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Abstract

A large body of applied research on energy efficiency characterises drivers and barriers to cost-effective home renovations, and identifies personal and contextual influences on renovation decisions. Resulting policies to promote energy efficiency in homes aim to remove barriers or strengthen decision influences. The Green Deal in the UK is a recent example, allowing accredited third party financing of energy efficient renovations to remove capital cost barriers and strengthen trust and confidence in the efficiency supply chain. Although tractable, empirical, and instrumental in designing policy, the explanatory power of applied energy efficiency research is self-limiting for both methodological and conceptual reasons. Methodological limitations include priming biases towards financial variables, and cross-sectional depictions of decisions as events. Conceptual limitations include a constrictive scope of enquiry that emphasises efficiency renovations to the exclusion of amenity and other types of home improvement, houses as physical spaces to the exclusion of emotional and social characteristics of homes, and households as coherent decision making units to the exclusion of dynamics and differentiated roles within the home. Social research on homes and domestic life addresses these limitations yet has run largely in parallel and even at polarised counterpoint to applied energy efficiency research. This in turn has constrained the scope and effectiveness of energy efficiency policies like the Green Deal. Renovation decision-making should be understood within the conditions of everyday domestic life from which decisions emerge.

1. Introduction

Policies and programmes to stimulate energy efficiency in the home have waxed and waned over the decades since the 1970s oil shocks sharply increased the financial incentive for reducing energy use. With a renewed emphasis spurred by climate mitigation and energy security goals, residential efficiency is again ascendant. In the UK, seemingly prosaic aspirations to diffuse cavity wall and loft insulation throughout the housing stock is now a central plank of government climate policy (HMG 2009; DECC 2012b). Meeting long-term targets imply "*one building would need to be retrofitted every minute for the next 40 years at an estimated cost of £85 billion for homes alone*" (Dixon and Eames 2013). Insulation is the most cost-effective measure, and opportunities abound (Dowson, Poole et al. 2012). One in every three UK homes with a loft currently lacks sufficient (>125 mm) loft insulation; one in every three UK homes with cavity walls lacks inexpensive insulation in those cavities; and 98% of UK homes without cavity walls lack solid wall insulation (DECC 2012c).

Policies and programmes to improve the energy efficiency of UK homes have traditionally been delivered through utilities and funded by ratepayers. The January 2013 launch of the Green Deal shifted the emphasis to homeowners and markets. The 'Green Deal' is a major regulatory innovation to put "*consumers back in control*" and in so doing, instigate "*a revolution in British property*" (p10, DECC 2011b). Described as "*the biggest shift in the history of energy efficiency policy in the UK since the oil crises*" (Rosenow, Croft et al. 2013), the Green Deal allows the upfront costs of energy efficient renovations to be financed by a third party and repaid over time through the electricity bill for the property. Repayments should cost less than the energy saving benefit from the efficiency measures (the so-called 'Golden Rule') (DECC 2010). Green Deal financing is only available from accredited providers and subject to a prior technical assessment by certified home energy experts.

Around 70% of UK homes are owner-occupied (DCLG 2008). For this majority market segment, the Green Deal is premised on a particular understanding of renovation decisions. Financial considerations are seen as paramount (Rosenow and Eyre 2013). These include upfront costs, cost savings over time, payback periods, interest rates, repayment mechanisms, and value for money. A second premise is that homeowners' decisions to renovate are influenced or constrained by issues of trust, credibility, and uncertainty. These are tackled through a range of quality assurance measures (DECC 2011c).

This understanding of renovation decision making is supported by a large body of applied research on energy efficiency. This draws on microeconomics, social psychology and diffusion theory (e.g., Jaccard and Dennis 2006; Whitmarsh, Upham et al. 2011), as well as grey literature on consumer behaviour and marketing (e.g., GfK 2011). We label this body of work 'applied energy efficiency research' as it is foremost concerned with the policy application of empirical findings rather than theorising or conceptual advances.

The Green Deal's premise that homeowners are motivated to renovate to save money but are prevented from doing so by capital constraints and contractor reliability are part of what Maller and Horne (2011) call a rationalisation discourse in applied energy efficiency research. The effectiveness of resulting policies is limited as the underlying research fails to address "*the conventions and practices of households … which have remained largely in the shadows*" (p61, Maller and Horne 2011).

Several decades of sociological research into these conventions and practices has established a rich and compelling critique of the rationalisation discourse (e.g., Shove 1998; Guy and Shove 2000; Hobson 2001). This critique rejects cognition, decision making, and individuals as the central objects of enquiry, and consequently challenges the hegemonic policy-relevance of applied energy efficiency research (Shove 2010). Yet policies like the Green Deal remain.

The aim of this paper is to show how situating applied research on energy efficiency within a broader conceptualisation of renovating, homes and households can enrich and strengthen an instrumental

understanding of why homeowners decide to renovate energy efficiently. This in turn can broaden the evidence base for policy initiatives like the Green Deal.

Situating applied research on energy efficiency does not mean including myriad social factors as additional contextual influences on an otherwise unchanged model of rational decision making. By 'situated' we mean making descriptively-realistic renovation decision processes endogenous to the dynamics of life at home. As Guy & Shove (2000) conclude in their sociological critique of narrowly-framed research on energy efficiency: "*greater attention should be paid to the changing contexts of energy-related decision-making*" (p135). Retaining an explicit representation of renovation decisions is important because they are the direct antecedent to efficiency improvements in homes, the outcomes of interest to policy.

The paper is structured in three parts.

First, we synthesise the key approaches and findings of applied energy efficiency research, and show its usefulness in informing policies like the Green Deal.

Second, we systematically develop a critique of this body of applied research along conceptual, empirical and methodological lines. These include sampling and priming biases, and restrictive definitions of the problem and so the object of enquiry. We show how renovation decisions are represented or modelled as discrete events with static influences or explanatory variables. This precludes the detection and attribution of change through the course of the renovation decision process (Fawcett and Killip 2014). We argue that common relationships between energy efficient and non energy-related 'amenity' renovations are largely ignored (see Box 1 for definitions), even though kitchens, bathrooms and space conversions dominate the money, time and effort invested in homes (JCHS 2009; Wilson, Chryssochoidis et al. 2013). Drawing extensively on longstanding critiques of the rationalisation discourse in efficiency research, we consider how renovation decisions are framed as deliberative and circumscribed rather than emergent from domestic life and the dynamics of homemaking (Bartiaux, Gram-Hanssen et al. 2014).

Third, we set out the case for a situated research agenda on renovation decision making that maintains policy-relevance as well as descriptive plausibility within the context of domestic life. This research draws on divergent (and often polarised) research relevant for understanding energy efficiency in homes. In so doing, we seek to contribute to this journal's longstanding interest in understanding households' needs and expectations towards their homes (Coulter, van Ham et al. 2011), in the complexities of decision making within the home (McCormack and Schwanen 2011), and in the influence on policymaking of a narrow body of applied research (Shove 2010).

Box 1. Definitions and Terms.

We use the term 'renovations' to mean major structural improvement work to a home, or "*substantive physical changes to a building*" (Dixon and Eames 2013). Energy efficient renovations typically involve changes or upgrades to the building envelope - windows, doors, cavity or loft insulation - or the heating and hot water systems (Gardner and Stern 2008; Dietz, Gardner et al. 2009).

In contrast, we use the term 'amenity' renovations to describe changes to kitchens, living areas, loft or garage spaces, and so on. These are not primarily energy-related although may include some efficiency measures.

Renovations have high time, cost, and skill requirements, and are typically carried out by professional contractors with appropriate technical expertise (Maller and Horne 2011). In contrast, 'retrofits' and 'refurbishments' are predominantly DIY (do-it-yourself) projects carried out by homeowners although often at the same time as renovations. 'Home improvements', and in the US, 'remodelling', are general umbrella terms for all these activities (JCHS 2009).

2. Applied Energy Efficiency Research

This section synthesises a large body of applied research on energy efficiency with relevance to homes. It sets up the dominant 'drivers and barriers' problem framing on which policy solutions are based, and shows how formal models of renovation decisions overwhelmingly emphasise financial attributes. Other empirical studies from a range of research traditions introduce a wider set of personal and contextual variables that influence renovation decisions.

2.1. The energy efficiency gap

Efficiency improvements with the highest potential energy savings involve structural changes to the building envelope (e.g., cavity wall insulation, triple-glazed windows) and upgrades to the heating and hot water systems (e.g., high efficiency boilers) (Dietz, Gardner et al. 2009; Dowson, Poole et al. 2012). Cost savings from efficiency improvements can provide short payback periods on capital invested (EST 2010a), as well as a host of 'co-benefits' such as reduced drafts and condensation, improved thermal comfort, and increased property value (Jakob 2006; Fuerst, McAllister et al. 2013). Yet installation rates of efficiency measures are stubbornly slower than these economically rational 'drivers' of renovation decisions would suggest. The resulting 'energy efficiency gap' between technical and economic potential on the one hand, and actual market adoption on the other, has long been documented (Jaffe and Stavins 1994). Explanations and perspectives vary, but most tend to invoke 'barriers' to otherwise cost-effective technology adoption decisions (Brown 2001; DECC 2012b). "*If there are profits to be made, why do markets not capture these potentials? Certain characteristics of markets, technologies and end-users can inhibit rational, energy-saving choices …*" (p418, Levine, Ürge-Vorsatz et al. 2007).

Barriers to the adoption of cost-effective efficiency measures in home renovations include capital availability and high implicit discount rates, split incentives in rental properties between landlords (who make structural investments) and tenants (who pay energy bills), and the perceived lack of credible and available information on efficiency measures. Table 1 organises these and other commonly identified barriers into three main categories relating to finance, information, and decision making. None of the barriers shown in Table 1 are ostensibly technical.

Identifying barriers to energy efficient renovations leads directly to policies and programmes for removing barriers. Examples of trialled or proposed approaches are shown in Table 1. The Green Deal is included as a policy solution for overcoming the specific barriers of capital availability and contractor reliability (Rosenow and Eyre 2013).

The 'drivers and barriers' framing of the energy efficiency gap dominates both research and policy. A recent EU project 'BarEnergy' was explicitly designed to identify the strength and relevance of barriers to changes in energy behaviour in households (Emmert, van de Lindt et al. 2010). The UK government's Energy Efficiency Strategy published by DECC in 2012 is structured around "*four overarching barriers to greater energy efficiency that have to be overcome*" (p5, DECC 2012b). Cited barriers relevant to energy efficient renovations include: lack of trust, access to information, financing, split incentives (e.g., between landlords and tenants), complexity and uncertainty, and hassle and inconvenience (DECC 2012a). These barriers are repeatedly emphasised in studies and reports by policymakers, service providers, and consumer behaviour and market researchers in the UK (DEFRA 2009; Skelton, Fernandez et al. 2009; EST 2010a; Bioregional 2011; Cabinet_Office 2011), in Europe (Jakob 2007; Emmert, van de Lindt et al. 2010; Huber, Mayer et al. 2011; Weiss, Dunkelberg et al. 2012), and in the US (Ehrhardt-Martinez and Laitner 2010; Bell, Nadel et al. 2011).

Table 1. The Energy Efficiency Gap: Barriers to Energy Efficient Renovations.

*Barrier**		Description of Barrier	Policy or Market Approaches for Removing Barriers	Key References
FINANCE	***upfront cost & capital availability***	• high capital costs • aversion to delayed gains (high implicit discount rates)	grants, upfront incentives, property-backed or on-bill loan financing (e.g., Green Deal)	(Stern, Aronson et al. 1986; Bell, Nadel et al. 2011; Cabinet_Office 2011)
	split incentives	• investor & beneficiary are different (e.g., owner - tenant)	regulation (landlord / seller obligation), renovation mandates	(IEA 2007; Meier and Rehdanz 2010; Phillips 2012)
INFORMATION	***lack of information***	• imperfect or biased knowledge of energy costs • lack of awareness of potential energy savings	energy audits, technical & peer feedback, home energy ratings (e.g., EPC)	(Jaffe, Newell et al. 1999; COI 2010; Amecke 2012)
	low or misperceived salience	• invisibility of energy use and/or efficiency measures (e.g., cavity wall insulation) • low % cost of household budget • misperceptions of high and low energy using appliances	rising energy prices, energy use monitors	(Sanstad and Howarth 1994; Lutzenhiser 2002; Attari, DeKay et al. 2010; Emmert, van de Lindt et al. 2010; Hargreaves, Nye et al. 2010; p105, Whitmarsh, Upham et al. 2011)
	social 'invisibility'	• weakly supporting social norms • weak social signalling / comparison	neighbourhood programmes, integrating with micro-renewables, visible home energy ratings, comparative billing	(Nolan, Schultz et al. 2008; Wilson 2008; Ayres, Raseman et al. 2009; Allcott 2011; Ward, Clark et al. 2011)
	uncertainty (trust) / contractor risk	• contractor credibility • unknown quality of work • unknown performance outcomes	trusted brands, accreditation schemes (e.g., Green Deal), quality assurance	(DECC 2011a; Weiss, Dunkelberg et al. 2012)
	uncertainty (outcomes)	• unknown future energy savings or energy prices • unknown comfort or health effects • (related to high implicit discount rates – see under finance)	risk transfer to energy service companies	(Jakob 2006; Farsi 2010)
DECISION MAKING	***opportunity costs***	• crowding out of higher utility decisions (e.g., amenity renovations)	using trigger points to cross-sell efficiency	(Sutherland 1991; Skelton, Fernandez et al. 2009)
	cognitive burden	• high transaction cost of information search • complexity of decision (information processing)	one-stop shops, use of intermediaries	(Rivers and Jaccard 2005; Phillips 2012)
	hassle factor	• anticipated disruption to domestic life from renovation work • perceived stress, hassle inconvenience of renovation work	loft clearance schemes	(Roy, Caird et al. 2007; Cabinet_Office 2011; Weiss, Dunkelberg et al. 2012)
	irreversibility	• irreversible investments, can't be trialled • loss of option value	peer feedback	(Pindyck 1991; Hassett and Metcalf 1996; van Soest and Bulte 2001)

* The Intergovernmental Panel on Climate Change (IPCC) and the Global Energy Assessment (GEA) use similar taxonomies, but further distinguish barriers from 'real market failures' such as split incentives and imperfect information (p419, Levine, Ürge-Vorsatz et al. 2007; pp698-702, Ürge-Vorsatz, Eyre et al. 2012).

2.2. Renovation decision models

More formal models of renovation decisions reinforce the 'drivers and barriers' problem framing. Discrete choice models have been widely used to express households' preferences for energy efficient renovations (see Table 2). Many such models use data from structured surveys asking respondents to make hypothetical choices between alternative renovations. The characteristics or attributes of the alternative renovations are varied systematically (hence, choice experiments).

As an example, Jaccard & Dennis (2006) run a choice experiment on a sample of Canadian homeowners to elicit preferences for efficient or non-efficient home renovations. Each renovation alternative is described by four attributes (capital cost, annual heating costs, purchase subsidy, comfort level). Over successive choice sets, attributes are varied over two to four levels (e.g., purchase subsidy could be either $0, $500, or $1500).

The combination of alternatives, attributes and attribute levels therefore represents the choice in its entirety, and so imbues the resulting decision model with its basic descriptive realism. The selection of attributes emphasises the overtly financial framing of the renovation decision. In the Jaccard & Dennis (2006) study, only one of the four attributes offered as a possible source of utility was non-financial ('comfort', measured as either high or low air quality).

Table 2 summarises nine articles found in a literature search of studies using choice experiments to parameterise renovation decision models. Attributes used in the decision models are grouped into three: financial attributes (e.g., upfront cost, running costs); information and decision-making attributes (e.g., energy audit, quality assurance); and all other attributes (e.g., comfort, CO_2 savings). Financial attributes are consistently and strongly dominant; attributes describing features of energy efficient renovations *not* relating to finances and information are few (see Table 2).

Models of renovation decisions (and microeconomic research more broadly) are used to quantify the marginal effect of financial incentives or policy mechanisms (Achtnicht 2011; Element_Energy 2011), consumers' willingness-to-pay (WTP) for efficiency measures (Banfi, Farsi et al. 2008; Phillips 2012), and implied rates of time preference or discount rates for future energy cost savings (Jaccard and Dennis 2006). The systematic tendency to emphasise financial influences on energy efficient renovation decisions is consistent with the drivers and barriers framing of the energy efficiency gap (see Table 1). The problem framing shapes the interpretation of findings. For example, implicit discount rates that far exceed market interest rates are interpreted as consumer aversion to delayed returns on investment and to irreversible and uncertain outcomes (Train 1985; Christie, Donn et al. 2011).

Table 2. Attributes of Discrete Choice Models of Energy Efficient Renovation Decisions from Nine Stated Preference Studies.

		FINANCIAL ATTRIBUTES				INFORMATION / DECISION ATTRIBUTES					ALL OTHER ATTRIBUTES		
Study	**Energy Efficient Renovation Measures**	**upfront cost**	**energy / operating costs**	**payback period / interest rate**	**incentive / financing**	**energy audit / assessment**	**source of recommendation**	**quality assurance**	**guarantee / contract length**	**inconvenience / disruption / work**	**air quality (comfort, pollution)**	**response time (heating)**	**CO2 savings**
(Jaccard and Dennis 2006)	windows, insulation (wall, ceiling, floor), weather-stripping	X	X		X						X		
(Jaccard and Dennis 2006)	natural gas / oil boiler (standard & high efficiency), electric heating, heat pump	X	X		X							X	
(Oxera 2006)	insulation (loft, cavity), appliances (not covered here)	X	X				X	X		X			
(Banfi, Farsi et al. 2008)	windows, insulation (wall), ventilation system	X											
(Kwak, Yoo et al. 2010)	windows, insulation (solid wall), ventilation system	X											
(Achtnicht 2011)	insulation, heating system	X	X	X	X	X			X				X
(Willis, Scarpa et al. 2011)	combi-gas boiler, micro-generation (biomass boiler, heat pump)	X	X				X		X	X			
(Element_Energy 2011)	insulation (solid wall, cavity, loft), boiler upgrade	X	X	X		X							
(Phillips 2012)	windows, insulation (wall, ceiling), heating system	X				X							
(Rouvinen and Matero 2012)	heating system (wood, electric, ground source, oil, district heat)	X	X							X	X		X
	total n (of 10)	***10***	***7***	***2***	***3***	***3***	***2***	***1***	***2***	***3***	***2***	***1***	***2***

Homeowner or household preferences for energy efficient renovations based on national surveys or observable market data can also be used to model renovation decisions. Such studies similarly focus on financial attributes of renovation decisions (e.g., Skelton, Fernandez et al. 2009), but also typically include a wider range of explanatory or control variables. Poortinga et al. (2003) controlled for socioeconomic variables and environmental attitudes in their conjoint analysis of UK household preferences for efficient heating systems and insulation measures. Jakob (2007) and Grosche & Vance (2009) tested the influence of household and property characteristics on the adoption of different home efficiency measures in Switzerland and Germany respectively. Braun et al. (2010) also modelled heating system purchase decisions as a function of property and household characteristics, but extended the set of control variables to include location and home tenure. Michelsen and Madlener (2012) include technology attributes as well as home and spatial characteristics in their modelling of renewable heating system choices in Germany.

The inclusion of these various control variables extends the scope of decision influences. The most common control variables are certain household and socioeconomic characteristics (e.g., income,

education, household composition) and certain property characteristics (e.g., type, age, size). Models thus broaden from a narrow financial representation of the renovation decision (see Table 2) to include a number of variables describing renovation decision makers and decision contexts.

2.3. Renovation Decision Makers & Decision Contexts

Applied energy efficiency research draws on diverse research traditions including diffusion of innovations, social psychology, marketing and consumer behaviour, as well as microeconomics. The scope of enquiry is much broader than the efficiency measures and decision attributes used in choice analysis. Characteristics of both decision makers and decision contexts can potentially be influential. These two categories of exogenous influence on the decision correspond to the distinction in diffusion research between adopter characteristics and innovation attributes (Rogers 2003) and the distinction in social psychology between personal and contextual influences (Stern 2000).

Diffusion research emphasises social networks as a key feature of technology adoption decisions (Rogers 2003). A UK study found information sought through personal contacts increases the likelihood of adopting efficiency measures by a factor of four (McMichael and Shipworth 2013). Information transmitted through social networks is much more influential than expert advice, assessments, audits, certificates, and reports, particularly in the mainstream renovation market. Interpersonal communication through networks of friends, family, and known or recommended contractors is a characteristic feature of renovating (Bartiaux, Gram-Hanssen et al. 2014).

Diffusion research also focuses attention on the attributes of efficiency measures. Successful innovations are characterised by relative advantage, compatibility, simplicity, observability and trialability (Rogers 2003). In the case of energy efficient renovations, measures are only weakly observable and trialable as they have low visibility or visual salience, and are irreversible once installed (Roy, Caird et al. 2007; Emmert, van de Lindt et al. 2010). A study of microgeneration technology adoption in Ireland interpreted both attributes more broadly: trialability as being able to see the technology working in the home of a friend of neighbour; observability in terms of subjective norms or social approval (Claudy, Michelsen et al. 2011). A German study combined all five innovation attributes with attitudinal and contextual influences as explanatory variables for the adoption of renewable heating systems. The mainstream market of adopters identified convenience and comfort rather than cost as influential sources of relative advantage (Michelsen and Madlener 2013).

In social psychology and market research, personal and contextual influences are more explicitly distinguished (see Table 3). Variables describing personal influences include attitudes towards energy use or efficiency, and beliefs about the impact of energy use on the environment (Gardner and Stern 1995). These are expressed towards energy efficient renovations specifically, or energy - environment linkages more generally (rather than towards homes or domestic life) (e.g., Nair, Gustavsson et al. 2010).

Contextual influences can be grouped in one of four categories: home tenure (ownership, duration), household characteristics (size, lifecycle, socio-demographics), physical characteristics of the home (size, age, type), and policy inducements (incentives, subsidies). These contextual influences primarily describe households and houses. Table 3 summarises the full scope of renovation decision influences identified in applied energy efficiency research, building on the decision barriers shown in Table 1 and the overtly financial characterisation of renovation choices shown in Table 2. Figure 1a shows the basic underlying model of renovation decision making implied by this body of research.

2.4. The Green Deal

Upfront costs and capital constraints are the most commonly cited barriers in applied energy efficiency research. These insights have led naturally to decades of policy experiments with grant,

loan, mortgage-backed, property tax, on-bill, and other innovating financing mechanisms (Bell, Nadel et al. 2011). With its emphasis on removing capital cost barriers to energy efficient renovations, the Green Deal has a rich collective ancestry. Its specific design features were informed by the italicised decision influences shown in Table 3. Third party financing targets the capital cost barrier. Accreditation underwrites trust in contractors and provides quality assurance. Home energy assessments identify cost-effective measures and quantify expected energy savings. Searchable databases of accredited assessors, contractors and finance providers simplifies information search. Assigning repayment obligations to properties rather than households addresses uncertainties over future tenure. Enabling tenants to request efficiency improvements from landlords overcomes the split incentive barrier.

Requiring a home energy assessment as a precondition for accessing Green Deal finance assumes prior interest or commitment to energy efficient renovations. A survey of 2200 UK households specifically commissioned to help design the Green Deal found household lifecycle and tenure were important among a sample of households with generally strong beliefs and intentions towards efficiency as well as considerable prior experience (GfK 2011). Many studies find stated intentions with respect to energy efficiency are strong, and experience with efficiency measures such as double glazing and loft insulation is widespread (DEFRA 2009; Skelton, Fernandez et al. 2009).

Other studies informing the design of the Green Deal affirmed the importance of salient events in the household lifecycle to renovating, such as moving house, replacing boilers, or having new tenants (DECC 2011c; DECC 2011a; Element_Energy 2011). Such events serve as 'trigger points' for energy efficient renovation work (Skelton, Fernandez et al. 2009), an argument that has been extended to home improvements more generally (EST 2010b). Using UK panel data, Coulter et al. (2011) similarly found decisions about moving home were either externally triggered, or gradually reinforced over a period of time by both expectations (being able to move) and desires (wanting to move due to dissatisfactions with home or neighbourhood).

Table 3. **Decision Influences in Applied Research on Energy Efficient Renovations.** (Italicised influences are incorporated in the design of the Green Deal).

		Commonly identified	Occasionally identified
Attributes of efficiency measures	**technical**	• *energy savings*	• *complexity*
	financial	• *cost* • *energy cost savings* • *financial payback*	• *financing options*
	experiential	• comfort	• aesthetics / appearance
Decisions about efficiency measures	**information & beliefs**	• *expert advice* • *expectations of energy cost savings* • *credibility / trust of contractors*	• *sources of information* • *credibility / trust of information sources* • *energy assessments, audits* • *quality assurance of assessments* • *certainty of expectations of energy cost savings* • social learning / transmission • social networks / interpersonal communication
	incentives	• *financial incentives*	• ease and timing of access • salience of incentives
	installation	• *quality assurance of contractors* • disruption / hassle	• own DIY / technical skills
	decision making		• *information search costs* • other transaction costs (time / effort) • opportunity costs
Decision maker **(also: Personal influences)**	**motivations (drivers)**	• *energy saving* • thermal comfort	• aesthetics / appearance • property value
	experience, skills		• technical skills or knowledge • past experience with specific measures • past experience with renovating
	attitudes & beliefs	• awareness of energy-environment issues • beliefs & understanding of energy-environment issues	• expectations of future energy prices • implicit rate of time preference • awareness of housing market & prices • attitudes & beliefs on homes / renovating
	socio-demographics	• age, education • income	• location (e.g., urban-rural)
Decision context **(also: Contextual influences)**	**household**	• size • lifecycle (e.g., number of children)	• household dynamics (e.g., gender roles) • decision making roles
	home tenure	• *status (own, rent, social housing)*	• duration • *expectations of future duration*
	physical characteristics of house	• size • age • number of rooms • heating system • insulation	• number of different types of room • room occupancy profiles • infrastructure availability (e.g., gas network) • functions / characteristics of rooms / spaces to be renovated (e.g. lofts)
	salient events	• moving home	• triggers or disruptions to routine (e.g., boiler breaking down) • *tenants moving in*

Table references: see text for details, and: (Gardner and Stern 1995; Poortinga, Steg et al. 2003; DEFRA/Brook_Lyndhurst 2007; Jakob 2007; Roy, Caird et al. 2007; Gardner and Stern 2008; DEFRA 2009; Grosche and Vance 2009; Skelton, Fernandez et al. 2009; Braun 2010; COI 2010; EST 2010a; Nair, Gustavsson et al. 2010; DECC 2011c; DECC 2011a; GfK 2011; Whitmarsh, Upham et al. 2011; Michelsen and Madlener 2013).

3. Limitations of applied energy efficiency research

The Green Deal is a clear recent example of applied energy efficiency research offering a clear and tractable analytical framework for understanding renovation activity, identifying important influences on renovation decisions that can be directly acted upon by financial and information-based policies.

Over the period January 2013 to May 2014, over 234,000 Green Deal assessments were carried out representing around 1% of the UK housing stock. Conversion rates from assessments to financing plans have been low: just over 1 from every 100 assessments (DECC 2014). Yet numbers of accredited assessors, contractors and finance providers continue to rise. It is too early to assess the effectiveness of the Green Deal at transforming the market for energy efficient renovations in the UK. However, it is possible to evaluate whether the design of the Green Deal (see Table 3) effectively diagnoses the problem and its resulting solution.

In this respect, the body of applied research on energy efficiency underlying the Green Deal has important limitations. Shove (1998) set out the consequences of a narrow 'drivers and barriers' problem framing: social science is reduced to explaining and filling the 'gap' identified by technical analysis given assumptions of psychologically-motivated individual decision makers. The emphasis of social research on the patterns and meanings of everyday domestic life is marginalised. We draw on this literature from outside the body of energy efficiency research to substantiate our conceptual, empirical but also methodological critique. Methodological limitations include priming biases and sampling biases associated with cross-sectional analysis of decisions as points in time. Conceptual and empirical limitations relate to narrow problem definitions and research questions (Guy 2006; Shove 2010). The scope of enquiry is drawn around: decision makers not households; energy efficiency not amenity renovations; the extraordinary not the everyday; renovations not renovating; and houses not homes. We consider each in turn.

3.1. Priming biases and financial variables

First, research designs in applied energy efficiency research that use a 'drivers and barriers' problem framing strongly prime attention to the financial characteristics of renovations (see Table 1 and Table 2). In the recent Green Deal studies (DECC 2011a; Element_Energy 2011; GfK 2011), cost and financing are commonly cited as barriers, reinforcing the perceived importance of financial incentives and financing mechanisms provided by the Green Deal. Closed-ended survey methods invariably solicit perceptions or understandings of cost, cost savings, energy prices, payback periods and time preferences (Nair, Gustavsson et al. 2010; DECC 2011a; GfK 2011).

Qualitative research commissioned to inform the Green Deal similarly focused on how its novel features relating to assessment, installation and financing might affect decision making (DECC 2011a). Directly asking about specific barriers strongly increases the likelihood that these barriers will be identified as influential.

Open-ended research helps draw out a much wider set of considerations with respect to renovation decisions (e.g., Skelton, Fernandez et al. 2009; Emmert, van de Lindt et al. 2010). But qualitative factors are often then lost in quantitative models (see Table 2) or reduced to terms shorn of meaning and context, as in the use of air quality as a proxy for 'comfort' (Jaccard and Dennis 2006).

As an example, the importance of building appearance or home aesthetics as influences on renovation decisions has been found in studies designed to test for it (Novikova, Vieider et al. 2011; Wilson and Dowlatabadi 2011). Yet aesthetics are infrequently included in closed-ended research instruments. In their extensive review of energy-related behaviours, Whitmarsh et al. (2011) conclude: "When people refurbish their homes they invariably want to *see* the results of their *investments*" (p105, *our emphasis*). Even here though, renovations are still framed as investments and so overtly financial.

3.2. Sampling biases and decisions as points

Applied energy efficiency research seeks to understand renovation decisions, but either explicitly or implicitly treats the decision statically as a discrete event or point in time with a characteristic set of influences (see Table 3 and Figure 1a). Treating decisions as singular moments, undertaken by an individual or discrete set of actors, is also common in research on homes and housing more generally (Christie, Smith et al. 2008; McCormack and Schwanen 2011).

A useful contribution of Green Deal-specific research has been its framing of a 'purchase decision journey' or 'customer journey' (DECC 2011a). The 'journey' terminology acknowledges that decision influences change over time and are cumulatively reinforced, with the decision event itself as a culmination. This is recognised by decision models in other fields, such as health and addiction (Prochaska, DiClemente et al. 1992) or innovation adoption (Rogers 2003). Recent research has confirmed the often protracted nature of renovation decisions (Wilson, Chryssochoidis et al. 2013). The extent of past experience points to renovating with efficiency measures as a periodic or ongoing feature of domestic life rather than a one-off decision event (Fawcett 2013).

For stated preference research using cross-sectional samples, this implies that *when* during the decision process households are studied is important in determining *what* they say (Wilson 2008). A German study sampled households planning renovations within the next two years, households who had completed renovations in the past five years, and households who had never renovated (Novikova, Vieider et al. 2011). Comparing the pre- and post-decision cross-sections showed how decision influences and perceived barriers changed as renovation intentions strengthened and were ultimately realised (Novikova, Vieider et al. 2011).

Wilson & Dowlatabadi (2011) similarly find evidence of differences between expectations and experiences (pre- and post-renovation). Homeowners are more likely to cite building appearance as an important motivation prior to renovating, but retrospectively emphasize thermal comfort and energy savings. Experiences of renovating *ex post* affect self-reported motivations for renovating *ex ante*. Renovation decisions have a tendency to be rationalised after the fact (see Haidt 2001 for a broader discussion).

Sampling design therefore influences research findings. Applied energy efficiency research that draws on self-selecting samples of would-be renovators or successfully-completed renovators is particularly prone to bias (e.g., Huber, Mayer et al. 2011; Weiss, Dunkelberg et al. 2012). This includes studies of households participating in incentivised renovation programmes or policy trials (e.g., Bioregional 2011; Michelsen and Madlener 2013). The inclusion of a 'control group' of non-renovators is a simple remedy yet is omitted in many studies. This methodological limitation is inconsistent with the instrumental rationale of applied energy efficiency research, which is to diffuse efficiency measures throughout the housing stock by converting non-renovators into renovators.

3.3. Decision makers or individuals not households

The household has been recognised as an important scale of enquiry for examining environmental behaviour (Reid, Sutton et al. 2010; Gibson, Head et al. 2011) and the transformation of cities and the built environment (Buzar, Ogden et al. 2005). Observed renovation behaviour (in markets, in field trials, or in intervention studies) directly measures household-level decision outcomes. As the subjects of a decision process, households are seen as functional, operational units (van Diepen 1998). The UK Government's statistical service defines a household primarily as a bounded physical construction: "*as a person living alone, or a group of people (not necessarily related) living at the same address who have the address as their only or main residence, and either share cooking facilities and share a living room or sitting room or dining area*" (ONS 2011).

Applied energy efficiency researchers frequently use the term 'household', but households are neither defined nor identified empirically in a consistent way (Casimir and Tobi 2011). Renovation

decision makers subject to personal influences tend to be individuals, albeit in a household context (see Table 3). Self-report data from individual household members are commonly generalized to the household as a whole. Even approaches that explicitly characterise differences between households in terms of archetypes or 'personas' recognise that a household may comprise more than one persona with distinct goals and aspirations in the renovation decision process (Haines and Mitchell 2014).

Decision making can be interpreted at the household level measured through proxy variables such as household lifecycle or size. The number, age, gender, income and relationships of household occupants can also be used to create meaningful socio-cultural units for analysis (Wilhite 2005). Applied energy efficiency research does not, however, account for the possibility of distinctive households nor differentiated roles within the household (Wilhite and Wilk 1987; Oates and McDonald 2006).

3.4. Efficiency measures not home improvements

Applied energy efficiency research generally excludes amenity renovations (e.g., kitchens, bathrooms) and other types of home improvement including DIY that may be carried out together with efficiency measures. Energy efficient renovation decisions are treated as distinctive, with their own characteristic set of drivers and barriers (Tables 1 and 3), and unrelated to other decisions householders might make with respect to their homes.

Yet in the UK only one in ten would-be renovators are considering only efficiency measures (Wilson, Chryssochoidis et al. 2013). Efficiency measures are also three times more likely to be included in the scope of broader amenity-based home improvement projects than considered alone. Judson and Maller (2014) found that efficiency measures in one part of the home often went hand-in-hand with expansions or intensifications of other parts of the home (e.g., additional bathrooms). In the US, renovation expenditure on amenity features of the home, particularly kitchens, is over five times that spent on energy-related measures (JCHS 2009). Mainstream marketing messages on home renovations promote amenities not efficiency measures (Lutzenhiser 2002).

3.5. Extra-ordinary events not everyday domestic life

Applied energy efficiency research focuses on energy efficiency measures and influences on renovation decisions. But seeing efficiency renovations as distinctive serves to decontextualize them. Efficiency renovations categorised as one-off, extra-ordinary events detaches decisions from everyday domestic life and weakens links to households' lived experience (p217, Lutzenhiser and Shove 1999). "*Domestic retrofit is not an activity of changing a house … from poor energy performance to exceptional energy performance, but an intervention into the rhythms of domestic habitation*." (p569, Karvonen 2013). Thermally insulated walls and windows, and efficient heating systems, provide a range of useful services that enable normal and socially acceptable activities to be carried out (Wilhite, Shove et al. 2000). Households' needs and expectations for these services evolve. Renovating a building envelope or heating system is one way of adapting homes to households' evolving needs. Moving home is another way (Coulter, van Ham et al. 2011).

Renovation activity is situated in the home; decisions to renovate unfold as part of life at home (Hand and Shove 2004). Contextual influences on renovation decisions such as household and property characteristics (see Table 3) should not be treated as exogenous to the decision but as part of it. Renovation decisions need to be understood "*in the context of the relations between everyday practices and the environments within which these practices unfold*" (McCormack and Schwanen 2011).

This casts the net of potential influences on renovation decisions far wider. The scope of enquiry of renovation research needs to include the ultimate reasons why people might decide to redesign or structurally change a particular part of their domestic environment, such as a kitchen or bathroom

(Shove, Watson et al. 2007). Decision-making research should account for space (house, home), influence (household members, dynamics), enactment (social roles, learning, reinforcement) and recognition (experiences, evaluation) (McCormack and Schwanen 2011).

3.6. Renovations not renovating

Applied energy efficiency research is concerned with renovation measures and the consequence of physical changes to the home on energy savings. The renovation decisions that lead to these changes are information-based and shaped by personal and contextual influences (Figure 1a).

Sociological research including DIY within home renovations moves away from cognition and cognitive processes, and emphasises bodies, things, and skills. Energy efficiency or other renovation measures are objects that facilitate and constitute particular actions and ways of living (Hand, Shove et al. 2007). Kitchen renovations that result in 'having' a new kitchen are part of the shifting materiality of the kitchen space with its changed cupboards, sink and spice racks (Southerton 2001). Including DIY activities as part of the renovation process raises questions of how objects such as a hammer, if placed in a skilled practitioner's hand, becomes an extension of the body and enables particular 'doings' (Shove, Watson et al. 2007). Without either hammer or skilled practitioner, there would be no renovation activity.

This focus on objects and skills by examining things in motion – the 'havings' and 'doings' of renovating households - diffuses the narrow focus on the specifics of renova*tions* into an exploration of renova*ting* as an everyday, even routine activity (Hand, Shove et al. 2007). Whether renovating is a social practice remains contested. Judson and Maller (2014) argue it is, conceptualising renovating as a practice constituted by four interacting elements: rules, materials, skills, and common understandings. Bartiaux and colleagues (2014) argue that renovating is not (yet) a social practice as it is insufficiently widespread. Regardless, home improvement activities to change the structural features of a home are enacted through replication, continuation, alteration - what's been done before, how that is ongoing, and how that is tinkered with or adapted (Shove, Watson et al. 2007). Through this lens, discrete renovations should be understood as part of renovating.

3.7. Houses not homes

Applied energy efficiency research emphasises physical and structural changes to the fabric or energy systems of a property, house or dwelling. But the notion of 'home' extends far beyond the physicality of the house. House and household are certainly components of home, but so too are more complex social and emotional relationships (Blunt and Dowling 2008). The home is not a static construct or representation but a dynamic expression of household members' feeling towards it (p230, Baillie and Benyon 2008).

Households' emotional connections to the home are also intrinsically related to energy efficient renovations and more generally to the use of energy. The characteristics ascribed by different household members to their homes when thinking through changes made to the physical house can be understood through different meanings: 'home as a project'; 'home as a haven'; and 'home as an arena for activities' (Aune 2007). These various meanings are neither exclusive nor fixed. Rather they emphasise how households' emotional and symbolic connections with their homes impact on their expectations of comfort and associated homemaking activities (including renovating).

Sociologists have characterised the home as a site of consumption (Madigan and Munro 1996; Bell and Valentine 1997), particularly in relation to family and the dynamics of family life (Finch 2007). Examining consumption practices requires a differentiation of the spaces inside the home such as the kitchen as a locus or focus of household activity (Martens and Warde 1999). Domestic space is far from a neutral backdrop against which the enactment of daily life can be examined (Nansen, Arnold et al. 2011).

In other words, homes are both a physical space and an imaginary place; the two need to be studied together, not as distinctive parts. Household typically defines the number and type of people in the physically bounded space, but home is a looser term that also describes emotional and social connections with its differentiated places. Going back to its Greek origins, Baillie & Benyon (2008) argue that the term 'Oikos' includes "*not just the concept of space, or place as 'home' does, or social networks, as 'household' does, or a family-oriented work as 'domestic' does but all of these*" (p229).

4. Situating renovation decisions within domestic life

In sum, applied research on energy efficient renovations, which supports and informs policies like the Green Deal, is both methodologically and conceptually limited. The scope of enquiry is defined by an interest in:

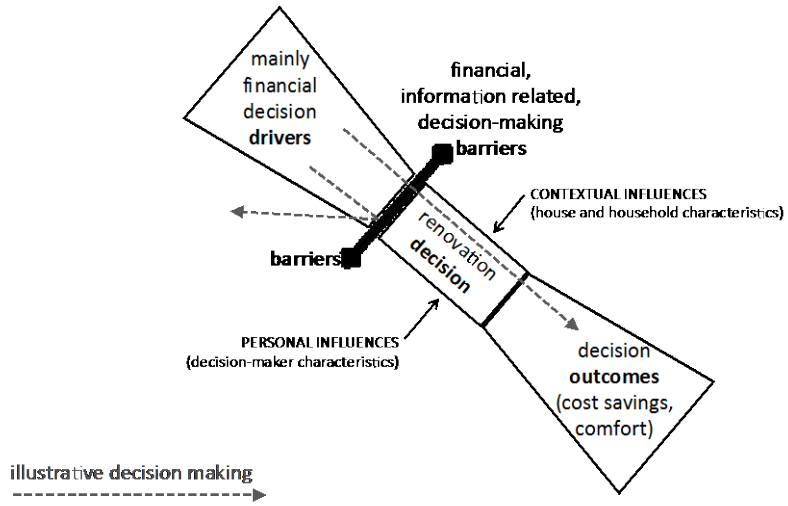
i. *renovation decisions*, but not the processes preceding them nor the domestic context from which they emerge;
ii. *financial drivers and barriers* of energy efficient renovations, but not the manifold other characteristics of major structural changes made to homes;
iii. *energy efficiency measures*, but not other types of amenity renovation and improvements to the home;
iv. *households* as discrete units of measurement and function with representative decision makers, but not dynamic and differentiated entities;
v. *houses* as physical structures and unitary spaces, but not homes encompassing both multiple spaces and personal places imbued with meaning and emotion;
vi. *renovations* as physical changes to homes, but not as enactments of renovating, an everyday activity of both objects and skills.

These limitations of applied energy efficiency research result in a narrowly-defined problem and so a restricted palette of explanations and decision influences for policies like the Green Deal to draw on. Situating an applied understanding of renovation decisions within a broader conceptualisation of homes, households and domestic life would help address these limitations. Yet in drawing on a diverse body of social research, it is important that alternative problem framings do not wholly displace or undermine the attractiveness of applied energy efficiency research to policymakers. Renovation decisions should remain central as they are direct antecedents to renovation outcomes in owner-occupied homes. Renovation outcomes such as energy performance improvements, numbers of installed measures, or renovation rates, provide observable metrics linked to policy objectives. Robust, repeatable, and broadly-representative empirical studies are needed to substantiate the conceptual richness of situated accounts of renovating.

Figure 1b offers a simplified representation of a situated approach to renovation decision making. Its key features are: (1) to distinguish renovation decisions as processes, (2) that emerge from and take place within the conditions of everyday domestic life, (3) subject to influences that vary in their immediacy.

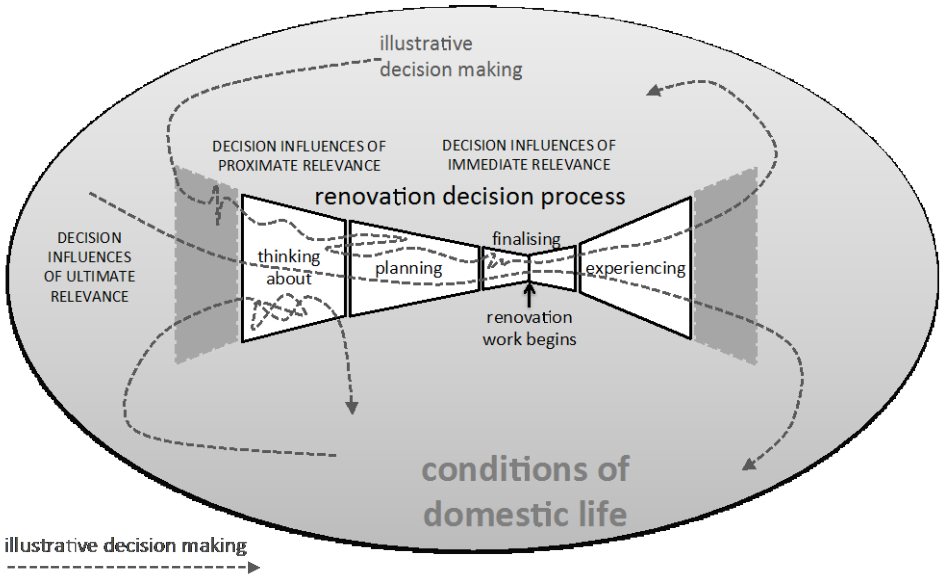
Figure 1. Representations of Renovation Decision Making: Applied Energy Efficiency Research (1a, upper panel); Situated Decision Making Research (1b, lower panel).

Figure 1a. Renovation decisions in applied energy efficiency research.



Notes: Downward sloping renovation decision represents sufficient motivations prevented from being realised by barriers (cf. rivers and dams). Personal and contextual influences are exogenous to the renovation decision. Dotted grey lines illustrate decision making.

Figure 1b. Situating renovation decisions in domestic life.



Notes: Grey egg represents conditions of domestic life relevant to renovating. White wedges represent renovation decision process; width of wedge represents focus and specificity. Wedges narrow as intentions strengthen and decision becomes more focused (cf. Rogers 2003).

The representation in Figure 1b distinguishes influences on renovation decision processes as immediate, proximate and ultimate. Immediate influences affect specifics of the renovation decision close to, or at the point of sale: measures or products, contractors, timing, financing mechanisms with their implications for cost, quality assurance, disruption, administrative simplicity, and so on. These influences form part of the product and service offerings of renovation contractors and service providers. Proximate influences act on renovation intentions and plans that may be triggered by external events (e.g., boiler breaking down, moving home) or may emerge from household desires and wants, becoming cumulatively reinforced (Coulter, van Ham et al. 2011). Proximate

influences correspond with the 'thinking about' and 'planning' stages of the decision process shown in Figure 1b; immediate influences correspond with the 'finalising' stage. Applied energy efficiency research characterises these proximate and immediate influences in some depth. They include personal and contextual factors (Table 3), financial attributes (Table 2), and drivers and barriers (Table 1).

Situating decision processes within the conditions of domestic life also recognises the ultimate influences that originate and shape the decision process in its entirety. Guy and Shove (2000) argue that *"more or less energy efficient choices are made in response to changing opportunities and pressures … knowledgeable actors creatively adopt and adapt strategies and practices that suit their changing circumstances"* (p133). These changing circumstances or 'contexts of action' are what the conditions of domestic life aim to represent: the dynamics and restlessness of life at home associated with renovation activity. Marginalised in applied energy efficiency research, these dynamics include social practices, meanings of home, emotional and social attachments to places within the home, and negotiations within differentiated households. Deciding to renovate is rooted in and endogenous to these conditions of domestic life. Decision outcomes and the subsequent experience of living in a renovated home in turn (re-)shapes these conditions. The trajectories between the emergence of renovation decisions and their eventual realisation are cumulative, reinforcing and iterative, but are also uncertain, non-deterministic, and potentially reversible (see illustrative dotted lines in Figure 1b).

Table 4 provides examples of influences or variables of immediate, proximate, and ultimate relevance to the renovation decision. The lower rows correspond to constructs and themes identified as important in social research on homes and domestic life (relevant to renovating). These strongly characterise ultimate influences, but can also be of proximate or even immediate relevance to renovation decisions.

A boiler breakdown is an example of a proximate influence on a renovation decision. The recommended models and costs of replacement boilers offered by an emergency callout contractor are corresponding examples of immediate influences. The role of the boiler in providing thermal comfort, differentiating the use of rooms and spaces, and enabling patterns of social activity in the home, are all examples of ultimate influences.

By situating renovation decisions within domestic life (Figure 1b), the tractable, instrumental and empirical strengths of applied energy efficiency research can be retained in a richer, theoretically-grounded scope of enquiry. This situated research explicitly recognises the complexities of homes as adoption environments for renovation measures. Reframing renovation decision making as endogenous to the conditions of domestic life provides fertile new ground for policymakers seeking to influence renovation decisions (Table 4) and opens up policy-relevant research to a broader, critical body of social science (Shove 1998; Guy 2006).

Table 4. Examples of Immediate, Proximate and Ultimate Influences on Energy Efficient Renovation Decisions.

	Immediate Influences (informing or influencing point of decision)	**Proximate Influences** (initiating, informing, or influencing cumulative decision process)	**Ultimate Influences** (originating or shaping meaning and intent of decision process)
Attributes of efficiency measures • (see Table 3)	e.g., financing options	e.g., energy savings	e.g., experience of previously-installed measures
Decisions about efficiency measures • (see Table 3)	e.g., reliability of contractor	e.g., energy assessment or audit	e.g., juggling competing commitments in domestic life
Decision maker (individual / household) • (see Table 3)	e.g., energy saving motivations	e.g., awareness of energy / environment issues	e.g., life course
Decision context • (see Table 3)	e.g., emergency repair	e.g., age of property	e.g., physicality of ageing
Everyday domestic life • norms & expectations • materiality, physicality • social practices	e.g., marketing by home products store	e.g., importance of objects in domestic routines	e.g., dynamics of domestic practice in amenity spaces of home
Differentiated households • roles • relationships • use of spaces	e.g., risk-aversion of financial decision maker	e.g., different opinions on preferred renovations	e.g., roles and negotiated positions as part of household dynamics
Emotional and social homes • meanings & identities • ideals & visions • emotional connections	e.g., product aesthetics	e.g., environmental objectives	e.g. notions and characterisations of family life

5. Conclusions

The widespread diffusion of energy efficiency measures through the existing housing stock is an important social objective. A wealth of policies, regulations, incentives, and other interventions have been introduced to stimulate and support this diffusion over the past four decades (Gillingham, Newell et al. 2006; Karvonen 2013). The Green Deal's launch in January 2013 in the UK is a landmark recent example. Yet despite all these inducements, instructions, prompts and prods, homeowners remain stubbornly resistant to improving their home's energy efficiency by making structural changes to their walls, heating systems, walls, windows, doors, lofts and basements.

The aim of this paper was to show how the body of research on which policies like the Green Deal are based can be situated within a broader conceptualisation of renovating and domestic life. This strengthens understanding of why and how homeowners decide to renovate energy efficiently.

Applied research into energy efficient renovations understands renovation decisions in terms of drivers and barriers. This body of work has identified a wide range of explanatory variables describing why homeowners may be motivated to renovate or why these motivations may be thwarted. These variables can be grouped into four types:

- renovation decision attributes, including upfront cost and payback periods on capital invested;
- renovation decisions, including expectations for energy savings and the perceptions of reliability and trustworthiness of contractors;

- renovation decision makers, including age and education, attitudes towards energy and the environment, and household size and composition;
- renovation decision contexts, including home tenure and the physical characteristics of the homes.

Each of these explanatory variables presents a lever or opportunity for policy to exert influence. The Green Deal, for example, aims to remove the capital cost barrier (decision attribute), mitigate concerns of contractor reliability (decision), and address short or unknown future home tenures (decision context).

Although applied energy efficiency research speaks directly to policy concerns, it also has limitations. Methodological limitations include a reliance on stated preference data drawn from potentially biased samples and a strongly-financial framing of renovation decisions. These limitations can be addressed through research designs that include control groups of non-renovators, that sample renovators at different stages of the renovation decision process, and that use open-ended methods to inform a less constrictive scope of closed-ended questions for studies with larger sample sizes.

Conceptual limitations of applied energy efficiency research are all associated with an overly-narrow problem definition or scope of enquiry. Energy efficient renovations are implicitly conceptualised as a distinctive type of physical change made to houses as the outcome of a decision by a unitary household decision maker. This conceptualisation is challenged by broader lines of enquiry into homes and domestic life.

From these viewpoints, energy efficiency renovations are not inherently distinctive nor unique, and should not be partitioned off the other types of home improvement, large or small, with which households are continually engaging as part of the restlessness and motion of everyday domestic life. Nor should the physical structure of houses be shorn away from the strongly social, symbolic and emotional connections of homes, as ultimately it is these homes that are being changed. And finally, households should not be assumed as cohesive decision making units, but rather multi-faceted and potentially discordant sets of relationships.

Situating energy efficient renovations within a broader understanding of why homeowners decide to renovate their homes means moving beyond immediate and proximate influences to the deeper, ultimate influences that explain the emergence of renovation decisions. This does not imply nor require a grand, integrative research agenda, but rather a greater sensitivity to the strengths and limitations of contrasting research approaches. Tweed (2013) argues that studies of social practices in domestic life may deepen and enrich understanding of home renovation activities, but neither inherently nor necessarily lead to better retrofit outcomes from the perspective of occupants. Nor do they explain occupants' concerns, enthusiasms, and ambivalence about renovating (Tweed 2013). Conversely, applied energy efficiency research may measurably improve retrofit propensity and outcomes, but largely fail to explain why retrofits are needed or desired in the first place. The conceptualisation of renovation decisions as processes situated within the conditions of domestic life draws constructively on these diverse perspectives.

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