as a 2013 poll found that 57% of people believe energy efficiency should be in the government’s top infrastructure priority [35].

From an economic perspective, the infrastructure approach could create jobs, stimulate local economies, and help poorer households [41]. It would enable subjecting energy efficiency projects to economic appraisals, raising their profile by highlighting their benefits, not only their costs [39], as a think tank analyst (#1) put it:

“Using the same methodology that the government uses for other infrastructure, which it is going ahead with, in the age of austerity... We found that the refurbishment of buildings outperformed those other infrastructure investments [Hinkley, Crossrail and High Speed 2]. On a like for like basis, there is a strong economic rationale for doing this.”

Therefore, the right energy efficiency policies could attract investors who currently invest in infrastructure projects. Nonetheless, doubt was expressed by an academic researcher (#4) about whether such investment would in fact yield the returns on investment that would make it attractive, as:

“at the moment it just doesn't give the kind of return to private capital that private capital looks for. So if the government is not prepared to subsidise it, for want of a better word, in some way then I don't think it is viable, no. ... I think energy is just too cheap at the moment [for many energy efficiency measures to make economic sense].”

Defining energy efficiency as infrastructure would enable shifting energy efficiency to the capital expenditure budget, unleashing both the potential of public-private partnerships and the power of local and regional authorities to deliver energy efficiency and demand reduction measures [39]. This would also enable the benefits of energy efficiency investments to be compared to those of other infrastructure investments, as the government requires the National Infrastructure Commission to make recommendations as to what the most critical long-term infrastructure needs are [44].

While there was support for the idea of treating energy efficiency as infrastructure from most of the interviewees, and some had in fact worked on the idea, concerns were raised by consultants, including the challenge of aggregating together a large number of small projects:

“I think energy efficiency has a lot in common with infrastructure in that it's long-term, low risk investment. The way in which it differs very markedly from infrastructure, of course, is this whole issue of scale and aggregation because infrastructure funds typically want to invest very, very large amounts.... I have a friend who runs an infrastructure fund. Even if it's €1billion, they're kind of, 'It's a bit small.'” (#10)

Another issue was that the idea isn't well known in mainstream investment circles, leading to concerns over lacking a concrete 'thing' to invest in:

“I guess the issue is that with infrastructure projects, whatever happens, you know, I'm going to own a piece of a railway for instance, or a bridge. In energy efficiency projects I'm going to own a sort of promise to pay the difference between what I would have otherwise spent on energy and what I now do because you've upgraded my capital. So, I don't think it is the same business case.” (#3)

These concerns highlight the difference in the challenges of financing energy efficiency and renewable energy. Energy efficiency is diverse and disaggregate, requiring too big an investment for many households, but too small for most investors. We suggest that there is a need for new business models and new financing models, which can help raise demand and link energy efficiency projects to available finance. Framing energy efficiency as infrastructure could help make these links, but does not in itself create innovative finance; in fact, new private financing models for infrastructure appear to have slowed in recent years in the UK [44]. Interviewees' views also support the need for a strong and consistent policy framing from government, as the long-term planning and investment required for infrastructure mean it cannot be provided by markets alone. Even if private finance can provide significant infrastructure investments, there is an important role for governments and public finance in directing change and reorienting global finance towards sustainable infrastructure markets [15,45]. We turn next to look at the drivers and constraints from the perspective of investors, using the example of pension funds.

4.2 Short termism and pension funds

We turn now to consider how framing energy efficiency as infrastructure could intersect with another financial issue: *short termism*. Changes to the global finance system including the expansion of capital markets have led to pressure from financial markets to maximise short-term returns. In addition, in the wake of the 2008 global financial crisis, policies of quantitative easing and near zero interest rates led to expansion of liquidity, making it harder to source ‘patient capital’ to invest in long-term, low-return, low-risk projects [46,47]. This increasing ‘short-termism’ makes companies less able to invest and build value for the longer term, reducing the stability of the financial system, and sidelining long-term issues such as sustainability [21,45,48,49].

Institutional investors such as pension funds have traditionally been seen as sources of long-term capital. Pension funds are among the world’s largest asset owners, and they invest on behalf of long-term savers. Such institutional investors should be concerned with long-term performance, given their long-term liabilities, and that they can act as patient capital, investing in a counter-cyclical manner, including investment in riskier assets and at times when markets are weak, thereby increasing stability [24]. However, there are structural constraints on low carbon investment by institutional investors, including immaturity of asset classes, lack of liquidity of long-term investments, short-term drivers pressuring fund managers and lack of secondary market vehicles [9]. Interviewees from the finance sector confirmed that pension funds are now seen more and more as short-termist. These could be due to pension funds either succumbing to political pressure or lacking the expertise to make long-term investment decisions [24,48], as well as easier fund management, as an independent consultant explained (#3):

“Illiquid assets, which [are] very hard to value, become this sort of big, quite volatile element on your balance sheet. And so pension schemes are generally encouraged by their sponsors to be more short-term. Not necessarily because the returns are better, but because the management process and the accounting process dovetails better.”

The consultant (#3) also suggested the culture of the finance world gives impetus to short-termism, and the regulation fosters this culture. An example of this dynamic is the growing trend towards defined contributions (DC) pensions², as an investment officer of a large pension scheme explains (#6):

“Defined contribution pension schemes, which are the growing ones at the moment, it’s industry convention that they invest in investments that are daily priced, so you can trade them daily. So there’s a problem for DC schemes investing in illiquid, longer-dated investments.”

However, there are now signs that such institutional investors are starting to pay attention to these changes, with pension funds more aware of their power. In the UK, some of the largest pension funds are now ‘active stewards’ of their assets [50]. Pension funds can sign

² In direct contribution (DC) pensions, the pension paid is related to the total amount paid in and how well the investments have done, rather than to, for example, the final salary.

up to 'smarter' schemes and indices that can enhance environmental, social and governance (ESG) considerations in investment decisions, making it possible to engage with climate finance and other issues [51]. A programme officer at an energy efficiency partnership (#9) explained, while some investors are governed by short-term interests, "many investors are working towards decarbonising their portfolios now, which is why they are becoming increasingly interested in investing in more energy efficient assets".

However, pension investments in energy efficiency schemes are largely off the radar, again suggesting that aggregation and linking investors to projects are key, as illustrated by a pension scheme officer's (#6) experience:

"We've also invested whereby people have aggregated all of the solar panels on houses in a certain area, and then we've supplied the debt for that. But we didn't go out and instigate that; they were looking for investors in that debt."

A further complication, explained by an investment bank research analyst (#2), is that energy efficiency is not as appealing as breakthrough technologies like electric vehicles: "It's just not a theme which brokers or sector analysts are suggesting as an excitable investable theme at the moment compared to a few years ago".

Framing domestic energy efficiency as infrastructure shows that it is theoretically feasible to link institutional investors such as pension schemes to energy efficiency projects. We argue that this could satisfy the logic of long-term, low-risk investments for pensions, and their interest in more sustainable future and decarbonising their assets. However, this goes against the prevailing financial culture, where institutional investors take a de facto short-term approach focussing on liquid assets, and are therefore less likely to invest in endeavours like energy efficiency as infrastructure. Even when institutional investors do invest in infrastructure schemes, the case for energy efficiency as such a scheme has not yet been made sufficiently, leaving investors either unaware or unconvinced of this avenue of investment, i.e., the links between financier and financeable projects still need to be made. Finally, the question of scale is crucial, as institutional investors require large scale investment, and will not normally invest in small schemes. This raises the question of aggregation of energy efficiency projects into large, investable packages in order for them to be of interest to mainstream finance mechanisms. We will consider this further in the context of business models and market solutions that could enhance the ability of investment in energy efficiency measures.

5 Business models and markets

Policymakers, in the UK and elsewhere, are looking to the private sector to fund the transition to a low-carbon economy (e.g., [22]). Private actors' investment behaviour depends on policy and market signals, predictable and stable profit, and strategic potential. Therefore, shifting patterns of climate finance investment depends on managing project risks, as well as access to finance and gaining technical expertise [51]. In the context of energy efficiency, investments are hampered by split incentives, disaggregated scale and poorly understood performance (which increases risk), making conventional financing

mechanisms a poor fit [52]. All of this suggests considering what the current business models are for financing energy efficiency, and whether – in the context of the UK residential sector – energy efficiency retrofits can be supplied through market mechanisms.

5.1 Lessons from the failure of the Green Deal

The Green Deal was an ambitious initiative launched in 2013 by the UK Government to encourage (financially sound) households to invest in energy efficiency improvements. The ‘pay-as-you-save’ (PAYS) finance mechanism aimed to deliver large scale retrofits without public subsidies in an age of austerity [37,53]. The PAYS mechanism is based on the idea of a loan to finance energy efficiency measures, which is paid back over time, e.g. through energy bills, so that for the payback period, the cost savings are effectively shared between the householder and the financier. Along with the Energy Company Obligation (ECO), the Green Deal was intended to improve residential energy efficiency, replacing two previous policies for household emissions reduction based on obligations on energy suppliers, the Carbon Emissions Reduction Target (CERT) and the Community Energy Saving Programme (CESP), as well as the fuel poverty reduction programme Warm Front [54,55]. The Green Deal is widely regarded as a failure, with original intentions of refurbishing millions of homes by 2020 failing to materialise, as only around 20,000 home energy improvements were funded between 2013-2015 [37].

There are various explanations of the Green Deal’s failures to attract householders, with [53] defining three areas to learn from. First, it was a poorly designed policy. There were no guarantees of energy savings and more expensive measures were effectively excluded. Frequent criticisms from our interviewees were that it was overly complex and bureaucratic. Second, the Green Deal had limited financial appeal, with interest rates above mortgage rates or high street secured loans, compounded by lack of grants. Even the upfront assessment costs (Green Deal Advice Reports) were more expensive than many households were willing to pay [54]. The Green Deal also failed to leverage private investment, resulting in a high cost to the taxpayer, when the political attraction of the Green Deal was private finance without government support [37,53]. Third, there was narrow engagement with consumers, as the policy looked solely at financial savings, ignoring home aspirations such as comfort, well-being and health.

Given the Green Deal’s narrow economic framing, it is not surprising that saving money was the primary motivation for participating households [54]. However, an academic researcher’s (#4) argued that while UK homeowners might be interested in the Green Deal offer, “it is certainly the case that they’re not prepared to finance it for themselves, except under rather special circumstances”, pointed out that when grants (i.e., upfront support, unlike PAYS) were available for retrofitting, there was no shortage of demand. In other words, this view suggests that a market correction with lower cost loans would be insufficient to solve the Green Deal’s failings.

The Green Deal’s failure inflicted lasting damage to the retrofit sector in the UK, as the loss of momentum led to significant drops in the rate of retrofits since 2013 [56], with the home insulation rates in dropping to a 2017 low of 5% of the 2012 peak rate [57]. This lack of an

effective financing mechanism means that even cost-effective and comfort enhancing opportunities are now missed, including loft and cavity wall insulations, each of which could save a typical home £100 a year or more in energy bills, with a payback time of less than four years [58].

Interviewees expressed concern about where the post-Green Deal policy left us, including shocks to the markets and putting off skilling people in appropriate retrofitting in the future, as an academic researcher (#4) explained:

“There will be a lot of people who went through that training who now have skills that are not being used and will make other members of the profession much less likely to engage in that kind of upskilling in the future. So that was, in a way, a real tragedy.”

These shortcomings highlight both the sheer scale of the energy efficiency challenge, in terms of number of diverse households that have to be convinced or helped to retrofit, and the need for a coherent and consistent policy environment in enabling a healthy energy efficiency sector with enough skilled labour to carry out the work.

Unlike the scathing criticisms cited above, most interviewees thought the PAYS mechanism was useful, with a sustainability officer in a local authority (#12) suggesting it would incentivise people if it had a low or 0% interest rate. Several interviewees said that the basic structure of the Green Deal was sound, as this analyst (#1) put it:

“The Green Deal Finance Company was a really excellent initiative. The problem was there was never a focus on how you were going to change demand at scale. Actually, that whole programme, the Green Deal, with a few tweaks around demand creation would have really nailed the issue on how we connect capital to projects.”

While the head of an energy efficiency NGO (#7) suggested that the Green Deal did what many in the energy efficiency field expected, appealing to certain households only, and:

“It was only a political decision to characterise the Green Deal as something that was going to solve every problem that meant that it failed. So I think it was mis-sold by the politicians.”

However, others disagreed, with one policy expert (#8) questioning the Green Deal focus on getting the interest rates right, “Or is it that it simply doesn't work effectively as an opt-in model, that you have to create a systematic model?”. Another point raised was how poorer households would be served by these business models. A programme officer at an energy efficiency partnership (#9) suggested the Green Deal's goals could be achieved by leaving it to energy planners, and that:

“If you find a better way to benchmark, to evaluate, and monitor your projects then there you go, you don't necessarily need an innovative business model in order to make that work.”

We suggest that the focus on financial barriers was inadequate in its appeal to homeowners, certainly correcting the ‘market failure’ of the Green Deal with lower cost loans would be insufficient, and that a different engagement with households would be necessary. The

Green Deal would in any case be limited to economically attractive measures and to households able to pay an upfront cost and *motivated* primarily by finance (i.e., return on investment).

Considerable research into the decision-making of homeowners who undertake energy efficiency retrofitting indicates that, while financial concerns are important, so are context, routine and disruption, and social influences (for a good review see [59]). Recent research further highlights the importance of positive experience in both process and outcome, recommending social networking for homeowners to share experience and recommendations [60]. Some interviewees mentioned comfort and long-term guarantees as crucial for a successful business model. The director of an energy advisory company (#10) highlighted the importance of a good 'value proposition' (offer to customers):

"Comfort and modern housing, or housing that's fit for the 21st century, is a much better customer proposition than, 'You might save a couple hundred quid on your energy bill.' With the emphasis on might because you're not actually that sure... You retrofit because you want a modern, comfortable, healthy house."

This matches applied behavioural research, which recommends situating energy efficiency retrofits within the broader question of why homeowners renovate their homes, and considering everyday life in energy policy, not just one-off decisions [61]. With this in mind, the next section considers on how new business models might be built, learning from the Green Deal.

5.2 New business and financing models

This section considers the prospects for new business and financing models that might learn from the Green Deal, and successfully increase uptake of good quality energy efficiency measures in UK households. We focus on two examples: revolving funds and holistic, whole-house retrofits.

One proposed financing approach using the pay-as-you-save (PAYS) model is the *revolving fund*, which is based on the idea of capital raised being circulated and used more than once: loans are repaid with interest, replenishing the fund and allowing for further loans to be made. Revolving funds are established with the intention of being self-sufficient for long periods, usually requiring a one-time initial investment with capital coming from public sector or private sector loans [17,62]. This model has been suggested for household energy efficiency [63]: Initial funding, probably from private investors, is collected in a 'special purpose vehicle' (SPV), which invests funds in domestic energy efficiency measures. Participating households in turn make regular repayments to the SPV, allowing it to pay installers, and over the longer term, repay investors, potentially making the fund cost neutral over time.

There are advantages and disadvantages to a revolving fund [17,63]. The PAYS mechanism offers households a share of the energy savings generated, while the aggregation of many households offers a more attractive scale of investment to finance, with economies of scale reducing cost and risk. Revolving funds can reduce dependency on external investors,

offering a long-term financing structure, potentially free from political influence. However, this model requires the government to underwrite loans to homeowners, in order to mitigate investment risks, which could be interpreted as a subsidy to the private sector. Further, revolving funds in energy efficiency require substantial upfront investment and could be cumbersome and expensive to administer. Finally, as with the Green Deal, the market orientation means the fund might be limited to economically attractive measures and exclude poorer households; this might not suffice to meet climate change commitments, and market forces could mean local government and communities lose power over deciding local priorities. A framing of energy efficiency as (part of) a long-term government vision could address many of these issues, e.g., by offering reassurances to private investors, prioritising administration and regulation to guarantee energy savings, and leaving decision making powers in the hands of homeowners and local authorities.

A very different approach is taken by a recent study of residential retrofits in the UK [64], suggesting a successful business model would include a value proposition which focuses on “aesthetics, comfort, health and wellbeing”; guaranteed energy savings; a simplified customer interface; and a low-cost financial model. The study criticises the ‘atomised’ business model, which suffers from a siloed supply chain, focusing on individual measures installed by separate contractors, and does not guarantee energy performance. It rather supports whole house retrofits and a ‘one-stop shop’ providing customers with a single point of contact. The whole house retrofit approach opens the possibility of a wider market, as it can attract homeowners interested in renovation who had not considered improving the energy efficiency of their homes – and could enable policy to bundle energy efficiency measures with other home renovation measures [61]. One example is Energiesprong [65], a company offering whole house retrofits with an innovative business model: retrofits are financed through energy savings and reduced maintenance costs (for housing associations); the company uses the social housing sector to launch their market; and they work with governments to improve regulations. The market approach of Energiesprong is in line with the opinions of the director of an energy advisory company (#10):

“If you came up with the right business model that was very popular in a particular market segment like single-family homes or large apartment blocks run by housing associations, if you have the right customer proposition, you would be overwhelmed by demand I suspect. Nobody seems to have come up with that customer proposition yet.”

On the other hand, the fact that no business has come up with the right customer proposition is telling, and indeed, other interviewees’ disputed the idea that new business models were needed, and whether, in fact, the market approach was the right one. Regardless of business model, most interviewees agreed that lack of available finance was not the main barrier to investment in energy efficiency. Rather, there needs to be demonstrable demand in place for the finance world to have the confidence to invest, as head of an energy efficiency NGO put it (#7):

“We keep being told that the finance companies are keen on this, yet they're not pushing it. I can only conclude, from that, that they don't think there's a market at the moment. It's not worth them promoting this.”

Finally, it is worth considering the scale of the challenge: energy efficiency is not a single market, but includes a range of end-users and decision makers in small dispersed projects [17]. It is hard to picture how a single, successful business model would appeal to *all* households; rather, there is a need for diverse and robust policies to support and convince a large number of diverse homeowners and other households in their decision to retrofit. For example, PAYS schemes are better suited to well off homeowners, while poorer households might require grants; and privately rented properties need different mechanisms due to the split incentives between landlords and tenants. In addition, specific measures to tackle more expensive ‘deep’ renovation are needed, such as obligations to direct a proportion of funds towards deep renovation or through special funding streams with contributions from the private sector [66].

In summary, the consideration of new business models does not lead to simple, nor fully agreed on policy solutions. However, there is general agreement of a need to engage consumers beyond the financial reasoning to establish demand; and that in order to link finance and demand, trust must be built through guaranteed savings for householders, and returns for financiers. We turn next to the role that more trusted institutions, including local and regional initiatives, could play in successful energy efficiency programmes.

6 Decentralisation, local and regional solutions

Another route for financing energy efficiency would be through dedicated institutions such as banks, which can provide investments that target policy priorities, or initiatives that might come from local authorities or local and regional partnerships.

6.1 Dedicated banks

State investment banks (SIBs) can catalyse low-carbon investments directly through capital provision, but also indirectly through ‘de-risking’ investments and ‘crowding in’ private finance by being a first or early mover. They can also play an educational role by assessing low carbon projects more in-depth than financial actors can, and signalling to the investment community that investments are trustworthy [67]. Beyond individual financial mechanisms, SIBs can play a part in implementing policy visions by taking on a ‘mission-oriented’ role, shaping and creating markets, not just addressing market failures [68].

In 2012, the UK launched the *Green Investment Bank* (GIB) with the government as its sole shareholder [69]. This was in line with suggestions following the global recession of 2008 that such a bank could strategically use public finance to secure private investment in low carbon infrastructure [70], and it has in fact been successful in lowering the cost of capital for more ‘difficult’ green infrastructure projects [69]. The GIB has successfully addressed a range of barriers for energy efficiency investment using skilled personnel and specialist funds and financial tools [67] but it has only financed energy efficiency measures for large

scale consumers [8,69]. It has not played a major role in domestic (or other small scale) energy efficiency measures, and only lends in terms equivalent to those of commercial banks [67]. In contrast, the German public development bank KfW is considered a success in investments for energy efficiency improvements, having financed retrofits in 9 million homes (as of 2010) to higher energy efficiency standards as of 2010 [71]. KfW uses its strong credit rating to source capital with which it offers refinancing options for energy efficiency loans and renewable energy projects, lending to fund smaller scale loans and enabling the local energy sector to grow [8,72].

This is an example of how the UK's centralised, market-based finance is structurally unsuited for supporting small scale energy projects, resulting in a 'finance gap' for projects below city level [8]. Some think "there's a clear logic for the Green Investment Bank to get involved [in domestic energy efficiency], in the sense that it's a very cost effective way of reducing carbon", as the head of an energy efficiency NGO (#7) put it, and therefore "surely, it should be high on the list of priorities for something like the Green Investment Bank". Given the scale of the energy efficiency challenge, a central body like the GIB which can manage lower cost loans, as the KfW does, is worth consideration; however, this would require more direction and long-term vision from government. Further, it requires energy efficiency investments to be made before renewable subsidies are paid, sending a clear message about demand (and emissions) reduction. An academic researcher (#4) explained that households had to put up a considerable part of the money for retrofits, but the greater the level of energy efficiency they aspired to, the higher the grant they received.

"And that seems, in the German context at least, to have been quite effective in encouraging householders who [wanted] to improve their energy efficiency, actually to go that one step further than they might otherwise have done, because they got a larger grant to do it."

6.2 Local action

In contrast to the centralised finance structure of GIB, research found that catalysing local (i.e., municipal) government can create new partnerships, helping to address local finance gaps and "mobilize the entire value chain of local climate finance. Through these partnerships, the creation of a 'market place' is enabled." [73](p 5).

UK cities are taking up the cause. A director of retrofit company (#11) detailed how larger cities like Birmingham, Bristol and Sheffield have invested in energy or waste projects, often in partnership with the private sector. These authorities are thinking long-term and taking advantage of their ability to borrow money at low interest rates, especially in the current economic climate. This action might also reflect dissatisfaction with central government, as a think tank analyst (#1) explained, "there is a general trend for local authorities just being really fed up with governments flip flopping in policy and trying to drive this agenda forward themselves".

One of the largest and most successful domestic retrofit schemes in the UK was the Kirklees Warm Zone, which installed insulation in over 50,000 homes in the Kirklees area of West

Yorkshire in 2007-2010 [74]. The scheme was the initiative of the local authority (Kirklees Council), which funded just over half the £20.9m costs, with the remainder funded by private company Scottish Power, managed by a not-for-profit energy company, Yorkshire Energy Services [74,75].

The scheme saw high uptake (nearly 3 in 10 households), notably exceeding standard projections for middle and high income areas. Energy use savings are estimated at 14.8% across participating households, with additional health benefits from warmer houses, stimulation of the local economy and a rise in house price value [74,75]. Webber et al. attribute the success to an emphasis on quality of installations and significant consumer engagement, including household visits and sustained marketing. Also, in contrast to the Green Deal, Kirklees Warm Zone offered free surveys and assessments, with free loft and cavity wall insulation installed where feasible [54,74].

Examples like this support the case for local and regional initiatives to help realise the potential of energy efficiency programmes. Unfortunately, the centralisation of control and the loss of local and regional capacity in the UK has reduced the effectiveness of policies [76], and there are few initiatives which “focus on supporting Regional and Local financial institutions in identifying needs, opportunities and gaps.” [73](p 5). Such initiatives can be more effective, ensuring that environmental and social benefits of projects are internalised [73], for example, by taking advantage of local authorities’ knowledge of fuel poor and vulnerable households [40]. Moreover, local institutions and businesses, as well as community groups, are more widely trusted than central government and large energy corporations [5]. For example, some regulators prefer PAYS schemes where bills are collected by a housing association or local authority, distrusting utilities, due to the risk of disconnection in case of default [17].

The ‘Civic Energy Sector’ refers to energy systems owned by local authorities and civil society structures such as communities, cooperatives and citizens, and their role in a transition to a low-carbon economy [8]. Local initiatives can be seen as examples of the UK’s small but growing civic energy sector, which has a potential to play an important role in financing and supporting energy efficiency and demand side management activities. The recent government Industrial Strategy Green Paper [27] suggests stronger, better developed sectoral and local institutions are good for economic competition. The description includes local financial institutions and local enterprise partnerships, compatible with the idea of a strong civic energy sector, although the emphasis is on the private sector, for example, giving businesses “direct role in shaping the future of their local communities” [27](p 120). We suggest a new framing for domestic energy efficiency would benefit from actively promoting the civic energy sector and increasing local capacity.

7 Conclusions and policy implications

Various policies over the years have not succeeded in raising energy efficiency of the UK housing stock fast enough to meet ambitious climate change targets. This paper argues there is a need for a new, more positive framing for domestic energy efficiency policy, which

moves beyond addressing barriers and market failures. We suggest have identified three aspects of a new policy framing: *energy efficiency as infrastructure; new business and financing models for energy efficiency provision; and decentralised financing institutions for energy efficiency investment*. We argue that this could help address the challenges of linking finance to energy efficiency projects by better addressing the needs of both householders and investors in order to create investable opportunities that are appropriate and attractive. We now offer some policy recommendations from our work.

The first area of recommendations is around **government action and leadership**. While our interviewees had different opinions of the role of government and public finance, there was strong agreement that the UK government lacks the direction or long-term vision needed for a major energy efficiency overhaul. There is a lack of continuity, with changes in policy direction and agenda, damaging the energy efficiency sector as investments in skills are not rewarded, and confidence in policy drops. This (perceived) lack of leadership stems partly from a neoliberal political economy in the UK, which frames the low carbon transition in terms of state-enabled competitive markets [8]. However, short-termism and risk avoidance in the finance world suggest the markets cannot be expected to solve the energy efficiency problem on their own. The government needs to show strategic, long-term commitment to domestic energy efficiency improvements: public policy can affect the direction of innovation and change, including shaping and creating markets [77]. In other words, there is an important and necessary role for government in any large scale energy efficient retrofitting of UK homes, *even if the mechanisms are to be market-based*. Showing commitment and leadership are necessary in order to signal to the private sector that financial investment in energy efficiency is a long-term government priority. An example of such leadership is Mission Innovation, the intergovernmental initiative launched at COP 21 to increase R&D funding for clean energy, in which the public sector seeks to draw in private sector investors [78]. An example at the national level might be reframing energy efficiency as an infrastructural issue, with government taking on responsibilities accordingly, including rewarding social benefits and providing capital spending where an investment gap now exists.

The second area of recommendations is around **guaranteed energy savings**. Homeowners require guarantees for financial planning and trust building, as well as for considerations of home comfort. Both the German KfW and the Kirklees Warm Zone show examples of successfully demanding high renovation standards, partly through decentralised finance and action from local actors and networks. Empowerment of decentralised institutions, through nurturing the UK's civic energy sector, could promote high standards, with local authorities and others working in collaboration with central government and in partnerships with the private sector. Government needs to work together with energy efficiency actors both to improve regulations for retrofits, but crucially also to ensure that innovators with new business models or value propositions are not hampered by current policies and regulations. These innovators can act as bottom up intermediaries who facilitate the creation of new business models and niche markets [79], as has been recommended in the energy services context [80]. Finally, a proven, sustained demand for energy efficiency is needed if private

finance is to be drawn in; guaranteeing energy savings would help challenge overly conservative risk assessments from the finance sector.

A third area of recommendations is around the **scale of the challenge**. Millions of households in the UK require energy efficient retrofits in order to meet climate change and affordability targets, suggesting this could be an investment large enough to interest mainstream finance. However, these homes and households are too diverse for any one policy or funding stream to address. Different approaches are needed for able-to-pay homeowners and poorer households; tenants of private landlords require consideration due to split incentives; and deeper retrofits, which are not financially attractive, might need separate funding streams. While aggregation of many projects, for example through a revolving fund, might be appropriate for many households and a suitable vehicle to attract investors, the government still has a role: first, in 'crowding in' and otherwise attracting private investors – for example, by underwriting loans in order to de-risk investments and by accepting that some public finance investments are inevitable, for example, through grants to poorer households. Again, we point to the high profile Mission Innovation as an example of governments seeking to crowd in private sector funding [78]. This finding supports previous research arguing that a comprehensive and well-targeted mix of policy instruments, based on a range of economic perspectives and analysis of what works in practice, is needed for energy efficiency policy [81].

Our final recommendations concern **engaging homeowners** beyond information provision and financial incentives. A wider framing could incorporate whole house renovation, and aspects beyond energy savings, such as comfort and modernity. New business models can play a part, for example through having a single point of contact for the consumer, for information, renovation and finance; and through more holistic business models and chains of supply suited to deep retrofits and a whole house approach, rather than piecemeal installations [64]. Decentralised institutions, such as local government, and even (local) social networks can also play an important part through engagement with consumers and using local knowledge to build trust.

While this study is UK based, and issues such as transforming housing stock to make it more sustainable are country and context specific, we believe there are lessons that can be generalised for other countries. Much of the finance related research we draw on is international. In the current global economic climate, there are limits to pure public funding on the one hand, while market-based solutions are limited by their very nature on the other.

Our study suggests that leveraging investment at the household level, as the Green Deal attempted, is not a viable large scale solution. Rather, for the scale of finance needed, new finance mechanisms are needed to make investments attractive to both householders and investors. This includes considerations given to different business models that might appeal to different types of households in terms of their finance and (potential) motives for renovation.

Thus, while the details of new framings for financing energy efficiency are necessarily country specific, depending on institutional settings, we believe the broad ideas outlined here are widely applicable. Specifically, we suggest treating energy efficiency as infrastructure, and decentralised financing institutions for local or regional funding, are two widely-applicable approaches.

We do not offer a complete and rigid framing for financing domestic energy efficiency. However, we suggest that a successful framing that would better enable private finance to invest would include long-term government commitment, as for infrastructure; would foster new business models and funding streams; and would empower a variety of decentralised actors and intermediaries to successfully engage with households.

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Appendix 1: questions for interviewees

Below are the questions that guided the semi-structured interviews. These were not used as a script, but as a list of points to cover, as appropriate by position of interviewee.

I: investment options.

1. What are the current financial investments options in energy efficiency (EE) and demand side measures (DSM) ?
2. What are the attitudes [in your sector] towards EE and DSM investment?
(i.e., Are EE and DSM seen as viable investments?)
Are attitudes changing?
3. How do you see the main barriers to increased investment in EE and DSM?
4. What might make the finance sector more interested in such investment?

II: policy and regulation.

5. How do you see the main regulatory barriers to increased investment in EE and DSM?
6. What policies and regulations currently support such investment?
7. What policies and regulations might increase such investment?
8. What role should the government play in investing and enabling investments?
Is public finance necessary or desirable to encourage investment?
9. What do you think of framing energy efficiency as an infrastructure issue?
10. Where does the demise of the Green Deal leave us? What might replace it?

III: institutions, tools models.

11. What role do institutions such as the Green Investment Bank play in large scale investments in EE and DSM? What role could they play?
12. What other financial institutions might increase such investment?
13. What financial tools or business models might enable and encourage such investment?
e.g., green bonds? revolving funds? PPI?

IV: local, city level.

14. What opportunities are there at city level for large scale investment in EE and DSM?
15. What are the main barriers to city- or council-scale investments?
16. What policies or regulations might enable such investments?
17. What business models might accelerate such investments?

Appendix 2: summary of interviews

Table 2 below summarises relevant views and insights from the interviews, loosely grouped by topic: finance, policy and government, business models and tools, and households. Table 2 below summarises relevant views and insights from the interviews, loosely grouped by topic: finance, policy and government, business models and tools, and households.

topic	discussion
finance	
short-term and long-term	<p>Several interviewees discussed the need for long-term investments and patient capital, and the problems of short-termism, which was blamed partly on the culture of the finance world.</p> <p>Pension funds were discussed as long-term, large-scale investors, although they don't often invest in infrastructure. The shift towards defined contribution was seen as making longer-term investments more difficult. Cheaper and simpler fund management was also a consideration.</p>
public and private funds	<p>Several interviewees discussed issues of public and private funding of energy efficiency.</p> <p>The scale of investment suggests it cannot be publicly funded, and that 'throwing money' at the problem was not helpful. Rather, the role of public finance could be to fund specific projects, underwrite and de-risk investments, and otherwise leverage or 'crowd in' private finance. It was recognised that there are currently few examples of private finance in the energy efficiency sector.</p> <p>The private sector would have a role in delivery, and the role of government could be in creating special purpose vehicles or public-private partnerships. It was stressed that that this needed to be managed with care to avoid giving perverse incentives to planners or otherwise having benefits 'siphoned off' by the private sector.</p>
barriers to investment	<p>A few interviewees detailed barriers, risks and uncertainties to private sector investment.</p> <p>Barriers included lack of confidence in demand for energy efficiency; lack of credible projects for investment; and lack of expertise in financial institutions; all of which hampered the creation of a market for energy efficiency. Additional barriers are lack of visibility of energy efficiency investments as part of real estate assets; and fossil fuel subsidies which send the wrong signal.</p> <p>Risks mentioned include low returns, especially without standardisation, and difficulty evaluating energy efficiency investments.</p> <p>Standardisation and aggregation were mentioned as necessary for</p>

	<p>financiers to invest, as individual – or even local – projects are too small and varied for large scale investment. Comparison to large and small scale renewable energy was made by some interviewees.</p>
<p>policy and government</p>	
<p>leadership</p>	<p>Several interviewees commented on the need for government direction and leadership in refurbishing the building stock. Currently, there are weak policies and a lack of long-term vision.</p> <p>Government roles mentioned included policy and regulation, leveraging private finance, directly financing elements that are a public good, such as data collection, and demand management.</p> <p>Overall, it was seen that government should lead on energy efficiency refurbishing of the national housing stock, with one suggestion that the government might be best placed to rollout large-scale refurbishment. Another interviewee highlighted that energy efficiency has been politicised (alongside issues such as energy poverty), complicating matters. Leadership could also be demonstrated using public estate portfolios.</p>
<p>stability</p>	<p>A few interviewees addressed long-term policy. There has been a lot of short-term thinking on renewable energy and energy efficiency; past policy shifts shocked the whole market. Without long-term policy being clear, the large energy companies will only deliver shorter term contracts.</p> <p>There is a need for a long-term energy efficiency strategy, with careful consideration of implementation, including detailed standards and sectoral policies, including building codes and appliance standards.</p> <p>There seems to be increased recognition from policymakers that energy efficiency is cost effective in fighting climate change.</p>
<p>local action</p>	<p>There has been a lot of action at local government level, with various cities having energy related projects. However, local government has limited powers in the UK.</p> <p>One example discussed was the Kirklees Warm Zone (see section...), a successful regional energy efficiency refurbishment scheme, where half the money came from the local authority and half from an energy company, as a conduit for a government grant.</p>
<p>business models and tools</p>	
<p>business models</p>	<p>There were different views on the need of new business models for energy efficiency. There were suggestions that better benchmarks would be sufficient, but others thought that a new value proposition for householders was needed, and that the lack of a good proposition was part of the failure of the green deal.</p>

	<p>Business models and mechanisms mentioned include household mortgages varying my energy efficiency rating and the Energiesprong refurbishment model at household level, up to revolving funds and even capacity markets with demand side bids to encourage larger scale investment and action. The motivation of suppliers was considered too, in terms of changing their business models to be better aligned with investments in long-term demand reduction.</p> <p>There was much criticism of the Green Deal (see section...), with mixed opinions about whether the basis of the scheme – the pay as you save mechanism – could be made to work at large scale, or whether the opt-in model was less effective than a systematic model.</p> <p>The Green Investment Bank was seen as only investing in large scale projects and avoiding households, unlike the German KfW.</p>
infrastructure	<p>There were mixed views on the possibility of treating energy efficiency as infrastructure (see section...). Conceptually, most agreed there was sound reasoning. However, in practice, only a few saw it as viable and desirable. Others were sceptical for reasons including the intangible nature of energy efficiency, the need for different mechanisms for different households, and the mismatch of scale between investors' sums and the small individual energy efficiency projects.</p>
households	
behaviour	<p>There were various opinions on householders' behaviour and motives for refurbishment, considering that demand for energy efficiency is a necessary part of the equation. Some suggested there is more money available for investment than demand for projects.</p> <p>Barriers to uptake include cost, hassle to find information and complexity of the process, and the disruption of the refurbishment itself. Another is cherry picking, with fast wins, such as loft and cavity wall insulation, already done for most houses, leaving more complex projects. The reputation of energy efficiency was also mentioned, with scare stories about the 'green sector' contributing to high energy bills.</p> <p>Reducing energy bills was not seen as a sufficiently attractive customer proposition. Rather, comfort and quality of life were seen as better motivators.</p>