



Original research article

## Rethinking retrofit: Relational insights for the design of residential energy efficiency policy

Donal Brown<sup>a,\*</sup>, Lucie Middlemiss<sup>b</sup>, Mark Davis<sup>c</sup>, Ruth Bookbinder<sup>b</sup>, Iain Cairns<sup>d</sup>,  
Matthew Hannon<sup>d</sup>, Giulia Mininni<sup>a</sup>, Marie Claire Brisbois<sup>a</sup>, Anne Owen<sup>b</sup>, Stephen Hall<sup>e</sup>

<sup>a</sup> University of Sussex, Science Policy Research Unit, University of Sussex Business School, UK

<sup>b</sup> University of Leeds, Sustainability Research Institute, School of Earth and Environment, UK

<sup>c</sup> University of Leeds, School of Sociology and Social Policy, Faculty of Social Sciences, UK

<sup>d</sup> University of Strathclyde, Hunter Centre for Entrepreneurship, Strathclyde Business School, UK

<sup>e</sup> Ashden Climate Solutions, 5 Wilton Rd, Pimlico, London, UK

### ABSTRACT

The ‘retrofit’ of energy efficiency, low carbon heating and renewable microgeneration measures in homes is a major focus for energy and climate policy. Yet despite policy interventions, few countries are achieving their residential decarbonisation targets. In this paper we argue that a core reason for this failure is the mainstream ‘rational actor’ framing of households, which guides energy efficiency policymaking. We introduce an alternative ‘relational’ framing to re-examine the assumptions surrounding the retrofit ‘customer journey’ and the accompanying policy framework. In doing so, the study draws on three United Kingdom (UK) case studies, exploring the customer journey of households self-funding renovations and retrofit, via ( $n = 30$ ) semi-structured interviews. We argue that by paying attention to relational dynamics, we can better design policies that work with the grain of existing household practices and social relations. This includes: 1) Leveraging existing entry points such as when renovating or moving home 2) Aligning with how households currently seek advice and procure renovation services 3) Developing solutions which factor broader motivations than simply cost savings 4) Designing inclusive and long-term financing models and 5) Building trusted ongoing relationships between contractors and communities. Consequently, we argue a paradigm shift in retrofit policymaking towards a relational approach is now required.

### 1. Introduction

The ‘retrofit’ of energy efficiency, low carbon heating and renewable microgeneration measures in existing housing is a major priority for energy policy. In the high income nations of Europe and North America retrofitting remains a pressing, yet intractable energy policy challenge for achieving net-zero carbon emissions. In Europe this challenge is expected to require approximately \$1.3 trillion in investment by 2035 [1] and a tripling of the annual renovation rate from <1 % to >3 % [2]. This challenge is especially acute in the United Kingdom (UK), where a large proportion of the existing housing stock is over 100 years old, and is still likely to comprise most housing in 2050, when UK net-zero ambitions must be achieved [3]. Indeed, in their ‘balanced pathway’ scenario, the UK’s Climate Change Committee (CCC) estimate that 15 million households will require at least one main insulation measure (loft/wall/floor), a further 8 million requiring draft-proofing, and almost all un-insulated hot water tanks receiving insulation by 2050. Further, around 21 million homes will also need to be retrofitted with a

heat pump to meet the 2050 net-zero objectives [4]. The aim of this work is reframe how this retrofit policy challenge should be conceptualised and delivered.

The low uptake of cost-effective<sup>1</sup> energy efficiency measures has long been presented as a paradox in energy policy discourses [5]. Under the logic of micro-economic theory, rational households seeking to improve their welfare should invest in measures that have the potential to reduce energy costs and result in net savings over the long term [6]. Yet uptake remains low. This has typically been explained through the language of ‘barriers’ [7], where market failures impede the efficient allocation of resources [8] and if these are lifted, uptake will grow. Consequently, ‘applied behavioural research’, grounded in microeconomics and psychology has dominated the framing of how policy can unlock retrofit [9]. This literature emphasises: 1) Overcoming information asymmetries – where households are unaware of the energy saving options available [10] 2) Hidden or transaction costs – relating to the time, work and cost involved in procuring energy efficiency measures [11] 3) Insufficient access to capital – meaning households cannot afford to invest in energy

\* Corresponding author.

E-mail address: [donal.brown@sussex.ac.uk](mailto:donal.brown@sussex.ac.uk) (D. Brown).

<sup>1</sup> Cost effectiveness is generally understood to mean measures which pay back their cost of installation and maintenance with energy savings over the measure’s lifetime. However, this payback period will be affected if discounting is applied.

efficiency measures, despite potential returns [12] and, [4] Bounded rationality – “where constraints on time, attention, resources and the ability to process information lead to optimising analyses being replaced by imprecise routines and rules of thumb” [13]. The ‘rational actor’ framing that this literature adopts suggests that public policy’s role should be focused simply on removing these barriers, to allow households undertake what are assumed to be cost optimal improvements.

Microeconomic and psychological framings have been extremely influential in retrofit policy design across Europe and North America. These framings have shaped the approach inherent in the UK retrofit policy regime over the last 25 years or more, including the development of public information programmes, consumer protection and accreditation standards, home energy audit and energy performance certificates, grant funding, and specialist debt finance [14]. However, while noting some clear successes,<sup>2</sup> few countries are on track with their retrofit objectives to deliver home decarbonisation [16]. The UK, for example, has had a series of high-profile policy failures in recent years [17,18], and retrofit rates have dropped from almost 2 million homes in 2012 to about 100,000 in 2021 [19]. Unlike the thriving home renovation maintenance and improvement (RMI) market, representing ~£22bn p.a. in the UK in 2017–2019 [20], few nations have yet developed a significant self-funded retrofit sector, beyond government grant programmes [21].

In this paper, we argue a core reason for this continued failure is the mainstream framing of the retrofit challenge, which guides public policymaking. We argue that rational choice theory [22], behavioural psychology [23] and welfare economics [24] provide an important but limited theoretical contribution to solving the retrofit challenge in the coming decades. Instead, we introduce an alternative framing of this challenge via relational sociology, which helps us to reconsider some of the assumptions that have shaped residential energy policy in recent decades [25–27]. In doing so, we re-envision the retrofit ‘customer journey’ through a relational lens, learning both from sociological theory, and from the RMI market in which households invest billions each year (e.g. [25]). We subsequently provide policy recommendations for how retrofit policy design could integrate the relational perspective.

The paper is structured as follows. In Section 2 we introduce the concept of the customer journey, as an analytical device which increasingly pervades policymaking in this space, before introducing the relational perspective. Section 3 outlines our methodology. Section 4 offers an analysis grounded in the UK experience and draws on 30 semi-structured interviews with UK homeowners in different tenures and locations, who had recently undertaken renovation and retrofit measures on their home. Section 5 provides a discussion of the findings and their implications for retrofit policy design, while Section 6 outlines our conclusions and policy recommendations.

## 2. Literature review

### 2.1. Dominant policy approach & introduction to relational sociology

The notion that individual economic and behavioural factors may not tell the whole story, is not new in energy policy discourses [32]. Yet, the contribution of sociology to understanding the challenges in moving to a low carbon society, has often been seen as a poor cousin of the more ‘scientific’ and positivistic explanations of the drivers of human behaviour. Indeed, Shove [33] highlights the limitations of public policy that seeks to influence the attitudes, behaviour and choices of individuals, whilst ignoring the importance of social and cultural factors, and how these influence practices surrounding home, energy use and climate change.

We find concepts from relational sociology especially insightful here (e.g. [23,48]). Relational sociologists emphasise that the unit of analysis

should not be individuals or institutional structures, but instead the ‘social relations’ between actors [77]. In this view, economic transactions such as undertaking a retrofit project are primarily socially constituted processes [26]. Here, the central concept of ‘relational work’ [34] from the relational sociology literature “elucidates how economic actors create, maintain, solidify, change, and perfect the relationships that exist between them through economic processes” [35].

Crucially, this literature argues that the heuristics that guide household decision making, and thus relationships to money, are not solely economically rational but instead largely socially relational in nature. Thus, households rely upon networks of strong and weak ties with family and friends, neighbours, and place-based intermediaries to gather advice [9]. People are usually seeking to satisfy goals beyond financial returns alone, and generally rely on trusted relationships or personal recommendations when selecting contractors [9]. We believe this has important implications for the effective design of retrofit policy.

### 2.2. The retrofit ‘customer journey’

The customer journey has become a prevalent feature of commercial service design [29] and increasingly pervades public policy [30]. The basic concept is that customers undergo a series of sequential steps when receiving a service, and at each stage there are opportunities and pitfalls to ensuring a smooth and positive customer experience. This thinking is manifested in the design and delivery of UK retrofit policies, where both the Green Deal [31] and Energy Companies Obligation (ECO) [32] policy documents prescribe a specific customer journey, involving the initial entry point, a household survey, obtaining contractor quotations, securing financing, and the completion of works (see Fig. 1).

In the following sections, we first explain how the retrofit customer journey is envisaged in the contemporary UK energy efficiency policy discourse, highlighting some of the core ‘rational’ assumptions which inform these policy approaches and how this frames the problems they seek to solve. We then continue to operationalise some of the key ideas and concepts from relational sociology, contrasting the insights and implications for each step. Note that we are aware that this is somewhat of a simplification in places: in the sense that ideas rooted in micro-economic theories are not followed precisely in policy. We do contend, however, that these assumptions are either explicitly, or implicitly, designed into many UK energy efficiency programmes, and are codified into public procurement guidelines, such as regulatory frameworks, training standards and building regulations [14]. We offer examples throughout to bring this contention to life.

#### 2.2.1. Entry /trigger point

Much policy design is informed by a micro-economic logic, and tends to hold a strong assumption that energy consumers are primarily motivated to save money on their energy bills, and thus would respond to marketing and information centred on cost savings. We see this in the language used in relation to retrofit grants and loans, which frequently discusses the ‘payback period’, assuming that the household’s motivation to engage is saving money. Drawing from behavioural and welfare economics (e.g. [39]), the assumption, therefore, is that the likely entry point for households is their willingness to undertake an energy efficiency project as a means of saving money on their energy bills. The primacy of this assumption was most evident in the UK’s Green Deal retrofit loan programme (2013–2016), which required all measures financed under the programme to have a payback period within the lifetime of the loan, forming a ‘golden rule’ [31].

A logic drawing from relational sociology suggests that a broader range of motivations to engage in renovations and retrofit are likely. These may involve aesthetic or amenity improvements, increasing comfort, fixing damage, or increasing space and functionality for the occupants [34,35]. Relational studies highlight how these decisions are often suffused with alternative meanings and are designed to satisfy the emerging needs of changing households, for example increasing space as

<sup>2</sup> Such as the rapid diffusion of condensing boilers in the 2000s [15]

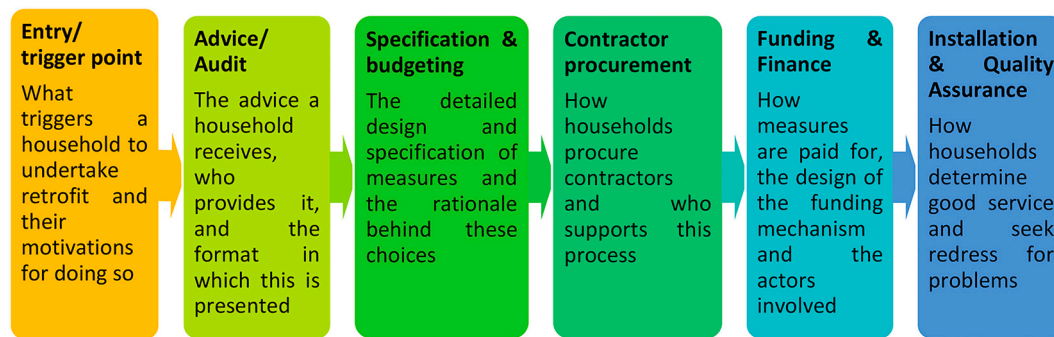


Fig. 1. Schematic of generic retrofit/renovation customer journey (Derived from [31]).

families grow, or ensuring comfort for older relatives [36]. By unpacking the range of entry points and motivations for undertaking a renovation project, we are better able to grapple with the plurality of goals, life needs and relationships that drive these decisions – providing a more nuanced understanding of how we might influence change.

### 2.2.2. Advice and energy audit

A second assumption concerns energy saving advice and the role of an energy audit in determining a home's suitability for different measures. Here, following a rational choice logic, policy aims to address the market failure of 'imperfect information' regarding knowledge of the costs and benefits of energy efficiency measures [37]. Thus, motivated households are assumed to seek out advice on different energy options via public information programmes and websites. Subsequently, home energy audits or surveys are undertaken by a trained professional who provides detailed technical advice.<sup>3</sup> For example, the UK's energy regulator Ofgem's ECO Guidance [38] stipulates that measures must be recommended via a pre-retrofit assessment, development of an improvement option evaluation and medium-term improvement plan. This has given rise to specialist accredited professions that undertake these audits and provide advice, such as Domestic Energy Assessors (DEA), and the more advanced Retrofit Coordinator pathway (a form of independent project manager). It has also resulted in emergence of retrofit one stop shops [39] (e.g. Cosy Homes Oxfordshire), however within these schemes, information is still typically presented in terms of cost savings and payback periods.

A relational approach would suggest that rather than seeking specialist advice from accredited professionals, *relationships of care and intimacy* with family and friends, or those with neighbours and colleagues are likely to be the key trusted networks from which advice is sought [36]. Indeed, studies highlight a bricolage approach to seeking advice [74] where more intimate forms of advice are augmented with specialist advice via *relations with agencies and communities* [36], typically a local council, neighbourhood internet forum or community energy agencies. A relational approach would also expect *relations of identity* (ibid.) and *past experiences* to further shape whether this advice is trusted. Here factors such as gender, ethnicity, age, religion, may have a major impact on decision making, including who to turn to for advice. For example, Owen et al., [40] observed how low income, Asian origin households - living in terraces, in cities such as Bradford - applied for the ECO grant at a rate twelve times higher than average. This is suggestive of social relations within these communities being a key driver in the adoption of the ECO scheme (ibid.).

### 2.2.3. Specification and budgeting

A rational choice logic would assume that rational consumers will specify only those measures that deliver lifetime cost savings and

<sup>3</sup> i.e., using Standard Assessment Procedure (SAP) energy modelling software, which underpins the UK's Energy Performance Certificate system (EPC)

prioritise those with the shortest payback periods. Many energy efficiency programmes do indeed place prescriptive requirements on which 'eligible' measures can be installed or funded. For example, the UK's Green Homes Grant required households to install a minimum number of 'primary' insulation or low carbon heating measures, before they could be eligible for 'secondary' measures such as double/triple glazing with longer paybacks [41]. The Green Deal policy (2013–2015) required cost savings greater than the finance repayments [31].

From a relational perspective, the selection of home improvement measures is usually linked to the broader motivations for undertaking a renovation, with numerous goals often pursued in a single project (reference redacted [42]). Moreover, households rarely view energy measures and wider renovation works as conceptually separate [34]. In general, during renovation projects – even where energy saving, or comfort is also an objective – households do not typically consider "payback periods" in their assessment of project viability; instead mobilising qualitative justifications for why particular measures, products or manufacturers are appropriate for them [9]. These insights problematise retrofit strategies that rely on a prescriptive and overly financialised format to guide what householders choose to or are 'allowed' to do to their properties. Contractors can also be hugely influential in the final specification and have been shown to steer households away from renewable and energy saving measures [43].

### 2.2.4. Contractor procurement

During contractor procurement, under a rational choice logic, the customer would place a high value on having choice in a competitive marketplace, and to choose contractors on a lowest cost basis (c.f. [41]). In government led energy efficiency programmes, households are often asked to choose contractors from an approved list or via eligible accreditation programmes. New accreditation processes and standards are often required to deliver new retrofit programmes, where accreditation tends to be easier for larger and better resourced firms. For example, during the Green Homes Grant, contractors needed to be certified under the government's Trustmark scheme and PAS 2030:2019 and to also be following PAS2035 standards [45]. Given the short run nature of the programme, few small contractors had time to gain these certifications, resulting in accredited contractors travelling large distances to deliver measures [18].

Finding trusted contractors and how households build trust in this relationship is a critical element in the retrofit process when seen relationally. This process of *relational work* in building relationships with contractors, energy advisors, financiers, demands emotional and social labour. This may include asymmetries in knowledge and power, where one side must defer to the expertise of the other – trust that a verbal contract will be honoured, or an invoice be paid. It is therefore unsurprising that those engaged in renovation activity rely on trusted relationships, personal referrals and peer networks when seeking out these services – reducing this relational work. Such trusted relationships may be more likely between customers and small contractors, based locally,

making the accreditation process discussed above problematic. Moreover, these factors are especially prevalent within the RMI construction sector, well known for its informality and tacit knowledge base [28]. The desire to reduce relational work and the reliance on a wider relational infrastructure of friends, family, neighbours, or local social media forums for recommendations is clearly evident in the relational research on renovation to date [9,40]. Indeed, these approaches likely form the dominant means of procuring the billions of pounds of small building works that occur each year.

### 2.2.5. Funding and finance

Overcoming the financial barrier to undertaking retrofit projects has been a major policy focus – assuming that households are willing to either take on some form of debt and/or complete eligibility checks and paperwork to receive grants [12]. These funding approaches are usually designed to be ‘stand-alone’, assuming energy efficiency retrofit works are happening in isolation from other home improvements (e.g., refurbishment, extensions). For example, the Green Deal – a form of ‘on-bill finance’ – was designed to ensure that repayments do not exceed expected energy savings, such that households are financially better off following the retrofit. Moreover, many grant programmes are insufficient to cover the full cost of works and often include arbitrary cost caps which must be supplemented with a household's own contributions.

Relational sociology also provides important insights into how households view money and apportion different meaning to separate income streams and savings. This is embodied in Zelizer's [26] work on ‘earmarking’ – “*the way individuals and families ‘jam jar’ pots of money for specific purchases (e.g., food budget, bills, clothes, holidays, savings, and so on)*” [78]. Indeed, relational research on renovation suggests that people may earmark and envisage the suitability of alternate ‘forms’ of money on home renovation in different ways. For example, Bolton et al., [9] highlight a common refrain that money which is gifted or inherited is ‘earmarked’ as being suitable for investment in home improvements, while [78] note that many households have an aversion to debt in general. These studies confound the conventional wisdom of the welfare economics behind policymaking, namely that households treat all forms of money as equal, and fungible to any application [26].

### 2.2.6. Installation and quality assurance

The final steps in the retrofit customer journey are the installation works themselves, and processes of quality assurance designed to ensure works are undertaken to a high standard. A rational choice approach would suggest that an ‘information asymmetry’ exists between the customer and contractor – leading to a risk of ‘moral hazard’ [37]. For example, where the contractor cuts corners with substandard work, of which the consumer has limited knowledge and understanding. Policy recognises this risk and industry has relied on ‘competent persons schemes’<sup>4</sup> and compliance frameworks to mitigate the risk of poor-quality work and low customer satisfaction. Consequently, in 2016 the UK government undertook the ‘Each Home Counts’ review [46], recommending a range of strengthened retrofit compliance standards, including the Publicly Available Specification (PAS) 2030 and 2035 – now required on all publicly funded retrofit schemes. Householders are then expected to discern quality and seek redress from these standards.

Relational sociology further suggests that trust and the interpersonal dynamics between household and contractor are critical in shaping both the outcome of a renovation project, and in shaping attitudes towards undertaking future works. Thus Bandelj, [47] emphasises how *past experiences* shape *future expectations* – or in renovation terms, how poor-

quality work or unreliable tradespeople influence future decision-making, with negative past experiences causing a reluctance for undertaking renovations. Indeed, the relatively high prevalence of bad experiences in RMI construction [48] provides a strong explanation for why households turn to trusted social relations when conducting due diligence and seeking quality assurance. For contractors, the desire to maintain a customer base through social ties and word of mouth is one key motivator for employing best-practice and delivering a high-quality service [44]. This suggests that competent persons and compliance frameworks may be of limited value for households who prefer to develop ongoing relationships with trusted contractors in their local areas, the same contractors that may not be certified to do the work.

## 3. Methodology

This study examines three recent UK case studies, exploring the customer journey undertaken by 30 households to retrofit and renovate their homes. We use insights from these case studies to develop theory for a relational approach to the retrofit customer journey. We explicitly focus on data from retrofit and renovation projects, which were not directly funded or delivered by government retrofit policies, to inform the future design of these programmes. In doing so, we examine interview data from three UK case studies undertaken during 2021 and 2022 in Brighton and Hove, East Sussex; Otley, West Yorkshire; and Crosshill, Southside, Glasgow. These case locations were selected due to their familiarity and proximity to the three universities which contributed to the study. While there are differences between these locations, there was also significant variation within them including demographics and house type. In what follows, we do not focus on the differences between the locations, but rather the common features and experiences in self-funding retrofit and renovation work.

### 3.1. Case studies

In Otley, we explored renovation experiences of single occupancy dwellings (interview codes O#X). This involved 11 interviews with 15 people, from September to December 2021. Interviewees were recruited through social media using purposive sampling; selecting interviewees who were 1) owner-occupiers; 2) who lived in the Otley area; and 3) had recently carried out significant home renovations which had not used government grants to help fund the works.

In Glasgow, we examined the renovation experiences of multi-property buildings - typically referred to as tenements (interview codes G#X). Data was gathered through 11 interviews with 3 landlords and 8 owner-occupiers between November 2021 and January 2022. The study used multiple methods of recruitment, including social media via community Facebook pages; a local project partner's social media; posters on the streets of the case study area and flyers through letterboxes.

In Brighton and Hove, we examined the renovation experiences of private rented sector (PRS) through interviews with 8 landlords – between December 2021 and April 2022 (interview codes B#X). This included a range of building types. Interviews were sourced through key informants, snowballing techniques and via a university student union lettings agency and management company. Interviewees include six single property landlords, two of which did not originally intend to be landlords, while two had a portfolio of properties.

Focusing on households who had self-funded renovations enabled us to consider the decision-making processes for people who have already paid for retrofit and renovation works. We provided interviewees with a basic questionnaire covering their backgrounds and asked them to summarise the renovations they had done to confirm their suitability for the project. Interviewees were asked questions relating to their motivations for undertaking the works, how and why they selected contractors, the funding approaches they used and their overall experience of the works. Interviews were digitally recorded and transcribed by the research team.

<sup>4</sup> Competent person schemes are a way for tradespeople to prove their ability to carry out certain work to required standards. e.g., Association of Plumbing and Heating Contractors (Certification) Limited (APHC), Cavity Insulation Guarantee Agency Limited (CIGA), Building Engineering Services Competence Assessment Limited (BESCA).

The research team used the same coding framework to analyse the interview data across the case studies using NVivo software. The list of interviews is provided in Appendix A. The generic interview schedule, informed consent used & ethical approval, data storage and protection information is provided as supplementary material to this paper.

### 3.2. Data analysis

To determine overarching insights from the interviews, we adopted a framework analysis methodology. Here, data (in our case interview data) is sifted, charted and sorted according to key issues and themes using five steps: familiarization; identifying a thematic framework; indexing; charting; and mapping and interpretation [49]. This involved the lead researcher from each case study, coding their interview data under the key stages of the customer journey, to identify what was done, who provided the service and the explanatory factors or why these steps were taken, inputting these responses into a large spreadsheet table. A fourth researcher then recoded this data under a series of simplified categories of response, which could be rationalised under a single heading. For example, the diversity of entry points was reduced to several recurring themes such as “major renovation” or “stress purchase”. This allowed for a simple quantification of the prevalence of different themes and their presentation in graphical form. A glossary of these terms is provided in Appendix B. To supplement this analysis, especially for the “why” type answers, a conventional qualitative coding approach was taken using the core concepts from relational sociology outlined above, allowing for longer form quotations and interpretation of the data.

## 4. Results

We now present the findings from the case study data, structured using the six stages of the customer journey. At each stage we explore *what* activities occurred, *who* undertook them and *why* this approach was taken.

### 4.1. Entry points

The review of the interview data showed a range of entry points for *what* triggered the works. The most common was to undertake a “major renovation”, the second most common was works triggered by a “new house” purchase, while the third most common was due to a “stress purchase” such as a broken boiler (Fig. 2). However, works were also triggered by a “growing family”, “death” of a relative or an “inheritance”. Only one respondent described “high bills” as the main trigger for doing works, while another commented “[energy efficiency] is “not really something that I’ve ... thought very much about” (G3).

In general, the decision to undertake works was arrived at collectively by the adults in the household (i.e., G6; G8; O2; O3; O9; O14), although several mentioned the influence of friends and family, such as visiting a relative or friend’s new kitchen or extension as a key trigger for considering improvements (i.e., G9, O2; O13). None had been directly triggered by the influence of an external salesperson or direct marketing,

as is commonly assumed in energy efficiency programmes.

Key motivations as to *why* works were undertaken are shown in Fig. 3. These were most commonly ( $n = 8$ ) to make “aesthetic improvements” of the home:

“So, a lot of aesthetic reasons, but as I started to do work, I was finding bits of workmanship that wasn’t ideal, so you just end up going deeper and deeper until you’re happy with it” (O8)

As this quote shows, motivations to make “aesthetic improvements” would often then identify issues that required “damage repair”.

However, many households also cited “energy efficiency” and improved “comfort” as key motivations. Interestingly, only one respondent cited “bill savings” as the standalone reason. Instead, several undertook energy efficiency works alongside aesthetic and amenity improvements, to improve comfort and modernise the property:

“[We did] more decorative improvements, but we also installed secondary glazing and we’ve insulated the roof because we’re at the top where the roof is. And we have also insulated the back wall, which is north facing, because it’s the coldest wall” (B5)

### 4.2. Advice

The households interviewed generally had received informal advice from contractors, friends, family and neighbours on how to progress their project, and despite many undertaking energy efficiency measures, none had undergone an energy efficiency audit. Indeed, two interviewees from the PRS case study expressed an explicit distrust in the formal energy efficiency advice available: “calls from ... my local energy efficiency advisor ... we all know, are scam calls.” (B8), and “there is an issue of trust toward the government website regarding choosing the products (e.g., windows) and grants. Which products are good and why? What is the latest technology?” (B6). Instead, households relied on relations of intimacy such as family, friends, and neighbours as their key source of advice, although a large share also asked building contractors for advice. Remarkably few (only 5 of 30) households sourced the initial advice from “construction professionals” (engineers, architects, and surveyors) (Fig. 4). Several also relied on their own knowledge.

Respondents also commented on how a lack of good advice was a concern: “I don’t know that anybody really knows quite where to ... get sound advice” (B8), while another landlord (B1) had poor advice from an architect who was also a relative, having started an extension without planning permission and then had to demolish it. A lack of good quality advice was especially prevalent for energy efficiency and retrofit measures, where one interviewee had been discouraged from undertaking these works by a friend (O5). While another, frustrated with the lack of good online advice, sought advice from their engineer brother:

“It was difficult to choose which consumer guidance portal... I then spoke with my brother for advice, who is a mechanical engineer. He is not a tradesman. He understood what a good product was meant to be” (B2)

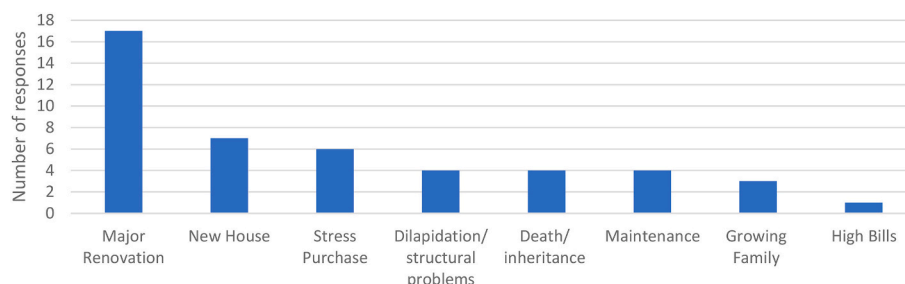


Fig. 2. What: Entry point for undertaking the works.

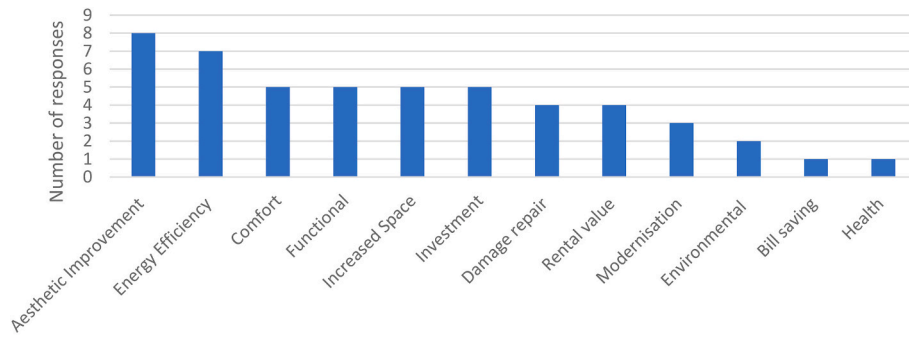


Fig. 3. Why: Motivations for undertaking the work.

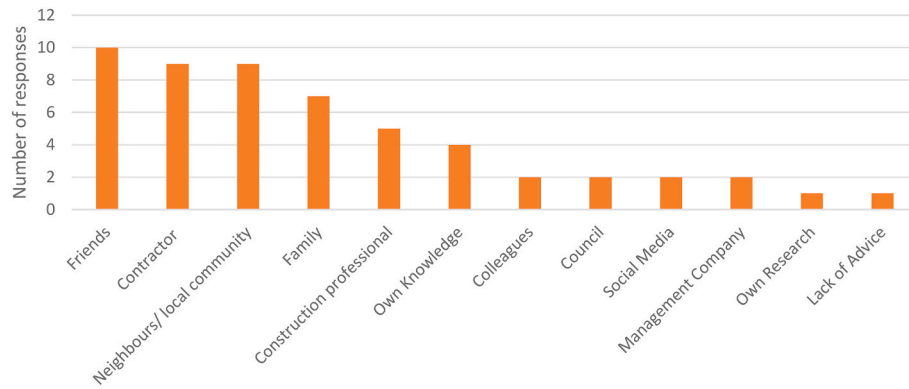


Fig. 4. Who: provided advice.

4.3. Specification and budgeting

While a large share of the measures installed across the 30 households included energy related measures (shown in red in Fig. 5), none of

the projects involved ‘standalone retrofits’ (energy measures alone). As a result, the rationale guiding the selection of measures was rarely just about cost savings but aiming to satisfy a multitude of motivations (as outlined in Fig. 3).

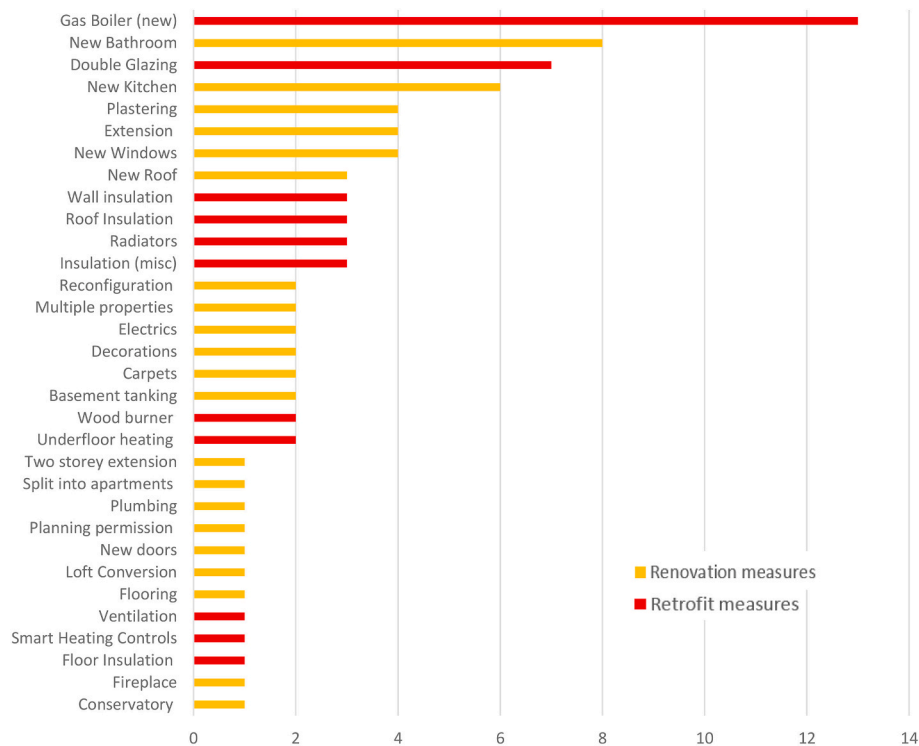


Fig. 5. Number of measures installed.

In developing the budget and specification, seven households used the contractor to choose the appropriate measures, while seven developed the specification themselves using internet searches, four utilised the support of family or while five relied on neighbours or their local community (Fig. 6). Friends were less relied upon at this stage. Thus, when making these final decisions, interviewees tended to rely on people with more specialist technical knowledge and information, i.e., when it came to the specifics of what kind of boiler to install, G3 spoke to installers explaining “sometimes [friends] were a little bit out of date with some of their information”. However, three interviewees did not create any kind of specification or budget.

Several respondents, mentioned that the initial budget was usually below the final cost of the project:

“It’s always 10 % or 20 % more because, with all houses, you’re never sure. That’s the problem. Once you take the wallpaper off, (Laughter) [you realise] the plaster below, behind it, is old, [what’s called] lime mortar plaster. (B3)

O10 also used a contractor’s site visit and specification, to inform their own DIY approach:

“I did get somebody to come round to price up the tanking downstairs. But really, I mean, I was just trying to find out how to do it actually. They told me. And then I just sourced some materials and did it myself, they were asking, quite a lot of money, you know...over £10,000”

(O10)

While, O13 felt that as a single woman, contractors were often trying to take advantage of them due to their gender “you sort of feel that people think you’re being a bit stupid sometimes”.

#### 4.4. Contractor procurement

Many relied on local contractor recommendations, when sourcing contractors, with a significant proportion undertaking work themselves. Indeed, the reliance on existing and local relational ties was once more strongly evident, with friends, neighbours, and social media again key routes to finding contractors. Fig. 7, shows the routes that households used to source them. When selecting quotes, eight interviewees directly mentioned comparing multiple quotes, while one sourced only one quote.

Trust and personal recommendations were key factors in deciding which contractors to use. “Once [I] established a good relationship with them [I would use them again] ...Trust was ... absolutely essential (B7). Indeed, some respondents evidently had strong relational networks with contractors on which to rely:

“Because in the building community, I know all the trades. I know architects. I know people who can draw plans.” (B3)

However, this process was also often seen as difficult due to a lack of good affiliations with trades:

“It was important to have someone they [the tenants] felt comfortable with...It is generally difficult to find tradespersons. It is difficult to find people to trust.” (B2)

Another participant felt the need to ‘test’ tradespeople to make sure they weren’t trying to take advantage of her:

“I think by doing that, people show their true colours as to how honest they are. If they say it in a way that makes it very clear to understand, and they give a reason that makes total sense... then you know that you’re onto a tradesman who knows what they’re on about.” (O3)

Others overcame this problem through relations to familiar household names such as British Gas: “the trust in a big company and a big organisation that we’d been dealing with for years ... It’s just easier to stick with the status quo, isn’t it?” (G3).

#### 4.5. Funding and finance

Half our interview sample used some form of savings to fund works, with inheritance second at 17 %, mortgage finance third at 9 % (Fig. 8).

We observed the regular earmarking of monies for specific renovation purposes in the data. Households were often averse to using debt and “would rather [use savings] than get a loan” (O9). One householder explained “I’m not into borrowing money, so unless I can save up and buy something I just don’t have it.” (G5). Some also linked this to family wisdom or household power dynamics “My father always said the heaviest thing you can hang around your neck is debt” (O12). Several respondents noted that receiving an inheritance prompted them to get work done (O1; O6; O7; O14), suggesting that interviewees may have viewed home improvement as a prudent rather than frivolous use of monies from deceased loved ones.

Several respondents also indicated a strong association between energy efficiency measures and grants, suggesting that households may have come to expect government support for these types of measure:

“I looked briefly [for grants] when we were putting in the new boiler, briefly at kind of newer ideas of heat pumps and all that sort of stuff, and grants around those. If I was going down that route, which we didn’t for cost reasons ... that was as far as I looked for grants, etc.” (O8)

“I looked for it but for windows and boilers I couldn’t find anything. There were some funds for solar panels” (B2)

However, there was little or no discussion of grant funding for wider renovation measures.

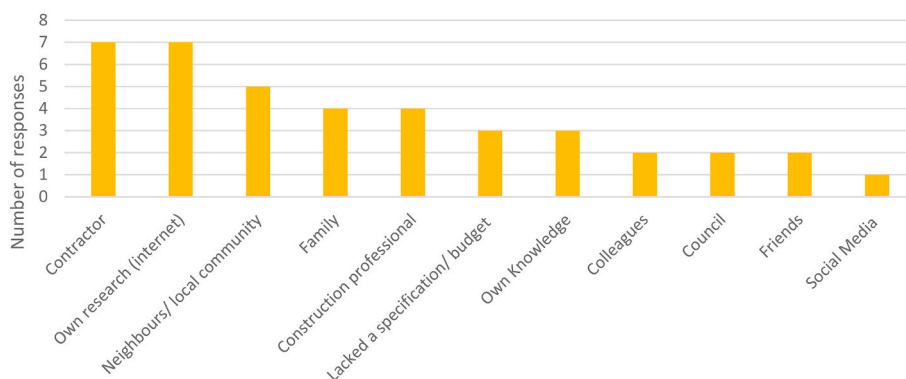


Fig. 6. Who: supported householders with the budgeting and specification of measures.

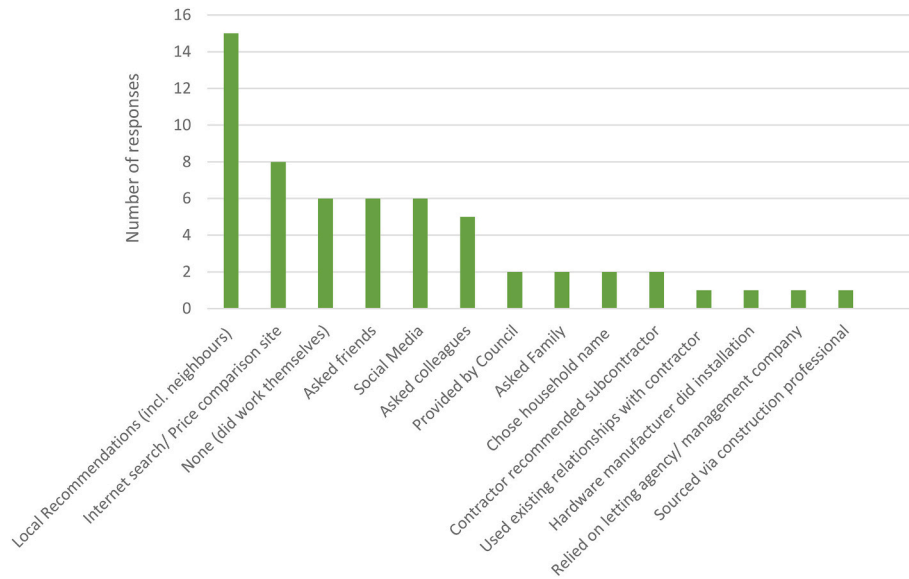


Fig. 7. How: did you procure contractors?

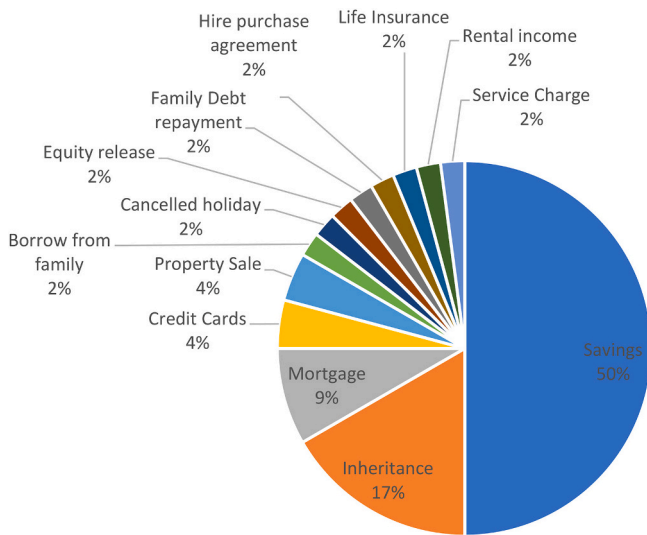


Fig. 8. How: was the retrofit/ renovation paid for.

4.6. Installation & quality assurance

Quality assurance is ideally seen something that occurs through the retrofit customer journey, however, the completion of the work was usually the point at which most respondents took a view on the overall quality of the works. Few of our respondents adopted a formal quality assurance process, sought redress through specific design standards (i.e., MCS, PAS 2030/2035) or respective trade bodies (FMB, NICEIC, CORGI). Instead, they relied on their own judgement, that of family or friends, and maintaining strong interpersonal relationships to ensure work was undertaken to a high standard. Households' past experiences of renovation work heavily shaped expectations and experiences during the installation phase. This could be both positive *“they were continuing to kind of reinforce [their] reputation with us”* (G5). But many also had negative experiences *“as soon as they [the contractor] went ... I tried to open it, and the knob of the window came [off] into my hand”* (O1). As shown in Fig. 9, 42% of those we interviewed had some form of negative experience, while 55% didn't report any major problems (‘no issues’).

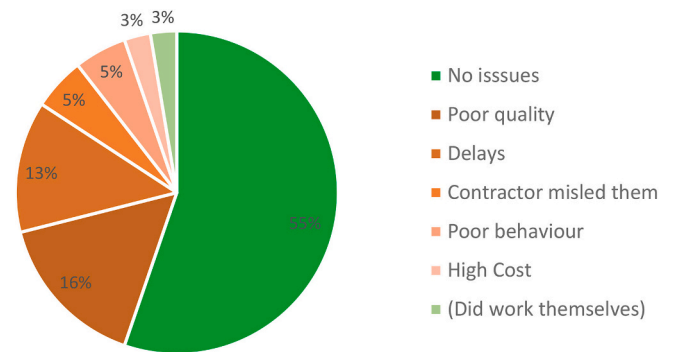


Fig. 9. Household experience of installation phase.

*“The building contractors were careless, disrespectful, ultimately untrustworthy, they were lying to us, didn't show up when they said they would, they weren't doing stuff in the way that they said they would, they were completely ignoring the architect's drawings and just making stuff up”.* (O8)

Several respondents also cited being female as a barrier when interacting with contractors, with one describing having to involve a male neighbour to get contractors to deliver on time:

*“He came round [the neighbour], and he gave him [the contractor] a right massive talking to, a real bollocking ... he says “when are you doing this?, when you doing this?, when you doing this?””* (O1).

This lack of trust in contractors also provided justification for doing the quality assurance themselves:

*“And that's why I do my own reading, because that's how you figure out people are telling you a lot of a load of nonsense; because he didn't think you needed Building Regulations approval and we did, so I had to do that separately after the job was done.”* (O8)

In one example, an interviewee was motivated to seek legal action due to the poor standards of work and lack of remediation (O1). Meanwhile, another interviewee noted that they had to retroactively get approval for works after the tradesperson *“didn't manage building regulations properly”* (O8). Indeed, the prevalence of negative experiences further underlines the logic of using contractors who come via



recommended sources.

#### 4.7. Summary

Table 1 summarises these relational insights on the renovation customer journey drawing on a synthesis of our interview data, comparing them to the rational assumptions outlined in Section 2. This includes *what* was done, *who* did it/ supported it and *why* this path was taken.

### 5. Discussion: rethinking retrofit policy

Drawing on our findings, we now share four key policy insights from our relational perspective, challenging ‘rational actor’ assumptions, towards reframing retrofit policy design. This discussion draws on a body of recent policy literature that identifies a range of potential policy interventions in the UK residential retrofit policy space, such as Brown and Bailey [50] and the UK National Retrofit Strategy [51].

#### 5.1. Policies to promote uptake

The first insight is that retrofit policies designed to leverage existing entry points to undertaking renovation works are much more likely to be successful [21,28]. Indeed, beyond a small market of early adopters willing to undertake ‘standalone’ retrofits, our research suggests that many more households may consider energy efficiency measures, when planning a major renovation, moving to a new house, when making repairs or replacing a broken boiler, or during key life junctures such as a new baby, or when their financial situation changes (i.e., inheritance). However, the pressures around a stress purchase may prove a more challenging entry point to drive the adoption of retrofit measures.

Our findings suggest a key area where policy can leverage existing activity and relationships is via the tax system. However, to be successful, these policies need to integrate with the existing network of professionals advising and operating in this space. For example, mortgage brokers, estate agents, property solicitors and surveyors, will be crucial in supporting energy saving stamp duty proposals, which would reward new home buyers for making efficiency improvements [52]. By allowing energy saving RMI projects to charge VAT at 5 %, provided EPC improvements are met, contractors and construction retailers could offer reduced quotations to households, ‘up-selling’ energy efficiency measures to customers with whom they already have a relationship. As an inheritance often triggers renovation work, incentives could also be linked to Inheritance Tax, which could be reduced where energy saving improvements have taken place. Again accountants, and tax advisors would play a crucial role here, as they are the key relational actor advising on tax affairs. However, these groups would require training and an expansion of their remit to fulfil this role.

Regulations are often seen as a last resort by policymakers concerned with public opinion, and economists with ‘deadweight losses’ [6]. However, our study suggests that regulations could be a key trigger point at key stages of the retrofit journey. Relational sociology implies that households may in fact view regulations as a beneficial means of developing shared norms helping to set boundaries, reducing relational work in economic transactions [53]. From this perspective, a future moratorium on fossil fuel boilers or MEES at the point of sale or rent, could provide a regulatory ‘boundary object’ which legitimises the adoption of low carbon alternatives with the wider construction community [54]. Indeed, several other European countries such as the Netherlands and Germany are pursuing MEES and moratoria on new fossil fuel boilers in the 2020s [55]. Our research suggests that effective integration with the installer community will be key to avoiding push

**Table 1**  
A relational vs rational perspective on the retrofit and renovation customer journey.

	Frame	Entry/ Trigger point	Advice/ Audit	Specification & budgeting	Contractor procurement	Funding & Finance	Installation & Quality Assurance
What	Rational	Standalone energy efficiency project	Formal advice on energy efficiency options	Expert specification of highest payback measures	Competitive tender via procurement framework	Specialist debt finance or grants	Formal quality assurance
	Relational	Major renovations, moving house, stress purchases (e.g., broken boiler), major family & life events (e.g., death, birth, new disability)	Informal advice, relying on anecdotes and experiential evidence	Ad hoc development of specification, where energy and aesthetic/ amenity measures are considered together	Search usually involves local networks and multiple quotes. However, cost only one factor in decision-making, with personal recommendations, locality, and reputation also crucial	Savings and inheritance are dominant funding forms. Debt often viewed as “inappropriate”	Households tend to rely on informal quality assurance, although are often dissatisfied with standards of work.
Who	Rational	Individual decision making, influenced by marketing/ sales professionals	Professional energy advisor	Trained professional energy advisors, architects, and engineers	Lowest cost contractor quote is chosen	Financial intermediaries and banks	Specialist retrofit coordinators and project managers
	Relational	Collective decision making by household members, but influenced by peer network	Friends, family, neighbours, and contractors, occasionally other professionals	Generally done by households themselves, although occasional use of professionals (contractors, architects, engineers)	Friends, family, and social network/social media heavily relied on. Where local networks are weak, trade directories and brand recognition important	Household and family dynamics may affect how money is managed and allocated. Concerns in involving finance and lending community	Where issues cannot be resolved by household, recourse to expertise in social network before more formal redress is sought
Why	Rational	Save money on energy bills	Need specialised technical expertise & advice	Maximise payback on energy saving measures	Consumer choice and lowest cost tender is preferred	Financial product will enable a return on investment	Quality assurance and compliance framework will ensure good practice
	Relational	Aesthetic improvements, energy efficiency & comfort, increased amenity & functionality, changing needs of household members	Trusted social networks seen as best source of advice	Seeking to meet multiple goals, and household needs, with only some goals financial	Existing trusted relationships and personal referrals seen as the most reliable methods.	Households use earmarking to delineate different forms of income, savings, and investment. Past encounters and social and cultural norms may	Low levels of trust pervade the RMI construction industry. Households therefore seek to develop existing relationships rather than rely on accreditation standards and frameworks
						shape views on financial institutions and products	

back on these policies [56,57].

A further entry point is to target retrofit programmes on a neighbourhood or area basis, leveraging the relational ties that exist in specific communities of place and practice. As Owen et al., [40] outline, fuel poverty programmes may be most effective when they engage a whole community, enabling word of mouth referrals from neighbours, and driving down the administrative costs of delivery. Therefore, our evidence suggests that area-based programmes, with less restrictive eligibility requirements, targeting specific neighbourhoods, and a range of income levels could be more successful.

## 5.2. Policies to support delivery

Secondly, our findings emphasise the ways households seek advice, choose which measures to install and the methods they use to source contractors are inherently relational. Thus, the provision of advice that relies on techno-economic payback periods, framed solely in terms of cost savings, fails to address the real reasons most people make improvements to their homes. Moreover, the centrality of relational ties and relational work in who households go to for advice, and the subsequent premium placed on personal referrals from trusted sources, problematises retrofit policies and programmes which ignore or even undermine these networks and relationships.

The lack of separation of energy efficiency works from general renovation measures, was also found by Kerr et al., who identify range of renovation narratives which provide a “*holistic perspective by incorporating a comprehensive range of the influences on the renovation experience*” [34]. As a minimum, home energy audits should gather information beyond just the building's physical characteristics and energy systems, but also the household's composition, their aspirations and plans for future home improvements, past experience with contractors, views on financing options, comfort and heating practices.

Our findings also emphasise how community groups could be of real significance in developing demand for retrofits. Putnam and Brown's [58] research on community-led retrofit, and wider research on the role of civil society in delivering social and environmental objectives [59], points to some potential policy solutions. While there are a few nascent examples, these programmes seek to build trust by developing local networks of advice and advocacy. These initiatives aim to utilise existing community organisations (such as sports clubs or faith groups) or create new ones, often under the banner of “community energy initiatives”. When successful, these approaches build grassroots networks of advocates and engage a broad polity of different household groups, via local intermediaries and champions [60]. However, while low cost and effective, this type of community outreach activity should not be viewed as a free resource. For example, when considering vulnerable households, a single point trusted point of contact may be required to support their journey throughout the delivery of the retrofit project [61–63]. This suggests public policy should provide financial and other support to these groups when designing delivery programmes.

Household preferences for contractors that are either known to them or referred from their social network also present significant challenges to the existing policy paradigm. The relational perspective offers two potential policy strategies to break this impasse. The first is that the RMI construction industry - poorly served by past energy retrofit policies such as the Green Deal and Green Homes Grant [17,64] - now have low trust in the policy process. Moreover, the levels of retrofit knowledge and skills in the UK RMI sector remains low [65]. Resolving this will require extensive retraining programmes, to build trust and capacity, adopting just transition principles (ibid). Given the influence of contractors on the choice of measures [43] this may be crucial to gaining industry buy-in [66].

A second strategy involves diversification of the workforce. Multiple female interviewees (HH7, HH12, O1, O3, O10, O13) reported gender discrimination from contractors - with no male interviewees reporting these issues. As evidenced by Bartiaux [67], our research suggests that

the construction industry needs to diversify to become more representative of the communities it serves, alongside improved training and codes of conduct targeted at the existing workforce. The UK construction industry has among the lowest female representation of any industry, with <2 % of female site workers, and only 5.4 % black or minority ethnic origin [68]. Making the construction sector more appealing to women, minorities and young people via greater employment rights and protections, such as holiday pay, sick pay, pensions, childcare support and on-the-job training and career development is likely critical [58].

## 5.3. Policies to support investment

A third area where the relational perspective can make a significant contribution, surrounds the funding and financing of retrofit measures. While our research emphasises that financial benefits are just one reason why households choose to renovate, the funding challenge to reach net-zero and address fuel poverty is substantial. In our data, we see an instinct to use savings and inheritance to fund improvements. Clearly, for many households this is not possible or desirable. However, our findings do provide important lessons for how public policy can design funding programmes to be more effective.

A central feature of contemporary retrofit grants is their restrictive eligibility requirements and onerous application processes. Such features may lead to these programmes serving those most able to navigate these processes. Specific attention should therefore be paid to supporting vulnerable groups [69]. Evidence from our research, previous ‘place based’ retrofit programmes [58,70], and Owen et al.'s [40] recent study in Bradford, also demonstrates a ‘relational adoption effect’, where community ties can be harnessed to increase adoption. Given the restrictions on the share that can be grant funded, Brown and Bailey [50] propose to combine grants and loans into a blended finance offer to most households, with the ratio dependent on income level. Thus, by removing the delineation between ‘able’ versus ‘unable to pay’, inclusive place-based programmes, could harness this effect, where most homes on a street could be eligible.

The aversion to financing retrofit via “debt” we encountered during our interviews presents a further challenge. In most UK policy scenarios, the lion's share of £500bn + for a national retrofit transformation is expected to come from private investment [51]. This suggests that policymakers must think creatively about the design and framing of future private finance mechanisms. As outlined by Brown et al., [12], successful programmes from elsewhere have tended to have simple administration, allow funding for non-energy measures and include a low rate of interest. Indeed, the research on property linked finance emphasises how long-term funding models, such as green mortgages or those linked to energy bills, or the tax regime may be viewed more favourably, especially if they are seen as integrating with wider renovation and improvement work [71]. Other finance options, such as council-issued climate bonds for social housing [72] and incentives tied to Council Tax could help to mitigate aversion to debt. Finding ways to link retrofit finance to a geographically-fixed house or property – e.g., US-style PACE financing – rather than to a geographically-mobile householder, would, therefore, appear consistent with how people interpret and earmark different ‘monies’ within the home. However, the ways in which these issues of trust, saliency and earmarking play out in the real-world context of retrofit and renovation financing requires further research.

## 5.4. Policies to mitigate relational work

A final overarching finding concerns how the different stages of the customer journey are integrated. For example, the typical customer journey during government retrofit programmes, involves multiple interactions with marketing agents, energy assessors, contractors, finance providers, and retrofit coordinators. When viewed through the prism of relational work, this level of complexity is potentially problematic.

Indeed, our findings suggest that households prefer to engage with as few unknown actors as possible, usually working with friends or family to find a trusted contractor who they rely on for the duration of the project, and ideally on future jobs. This presents challenges however, as there may not be a strong correlation between those who a household may trust, and those with the actual competencies needed to deliver complex retrofit projects. This suggests wider upskilling of the RMI construction industry on retrofit methods and techniques is needed [21].

Problematization of the effort involved in project managing these multiple elements is highlighted by Brown [62] and in Mahapatra's [73] work on retrofit one-stop-shops. Indeed, a range of retrofit one-stop-shops are emerging in the UK and Europe, with the aim of simplifying the retrofit customer journey [39]. However, there is as yet little peer reviewed research on the impact of one-stop-shops for households in different circumstances. Our research suggests that a 'one-size-fits-all' approach to retrofit programmes may be poorly suited to the complex needs, varying motivations and different circumstances faced by different households. This suggests a need for models that are flexible to individual needs and circumstances, trusted by communities and within social networks and responsive to existing actors and local supply chains.

Fig. 10 provides a summary of our relational policy insights for the retrofit customer journey.

In summary, the growing literature on the relational dimensions of energy demand (e.g., [9,36,40,62,74]) is providing important contributions to, and critiques of, contemporary residential energy policy. Indeed, this study has applied these concepts in the context of the retrofit customer journey, providing new, more granular insights and specific recommendations for policy design. However, given the focus on interpersonal dynamics, this literature is perhaps less able to elucidate the broader structural features, institutional norms and ideological underpinnings which produced this policy landscape in the first place. This suggests that, if we are to escape the individualising and 'rational choice' energy policy paradigm [9], new work is needed to bridge the insights [36] and methods [27] from the relational sociology of energy,

with the structural thinking and focus of political economy and policy studies [75,76].

## 6. Conclusions and policy implications

In this paper we argue that the foundational assumptions that guide retrofit, and energy efficiency policy require reconsideration. A central premise is that by learning from and integrating with the thriving renovation, maintenance, and improvement (RMI) sector, we can better design policies that work with the grain of existing household practices and social relations. To illustrate the need for this change, we problematise how the current 'rational actor' policy regime approaches the retrofit customer journey. Here, we highlight how only a small proportion of households are likely to consider a standalone retrofit project. However, many more may consider retrofit measures as part of wider renovation projects, when moving to a new house, when resolving damage/replacing faulty hardware, or when their material or family circumstances change. We further problematise forms of advice, financing and retrofit specifications which present recommendations solely in terms of payback periods, ignoring the existing advisory networks and the plurality of motivations that guide renovation decision making. Moreover, the importance of personal referrals and trusted networks in procuring works, is largely ignored by the current policy paradigm - with the complex system of competent person's schemes and quality assurance standards currently failing to build trust and drive quality in the industry.

We instead propose a new policy paradigm which integrates a relational perspective to policy practice, with our key policy recommendations shown in Table 2.

Delivering on these recommendations requires further research and we welcome the wider energy policy community to take up the ideas presented here. We also have drawn on a relatively small sample in contrasting locations, which includes self-funded retrofit and works done in the private rented sector. This necessarily limits the generalisations that can be made from the data to other tenures and locations.

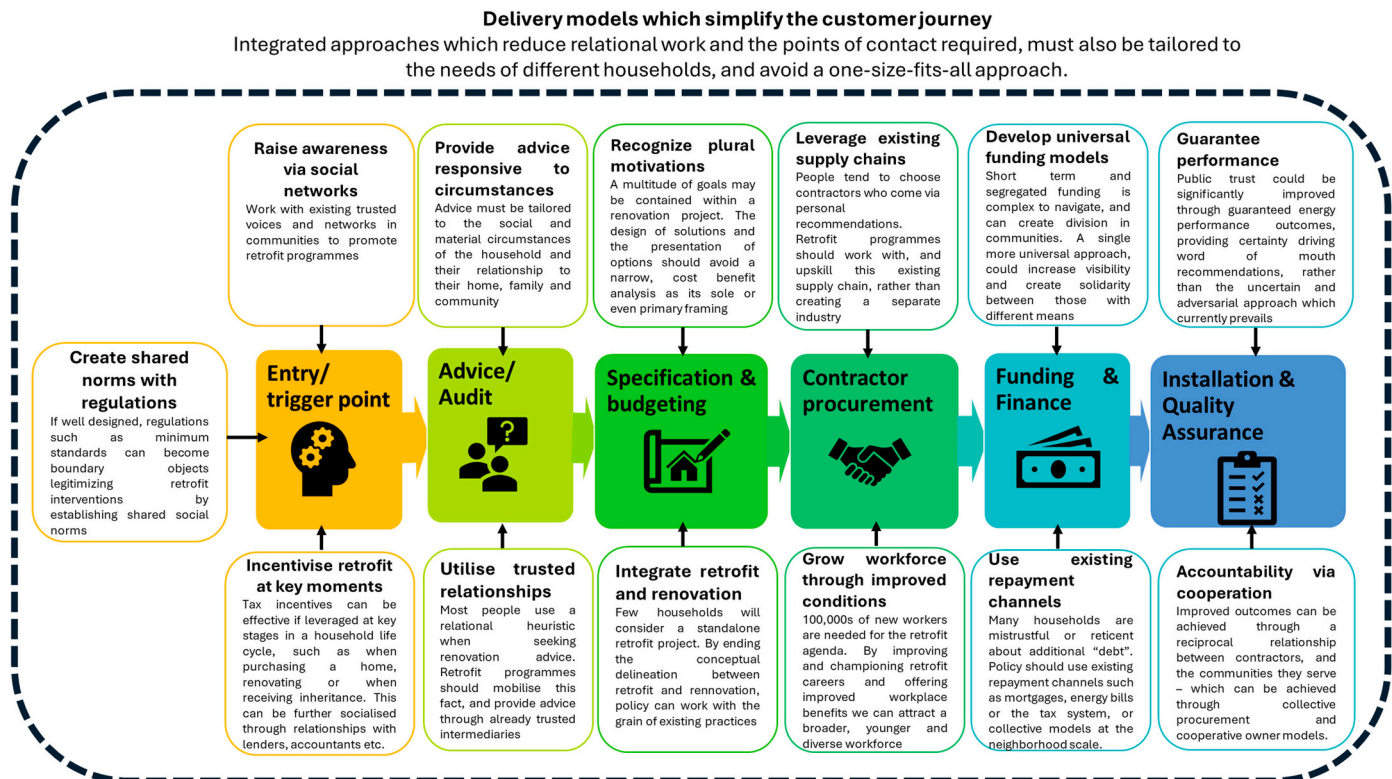


Fig. 10. Summary of relational policy recommendations for the retrofit customer journey.

**Table 2**  
Retrofit policy recommendations.

Delivery Models	Delivery models should avoid an inflexible ‘one size fits all’ offer, and instead focus on developing capacity and networks of social ties at key stages of the retrofit and renovation journey, with bespoke solutions (outlined below) tailored to the needs of different households.
Entry/ trigger point	Tax incentives, regulations and outreach activities which leverage existing trigger points and work with community ties are needed to drive uptake.
Advice and Audit	Retrofit advice must better align with the current ways in which households seek advice and procure renovation services, via trusted community sources.
Specification and budgeting	Retrofit assessments and subsequent specifications must factor broader motivations than cost payback periods and include non-energy and non-financial factors in their recommendations. Retrofit programmes should therefore seek to resolve existing maintenance and improvement works alongside energy measures.
Contractor procurement	<ul style="list-style-type: none"> <li>• Because households tend to rely on trusted contacts from their peer network, retrofit skills and accreditations within local SME supply chains should be addressed as a high priority</li> <li>• By focussing on improving the employment conditions of the SME supply chain, young people, women, and minority groups may be more encouraged to join the sector</li> </ul>
Funding and finance	<ul style="list-style-type: none"> <li>• Households’ aversion to debt requires the careful framing and design of financing mechanisms. Long term models linked to existing payment channels – such as property taxes – and integrated with wider renovation funding activities may be more successful</li> <li>• Combining place based fuel poverty and able to pay retrofit programmes by adopting a blended finance offer, may be more visible in communities and create solidarity between households with different incomes</li> </ul>
Installation and quality assurance	<ul style="list-style-type: none"> <li>• Quality assurance grounded in developing trusted ongoing relationships within communities, such as via workers cooperatives, may be more likely to succeed in ensuring quality than rigid compliance frameworks</li> </ul>

Future research should aim to develop a representative survey sample of households, to more fully characterise the range of motivations and activities occurring in the retrofit and renovation market and realise the potential for targeting policy at the neighbourhood level. We also combined data from three distinct locations, providing limited discussion as to the differences between them. Future, studies could look to compare the differences between locations, or the importance nuances

**Appendix A**

Case Study	Interview Code	Tenure	House type	Age	Education	Employment status	Job	Income	Key measures	Schedule
Brighton	B1	Private Rented Sector (PRS)								11.02.22
	B2	PRS private landlord								18.02.22
	B3	PRS private landlord								22.02.22
	B4	PRS professional landlord								28.02.22
	B5	PRS private landlord								18.10.22
	B6	PRS professional landlord								08.03.22
	B7	PRS private landlord								28.03.22

(continued on next page)

between different tenure types and demographic groups. In addition, each of the high-level policy recommendations mentioned in summary here merit further exploration and expansion.

Retrofitting the existing housing stock is one of great unresolved challenges in the fight against climate change, public health issues and rising inequality. In this paper we have shown how a decade of UK policy failure suggests a paradigmatic shift is now required, namely one that moves away from considering households as economically rational, individualised, and isolated utility optimising; towards understanding the essentially connected, relational and plural places homes and communities really are. We believe retrofit policy design that acknowledges this fact, stands a much better change of meeting this challenge.

**CRedit authorship contribution statement**

**Donal Brown:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Lucie Middlemiss:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Mark Davis:** Writing – review & editing, Writing – original draft, Validation, Methodology, Conceptualization. **Ruth Bookbinder:** Writing – review & editing, Writing – original draft, Project administration, Investigation, Formal analysis, Conceptualization. **Iain Cairns:** Writing – review & editing, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Matthew Hannon:** Writing – review & editing, Writing – original draft, Project administration, Conceptualization. **Giulia Mininni:** Writing – review & editing, Project administration, Investigation, Formal analysis, Conceptualization. **Marie Claire Brisbois:** Writing – review & editing, Project administration, Conceptualization. **Anne Owen:** Writing – review & editing, Formal analysis, Data curation, Conceptualization. **Stephen Hall:** Project administration, Funding acquisition, Conceptualization.

**Declaration of competing interest**

The authors declare that they have no conflict of interest.

**Acknowledgements**

This research was funded by the UK Energy Research Centre [UKERC Phase 4: EP/S029575/1].

(continued)

Case Study	Interview Code	Tenure	House type	Age	Education	Employment status	Job	Income	Key measures	Schedule
Glasgow	B8	PRS private landlord								11.04.22
	G1	Owner Occupier (OO)	Tenement Flat (split villa)	70+	Degree or equivalent	Retired	n/a	£25,000 to £35,000	Bathroom refit	16.11.21
	G2	OO	Tenement Flat (split villa)	50–59	Degree or equivalent	Working Full Time	Journalist	> £55,000	New boiler	17.11.21
	G3	OO; previously also landlord	Tenement flat	40–49	Degree or equivalent	Working Part Time	Humanitarian education specialist, working part time and also consulting part time	£ 35,000 to £45,000	Structural repairs to building, kitchen refit	25.11.21
	G4	OO	Tenement flat	50–59	Degree or equivalent	Working Full Time	Postgraduate Admin Officer in Further Education sector	£15,000 to £25,000	New heating system, considerable redecoration.	30.11.21
	G5	OO	Tenement flat	60–69	Degree or equivalent	Self Employed	Film Director / producer	£15,000 to £25 00	Bathroom refit	3.12.21
	G6	OO; current landlord	Tenement Flat	50–59	No qualification	Part Time	Hairdresser	> £55,000	New roof, new windows, other.	2.12.21
	G7	OO; previously also landlord	Tenement flat	50–59	GCSE grades A*-C or equivalent (O levels)	Unpaid Family worker (carer or parent)	Clothes maker; property manager / holiday manager; living off mother; rent	< under £10,000 (asset rich - half owns two houses - cash poor)	Stairwell repairs	7.12.21
	G8	OO	Tenement (main door) flat	30–39	Degree or equivalent	Unemployed	Film / TV Producer	£35,000 to £45,000	New kitchen	8.12.21
	G9	OO	Tenement Flat	30–39	Degree or equivalent	Voluntary worker	Marine Engineer	£45,000 to £55,000	New lightbulbs, and digital thermostat	10.12.21
G10	OO	Tenement Flat	30–39	Degree or equivalent	Working Full Time	PhD student; Research Assistant; Tutor	> 55,000	New Boiler	20.1.22	
G11	OO	Tenement Flat (split villa)	40–49	Degree or equivalent	Currently unemployed	Housing Officer	£25,000 to £35,000	Roof space extension	21.1.22	
Otley	O1	OO								Summer 2021
	O2	OO								Summer 2021
	O3	OO								Summer 2021
	O4	OO								Summer 2021
	O5	OO								Summer 2021
	O6	OO								Summer 2021
	O7	OO								Summer 2021
	O8	OO								Summer 2021
	O9	OO								Summer 2021
	O10	OO								08.11.2021
	O11	OO								10.11.2021
	O12	OO								15.11.2021
	O13	OO								18.11.2021
	O14	OO								18.11.2021
	O15	OO								08.12.2021

## Appendix B

	Term	Definition
Entry point	Major Renovation	The retrofit/renovation measures were part of a planned major improvement to the house
	New House	The retrofit/renovation measures were undertaken soon after moving in

(continued on next page)

(continued)

	Term	Definition	
Motivations	Stress Purchase	The retrofit/renovation measures were triggered by a broken appliance – usually a boiler	
	Dilapidation/ structural problems	The retrofit/renovation measures were undertaken as part of wider works designed to bring the home up to a habitable standard	
	Add space/ improve functionality	The retrofit/renovation measures were part of plans to add space/ improve the functionality of the home	
	Death/ inheritance	The retrofit/renovation measures were triggered by the death of a family member or other close contact	
	Maintenance	The retrofit/renovation measures were undertaken as part of routine maintenance	
	Growing Family	The retrofit/renovation measures were triggered by new additions to the family	
	High Bills	The retrofit/renovation measures were in response to high energy bills	
	Aesthetic Improvement	The retrofit/renovation measures aimed to improve the aesthetic character of the home	
	Energy Efficiency	The retrofit/renovation measures aimed to make the property more energy efficient	
	Comfort	The retrofit/renovation measures aims to make the property more comfortable for the inhabitants	
	Functional	The retrofit/renovation measures aimed to increase the functionality of the home, for example making a room more suitable for certain uses	
	Increased Space	The retrofit/renovation measures aimed to increase space for the occupants	
	Investment	The retrofit/renovation measures aimed to provide a return on investment when the property is sold	
	Damage repair	The retrofit/renovation measures aimed to fix something that was broken	
	Rental value	The retrofit/renovation measures aimed to increase the rental value of the property.	
	Modernisation	The retrofit/renovation measures aimed to bring features of the home to a more 'modern' standard	
	Environmental	The retrofit/renovation measures aimed to help reduce the environmental impact of the home	
	Save money	The retrofit/renovation measures aimed to save money on the homes' bills	
	Health	The retrofit/renovation measures aimed to improve the health of the occupants	
	Who provided advice	Friends	The household sought initial advice for the project from their friends
		Contractor	The household sought initial advice for the project from a contractor
Neighbours/ local community		The household sought initial advice for the project from their neighbours or others in their local community	
Family		The household sought initial advice for the project from a family member	
Construction professional		The household sought initial advice for the project from a construction professional such as an architect, engineer, surveyor or interior designer	
Own Knowledge		The household used their own knowledge	
Colleagues		The household sought initial advice for the project from colleagues	
Council		The household sought initial advice for the project from their local council	
Social Media		The household sought initial advice for the project from social media	
Management Company		The household sought initial advice for the project from their property management company	
Own Research		The household sought initial advice for the project from their own research	
Lack of Advice		The household didn't seek any advice	
Contractor		The contractor helped the household develop a detailed specification and budget	
Own research (internet)		The household developed the specification and budget using their own internet research	
Neighbours/ local community		The household developed the specification and budget using help from their neighbours and local community	
Who supported specification & budgeting	Family	The household developed the specification and budget using help from their family	
	Construction professional	The household developed the specification and budget using help from a construction professional such as an architect, engineer, surveyor or interior designer	
	Lacked a specification/ budget	The household didn't develop a project specification or budget	
	Own Knowledge	The household developed the specification and budget using their own knowledge	
	Colleagues	The household developed the specification and budget using help from their colleagues	
	Council	The household developed the specification and budget using help from their local council	
	Friends	The household developed the specification and budget using help from their friends	
	Social Media	The household developed the specification and budget using social media	
	Local Recommendations (incl. neighbours)	The household found the contractor via recommendations from their neighbours and local community	
	Internet search/ Price comparison site	The household found the contractor via internet searches or price comparison sites	
	None (did work themselves)	The household did not use a contractor and did the work themselves	
	Asked friends	The household found the contractor via recommendations from their friends	
	Social Media	The household found the contractor via recommendations/advertisements from social media	
	Asked colleagues	The household found the contractor via recommendations from colleagues	
	Provided by Council	The household found the contractor via their local council	
Asked Family	The household found the contractor via recommendations from their family		
How did you procure contractors	Chose household name	The household used a big name contractor, with which they were already familiar (i.e., British gas)	
	Contractor recommended subcontractor	The contractor recommended a subcontractor for the project	
	Used existing relationships with contractor	The household had pre-existing relationships with the contractor and selected them directly	
	Hardware manufacturer did installation	The installation was undertaken by the supplier/manufacturer of the hardware/product	
	Relied on letting agency/ management company	The household found the contractor via their letting agency/ management company	
	Sourced via construction professional	The household found the contractor via recommendations from a construction professional (defined above)	
	Savings	The retrofit/renovation measures was paid for via household savings	
	Inheritance	The retrofit/renovation measures was paid for via inheritance monies	
	Mortgage	The retrofit/renovation measures was paid for via a mortgage	
	Credit Cards	The retrofit/renovation measures was paid for via a credit card	
How: was the retrofit/ renovation paid for	Property Sale	The retrofit/renovation measures was paid for from the sale of another property	
	Borrow from family	The retrofit/renovation measures was paid for via a loan from a family member	
	Cancelled holiday	The retrofit/renovation measures was paid for from a cancelled holiday	

(continued on next page)

(continued)

	Term	Definition
Household experience of installation phase	Equity release	The retrofit/renovation measures was paid for from equity released from the property
	Family Debt repayment	The retrofit/renovation measures was paid for from money that was owed by a family member
	Hire purchase agreement	The retrofit/renovation measures was paid via hire purchase financing instalments
	Life Insurance	The retrofit/renovation measures was paid via a life insurance payout
	Rental income	The retrofit/renovation measures was paid for from rental income
	Service Charge	The retrofit/renovation measures was paid for from a service charge
	No issues	The household experienced no negative issues during the retrofit/renovation installation phase
	Poor quality	The household perceived aspects of the retrofit/renovation work to be of poor quality
	Delays	The household perceived experienced delays during the retrofit/renovation work
	Contractor misled them	The household perceived that the contractor misled them about aspects of the retrofit/renovation work
	Poor behaviour	The household perceived that the contractor exhibited poor or disrespectful behaviour during the project.
	High Cost	The household perceived the project to have high costs relative to their expectations
	(Did work themselves)	The household undertook the work themselves

## Appendix C. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.erss.2024.103863>.

## Data availability

Data will be made available on request.

## References

- [1] EEFIG, Energy Efficiency – the first fuel for the EU Economy, 2015, p. 127.
- [2] European Commission, Renovation wave [Internet] [cited 2022 Dec 3]. Available from: [https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave\\_en](https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en), 2020.
- [3] CCC, Net Zero - The UK's contribution to stopping global warming [Internet] [cited 2023 Jul 17]. Available from: <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>, 2019.
- [4] CCC, The Sixth Carbon Budget The UK's path to Net Zero, 2020.
- [5] A.B. Jaffe, R.N. Stavins, The energy-efficiency gap what does it mean? *Energy Policy* 22 (10) (1994) 804–810.
- [6] H. Allcott, M. Greenstone, Is there an energy efficiency gap? *J. Econ. Perspect.* 26 (1) (2012) 3–28.
- [7] F. Fylen, D. Glew, M. Smith, D. Johnston, M. Brooke-Peat, D. Miles-Shenton, et al., Reflections on retrofits: overcoming barriers to energy efficiency among the fuel poor in the United Kingdom, *Energy Res. Soc. Sci.* 21 (2016) 190–198.
- [8] S. Sorrell, J. Schleich, E. O'Malley, S. Scott, The Economics of Energy Efficiency: Barriers to Cost-Effective Investment, Edward Elgar, Cheltenham, 2004.
- [9] E. Bolton, R. Bookbinder, L. Middlemiss, S. Hall, M. Davis, A. Owen, The relational dimensions of renovation: implications for retrofit policy, *Energy Res. Soc. Sci.* 96 (2023 Feb) 102916.
- [10] W. Abrahamse, L. Steg, C. Vlek, T. Rothengatter, The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents, *J. Environ. Psychol.* 27 (4) (2007) 265–276.
- [11] C. Nolden, S. Sorrell, F. Polzin, Catalysing the energy service market: the role of intermediaries, *Energy Policy* 98 (2016) 420–430.
- [12] D. Brown, S. Sorrell, P. Kivimaa, Worth the risk? An evaluation of alternative finance mechanisms for residential retrofit, *Energy Policy* 128 (2019 May 1) 1–24.
- [13] S. Sorrell, A. Mallett, S. Nye, Barriers to industrial energy efficiency: a literature review. *U N Ind Dev Organ*, 2011. Working pa:98.
- [14] P.S. Mallaburn, N. Eyre, Lessons from energy efficiency policy and programmes in the UK from 1973 to 2013, *Energy. Effic.* 7 (1) (2014 Feb 1) 23–41.
- [15] J. Rosenow, N. Eyre, Re-energising the UK's approach to domestic energy efficiency, 2014, pp. 281–289.
- [16] P. Shukla, J. Skea, R. Slade, A. Al Khouridajie, R. Van Diemen, D. McCollum, et al., IPCC, 2022: climate change 2022: mitigation of climate change, in: Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change 10, Camb Univ Press, Camb UK N Y NY USA, 2022, 9781009157926.
- [17] J. Rosenow, N. Eyre, A post mortem of the Green Deal: austerity, energy efficiency, and failure in British energy policy, *Energy Res. Soc. Sci.* 21 (2016) 141–144.
- [18] A. Timms, We are all seeing red over the government's Green Homes Grant | Consumer affairs | The Guardian, Guardian [Internet]. [cited 2021 Jan 14]; Available from: <https://www.theguardian.com/money/2020/dec/03/we-are-all-seeing-red-over-the-governments-green-homes-grant>, 2020.
- [19] CCC, Progress in reducing UK emissions - 2023 Report to Parliament, 2023.
- [20] AMA Research, Private Housing RMI Market Report - UK 2021-2025 [Internet] [cited 2023 Jul 17]. Available from: <https://www.amaresearch.co.uk/report/private-housing-2021/>, 2020.
- [21] G. Killip, T. Fawcett, C. Jofeh, A. Owen, M. Topouzi, F. Wade, Building on our Strengths: A Market Transformation Approach to Energy Retrofit in UK Homes, 2021.
- [22] J. Scott, Rational choice theory, *Underst Contemp Soc Theor Present.* 129 (2000) 126–138.
- [23] L. Steg, L. Dreijerink, W. Abrahamse, Factors influencing the acceptability of energy policies: a test of VBN theory, *J. Environ. Psychol.* 25 (4) (2005 Dec 1) 415–425.
- [24] R.E. Just, D.L. Hueth, A. Schmitz, The Welfare Economics of Public Policy: A Practical Approach to Project and Policy Evaluation, Edward Elgar Publishing, 2005.
- [25] N. Crossley, Relational sociology and culture: a preliminary framework, *Int. Rev. Sociol.* 25 (1) (2015) 65–85.
- [26] V.A. Zelizer, The Social Meaning of Money: Pin Money, Paychecks, Poor Relief, and Other Currencies, Princeton University Press, 2021.
- [27] L. Middlemiss, M. Davis, D. Brown, R. Bookbinder, I. Cairns, G.M. Mininni, et al., Developing a relational approach to energy demand: a methodological and conceptual guide, *Energy Res. Soc. Sci.* 110 (2024 Apr 1) 103441.
- [28] C. Maby, J. Gwilliam, Integrating energy efficiency into private home repair, maintenance and improvement practice in England and Wales, *Build. Res. Inf.* 50 (4) (2022 May 19) 424–437.
- [29] K.N. Lemon, P.C. Verhoef, Understanding customer experience throughout the customer journey, *J. Mark.* 80 (6) (2016 Nov 1) 69–96.
- [30] A. Ludwiczak, Using customer journey mapping to improve public services: a critical analysis of the literature, *Management* 25 (2) (2021) 22–35.
- [31] DECC, Which energy efficiency improvements qualify for Green Deal Finance? June, 2012, p. 14.
- [32] DECC, Energy Companies Obligation (ECO) Customer Journey [Internet], Available from: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/388693/ECO\\_Customer\\_Journey\\_Research\\_Technical\\_Report\\_FINAL\\_PUBLISHED.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/388693/ECO_Customer_Journey_Research_Technical_Report_FINAL_PUBLISHED.pdf), 2014.
- [33] K. Gillingham, R.G. Newell, K. Palmer, Energy efficiency economics and policy, *Annu. Rev. Resour. Econ.* 1 (1) (2009 Oct 10) 597–620.
- [34] N. Kerr, A. Gouldson, J. Barrett, Holistic narratives of the renovation experience: using Q-methodology to improve understanding of domestic energy retrofits in the United Kingdom, *Energy Res. Soc. Sci.* 42 (2018 Aug 1) 90–99.
- [35] C. Wilson, L. Crane, G. Chrysochoidis, Why do homeowners renovate energy efficiently? Contrasting perspectives and implications for policy, *Energy Res. Soc. Sci.* 7 (2015) 12–22.
- [36] T. Hargreaves, L. Middlemiss, The importance of social relations in shaping energy demand, *Nat Energy* 5 (3) (2020 Feb 3) 195–201.
- [37] L.G. Giraudet, Energy efficiency as a credence good: a review of informational barriers to energy savings in the building sector, *Energy Econ.* (87) (2020 Mar 1) 104698.
- [38] Ofgem, Guidance – Energy Company Obligation (ECO4) Guidance: Delivery [Internet], Available from: [https://www.ofgem.gov.uk/sites/default/files/2024-04/eco4\\_delivery\\_guidance\\_v2.1.pdf](https://www.ofgem.gov.uk/sites/default/files/2024-04/eco4_delivery_guidance_v2.1.pdf), 2024.
- [39] P. Bertoldi, B. Boza-Kiss, N. Della Valle, M. Economidou, The role of one-stop shops in energy renovation-a comparative analysis of OSS cases in Europe, *Energy. Buildings* 250 (2021) 111273.
- [40] A. Owen, L. Middlemiss, D. Brown, M. Davis, S. Hall, R. Bookbinder, et al., Who applies for energy grants? *Energy Res. Soc. Sci.* 101 (2023 Jul) 103123.
- [41] BEIS, Green Homes Grant: make energy improvements to your home - GOV.UK [Internet] [cited 2021 Apr 13]. Available from: <https://www.gov.uk/guidance/apply-for-the-green-homes-grant-scheme>, 2021.
- [42] T. Fawcett, G. Killip, Anatomy of low carbon retrofits: evidence from owner-occupied Superhomes, *Build. Res. Inf.* 42 (4) (2014) 434–445.
- [43] C. Maby, A. Owen, Installer Power - the Key to Unlocking Low Carbon Retrofit in Private Housing, 2015.

- [44] A. Faiers, M. Cook, C. Neame, Towards a contemporary approach for understanding consumer behaviour in the context of domestic energy use, *Energy Policy* 35 (8) (2007 Aug 1) 4381–4390.
- [45] DESNEZ, [Withdrawn] Green homes Grant: installer terms and conditions [internet]. GOV.UK [cited 2024 Aug 16]. Available from: <https://www.gov.uk/government/publications/green-homes-grant-terms-and-conditions/installers>, 2020.
- [46] BEIS, Each Home Counts: Review of consumer advice, protection, standards and enforcement for energy efficiency and renewable energy [internet]. GOV.UK [cited 2023 Aug 4]. Available from: <https://www.gov.uk/government/publications/each-home-counts-review-of-consumer-advice-protection-standards-and-enforcement-for-energy-efficiency-and-renewable-energy>, 2016.
- [47] N. Bandelj, Relational work in the economy, *Annu. Rev. Sociol.* 46 (1) (2020 Jul 30) 251–272.
- [48] G.D. Holt, D.J. Edwards, Domestic builder selection in the UK housing repair and maintenance sector: a critique, *J. Constr. Res.* 6 (01) (2005) 123–137.
- [49] A. Srivastava, S. Thomson, Framework Analysis: A Qualitative Methodology for Applied Policy Research (SSRN Scholarly Paper No. ID 2760705), Social Science Research Network, Rochester, NY, 2009.
- [50] D. Brown, T. Bailey, P. Griffin, Cheaper Bills, Warmer Homes [Internet], Available from: <https://retrofitworks.co.uk/wp-content/uploads/2022/11/FUTURE-FIT-REPORT.2022.pdf>, 2022.
- [51] CLC, Greening our existing homes: national retrofit strategy - a consultative document. Construction Leadership Council, 2021. <https://www.constructionleadershipcouncil.co.uk/news/national-retrofit-strategy-v2-launches/>.
- [52] EEIG, COALITION LETTER TO CHANCELLOR CALLING FOR AN ENERGY SAVING STAMP DUTY INCENTIVE [Internet] [cited 2023 Jul 18]. Available from: <http://www.theeeig.co.uk/media/coalition-letter-to-chancellor-calling-for-an-energy-saving-stamp-duty-incentive/>, 2022.
- [53] F. Block, Relational work in market economies: introduction, *Polit. Soc.* 40 (2) (2012) 135–144.
- [54] N.J. Fox, Boundary objects, social meanings and the success of new technologies, *Sociology* 45 (1) (2011) 70–85.
- [55] D. Brown, M. Martiskainen, Deliverable 6.3, User acceptance and policy strategies, University of Sussex, 2023 (Project Title: Solar-Biomass Reversible energy system for covering a large share of energy needs in buildings).
- [56] A. Owen, G. Mitchell, A. Gouldson, Unseen influence—the role of low carbon retrofit advisers and installers in the adoption and use of domestic energy technology, *Energy Policy* 73 (2014) 169–179.
- [57] F. Wade, R. Hitchings, M. Shipworth, Understanding the missing middlemen of domestic heating: installers as a community of professional practice in the United Kingdom, *Energy Res. Soc. Sci.* 19 (2016 Sep 1) 39–47.
- [58] T. Putnam, D. Brown, Grassroots retrofit: community governance and residential energy transitions in the United Kingdom, *Energy Res. Soc. Sci.* 78 (2021) 102102, <https://doi.org/10.1016/j.erss.2021.102102>.
- [59] N. Frantzeskaki, A. Dumitru, I. Anguelovski, F. Avelino, M. Bach, B. Best, et al., Elucidating the changing roles of civil society in urban sustainability transitions, *Curr. Opin. Environ. Sustain.* 22 (2016) 41–50.
- [60] M. Martiskainen, P. Kivimaa, Creating innovative zero carbon homes in the United Kingdom — intermediaries and champions in building projects, *Environ. Innov. Soc. Transit.* 26 (2018 Aug 30) 15–31.
- [61] P. Ambrosio-Albala, L. Middlemiss, A. Owen, T. Hargreaves, N. Emmel, J. Gilbertson, et al., From rational to relational: how energy poor households engage with the British retail energy market, *Energy Res. Soc. Sci.* 70 (2020) 101765.
- [62] D. Brown, Business models for residential retrofit in the UK: a critical assessment of five key archetypes, *Energ. Effic.* 11 (6) (2018 Mar) 1–26.
- [63] R. Gillard, C. Snell, M. Bevan, Advancing an energy justice perspective of fuel poverty: household vulnerability and domestic retrofit policy in the United Kingdom, *Energy Res. Soc. Sci.* 29 (2017) 53–61.
- [64] J.M. O’Keeffe, D. Gilmour, E. Simpson, A network approach to overcoming barriers to market engagement for SMEs in energy efficiency initiatives such as the Green Deal, *Energy Policy* 97 (2016 Oct) 582–590.
- [65] Z. Branford, J. Roberts, The Installer Skills Gap in the UK Heat Pump Sector and the Impacts on a Just Transition to Net-Zero, 2022.
- [66] P. van Berkel, Realising a Just Transition to Gas-Free Heating in the Dutch Social Housing Sector, 2019.
- [67] F. Bartiaux, Gender roles and domestic power in energy-saving home improvements, *Build Cities* 3 (1) (2022) 824–841, <https://doi.org/10.5334/bc.232>.
- [68] CIOB, What construction can do to drive diversity in the sector [internet], Chartered Institute of Building (2020) [cited 2023 Jul 18]. Available from: <http://www.ciob.org/blog/what-construction-can-do-drive-diversity-sector>.
- [69] L. Middlemiss, R. Gillard, Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor, *Energy Res. Soc. Sci.* 6 (2015) 146–154.
- [70] P. Webber, A. Gouldson, N. Kerr, The impacts of household retrofit and domestic energy efficiency schemes: a large scale, ex post evaluation, *Energy Policy* 84 (2015) 35–43.
- [71] P. Bertoldi, M. Economidou, V. Palermo, B. Boza-Kiss, V. Todeschi, How to finance energy renovation of residential buildings: Review of current and emerging financing instruments in the <scp>EU</scp>, *WIREs Energy Environ* [Internet]. (2020 Jun 21), <https://doi.org/10.1002/wene.384> [cited 2020 Nov 10]; Available from:.
- [72] M. Davis, Community Municipal Investments: Accelerating the Potential of Local Net Zero Strategies, 2021.
- [73] K. Mahapatra, L. Gustavsson, T. Haavik, S. Aabrekk, S. Svendsen, L. Vanhoutteghem, et al., Business models for full service energy renovation of single-family houses in Nordic countries, *Appl. Energy* 112 (2013) 1558–1565.
- [74] I. Cairns, M. Hannon, A. Owen, R. Bookbinder, M.C. Brisbois, D. Brown, et al., Under one roof: the social relations and relational work of energy retrofit for the occupants of multi-owned properties, *Energy Policy* 190 (2024) 114166.
- [75] J.L. Campbell, Institutional analysis and the role of ideas in political economy, *Theory Soc.* 27 (1998) 377–409.
- [76] J.L. Campbell, O.K. Pedersen, Policy ideas, knowledge regimes and comparative political economy, *Socio-Econ. Rev.* 13 (4) (2015 Oct) 679–701.
- [77] I. Cairns, M. Hannon, A. Owen, R. Bookbinder, M.-C. Brisbois, D. Brown, M. Davis, L. Middlemiss, G.M. Mininni, M. Combe, Under one roof: The social relations and relational work of energy retrofit for the occupants of multi-owned properties, *Energy Pol.* 190 (2024) 114166, <https://doi.org/10.1016/j.enpol.2024.114166>. ISSN 0301-4215.
- [78] M. Davis, L. Middlemiss, S. Hall, D. Brown, R. Bookbinder, A. Owen, M.C. Brisbois, G.M. Mininni, I. Cairns, M. Hannon, Towards a relational sociology of retrofit, *Education and Urban Society* 0 (0) (2024) 1202–1216, <https://doi.org/10.1177/0013124518785012>.