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Why do people (not) energy renovate their homes? Insights from qualitative interviews with Danish homeowners

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Abstract Global climate changes and the need for transition to a low-carbon future have emerged as one of the most critical challenges of contemporary society, and decisions made by homeowners about major energy relevant renovations are essential as part of reaching climate goals. However, the installation of energy efficiency measures is still not widespread and needs to be stimulated to meet the goals set out in the Paris Agreement. This article provides insights into renovation processes by Danish homeowners currently being in the process of renovating their homes. Data were collected through 19 explorative qualitative interviews in the informants' homes. By using practice theory as an analytical framework, we seek to broaden the traditional policy approach of rational actors by contributing with a broader and more context-rich understanding of homeowners' renovation processes and how, or not, energy renovation is part of such processes. The results show that home

renovation is a dynamic process that is not always carefully planned or intended, but rather evolves as technologies, know-how, and meanings develop and change. Specific challenges for energy renovation are identified concerning its perceived benefits, complexities, policy conditions, and associated meanings. The challenges of energy renovation are researched in context of other types of home renovations that are often implemented at the same time, but which differ fundamentally. Based on systematic evidence of the challenges and implementation context of energy renovation, recommendations for initiatives relevant to stimulate in policy and marketing are provided.

Keywords Home renovation · Energy renovation · Decisions · Retrofit · Practice theory · Policy measures · Domestic life · Homeowners · Single family houses

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Introduction

Global climate changes and the need for transition to a low-carbon future has emerged as one of the most critical challenges of contemporary society. All over the world, public sectors and other stakeholders from civil society and the private sector are expected to implement measures to limit greenhouse gas (GHG) emissions and adapt to climate change (Lopes et al., 2020). As the energy consumption for buildings accounts for approximately 40% of total energy

consumption at EU level, energy optimization of the existing building stock is at the core of international, national, and local energy policies. In spite of national and European initiatives to regulate and promote energy renovation and energy savings, evaluations and studies suggest that energy renovation is still not widespread (Gram-Hanssen et al., 2018). In policy interventions aimed at influencing homeowners to energy retrofit their homes, there is a tendency to focus on the isolated retrofit decisions made by homeowners, expecting that information and subsidies may directly influence such decisions (Fyhn & Baron, 2017). Yet, it is often claimed that the nature of home renovation cannot be grasped by traditional simplistic policy approaches based on beliefs in rational actors choosing the best technology available (Palm & Reindl, 2016). In an early work, Wilk and Wilhite (1985) were among the first researchers to conduct ethnographic research to understand why households do not weatherize their homes. They found that economic rationality is inadequate in explaining energy conservation behavior and that sociocultural and psychological goals of homeowners are more influential. Hence, there is a need for a broader look at the processes leading to or from renovation, and the constituting forces of such processes, which do include not only homeowners and governments but also intermediary professionals (Fyhn et al., 2019).

Literature

Practice theory is viewed as being useful for intervention design due to its conceptualization of decisions as embedded in the habits and routines of daily life, rather than as an outcome of individual deliberation processes (Kurz et al., 2015). Practice theory's emphasis on the routine aspect of practices poses challenges when it comes to renovation activities, since most people doing renovations do so just once or a few times in a lifetime (Karvonen, 2013; Warde, 2014). To accommodate infrequent behaviors, such as domestic retrofit, some scholars have identified social practices by the presence of social conventions framing the practice instead of individuals' habitual repetition of the practice (Bartiaux et al., 2014; Judson & Maller, 2014; Judson et al., 2014; Karvonen, 2013). Bartiaux et al. (2014) illustrated how renovation is best understood as the result of co-evolving know-how, institutional procedures, social norms, and

technologies, thereby challenging the classic techno-economic assumption of a sovereign actor rationally "choosing" to retrofit. Recent research within practice theories suggests that energy renovation is rarely done for the sake of reducing energy consumption alone, but is also due to other interests that the household may have in their home and its maintenance (Gram-Hanssen et al., 2018). Fyhn and Baron (2017) find that maintenance and renovation is best understood as parts of the ongoing practice of dwelling and show how retrofit decisions are embedded in the daily lives of the occupants. Furthermore, research has highlighted how householders renovate their homes to better accommodate their everyday life and practices (Maller et al., 2012; Tjorring, 2016) thus arguing how this understanding of everyday life ought to be included in policy to promote energy renovation. One study found that energy renovation, understood as something separate from other renovation activities, is not considered an integrative practice by homeowners due to a lack of conventionalized routines and shared know-how and goals among relevant actors. In line with this, Fyhn et al. (2019) found that renovation is framed differently by government, homeowners and craftspeople. Other researchers emphasize the role of professionals, and how their routines and mindsets in the planning process greatly impact the energy measures implemented (or not) (Palm & Reindl, 2016). Owen et al. (2014) recognize the powerful role of advisers and installers in both adoption and use of domestic energy technologies, and Arning et al. (2019) show that advice on renovation from intermediaries, and especially craftspeople, is almost always followed when having trustful relationships with their clients. Other researchers emphasize that energy renovation is not about giving homeowners the "right" motivational information, but rather about adopting to social norms of what is normal to do and say (Bartiaux et al., 2014). McMichael and Shipworth (2013) found that seeking information among personal contacts is often associated with adoption of energy-efficiency innovations, increasing the likelihood of adoption by up to four times.

Common to studies using practice theories in analyzing renovation processes is that the focus is less on the single acts of individuals and more on the social practices themselves, and how routinized practices persist, are reproduced (or not) and shape behavior (Karvonen, 2013). Thus, practice theories incorporate

a temporal aspect that recognizes the dynamics of renovation processes and of the housing stock per se. Hence, practice theories propose an explanation of the low uptake of energy renovation by emphasizing the social and routinized aspects of renovation processes as an alternative to the more individualistic and rational focus of behavioral research (Karvonen, 2013; Klöckner, 2017; Wilson et al., 2015).

Contribution

In this article we intend to further develop this understanding of renovation by analyzing energy renovation activities as embedded in broader processes of home renovation, which again is seen as an integrated part of the domestic life of the occupants. Such a processual view expands the common focus on energy renovation as isolated acts. We use practice theories as an analytical framework, as they are claimed to be especially useful in understanding the complexity of renovation (Karvonen, 2013). The aim of this paper is, thus, to further develop the existing knowledge on how energy renovation must be seen as an integrated process considering how materiality, shared knowledge among different actors and learning processes of homeowners are integrated. We provide empirical evidence of how (and why) energy renovation differs fundamentally from other types of renovation activities that they are often implemented along with. As such, a main contribution of this paper is that it systematically unfolds the potential challenges of energy renovation compared to other types of amenity renovations that are often highly associated with social life and norms. This reveals a conflict that influencers and decision-makers within energy transition and home renovation must necessarily relate to due to the interconnections between different renovation decisions. Specifically, we are interested in how this knowledge can inform intervention measures relevant for stakeholders in both energy transition and home renovation such as political decision-makers and contractors (and their marketers) as well as relevant consumer associations providing knowledge and advice to homeowners.

Practice theory framework

Theories of practice have in recent years been used in different types of empirical investigations related

to sustainable consumption in general (Evans, 2018; McMeekin & Southerton, 2012; Sahakian et al., 2021) and more specifically also related to energy renovation (Bartiaux et al., 2014; Fyhn et al., 2019). Most of these studies build on approaches of theories of practice originally formulated by Schatzki (1996, 2001) and later appropriated for empirical use by Shove et al. (2012) and by Warde (2005). Common to these approaches is that the focus of investigations should be on the collective practices rather than on structures or actors. Practitioners carry practices, and perform them as individuals, though the subject of investigation is the entity of the practice (Reckwitz, 2002). Practices as entities are held together by elements which are named and numbered in slightly different ways by different authors—for an overview of naming of elements see Gram-Hanssen (2011). The practice elements are assumed to constitute each other and to change through processes of integration. Yet, co-existence does not guarantee that elements link together, only the potential (Shove et al., 2012). For a practice to exist, the elements must be conjoined and dynamically integrated by practitioners through regular and repeated performances. Practices thus emerge, persist, shift, and disappear as the links between elements are made, sustained or broken.

The different elements used in empirical investigations vary according to authors as well as related to the field of enquiry. In the present study we will thus follow the line from one of the studies working with energy renovation which has elaborated the framework in order to capture the distinct features in this field of enquiry (Bartiaux et al., 2014; Gram-Hanssen, 2014). In line with these researchers, we distinguish between two types of competences: (1) *know-how and embodied habits*, both regarding energy consumption and the renovation works carried out by homeowners or craftsmen, and (2) *institutionalized knowledge*, understood as the rule-based or theoretical knowledge structuring home renovation, including both explicit policy regulation and established technical knowledge (Bartiaux et al., 2014). In sum, we consider four linking elements central in a practice theoretical analysis and discussion of energy efficiency home renovations: *technologies, meanings, know-how and embodied habits*, and *institutionalized knowledge*. To accommodate infrequent behaviors, such as domestic retrofit, we focus on established understandings, practical consciousness, procedures,

and objectives of practices, and de-emphasize the habitual aspect when analyzing renovation decisions.

Methods

Qualitative design and data production

Data were collected through in-depth interviews with 19 Danish homeowners that were in the process of making decisions about renovation of their home. The informants were acquired from a Danish home renovation contractor's consumer database in the autumn of 2019. All informants had requested a consultation with the contractor before the interview and most of the informants had already made renovation considerations prior to the consultation, which were often altered or even changed through the consultation. As such, this research is based on homeowners being in a stage of their renovation processes where they did already display some motivation toward specific renovation measures and already booked or completed a consultation.

Sampling

The recruitment of homeowners for interviews was done by means of a *purposeful sampling* approach, meaning that individuals were selected because they were expected to purposefully inform the understanding of the research problem and central phenomenon in the study (Creswell & Poth, 2018). The informants were chosen based on the *type* of renovation, *progress*

in their renovation processes and *geography* to ensure maximum variation. The sample size was determined by the point of saturation, where further interviews did not yield new knowledge (Kvale & Brinkmann, 2009). The sample is summarized in Table 1.

Homeowners were recruited continuously and interviewed quickly after recruitment to secure minimal advancement in the decision process from the time of recruitment. Participants were first contacted by e-mail to motivate participation and clarifying that the interview had no direct commercial purpose and was conducted by a researcher and not the company. Also, they were informed that data would be shared and stored in line with the General Data Protection Regulation, and that they could withdraw from participation at any point. From the outset, no incentives were planned or promised, but because the recruitment went slow and contacted homeowners often expressed that they could not find time for or prioritize a meeting, we decided to offer an incentive of 500 DKK (\approx €67) for participating in an interview. To reduce possible response biases from the payment, we framed the incentive as a compensation for the homeowner's time use, seeking to promote an impression of fairness and sincere appreciation of their participation.

Interview procedure and interview guide

The interviews lasted between one and two hours and were carried out by the first author and an assistant. When possible, couples were interviewed together to capture information rich negotiations

Table 1 Sample criteria and number of interviewed households

Renovation type* <i>Sampling criteria 1</i>	Position in decision process <i>Sampling criteria 2</i>			Area <i>Sampling criteria 3</i>
	Booked consultation	Completed consultation	Accepted quote	
New roof, roof repair, ceiling insulation, wall insulation, energy windows/doors	3	3	2	Central Zealand
New roof, roof repair, roof renovation, ceiling insulation	1	2	2	Middle Jutland
New roof, roof repair, roof renovation, heat pump		2	1	Southern Jutland
New roof, roof repair, roof reparation, heat pump	1		2	North Jutland
Total interviews	5	7	7	19

*In the sampling strategy informants were selected to ensure variation in the renovation tasks asked for by the homeowners. Yet, the interviews were not limited to these specific renovations, since homeowners often talked enthusiastically about both already accomplished and desired renovations and often developed new renovation ideas and desires along the decision process

between family members yet keeping attentive to possible power relations. Interviews were conducted in the informants' home, and they were encouraged to give us a "guided tour" around the house. Situating the interviews as informal homely conversations with windows of observations can potentially reveal more valid knowledge than just asking outside the context (Kvale & Brinkmann, 2009). An overview of participants is presented in Table 2.

To guide the interviews, a semi-structured interview guide (available as supplementary files) was developed that was theoretically informed by theories of practice, thus focusing on actual doings more that reflected intentions. The purpose of the guide was to ensure relevance and contribution, and at the same time to be able to spontaneously follow leads and directions that were deemed relevant for the study (Sobh & Perry, 2006). The guide was structured from a general to a more specific level, only later involving potentially sensitive items such as the consultation and environmental discussions to avoid possible emotional or normative impact on the informants' reporting.

The first four interviews led to small adjustments of the interview guide. Interviews were recorded and transcribed ad verbatim by the first author, thereby also initiating the analysis process by gaining further familiarity with the data.

Data coding and analysis

The 19 interviews were processed and analyzed by means of content analysis and a coding template developed to summarize themes identified as important in the data set and to organize them in a meaningful and useful manner (Brooks & King, 2014). Themes were coded using NVivo12 in an iterative process of coding and analysis, including deductive coding and inductive coding as well as deductive condensation and interpretation. As such, the top themes, or main categories, were theory-driven and based on the practice theory framework, and the subcategories were more flexible and data-driven. This dual coding process ensured both structure and closeness to data. Codes and categories were validated by a second review and refinement of the main categories and subcategories. The results from the analysis are

Table 2 Informants listed by age of house and family type

Interview number	House construction year	Adult age	Children	Occupationally active or retired	Adult family status/type of interview
1	1972	60+	2, left home	Retired	Single woman
2	1887	> 50	2, home living	Active	Couple/only woman interviewed
3	1968	60+	2, left home	Retired	Couple/interviewed together
4	1976	> 60	2, left home	Retired	Single woman
5	1965	> 40	0	Active	Couple/interviewed together
6	1956	60+	4, left home	Retired	Couple/interviewed together
7	1976	> 40	1, home living	Active	Couple/only woman interviewed
8	1973	> 50	2, home living	Active	Couple/interviewed together
9	1953	> 50	2, home living	Active	Couple/only woman interviewed
10	1973	> 50	2, home living	Active	Couple/interviewed together
11	1979	> 60	0	Active	Single woman
12	1978	> 40	0	Active	Couple/only man interviewed
13	1966	60+	2, left home	Retired	Couple/only man interviewed
14	1957	> 50	1, home living	Active	Single woman
15	1924	> 50	2, home living	Active	Single man
16	1985	> 50	3, home living	Active	Couple/interviewed together
17	1978	60+	1, left home	Retired	Single woman
18	2015	> 50	2, home living	Active	Couple/only man interviewed
19	1981	> 50	2, home living	Active	Couple/interviewed together

presented below and exemplified by interview numbers in parentheses and selected quotes from the interviews to increase the transparency of the data analysis.

Results

The reasons why people renovate cannot be reduced to the physical condition of a house and it cannot be limited to the point of people buying and moving into a house that needs renovation. Home renovation is defined as continuous activities that are both related to the condition of the house affected by aging, wear and tear, but also to the people living in it, their everyday life and changing lifecycles (Gram-Hanssen, 2015). Using practice theory to analyze renovation processes as explained in the theory section, we present in the following the results by each of the four elements: *technologies*, *know-how and embodied habits*, *institutionalized knowledge*, and *explicit rules*

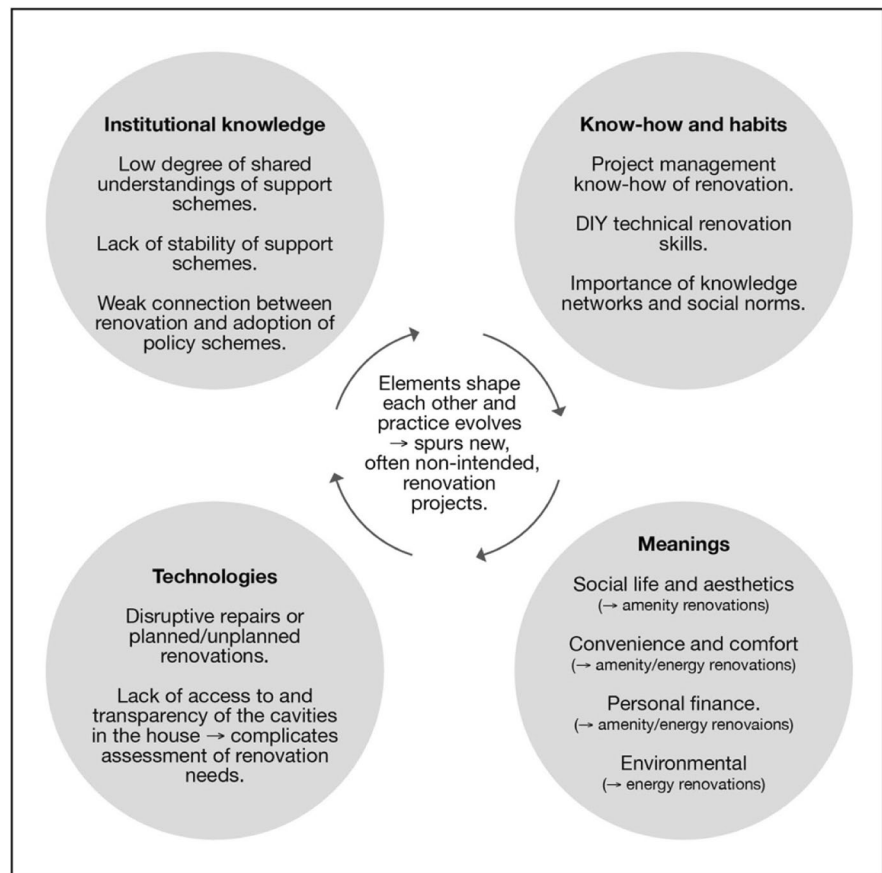
and *meanings*. The results are summarized in Fig. 1 illustrating the connection between the four practice elements and the main challenges of energy renovation identified in the analysis.

Technologies

In the context of home renovation, *technologies* represent the house itself and the tools, technologies, and materials available for renovation (Bartiaux et al., 2014). As such, the physical condition of the house, the available supply of renovation solutions, the qualitative characteristics of materials and the available tools and techniques are all co-constituting parts of a renovation practice.

Sometimes changes to the house are thoroughly planned renovations, and other times they are more disruptive, such as repair of sudden breakdowns or damages. In both cases, when people renovate their house, initial changes to the materiality and condition of the house often co-guide the flow and speed

Fig. 1 Summary of main results: identified challenges of energy renovation. Figure inspired by Shove et al., 2012, Fig. 2.3 p. 32



of the renovation project. The interview data cover several cases where either a planned renovation or a more disruptive breakdown leading to immediate repair, and the resulting changes to the physicality of the house, unintentionally led to other renovations, sometimes even an ongoing successive spiral of renovations that the homeowners had not considered in the first place (1, 3, 4, 7, 9, 11, 14, 13, 15, 19). Such unintended spirals of renovations are often grounded in the homeowner's *low knowledge* of the condition of the house. Such low knowledge relates to both lack of familiarity with the house and to the opacity of parts of the house. For example, homeowners having acquired their house within the past few years reported that they did not know their house well (2, 7, 19). This problem is expressed by a first-time buyer, a young woman:

“There is this strange thing about buying a house; at H&M you can try a cheap t-shirt and take it home for a month and then return it, but when you buy a house, if you've seen it twice, you've seen it many times. Those radiators; I hadn't noticed them until we bought the house and then I discovered that they are hideously ugly, and from there everything started to take root, ever so slightly” (7).

She expresses in the interview, how the family's renovation projects took shape in parallel with a growing insight into the materiality of the house, and therefore the materiality co-determined their renovation activities.

Other examples cover discrete breakdowns or damages creating unforeseen disruptions to the rhythm of everyday life, which initiated other related or even non-related renovations (1, 4, 13, 19). For example, a family reported a water leakage in their basement that needed instant repair, which led them to do a total renovation of the adjoining bathroom, which again led to the renovation of the bathroom on the first floor, which had no relationship to the initial water leakage (13).

When energy renovation is discussed in the interviews, some informants express that they find it difficult to assess the energy standard of their houses, partly because of a lack of access to the cavities of the house, such as the insulation in the cavity walls or under the floors (11, 13, 15). This uncertainty further makes it difficult to assess the energy

saving potential of energy renovations, because such an assessment requires an understanding of both the *existing* energy standard of the house, the *added* material in terms of the specific energy renovation measures as well as the *technical interaction* between the existing and added materials. These examples highlight the fact that the materiality of the house is much more complex than is evident on its surface, which can be a significant barrier to planning and assessing relevant renovation measures, and in particular energy measures, which are often implemented at the inner sides of the house and are therefore immediately invisible and intangible.

Moreover, it is evident in the data that larger renovation projects in many cases follow a path-dependent development, meaning that renovation decisions to a greater or lesser extent are determined by other renovation tasks due to material infrastructure or an inherent logic in terms of the most sensible, or sometimes the only possible order of execution. This is particularly relevant when renovation projects involve several interventions to interrelated parts of the house (2, 4, 5, 7, 12, 19). Sometimes, such path-dependencies also temporarily constrain the implementation of desired renovations, because they “dictate” some projects over others, or because the larger and more complex a project becomes, the more time and effort it takes to puzzle the project plan, eventually leading to a list of renovation activities. Hence, complex infrastructures and larger renovation projects can encourage specific renovation activities, but at the same time, they possess some degree of internal inertia that can slow down other renovations.

The availability of tools, methods and materials for home renovation is determined both by the homeowner's *knowledge* of the different possibilities in the market, and by their financial *resources* to acquire desired products or solutions. Since many renovation tasks are performed just once or a few times in a homeowner's lifetime, the relevant renovation tools and products are not necessarily familiar to the homeowner. Therefore, a critical aspect for the homeowners' knowledge of tools and materials relevant for their renovation projects is the intermediaries mediating available and relevant materials and solutions to homeowners' renovation desires. The role of intermediaries will be analyzed below in the “[Knowledge networks](#)” section.

Know-how and habits

In the context of home renovation, know-how and embodied habits, consisting of the routinized practical consciousness and psychical skills related to renovation, constitute an important element in renovation practices (Bartiaux et al., 2014). Also, more deliberately cultivated skills, as those acquired from knowledge networks, are relevant, since renovations are often not performed regularly and are therefore not routinized which calls for more conscious appropriation of knowledge. Shove et al. (2012) further distinguish practical know-how and skills from shared understandings of good or appropriate performance in terms of which specific enactments are judged. Knowing in the sense of being able to evaluate a performance is not the same as knowing in the sense of skills required to perform. This is relevant in relation to home renovation since the interview data indicate that homeowners' renovation processes are strongly influenced by their (different types of) knowledge.

Homeowners' craft skills and project management know-how

It appears from the 19 interviews that the knowledge which homeowners activate in their renovation processes and decisions differs markedly. Two main types of knowledge with importance for renovation decisions are identified: (1) *Practical craft skills* that emerged from and are further developed in DIY renovation projects (2, 5, 10, 12, 15, 18, 19). (2) Other homeowners demonstrated varying degrees of *project management know-how*, knowing how to judge and evaluate the steps on the way, for example, counseling, quotation, materials, crafts work, etc. (1, 3, 4, 6, 7, 8, 9, 11, 13, 14, 16, 17). No matter the type of knowledge, the data indicate that the more know-how or skills that homeowners develop through accomplished renovation projects, the more self-confidence they express in relation to starting new renovation projects.

Informants with practical craft skills had all renovated their current and sometimes also former houses extensively, including both amenity renovations and different energy renovations, and they all had plans for upcoming renovations. Some of them stated that their initial plan was *not* to engage in DIY (15,19), but they moved step by step into DIY projects as

their know-how and skills accumulated by observing craftsmen and recording information as exemplified by a young family man:

“I wasn't able to do anything when I was handed this key, but you get the hang of it very very quickly. When you buy something like this, you have two possibilities. Either you won't be done by the time you pop off, or you must pick up some knowledge, and you bet I have learned a lot during those years” (19).

Several of the skilled homeowners requested quotes on energy renovation measures from professional contractors rather than implementing the measures by DIY work. They explained this by perceived difficulties in estimating the interaction between the existing house and added measure, and hence the energy saving potentials, therefore needing professional expertise, and by needs of documentation of the new energy standard of the house. In general, the DIY informants displayed a routinized understanding of when to use professional craftsmen for certain tasks, such as plumbing work that requires authorization, major changes that are too risky to accomplish by DIY, or when documentation of the work is important for authority registration or credit assessment (12, 15, 18, 19).

In a similar way, the project management know-how of homeowners that relates to the process of dealing with contractors, appears to accumulate over time, along with practical experience through renovation projects. This development was evident among first-time homeowners as well as experienced renovators. The latter is exemplified by a single woman renovating her house extensively over several years in a process of adjusting it to the changing positions of her lifecycle, thereby developing a routinized mental script of how to approach and complete renovation processes with professionals (1).

As illustrated, skills and know-how are not fixed attributes and renovation projects are not necessarily accomplished as *either* DIY *or* contractor-based, because both types of knowledge co-evolve with practical performance: practice performance and knowledge co-evolve. However, the data indicate that the types of knowledge that people acquire are often closely related to embodied habits developed through life or related to people's professional occupations. For example, informants with highly developed

technical skills or process know-how explained that they come from practically or administratively skilled families (1, 2, 5, 12, 17), whereas others reflect upon their educational or occupational backgrounds in explaining how they deal with different aspects of the renovation process, such as financing, evaluation of consultants, product quality or DIY work (1, 2, 3, 8, 10, 11, 12, 13, 15). This indicates that even though knowledge co-evolves with practical performance, people might be prone to developing specific types of knowledge dependent on the embodied habits through life and/or occupation that they bring into the current renovation process. Hence, homeowners activate know-how and skills from both similar and different domains when renovating their homes. This might be because knowledge related to a specific renovation task is often non-routinized since many renovations are only performed once or a few times in a lifetime. Therefore, a lack of routinized skills or know-how on a specific task are compensated by extrapolating knowledge from other life-domains to support and facilitate the specific renovation projects. Hence, the embodied skills and know-how when performing different renovation tasks play a crucial role in sustaining and developing practice, whether DIY or contractor-led renovations. The analysis shows that knowledge accumulates with practical experiences and that different types of knowledge co-evolve. Yet, the development of homeowners' know-how and skills—whether DIY or project management-related—is related not only to the performance of renovation activities but also to a great extent distributed by knowledge networks.

Knowledge networks

The knowledge networks related to renovation are important parts of renovation practices in terms of homeowners acquiring knowledge from others to guide their renovation decisions and performances. Such deliberately cultivated know-how and skills from others help people deal with both the complexities of renovation projects and the lack of own experiences when deciding and performing renovation tasks—whether performed as DIY or contractor-led. The data show that homeowners use a wide range of intermediaries to acquire knowledge of the many different aspects of renovation projects: available and appropriate solutions, material qualities,

crafting techniques, prices, financing, etc., and such knowledge is often used for also controlling already acquired knowledge about specific solutions. The knowledge networks include professional contractors and craftsmen, friends, family and neighbors, different construction experts, real estate agents, DIY stores, and the Internet.

A male informant expresses that the Internet can provide some information, but cannot identify your specific problem and appropriate solution, in this example whether to repair or change the roof completely, which requires an individual consultation (6). This example illustrates the perceived complexity of home renovation in terms of both the difficulty of inspecting the specific house, and assessing the renovation needs and relevant materials as highlighted in the previous analysis. Also, the frequent use of professional contractors or craftsmen should be understood in context of the common lack of personal experience with specific renovations and related technical knowledge since many renovations are only done once or a few times in a lifetime. Several informants reported that they altered their renovation plans during the consultation with professional consultants or craftsmen (1, 3, 4, 9, 12, 13, 19), illustrating the importance of professionals in shaping renovation decisions and sustaining practice.

Also, several informants report that they use knowledge from professional consultations in advancing their own renovation skills or know-how and some of the DIY homeowners even report that they hired professional craftsmen with the aim of acquiring and advancing their own practical renovation skills (11, 12, 15, 18, 19).

However, advice from professionals and their applied methods sometimes differ fundamentally, which is exemplified by an email from a retired informant commenting on recommendations from two different advisors regarding wall insulation:

“Another contractor also had a look at it, but in his opinion, insulation wasn't an option at all. And I wondered why he was using a chisel; that surprised me. The other company brought a drilling machine, which was the only thing that made sense to me. I must say that the results that came out of that were different, and in my opinion the sensible thing to do is to insulate, so that's what I did” (13).

This example illustrates how a lack of uniformity in both applied methods, materials and recommended solutions by different professionals is potentially problematic. In the specific example, the informant uses his own years of renovation experience and preconceptions of the right methods and solutions as a guideline for navigating diverging advice, but it seems likely that less experienced and confident renovators could respond to diverging advice with uncertainty about the right thing to do at the risk of not implementing the renovation at all.

In the 19 interviews, family, friends, and neighbors are frequently mentioned as an important knowledge source related to home renovation. Homeowners with lower technical skills or little renovation experience more frequently mention trusted family, friends, and neighbors as important knowledge networks for learning about available and appropriate renovation solutions (1, 5, 6, 7, 8, 9, 13, 16, 17, 18). Social networks influence renovation decisions both in terms of socially desired solutions, which in turn relate to the performance of daily practices in the home, and when it comes to more specific questions of materials and qualities, prices, contractors, financing, etc. Also, family and friends with craft skills are often used as technical assistance in evaluating appropriate solutions both prior to the homeowners' consultation with professional contractors and after in evaluating and comparing solutions (1, 5, 9, 13, 17).

In sum, knowledge networks are important sources of knowledge diffusion in renovation practices, and the Internet, professional consultants and friends and family are prominent sources of diffusion of know-how and skills related to renovation.

Institutionalized knowledge and explicit rules

Home renovation is structured by both the practical know-how and skills and routines of homeowners, and the knowledge distributed through networks. Also rule-based knowledge including policy regulations, explicit rules and national subsidy programs related to renovation of houses are an important part of a renovation practice (Bartiaux et al., 2014). During the interviews, the informants reflected on different formal knowledge sources and their impacts on their renovation activities: the Danish energy label (EPBD), the Danish tax deduction scheme for energy renovations (Håndværkerfradraget), Home Condition

Report of the house, specific industry standards and the Danish Support Scheme for PV solar cells. Yet, the homeowners' awareness and use of the different programs vary markedly, and few informants related to programs extensively, others not at all.

In general, there seems to be no strong relation between the extent of renovations undertaken—and accumulated know-how and skills—and their adoption of such formal knowledge and policy schemes. Moreover, homeowners do not share conventionalized understandings of the purpose, value, and relevance of the different schemes. For example, some informants only find the Energy Label relevant when selling a house (12,13,19) while others do not relate to it because of ambiguity about its purpose, or the perception that its recommendations are too unclear and therefore useless (9,15,16). Likewise, the tax deductions for energy renovations aiming to increase energy renovation of private houses did not seem to have influenced participants' renovation activities markedly. Only one informant explains that she planned her renovations specifically to obtain the deductions (11). No other informants speak of the tax deduction scheme as having any decisive influence on their renovation plans and decisions, which one informant explains by the deduction being relatively low compared to the total costs of the renovation (9), while one comments on the administrative work and time spent on reporting back to the tax authorities (10). For example, a single female informant living with her child, who had extensive experiences with contractor-led renovation processes, commented on the complexity of policy regulations related to energy upgrades:

“Right now, the rule is that if you get a heat pump, you are financially rewarded. If you get solar cells, you're financially punished. I would like to know what their plan is. What will the electricity of the future be like, if it's 100% green electricity, then there's no reason to do it yourself, so here I am waiting for a Climate Act and a Finance Act and thinking about which way it will turn” (14).

Here, the informant reflects on three central issues related to policy schemes promoting energy renovation: (1) a lack of harmonization of regulations of different types of renovation in terms of benefits to homeowners, (2) a lack of stability in the provision

of policy support for energy renovation, and (3) a lack of knowledge about the future energy supply and uncertainty about future energy legislation. This uncertainty about the future for energy renovation—its basic conditions and potential attractiveness—impacts her renovation considerations and becomes a barrier to implementing otherwise desired energy-related investments.

Meanings

Meanings are understood as the mental activities, emotion and motivational knowledge that represent the social and symbolic significance of participation. Also, meanings are extended and eroded as a result of dynamic processes of association (Shove et al., 2012). As such, meanings include, but are not limited to, the reasons that homeowners express for renovating their homes (Bartiaux et al., 2014). The interviews reveal that people's renovation projects are associated with a broad range of different meanings, situated in both the individual and cultural context of the homeowner. Likewise, renovation activities almost always reflect a *complexity* of meanings, some being more prominent to the homeowner than others at a specific point in their life. We deduced four overall categories of meaning, that in a broad sense reflects the many different meanings expressed by the homeowners: "social and esthetics," "convenience and comfort," "personal finance," and "environment."

Meanings related to social life and esthetics

The data indicate that homeowners' renovation activities are often and commonly associated with their social life with family and friends. Changes in the layout of the house to facilitate social life with family and friends, as for example changing an enclosed kitchen to an open kitchen-dining area or expanding the living areas to facilitate more people socializing, is a very common renovation by the informants (2, 3, 5, 6, 9, 10, 12, 13, 15, 18, 19). Such socially conditioned renovations are often implemented before other, more functional renovations, such as changing the roof or windows or other energy renovations. Also, the esthetic dimension of the home in general seems to be of great importance to people's renovation activities (1, 2, 4, 7, 9, 12, 15). Some informants expressed that the esthetic meaning of specific

renovations was more important than functionality, exemplified by a woman with a husband and young children living at home:

"A herringbone floor doesn't have to make its money back, because every day I would just think, Jesus, this is really awesome. But a new roof, that's just something that you must have, but what the hell do I get out of that, so that's only sensible (9).

However, which parts of the house people consider of esthetic importance differ markedly, exemplified by an older single woman with out-of-home children who had her otherwise well-functioning roof changed simply because she found it ugly and worn by appearance. She refers to the new roof as "*the most beautiful roof on the street*" (1) and deliberately prioritized it over the plans of a conversation kitchen. This indicates, that social signaling to the neighbors through a nice and proper roof, which is externally visible, is more valuable to her than a new conversation kitchen, which is limited to internal visibility. Such examples suggest that the meanings which people associate with their renovation activities differ markedly, and that meanings relate to both social norms and the position in family lifecycles and the structure of domestic life. For example, in larger families, and especially with young children, where the "dominant project" is largely about running a family, the focus and attention are much inward directed at the social organization of the family members around the domestic life at home. In other types of households, without such organizational focus such as the single household above, or in households having already implemented social conditioned renovations to integrate family members, there might be room for other meanings to emerge, such as in the example where esthetic meaning is derived by comparing one's renovation results with those of the neighbors. Such social signaling through esthetic meaning illustrates that home renovation can be processes of adapting to social norms, which is common to several informants (1, 12, 13, 15, 17).

Meanings related to convenience and comfort

Some informants associated home renovation with the facilitation of a more convenient performance of domestic practices in the home. For example, a

couple considered establishing a new entrance to the utility room to facilitate easy access to laundry (5), and another family invested a considerable amount in a maintenance-free terrace for the main purpose of eliminating manual work of mowing grass and doing maintenance (9). Others reported a relief about their new windows being much easier to operate when venting the house (1,3). Meanings related to comfort relate primarily to energy upgrades of the home such as insulation in cavity walls and attic and new energy efficient windows, because of these measures' ability to eliminate thermal bridges, draught and related mould in the building envelope that cause discomfort in the homeowner's daily life (1, 10, 13, 14, 17). For example, a retired man:

"Insulation will improve your heating bill and your indoor comfort, and it is good for the house, because you may get mould in the corners, so you can actually beat back possible moulds." (13).

Also, two informants mentioned that the reason for insulating the attic was to get rid of pests living there and eating the existing insulation (3, 10). Other homeowners reported that they wanted to renovate or replace their old asbestos roofs because of its potentially negative health consequences, which were extensively discussed in the media and, hence, the meaning of their renovation is associated with eliminating health risks. Finally, comfort can also relate to enjoyment like adding a conservatory because it extends the summer and brings the homeowners closer to nature (6, 14, 17) or when renovating the bathroom to increase the personal sanitary comfort and the enjoyment of daily grooming (1, 5, 8, 13, 17).

Meanings related to personal finance

Most of the informants explicitly associated their home renovation activities with different meanings related to their personal finances (2, 3, 4, 6, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19). Such associations both include considerations about reducing the running energy costs of living in the house, which are mainly related to energy renovation measures, and increasing the overall investment value of the house, which also relates to other types of renovations.

The running costs of the house are associated with savings by reducing the energy consumption of the

house and mainly relate to energy upgrades such as insulation in cavity walls and attic, new energy efficient windows, radiators, and heat pumps. Several homeowners report that they planned or implemented energy renovations because they expect to achieve considerable savings on energy consumption of the house, relative to the investment (4, 10, 12, 13, 15, 17, 18, 19). A mother in a family with young children reflects that the running costs of living in the house is basically related to a feeling of economic security and being able to stay in the house:

"Energy was clearly on our minds, also to future-proof our economy. That is why we spend 130,000 DKK on efficient heating; it's about our operating economy and the monthly expenses." (2).

Expectations of energy savings are informed by the homeowner's knowledge network, such as friends and family or professional consultants, as well as estimates from energy reports or from the informant's own experiences with other energy appliances in their current or previous homes. The investment value of people's houses relates to all kinds of improvement made to the house—both spatial changes and material, and not only to energy renovations. Most informants report that their house is an important savings in terms of increasing the equity by continuously maintaining and renovating the house.

In general, the more renovation-experienced the homeowners are, the DIY's in particular, the more confident they are with the savings potential of implementing different energy efficiency measures. The data indicate that personal experiences trump mediated knowledge when forming expectations of the performance of energy renovation measures. Also, experienced renovators in general hold stronger associations between their renovation practices and increased value (1, 10, 11, 12, 14, 15, 17, 18, 19), and some of the DIY renovators even report explicitly defined strategies for value optimization, indicating that home renovation has somehow become a *business model* for them (12, 15, 19). Novice renovators seem to associate their renovation considerations not so much with return on investment as with more social or convenience-related meanings and in a broad sense with the social practices that the house is expected to facilitate (5, 7, 9). Summarized, financial meanings co-guide homeowners' renovation

decisions and the associations become stronger as renovation practices evolve.

Meanings related to the environment

The homeowners expressed varying degrees of interest in the potential environmental advantages of energy renovation measures (5, 7, 12, 13, 14, 18, 19). Some of the older informants reflected on presumed generational differences when it comes to pro-environmental consumption and explained that they perceived climate considerations as primarily a matter for the younger generations (3, 4). The younger informants were more environmentally concerned and reported environmentally friendly consumption in different life domains, such as food and transportation (5, 7, 12, 19). Yet, all informants, except one, explicitly expressed that they did not significantly associate environmental considerations with energy renovation in their own house. This gap between environmental concern and not renovating accordingly are often explained by a general perception that energy efficiency measures are more expensive than non-efficiency measures, here exemplified by a couple with small children:

“If you renovate your house and choose to do it in an environment-friendly manner, you have to give up something else because it is more expensive. So do you want to say to your family, you know what, we are not going on summer holiday this year because we are getting energy windows, no, you bloody won’t.” (19).

As illustrated, perceptions of paying extra for green renovation measures with negative consequences for other desired consumption—here leisure and holiday—can be a barrier to implementing them. The informants explicitly blame policymakers for the inconsistency between the promotion of green transition and at the same time not making energy renovation economically attractive to homeowners (2, 5, 8, 10, 12, 13, 19). In such reflections, the informants often do not recognize the savings potential of energy efficiency measures. A possible explanation is that the long-term and stepwise energy savings of such measures are not as highly valued as the instant savings by choosing conventional measures over energy measures, or not implementing the energy measure at all, or simply that the savings potential is too complex

or uncertain to estimate for the homeowner, and therefore omitted in their reflections, as mentioned in the “Technologies” section.

One interview differed significantly from the rest in that the homeowner—a divorced single mother of a young child—associated her ongoing renovation activities primarily with environmental considerations and deliberately prioritized energy renovation measures to amenity renovations with social and functional meanings. The woman reported that she was very concerned about the climate, and considered sustainability in every aspect of her everyday life and consumption as well as in her renovation plans, and as such she differed from the rest of the informants.

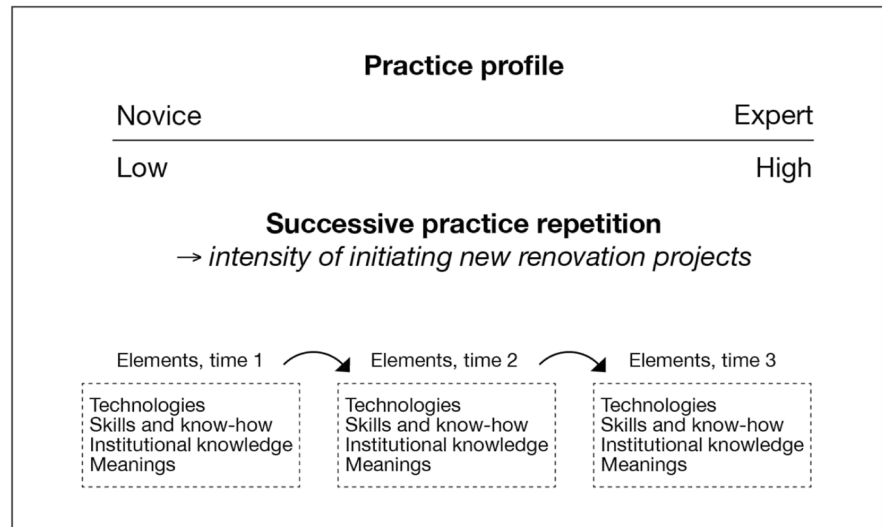
In sum, the homeowners expressed varying environmental concern, the younger in general being more environmentally concerned related to their different life domains. Yet, it is common among the informants that environmental meanings are not significantly related to energy renovation and that financial meanings and considerations are perceived to be more important.

Discussion and conclusion

This research has confirmed that home renovation processes are complex and are constituted of dynamic elements that shape each other and continuously change through repeated renovation performances. The former practice novice can become a practice expert as practical experience is acquired, and even unskilled renovators initially distancing themselves from craftsmanship sometimes end up doing DIY projects illustrating the formative nature of home renovation processes. This insight suggests that a central constitutive element of home renovation, including energy renovation, might be the ongoing practice in itself: as practice unfolds, it changes and evolves thereby empowering its carrier—the homeowner—to repeat and advance further practice performances. This dynamics of renovation practice is illustrated in Fig. 2.

By analyzing energy renovation in a broader context of home renovation and domestic lives of the occupants, this research has also revealed important challenges for energy renovation that should be addressed in future intervention design, and which will be presented next.

Fig. 2 The dynamics of renovation practices. Figure inspired by Shove et al. 2012, Fig. 2.4 p. 33



Main challenges for energy renovation

First, the homeowners in this study implemented energy renovations only after amenity renovations, a fact that somehow grants energy renovation a secondary status among other home renovations. Part of the reason appears to be that energy renovation is usually not immediately visible, and it is associated with a high uncertainty and complexity regarding both policy conditions and potentials of savings and comfort, which are individual to each house and its occupants. These difficulties around energy renovation simply makes it more available for more experienced practitioners who have already carried out several renovation projects and are more confident in renovation matters. In other words, homeowners who have reached a certain knowledge and confidence level through repeated practice performances, and therefore do not perceive energy renovation as (too) difficult and troublesome, were more likely to embed renovation into their renovation practices, and vice versa.

Second, this research also revealed that the practice elements which constitute energy renovations differ from the elements that constitute amenity renovations in several ways: (1) Energy renovation is associated with other and more technical complexities in terms of assessing the energy condition of often invisible parts of the existing house and the relevant energy measure to be added as well as estimating the interaction between the existing and added measure,

i.e. the energy saving potential. (2) The knowledge required to motivate and facilitate the implementation of energy renovation measures is similarly complex, which can explain why even the DIY's do not implement energy renovation themselves, and why even professionals are not always uniform in their advice. (3) The policy and support schemes for energy renovation differ from amenity renovations and lacks conventions and stability. (4) In this research, meanings related to energy renovation are limited to financial meanings and comfort, whereas also esthetic and symbolic meanings are associated with amenity renovations. This indicates that energy improvements are less influenced by desires to adapt to social norms. Neither do homeowners in general associate energy renovation with pro-environmental meanings associated with other consumption domains, such as food and transportation, despite the societal and political interest in this very association. Such lack of symbolic and normative anchoring might be one of the main challenges of energy renovation and may be part of the reason why it is often not embedded in the overall renovation practice.

Third, energy renovation only *indirectly* supports domestic practices such as the performance of daily chores. Energy renovation measures serve the energy efficiency of the house, which in turn serves the various appliances used in the household that facilitate daily household chores. Also, the energy supply and its efficiency are invisible to homeowners (and their families and friends) and therefore intangible. This

contrasts with amenity renovations that are often more *directly* related to domestic practices and to varying degrees improve or even alter such daily activities, such as for example a new conversation kitchen merging socializing and cooking. Also, amenity renovations are visible and therefore also tangible. Hence, energy renovation is identified as *not* being perceived by homeowners as having strong or direct connections with, or dependence on, the performance of the social practices of the household. This lack of immediate interdependence to related domestic practices might be one of the cores of the challenges of energy renovation.

Implications for policy and marketing

Based on the research insights and discussion, we have derived four key recommendations for policy, renovation professionals and related marketers:

First, knowledge networks and professional consultants play a crucial role in renovation decisions. The complexity associated with home renovation, and especially energy renovation, and the lack of experience with specific renovations, since they are often only done once or a few times in a life, can be reduced or compensated by an extensive use of knowledge networks. This study suggests that knowledge diffusion by professional consultants and craftsmen are more important in practice accumulation than existing policy support schemes or selling prices. As such, professional advisors are important to promote, support, and stimulate homeowners' knowledge of energy renovation in terms of empowering also less experienced homeowners to take up such measures. This also points to a relevance of tailoring information and personal dialog to the homeowners practice profile—for example on a continuum from novice to expert as illustrated in Fig. 2—to capture the dynamics and variability of homeowners as opposite to consumer types based on sociodemographic and lifestyles.

Second, the study has shown that energy renovation is usually not implemented in isolation, as a one-off renovation, but often follows or is guided by other renovations. They are also usually implemented by more experienced renovators, who have already implemented amenity renovations related to the social life at home. This suggests a relevance for policy and marketing of “bundling” energy renovation measures

with other renovations that are more likely to be implemented first, such as new kitchens, bathrooms, or minor repairs in the home.

Third, promote the meanings associated with energy renovation in a concrete and tangible manner, for example by using visualization and promoting the increased investment value of the house, rather than just the energy savings, and show how comfort gains improves aspects of domestic life. Also, it could be relevant to take a step backward and direct homeowners' attention toward the relationship between the household energy consumption and the daily practices of its occupants. If energy consumption is invisible and intangible to the occupants, and if people do not consider the relations between domestic practices and energy consumption, the motivation to streamline it through energy renovation might be correspondingly low, and vice versa.

Finally, the high and increasing societal and political focus on climate change, and the role and responsibility of consumers make it likely that the symbolic and normative anchoring of energy renovation might change over time as environmental meanings are more strongly associated with more consumption domains. Moreover, contemporary political conflicts in the world and related worldwide pervasive resource scarcity, in particular the current challenges of the worldwide gas supply, and price increases are likely to enhance people's awareness of consumption. Such challenges of resource scarcity might foster meanings associated more with security and safety related to energy supply which might further increase people's motivation to save resources and money. As such, a reinforced concern of both natural resources and the environment may possibly alter the motivations for energy renovation. Hence, it should be expected that the coexistence of such meanings will support the uptake of energy renovation in the future and offer new possibilities for promoting efficiency investments to homeowners.

Limitations and future research

As mentioned earlier, this research is based on homeowners being in a stage of their renovation processes where they did already display some motivation toward specific renovation measures and already booked or completed a consultation. Such motivated modes of the informants means that they

could be likely to be more positive toward the discussed topics than the average homeowner. This circumstance may partly be due to self-selection biases in the sample: (1) Homeowners in ongoing renovation processes may simply be more motivated for participating in process-relevant interviews than homeowners in stagnant or interrupted processes. Due to the perceived complexity of home renovation, homeowners might even use the interview as a source of knowledge, in line with other knowledge networks, or as a chance of (self)reflecting their plans and thoughts, and as such perceive participation as a two-way gain. (2) Informants were recruited at specific positions in their decision processes (see Table 1) and the interview agreements were made quickly, before the homeowners advanced in their processes. Therefore, people with a tendency to procrastinate may be less likely to enter into interview agreements, and even less so because of the rapid completion required. (3) Finally, even though we sought to reduce possible response biases due to the incentive of 500 DKK (\approx €67) for participating in the interview, it might have led to a skewed distribution of homeowners in the sample, i.e. an over-representation of homeowners who perceive this amount as significant.

The biggest market potential for energy renovation is houses inhabited by homeowners who are not yet considering such measures, which suggests that more research is needed on homeowners outside or in the very initial stages of the renovation decision process focusing on how to make them start the process of considering energy renovation of their houses. Also, the limitations of the sample in this study, both in terms of potential selection biases and sample size, emphasize the relevance of further quantitative tests of key insights of this qualitative study to strengthen the evidence base for designing relevant interventions to raise implementation rates of energy renovation.

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Data Availability The informants of this study were acquired from a Danish home renovation contractor's consumer database. Therefore, Interview transcripts are not publicly available to preserve individuals' privacy under the European General Data Protection Regulation.

Declarations

Conflict of interest The authors declare no competing interests.

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