

Home for the Common Future (HCF)

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Original research article

Home for the Common Future (HCF): The use of home-meanings to promote domestic energy retrofit

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ABSTRACT

The promotion of energy retrofit to homeowners is an important policy strategy to reduce operational energy use in dwellings and mitigate climate change. Energy research and policy typically focus on the *cognitive* (logical) aspects to motivate retrofit decisions, such as savings on energy bills and health considerations. However, this focus appears to have neglected the *emotional* aspects of how homeowners themselves make sense of the potential benefits of low-carbon dwellings.

To encompass both the emotional and cognitive aspects of energy retrofit decisions, the authors developed a *home-meanings framework* around the concept of *perezhivanie* (emotional and cognitive experience). We back-grounded our theoretical construction by drawing upon current literature of home-meanings and empirical insights from: (i) eighteen case studies, in ten of which homeowners achieved significant carbon emission reductions through retrofit activities, while in eight they did not; (ii) a stakeholder workshop ($n = 36$), representing various actors interested to advance domestic energy retrofit activities in the UK, e.g. industry, government, academia, intermediaries.

We analysed the data to identify positive experiences associated with low-carbon dwellings. These experiences are organised in five themes: (i) control over one's environment; (ii) Health and well-being & Happiness in everyday life, (iii) Climate concerns & Caring identity, (iv) Financial considerations & Future-resilience; (v) a full integration between and individual and their environment. The authors developed a Home for the Common Future (HCF) heuristic, which captures three out of five identified themes (ii–iv). We suggest that the heuristic can be used for promoting the benefits of low-carbon dwellings.

1. Introduction

The promotion of energy retrofit in the owner-occupied sector is an important strategy to reduce operational energy use in dwellings, meet global targets for carbon emission reductions [1,2], and mitigate climate change [3]. Residential buildings account for 22 % of global energy use and 17 % of global CO₂ emissions [4], while the majority of global residential stock is owner-occupied [5,6]. The installation of energy-

efficiency and renewable measures and technologies globally can contribute between 30 % and 70 % to the reduction of greenhouse gas emissions in the building sector [7]. Various policies have been implemented globally to encourage investment in domestic energy retrofit [8–10]. Despite this, the level of annual investment remains low [11], compared to 3.5 % GDP per annum deemed necessary to achieve desired reductions [12–14].

Research and policy on the built environment typically focus on the

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cognitive (logical) aspects of retrofit decisions such as health and well-being considerations [15,16], climate concerns [17,18], and financial considerations, i.e. returns on investment and savings on energy bills [19–22]. This focus neglects the *emotional* aspects of the sensemaking process [23,24], through which homeowners attach meaning to the potential benefits of low-carbon dwellings. However, emotional motivations can be more important predictors of technology adoption than cognitive ones (see debate on symbolic, environmental and instrumental motives [25,26]). Home is a place of a great significance and meaning for individuals, and previous research suggests that homeowner motivations to carry out energy retrofit should be understood through the meanings they attach to their homes [19,27]. As individuals pursue a broad set of goals and use both emotion- and cognition-based processes in their retrofit decisions, energy policies should use a broad range of behavioural tools that complement subsidies, taxes and regulations [7,28].

To broaden the current policy focus, the authors focus on emotional aspects of energy retrofit decisions and use the concept of *perezhivanie* (emotional and cognitive experience) to develop a framework to analyse meanings people attach to the low-carbon benefits of their homes. We draw on current literature of home-meanings, as well as empirical insights from: (i) ten cases where homeowners achieved significant carbon emission reductions through retrofit activities, and eight cases where they did not; (ii) a workshop with 36 participants, representing various actors interested to advance domestic energy retrofit activities in the UK, e.g. industry, government, academia, intermediaries. The analysis identifies five themes of positive emotional and cognitive experiences associated with low-carbon dwellings. We illustrate the analytical use of the home-meanings framework to build narratives for energy retrofit promotion, which resonate with homeowners emotional and cognitive reasoning.

The rest of the paper is structured as follows. Section 2 provides the underpinning for the chosen theoretical lens. Section 3 provides the methodology for empirical data collection and the framework for qualitative data analysis. Section 4 describes the study findings. Section 5 discusses the insights drawn from the findings in line with current literature and derives possible implications for policy. Section 6 concludes and provides suggestions for future research.

2. Theoretical conceptualisation

This section brings together the following conceptual elements to frame the analysis: (i) the concept of *home-meanings* necessary to understand homeowner energy retrofit intentions and subsequent decisions; (ii) the concept of *perezhivanie* (emotional and cognitive experience) to analyse home-meanings that underpin homeowner energy retrofit motivations; (iii) the concept of a *cognitive frame* to understand and shape the trajectory of one's energy retrofit motivations.

The conceptualisation for *perezhivanie* and cognitive frame draws upon the intellectual tradition of *cognitive developmental psychology* [29]. As this tradition is not well known in energy research, this section will first briefly describe it and make explicit links between the concepts used.

2.1. *Perezhivanie* and cognitive frame

Cognitive developmental psychology is a scientific study concerned with changes involved in human development from infancy to old age. Originally concerned with child development [29], the field has expanded to include the development through the entire human lifespan [30]. The field has recently expanded its focus to understand its role for sustainable development [31]. Most theorisation in cognitive developmental psychology can trace its routes to two influential psychologists of the last century — Jean Piaget (1896–1980) and Lev Vygotsky (1896–1934) [29]. In this paper, the authors draw upon two of their concepts — Vygotsky's 'perezhivanie' and Piaget's 'schema', with the

latter forming the basis for the concept of a 'cognitive frame'.

Perezhivanie was introduced by Lev Vygotsky [32,33], and is best translated into English as 'emotional and cognitive experience' [34,35]. The concept emphasises that only those elements of the environment that are refracted through the emotional and cognitive experiences of the individual are of developmental significance, shaping the whole organisation of consciousness and, subsequently, one's identity [35]. The concept emphasises that cognition and emotion is something an individual enacts through one's dynamic living activities. It is not something that happens solely in one's head [35]. The combination of one's *environment* and *living activities* gives one a platform for *perezhivanie*.

Schema (plural *schemata*) as a concept was introduced by Jean Piaget [36], and can be described as a pattern of thought or behaviour, through which people organise information to make the interaction with the environment more efficient [37]. The concept is reminiscent of Vygotsky's understanding of *perezhivanie* as a *prism* that refracts environmental moments and determines the influence of these environmental moments on the course of individual development [34]. In this paper, we do not rely on the terminology of a schema or a prism, and use a concept of 'cognitive frame' instead, which is one of the most prominent concepts within the field of communication studies, and which most researchers use analogously to schema [38]. We assert that promoting retrofit decision-making is a communication phenomenon, and thus a concept of 'cognitive frame' could apply. Framing is used to describe how people communicate about reality by emphasising specific aspects of it. Framing can and is often used in journalism and political discourse, to influence recipients' cognitive frames [38].

The concept of a 'cognitive frame' can be applied in discourse on the promotion of domestic energy retrofit. It is hypothesised that the way that a homeowner makes sense of what a low-carbon dwelling¹ is and evaluates its benefits, shapes their eventual decision on whether to make a significant investment in energy retrofit or not. Other actors, i.e. building professionals, government and local authorities, can utilise cognitive framing to shape their message to homeowners about the benefits of low-carbon dwellings, and through that, motivate them to retrofit their homes.

2.2. *Home-meanings framework*

We built on previous research that suggests that homeowner energy retrofit motivations should be ultimately understood through the meanings people attach to their homes [19,27]. We carried out a critical literature review to identify various layers, facets and dimensions of 'home' as a construct. A *critical literature review* is a non-systematic type of review, aimed to synthesise extant literature on a broad topic with a conceptual model being a typical outcome [39,40]. An initial broad search only included the word 'home', which returned ~380,000 results on the *Web of Science* database. Identified sources were sorted by the number of citations, and the titles were searched to identify sources that conceptualise the meanings people attach to their homes. The relevant, most cited sources were identified, and their references and citations were traced to identify further literature. The emphasis of this critical literature review was on the conceptual contribution of each new source to the understanding the notion of home. The choice was eventually narrowed down to fourteen sources (Table 1), which provide a rich synthesis of the current literature. The authors made a judgement that a further detailed review of the literature would not have made a significant conceptual contribution to the understanding of the notion of home.

¹ For this paper, low-carbon dwelling technology is conceptualised at the level of a technological system, rather than a design option or a particular product [121]. For instance, it could focus on a Passivhaus dwelling as a system, rather than on external of external wall insulation as design options, or a choice of a particular product for the insulation material.

Table 1

Literature sources used in the critical literature review.

Sources	Disciplinary approaches	Source	Source type
Blunt, 2005 [41]	Geography	Progress in Human Geography	Editorial article
Blunt and Dowling, 2006 [42]	Geography	Routledge	Book
Blunt and Varley, 2004 [43]	Geography	Cultural Geographies	Editorial article
Coolen and Meesters, 2012 [44]	Ecological psychology	Journal of Housing and the Built Environment	Editorial article
Després, 1991 [45]	Psychology	Journal of Architectural and Planning Research	Critical review
Easthope, 2004 [46]	Geography	Housing, Theory & Society	Review
Fox, 2002 [47]	Law	Journal of Law and Society	Critical review
Heidegger, 1964 [48]	Phenomenology	Routledge	Book
Mallett, 2004 [49]	Multidisciplinary	The Sociological Review	Review
Manzo, 2003 [50]	Psychology	Journal of Environmental Psychology	Review
Molony, 2010 [51]	Nursing	Research in Gerontological Nursing	Qualitative metasynthesis
Moore, 2000 [52]	Environmental psychology	Journal of Environmental Psychology	Review
Saunders and Williams, 1988 [53]	Sociology	Housing Studies	Theoretical position
Somerville, 1997 [54]	Sociology	Journal of Architectural and Planning Research	Critical review

Table 2

Research-identified meanings of home.

Després, 1991 [45]	Somerville, 1992 [57]	Mallett, 2004 [49]
Relationships with family and friends	Shelter (materiality)	House, neighbourhood, town
Material structure	Adobe (place)	People's relationships, especially family
A place to own	Hearth (warmth)	Lived space of interactions between people, places and things
Physical security and control	Heart (love)	Home ownership
Reflection of one's ideas and values	Privacy (control)	Being-in-the-world (being at home)
Permanence and continuity	Roots (source of identity)	Experience of one's (possibly fluid) identity
Refuge from the outside world	Paradise (ideality, sense of spiritual security)	Haven, comfort, ease, intimacy, relaxation and security OR <i>oppression, tyranny and persecution</i>
Indicator of personal status		Belonging OR <i>marginalisation and estrangement</i>
Acting upon and modifying one's dwelling		Feelings, repository of memories
Centre of activities		Staying, leaving and journeying

Note: Text in *italics* signifies the original author's acknowledgement that home might not be recalled or experienced in a positive way.

The review highlighted that *home* is a complex, multi-layered, multi-faceted and multi-dimensional construct, with a long-standing theoretical and practical research tradition on the topic [41–56]. The complex nature of the construct of home makes its clear definition² a difficult task. Some authors even argue that a complete definition of home is not only difficult, but is also undesirable [46], as the notion of home is imbued with personal meanings and is likely to mean different things to different people at different times and in different contexts.

For the same reason, a comprehensive and exhaustive list of all possible meanings that people might attach to their homes, is futile, as such a list of meanings is inevitably just a snapshot, specific to particular people, time and context. However, such lists can provide a good sense of the diversity of possible home-meanings. Table 2 provides three exemplary lists based on the findings from three key articles, recognised as such in the field [42], which rely on studies in the western world, where people were asked what home means to them [45,49,57].

There are several disciplinary theoretical models that describe the forces that shape home-meanings (see Box 1 for an overview). Each of them has conceptual limitations, as each emphasises certain home-meanings and downplays or neglects others [54]. This is not surprising, as a given theoretical model would need to relate to a particular

² One of the most comprehensive definitions of home has been put forward by Benjamin [55]: “The home is that spatially localised, temporally defined, significant and autonomous physical frame and conceptual system for the ordering, transformation and interpretation of the physical and abstract aspects of domestic daily life at several simultaneous spatio-temporal scales, normally activated by the connection to a person or community such as a nuclear family. It is thus the autonomous interpretation of domestic life, and that which is interpreted.” Benjamin acknowledges that his definition is not inclusive of all dimensions discussed in the literature on home-meanings. For instance, he points out that he chose to regard the home-as-state-of-mind as a metaphor, rather than a part of the definition.

research questions and disciplinary tradition.

The authors build upon the rich literature on the topic of home to develop a conceptual *framework of home-meanings*, which can be used to understand meaningful dimensions of low-carbon dwellings and, subsequently, homeowner energy retrofit intentions. Five dimensions of home-meanings are identified: Vygotsky's concept of (i) *perezhivanie (emotional and cognitive experiences)* is used to capture the diversity of psychological and social values and attributes, such as comfort and security. The concept suggests that emotional and cognitive experiences associated with low-carbon dwellings should be understood through the unity of one's (ii) *environment* and (iii) *activities*. The framework also acknowledges the importance of (iv) *real and ideal realms* and (v) *time* in shaping home-meanings. These five dimensions of the home-meanings framework are described in more detail below:

(i) *Perezhivanie (emotional and cognitive experience)* is afforded via the unity of one's environment and activities. Commonly³ identified positive emotional and cognitive experiences associated with one's home include a sense of happiness, joy, security, control, comfort, as well as self-expression and personal status. These experiences give meaning to a place [59], shape one's consciousness and give rise to multiple identities, such as the ones of gender, race, class and sexuality [35], and can potentially include one's environmental identity. The concept of *perezhivanie* also allows to capture the notion of home as a repository of memories [49].

(ii) The *environment* includes three elements, which are in the immediate proximity to the processes that shape emotional and cognitive experiences in one's home. First, *physical* and *spatial* elements, such as the type of structure of the dwelling, its size and aesthetic properties

³ For the reasons mentioned earlier, this framework does not give a definitive list of possible emotional and cognitive experiences, but rather provides a concept of *perezhivanie* to think about the diversity of possible experiences.

Box 1

Theoretical models of home-meanings (based on [42,45,54,58]).

Territorial/ geographical. This approach gives priority to the spatial boundaries associated with home. It emphasises the existence of different physical scales of home boundaries, and the idea that home places are simultaneously shaped in real and imaginative worlds. The emphasis in this approach is on the social and psychological attributes that places offer to individuals, primarily feelings of security, control, identity and stimulation.

Psychological. This approach traces the meaning of home to deeply rooted psychological needs. For instance, home can be defined as a powerful extension of psyche and a symbol of oneself. Alternatively, home can be understood as the means to fulfil the hierarchy of human needs, such as a need for privacy, security and control.

Social-psychological. This approach focuses on explaining how home plays a role in shaping people's self-identity, as well as being an important symbol of individual social identity.

Phenomenological and developmental. These approaches focus on the temporal dimension of home. Home is understood through a continuous process of creation and recreation of its meaning in the context of everyday life. Being-at-home is associated with a sense of familiarity and routine, which contributes to the creation of the feeling of continuity that connects individual's past and future.

Sociological. This approach focuses on the interpretation of home-meanings using concepts of social relations, particular the ones of family. Other sociological categories such as class, gender and tenure are also used for interpretations.

[45]; as well as spatial elements, such as the house itself, neighbourhood, hometown, homeland or the whole world [42,49]. Second, *self* and *social* elements, which include one's own self as well as one's social relations, such as family, friends or even ethnic groups [42,44]. Third, *financial* and *legal* elements, which include the type of tenure and modes of land ownership. These elements are used to suggest that a house can be a financial asset [47].

(iii) The *activities* in one's home are grouped in two types. The first type captures *recurring* activities, such as everyday mundane activities, seasonal or cyclical events, e.g. holiday celebrations, and rituals. With time, such repeated activities, begin to 'bind' an individual, as places and things get symbolically meaningful by this process of timebinding [60]. The second type captures *temporary* activities, such as formative experiences or home renovation. For instance, modifying one's dwelling has been shown to be an important part of expressing one's identity and making a house a home [45].

(iv) A distinction between *real and ideal realms* of one's home highlights that the notion of home is constructed simultaneously in both realms as part of a single process [42,54]. Material and imaginative geographies of home are relational to each other, as the material form of home can be altered through retrofit and personalisation based on what home is imagined to be, while imaginaries of home are influenced by the physical forms of a dwelling [42,45].

(v) *Time* as a dimension of home-meanings highlights that the notion of home is ever-changing and is found in one's memories and nostalgia for the past, everyday life in the present, and future dreams and fears [41,42]. When talking about home, an individual might refer to the place where one was born and raised, or the place where one had happily lived, for instance, before a tragic event, or the place one desires to have one day [44]. The temporal dimension of home can also be seen through seasonal and cyclical events, such as holiday celebrations or times of the season, which contribute to the formation of what home means to a particular individual [45].

These five dimensions of home-meanings should be understood within a broader economic, political, social and cultural *context* for a more comprehensive picture. The described framework is visualised in Fig. 1.

3. Methodology

The authors draw upon current literature on home-meanings, case-studies of homeowner energy retrofit and an expert workshop with stakeholders among those interested to advance energy retrofit activity in the UK, in order to (Fig. 2): (1) choose a conceptual base for the home-

meanings framework; (2) identify benefits of low-carbon dwellings through the meanings households articulate about their homes; (3) build narratives to promote energy retrofit that resonate with homeowners and account for their socio-cultural needs. The analysis features several iterations between the steps, and includes a combination of multiple-case studies and thematic analysis.

3.1. Data collection

Table 3 presents the three main types of empirical data used in the study, its sources and their use. The rest of the subsection describes them in more detail.

3.1.1. Case study profiles

The unit of analysis for the case studies is the household retrofit journey, and each one is considered a case [61]. The literature on multiple case-study research suggests 4–10 cases to generate enough complexity for theory development, while keeping the volume of the data manageable [62,63]. A *purposive* sampling strategy was used to select 10 *confirming* cases of successful domestic retrofit to low-carbon standards, and 8 *disconfirming* cases where retrofit activities did not result in low-carbon settings [63,64]. Another 8 case studies were used in the pilot to sharpen the research design prior to the main data collection. The main data collection was carried out from June 2018 to October 2019. All participants volunteered their participation, no incentives were provided.

Eight out of 10 confirming cases were selected from the SuperHomes network, a voluntary UK network of about 200 homeowners, who achieved at least 60 % carbon reductions⁴ as a result of a retrofit activities [65,66]. The participants were approached through a SuperHomes representative. Another 2 confirming and 8 disconfirming cases were selected with a convenience sampling strategy among first author's personal and professional network. All the cases are listed in Table 4. The case identifiers for 10 confirming cases start with 'C', and for 8

⁴ For these cases, the SuperHomes network used a Standard Assessment Procedure (SAP) to estimate both pre-retrofit and post-retrofit emissions with data collection at one point in time, post-retrofit [122]. The estimation procedure has changed since data collection for this paper. Since spring 2021 the network measures two variables: 'Energy and Emissions' and 'Health, Comfort and Wellbeing' on an absolute rather than a relative scale. The assessment takes place at two stages, Design and Evaluation. The former is based on the estimated performance, and the latter – on actual measured performance [123].

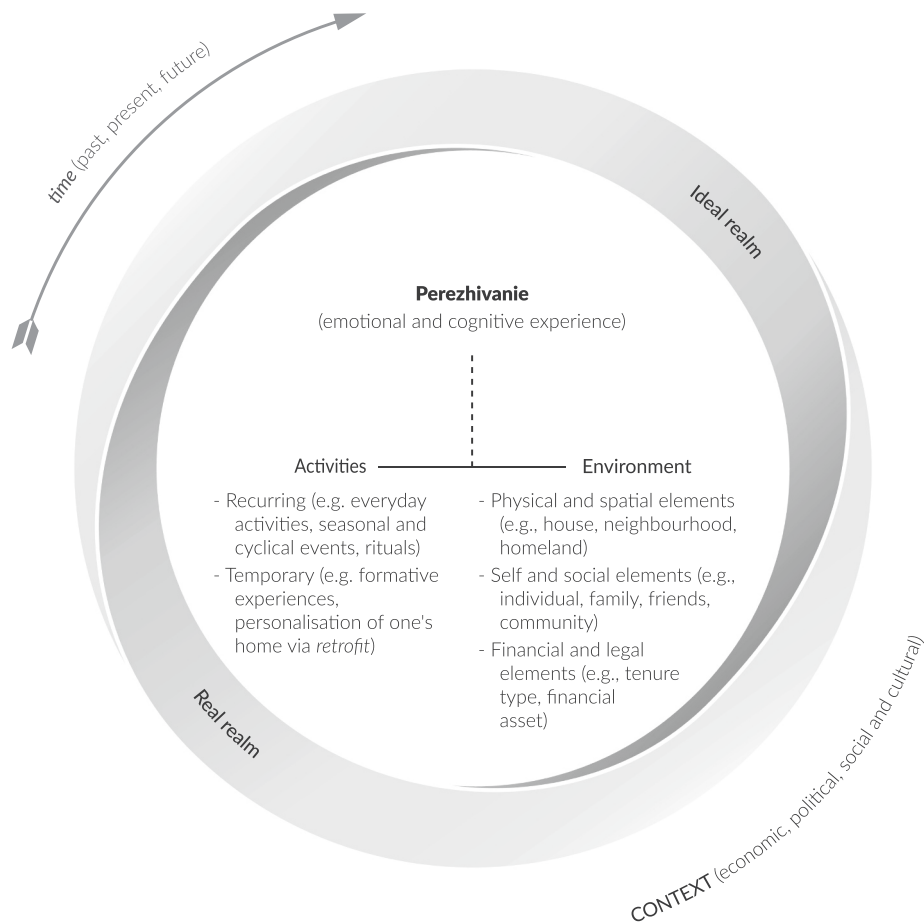


Fig. 1. Home-meanings framework.

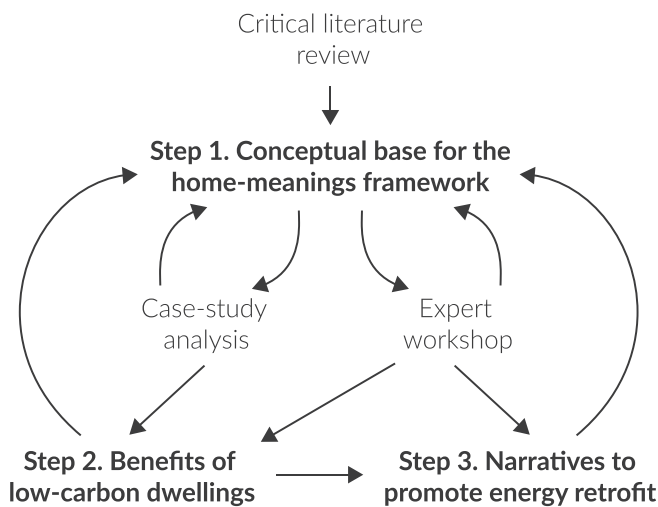


Fig. 2. Steps of the iterative research design.

disconfirming cases — with ‘D’. The selected cases range from Victorian terraced houses, to detached houses and converted ground floor flats. The houses are located in England, mostly London. At the time of data collection, the households in the study ranged from a single occupier to a family of five. Two households had tenants. Most adult occupants in the sample were professionally active with more than half having sustainability- or construction-related background. All owners in the sample carried out some home improvement activities, including energy

retrofit. A variety of fabric, ventilation, heating and energy generation measures were installed, a detailed description of which can be found in Appendix A.

3.1.2. Post-retrofit interviews with homeowners

Case-study data was primarily generated through *semi-structured interviews* with one of the owners, normally the one who was more involved in the retrofit project. In case C1, the owner rented out the property after the retrofit; so in this case, the interview included the owner-retrofitter and one of the tenants. In case C8, both owners participated in the interview. All interviewees received an information sheet and signed a consent form. The interviews lasted between 35 and 160 min and took place at interviewees’ homes.

The interviewees were asked to draw their retrofit timelines as part of the interview. The condensed presentation of a retrofit journey on a single diagram allowed interviewees to instantly assess the completeness of the information provided [67]. Interviews also incorporated a walk-through procedure – a spatial-visual technique used to evoke interviewee’s memories about the retrofit experience [68]. Photographs of different aspects of the retrofit were taken, to retain visual information for future analysis. Information was collected on general household characteristics, dwelling characteristics prior and post retrofit, the retrofit process itself, goals and motivations, pre- and post-retrofit living experience and practices affecting domestic resource use. See Appendix B for the summary of question topics. All interviews were digitally recorded and transcribed verbatim for analysis.

3.1.3. Associative experiments

Another part of case study data was generated through continuous associations. A *continuous association task* is a data collection method,

Table 3

Data, its sources and use.

Type of data	Sources	Use in the analysis
Interview transcripts	In-depth semi-structured interviews with homeowners-retrofiters: 10 cases of low-carbon retrofit (confirming) and 8 cases that did not result in low-carbon settings (disconfirming).	Multiple case-study analysis to identify benefits of low-carbon dwellings by recognising positive emotional and cognitive experiences (perezhivanie) associated with them.
Continuous associations	Associative experiments with homeowners-retrofiters (<i>see above</i>).	<i>Same as above</i>
Workshop transcript	Participatory workshop with actors, interested to advance energy retrofit activity in the UK: (i) demand side actors (n = 2); (ii) supply-side/ industry actors (n = 10); (iii) governmental actors (n = 5); (iv) intermediary organisations that operate to advance change towards sustainability (n = 11); (v) academics that specialise in low-carbon home retrofit (n = 8).	Participatory creation of narratives to promote energy retrofit, using home-meanings framework and benefits of low-carbon dwellings, identified in the case-study analysis. These were then analysed thematically.

where the participants are asked to produce as many responses as possible in association with a specific word or phrase [69]. The method is used to reveal the associative structure of a single individual. Regularities identified in word association, such as order and meaning apparent in association responses, have been used to cast new light on the meanings of words [70], to identify responders' knowledge in a specific area of studies [71], to make generalised statements regarding collective semantic understanding of particular cultural phenomena

[72] and others [69]. As part of the in-depth interviews, the homeowners were asked to say as many words as possible in an association with the words 'home' and 'low-carbon home'. Their responses indicate that they associate their homes with comfort, joy and overall positive experiences. Full responses to associative tasks can be found in Appendix C.

Table 4

Profile of sample households.

Case	House age/type	Location	Occupants	Owner-retrofitter professional background ¹	Carbon/energy rating ²
Confirming cases: achieved significant carbon/ energy reductions as a result of retrofit activities					
C1	Victorian, former mews house, <i>split into a ground-floor office and a four-bed flat upstairs, with loft conversion</i>	London	Four adult tenants	Architect	<i>75 % carbon reductions; CHS 4</i>
C2	1920, three-bed, mid-terrace, <i>heated glass conservatory not separated from the house</i>	London	Family of four	Former professional builder	<i>67 % carbon reductions; annual energy generation and consumption are roughly the same</i>
C3	1930s, three-bed, semi-detached	Buckinghamshire	Young couple	Architectural technologist	<i>70 % carbon reductions</i>
C4	Edwardian, three-bed, mid-terrace	Buckinghamshire	One adult, one child	Project manager in the energy efficiency/ renewable energy sector	<i>78 % carbon reductions</i>
C5	Victorian, five-bed including loft conversion, mid-terrace	London	Family of four and an au pair	Former energy and sustainability consultant	<i>68 % carbon reductions</i>
C6	1967, <i>five-bed/ fourteen-room, detached, extended internal layout over 50 %</i>	Hertfordshire	Family of five	Technical	<i>92 % carbon reductions</i>
C7	1925, semi-detached, former three-bed house, <i>two-storey side extension and one-storey back extension, split in two flats: two- and three-bed</i>	London	Family of four	Technical	<i>80 % carbon reductions</i>
C8	1933, three-bed with loft conversion, semi-detached	London	Retired couple, one tenant	Non-technical	<i>90 % carbon reductions</i>
C9	2011, four-bed, detached	Bedfordshire	Two adults	Academic position in Low-Energy Buildings	<i>EPC band B, carbon neutral for one year</i>
C10	Victorian, <i>three-bed with loft conversion, mid-terrace, side return extension</i>	London	Family of four	Urban planner	<i>n/a, self-reported good levels of thermal comfort</i>
Disconfirming cases: did not achieve significant carbon/ energy reductions as a result of retrofit activities					
D11	1900s, five-bed, detached	Leicestershire	Family of three	Technical	EPC band F
D12	1927, two-bed, mid-terrace	London	Family of five	Non-technical	EPC band D
D13	Victorian, three-bed with a loft conversion, end-of-terrace, side return extension	London	Two adults and a teenager	Academic position in Environmental Design and Engineering	EPC band E
D14	1880, ground floor two-bed flat in a mid-terrace house, 2007 back extension	London	Two adults	One owner – academic position in Energy and Sciences; another owner – academic position in Energy in the Built Environment	n/a
D15	1990, ground floor two-bed flat in a semi-detached house	London	Two adults	Academic position in Machine Learning for Smart Building and Cities	EPC band D
D16	1991, three-bed, semi-detached	Kent	One adult	Building Performance Analyst	n/a
D17	1930s, three-bed/ ten-room, semi-detached	Hampshire	Family of four	One owner – academic position in Building Performance; another owner – academic position in Energy and Buildings	n/a
D18	1960s. ground floor two-bed flat in an apartment block	Surrey	Two adults	Technical	n/a

Text in italics indicate changes achieved as a result of retrofit activities of the owners in the sample.

Note.

¹ Sustainability- or construction-related background is stated in detail; 'technical' indicates non-sustainability- or construction-related technical background; 'non-technical' indicates non-sustainability- or construction-related non-technical background. Background of only one owner is given if most relevant.

² Percentage of carbon emission reductions are calculated by a representative of a SuperHome network post-retrofit, using Standard Assessment Procedure (cases C1–C8).

3.1.4. Workshop

A 1,5-h online *workshop* was carried out on 25th May 2021 with 36 participants via online Zoom platform in line with participatory action research tradition [73,74]. The participants were recruited among those interested to advance energy retrofit activity in the UK. Interest was self-assessed, no incentives were given to participate. Participants were identified through the first author's personal and professional network, via publicly available contact details and via snowballing technique. A maximum variation-purposive sampling strategy was used to ensure the diversity of actors [63].

Workshop participants represented the following actors (Table 5): (i) *demand-side* actors ($n = 2$), both participants from a housing association; (ii) *supply-side/ industry* actors ($n = 10$), e.g., an architectural studio, an energy provider; (iii) *governmental* actors ($n = 5$), e.g. a government department, a local authority; (iv) *intermediary* organisations [75] that operate to advance change towards sustainability ($n = 11$), e.g. a charity/social enterprise, a member organisation; (v) *academics* that specialise in low-carbon home retrofit ($n = 8$). These actors can potentially act purposefully to shape homeowner cognitive frames around the meaning of low-carbon dwellings, and through that influence their motivation for energy retrofit.

Workshop participants filled in a survey via Opinio online platform prior to the workshop. It was used to collect participant names and contacts, the names and profiles of the organisations they work for, their job title/ role within the organisation, participant consent, as well as participant perceptions of UK policy on domestic retrofit (drivers and barriers to success). During the workshop, the participants were introduced to the project in the plenary session. They were then split in groups of three and four with each group overseen by a facilitator, with group sizing consistent with suggestions in the literature on participatory workshops [76]. Each group had representatives from different

actors (e.g. governmental, intermediary, academic) to facilitate thinking outside of the comfort zone. The groups were asked to build emotionally and cognitively compelling motivational narratives to encourage domestic energy retrofit among homeowners using the project insights. The workshop was digitally recorded and transcribed verbatim for further analysis.

3.2. Data analysis

The data analysis was iterative, a simplified representation of which can be described in three steps.

Step 1: Home-meanings framework. The critical literature review identified five dimensions of home (see Section 2.2). However, they lacked a conceptual binding (initially, the dimension of *perezhivanie* was captured by the idea of psychological and social attributes associated with one's home, such as the feelings of security or belonging). During the first iteration of the analysis, we followed an example by Coolen and Meesters [44] to use the concept of 'affordance' [77,78] to conceptualise what the environment of one's home can offer to the individuals. We later introduced the concept of 'practice' [79–83] to talk about recurring, mundane activities at one's home. Finally, the fourth author, ST, suggested the concept of 'perezhivanie'. The version of the framework, featuring all three concepts (*perezhivanie*, practice and affordance) was used during the project workshop, during which it became clear that the concepts are not self-exclusive as they often refer to the same dimensions of home. This resulted in confusion and loss of clarity among the workshop participants on how the framework can be used. The participants found the concept of *perezhivanie* especially helpful to aid their thinking. Therefore, the home-meanings framework was once again re-iterated to organise the dimensions of home around one concept only — that of *perezhivanie*.

Table 5
Profile of workshop participants.

Participant identifier	Actor category	Actor subcategory
WP01_int	Intermediary	Network of low-carbon dwellings (the participant is currently retired)
WP02_aca	Academia	Sustainable Design
WP03_gov	Government	Government department
WP04_int	Intermediary	National charity with the focus on improving the use of energy in buildings
WP05_aca	Academia	Energy and Buildings
WP06_int	Intermediary	Non-profit company with the focus on delivering energy locally
WP07_gov	Government	Regional governance body
WP08_ind	Industry	Professional services firm, including engineering, architecture, design, planning, project management and consulting
WP09_aca	Academia	Building Engineering Physics
WP10_int	Intermediary	National charity with the focus on sustainable energy
WP11_ind	Industry	Infrastructure consulting firm
WP12_int	Intermediary	Charity and social enterprise with the focus on sustainable ways of living
WP13_int	Intermediary	Non-profit organisation with the focus on ultra-low energy buildings
WP14_aca	Academia	Energy and Climate Change
WP15_int	Intermediary	Membership organisation with the focus on the built environment
WP16_dem	Demand	Housing association
WP17_ind	Industry	National energy provider
WP18_aca	Academia	Energy and Sustainable Development
WP19_int	Intermediary	Council owned local energy company
WP20_aca	Academia	Engineering and Architectural Design
WP21_dem	Demand	Housing association
WP22_ind	Industry	Sustainability engineering company
WP23_int	Intermediary	Community group with the focus on creating climate friendly and sustainable town
WP24_aca	Academia	Sustainable Urban Environments
WP25_ind	Industry	Architectural studio
WP26_gov	Government	Local authority
WP27_aca	Academia	Architecture and Civil Engineering (Building Technology)
WP28_int	Intermediary	Not-for-profit social enterprise with the focus on trusted tradesmen in the domestic sector
WP29_ind	Industry	Software development company
WP30_int	Intermediary	Not-for-profit centre with the focus on energy sector
WP31_gov	Government	Local authority
WP32_ind	Industry	Sustainability engineering company
WP33_gov	Government	Non-departmental public body
WP34_ind	Industry	Retrofit assessor
WP35_int	Intermediary	Council owned local energy company
WP36_ind	Industry	Building and energy consultancy

Step 2: Benefits of low-carbon dwellings. Case studies were analysed to identify benefits of low-carbon dwellings. Interview transcripts, the corresponding photographs and retrofit timelines were sorted into cases and reports were written for each case. Notes and memos taken during the interviews, and those arising from the interview reports were kept for further analysis. The interviews were coded by the first author, the analysis and results were continuously reviewed by the first two authors to further raise the confidence in data interpretation. The home-meanings framework (Fig. 1) was used *deductively* to sort data into five dimensions of the notion of home. The data was then analysed *inductively* to identify emotional and cognitive experiences associated specifically with low-carbon dwellings. This was achieved by juxtaposing emotional and cognitive experiences associated with one's home in general with the experiences associated with living in a low-carbon home in particular. The former was identified based on: (i) exciting literature on home-meanings (Table 1); and (ii) interviews and associative experiments from the case studies. The latter was identified solely based on the case studies.

Step 3: Narratives to promote low-carbon retrofit. The home-meanings framework together with the preliminary results on the benefits of low-carbon dwellings were presented at the project workshop. Workshop participants were asked to critically reflect on the framework and use it to create narratives to promote energy retrofit among homeowners. Participants were not corrected on their interpretations of the introduced framework. The home-meanings framework was reiterated based on the feedback from the workshop (see step 1). The final version of the framework was used to reanalyse case study data and analyse workshop transcripts and answers to the pre-workshop survey. After the final iteration, five themes of emotional and cognitive experiences were identified, capturing the benefits of low-carbon dwellings.

ATLAS.ti 8 and 9 CAQDAS software was used throughout to assist data analysis. The full coding scheme can be found in Appendix D. Cross-tabulation was used to support constant systematic comparison [63], an illustrative example of which can be found in Appendix E. A range of credibility strategies for qualitative research was followed [61,64,84], a full description of which can be found in Appendix F.

4. Results

4.1. Five themes of the benefits of low-carbon dwellings

The analysis focused on homeowner retrofit motivations⁵ and identified five core themes of positive⁶ *perezhivanie* (emotional and cognitive experiences) associated with low-carbon⁷ dwellings: (i) control over one's environment; (ii) health and well-being & happiness in everyday life, (iii) climate concerns & caring identity, (iv) financial considerations & future-resilience; (v) a full integration between and individual and their environment (Fig. 3).

The theme *control over one's environment* highlights one's desire to

⁵ Many factors beyond motivation affect retrofit decisions. As the focus of the paper is on motivation, they are not analysed here. A summary of such non-motivational factors mentioned during case-study interviews and the project workshop are summarised in Appendix G.

⁶ The results section of this paper focuses solely on the *benefits* of low-carbon dwellings. However, the analysis featured comparing and contrasting confirming and disconfirming cases to capture both positive and negative emotional and cognitive experiences associated with such dwellings, in order to capture the full emotional response. See Appendix H for further detail on reported negative experiences. See Appendix I for further insights on the similarities and differences of the confirming and disconfirming cases.

⁷ This results section of this paper focuses solely on the positive emotional and cognitive experiences associated with *low-carbon* aspects of the dwellings in the case studies. See Appendix J for further description of positive emotional and cognitive experiences, reported by the interviewees, which were not related to the low-carbon nature of their dwellings.

live one's own life rather than a life chosen by someone else. Thus, it relates to personal autonomy. Control is required to achieve positive emotional and cognitive experiences in any of the others four identified themes. Homeowners in the case studies described how their low-carbon dwellings give them more control to achieve desired indoor environment. For instance, the owner in case C7 mentioned that "it's never cold, it's not warm, you can control".

The owners in both confirming and disconfirming cases were aware of the positive effect of low-carbon dwellings on one's *health and well-being*, especially in relation to improved thermal comfort and indoor air quality. The analysis highlighted that these well-known desired rational outcomes can be supplemented to encompass a broader idea of home as a platform for *happiness in one's everyday life*. A well-designed and constructed low-carbon dwelling has better controls, thermal comfort, indoor air quality, moisture regulation, acoustic properties, lighting conditions, and is free of mould, draught and dust. As such, a low-carbon dwelling provides a better platform to be happy in one's home. The owner in case C7 explained: "When it comes to energy efficiency, which, actually, I don't think many people understand that is also a part of feeling cosy. That you have good air in the morning, you don't have draughts, you have a constant 20-22°C... it is quiet... I think it's a part of feeling cosy, for me at least". All owners in the confirming cases highlighted improved thermal comfort and its importance to feel comfortable in one's home. The owners in case C8 explain:

Interviewer: Could you tell me how the retrofit changed your living experience? How does it feel to live in such a house?

C8-homeowner1: It's so relaxing. We don't have to wear so many clothes. ... before, everything had to be done in the one room. And we couldn't spread out. So, everyone's trying to crowd into the same space, because the other spaces were not liveable.

C8-homeowner2: Because of the nature of the work I do [guitar teacher], I'd had problems... Because I don't do very well with cold. And if I have to practice new material, it got so cold... And I just... I couldn't get my mind into what's I was doing.

C8-homeowner1: Cold is a brain-numbing experience.

C8-homeowner2: It is, actually, it makes you kind of shut down. But since you'd have that done, well, that's gone.

C8-homeowner1: In this less arguing, like: "shut the door, or you are the one that left it open." Or, you know, all of that sort of thing, which comes from being uncomfortable, physically uncomfortable.

C8-homeowner2: So, yeah, I think, just more relaxed state of mind. Because it is warmer. It is that simple.

Energy retrofit can help minimise operational energy use and carbon emissions. Thus, it helps address individual *climate concerns* and desire to do one's part to save the planet. The broader emotional aspects are captured in the fusion of one's *caring identity* and the identity of a place called home. The analysis revealed that the idea of 'low-carbon home' is linked to an identity of a broader social responsibility, as compared to the idea of 'home', which is typically linked to oneself and one's family. This was most visible in homeowner associations. Associations with the word home 'home' were 'me'(C7), 'children'(C7, C8, C10, D12), 'family'(C3, C6, C7, C9, C10, D17), 'parents'(C10). Associations with the words 'low-carbon home' were 'citizenship'(C8), 'concerned'(C1), 'conscious'(C1), 'considerate'(C3), 'helping something bigger'(C10), 'responsibility'(C8, D16). One of the owners in the case C8 gave the following associations with the words 'low-carbon home': "Responsibility, citizenship... You know, low-carbon home sounds to me like... The whole world is safe, protected. it's much more national and global and then just us." Associations of the owner in case C9 were: "Future, secure. It's all about the future, that's how we see it. We don't do this for us, we are not doing this for ourselves to be honest. Because in my lifetime, what I am doing now, has no impact on my lifetime. It's all about the future." This social aspect of one's caring identity manifested in homeowners joining the SuperHomes network "as a means to share my knowledge and experience" (C3), "to promote that it could be done

Perezhivanie
(emotional and cognitive experience)

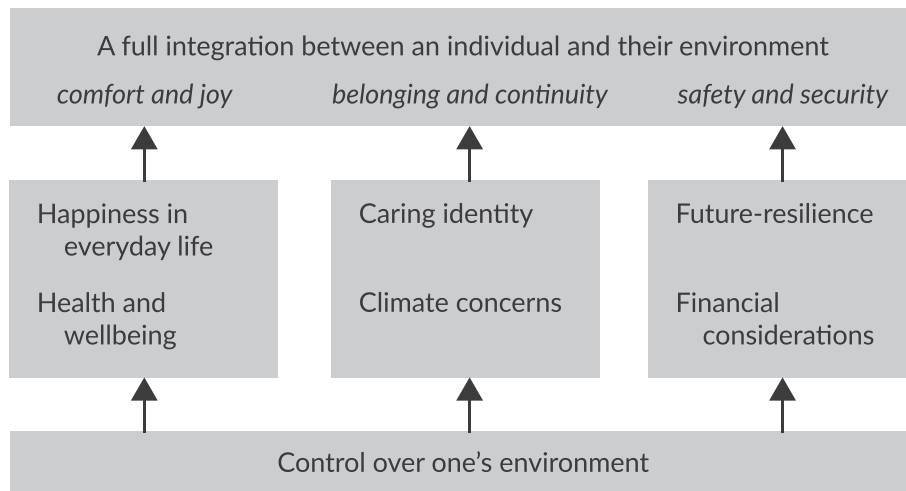


Fig. 3. Five themes of positive emotional and cognitive experiences (perezhivanie) associated with low-carbon dwellings.

in any kind of home” (C2), and to “inspire” (C4).

Energy retrofit is widely understood as able to address some of the homeowner *financial considerations*, and thus build a sense of *future-resilience*. In case C4, the owner explained: “I like the idea of being self-sufficient. The fact that I got a solar panel, helps me to feel that.” In case C6, the configuration of the on-site heating technologies meant that “even on the coldest winter day, we know we can heat the house with the power cut for three days in snow”. As governments around the world commit to a long-term net-zero target, there is a growing understanding that energy retrofit can futureproof one’s property investment, so “you have security that your house won’t be obsolete if and when you have to sell it” (WP21_dem). As this future unfolds, more and more properties will be retrofitted to low-carbon standards. Therefore, if households “don’t retrofit their properties against others that have been upgraded, their property value [will be] going down” (WP29_ind). Energy retrofit can build resilience against that potential future loss in the property value. In case C8, the owners spoke about financial resilience in their old age:

C8-homeowner1: We think prices are going to rise, and our income isn’t. So, we are worried about being sustainable in our old age.

C8-homeowner2: Yeah, I mean certain things are guaranteed that you are going to have to pay for. No matter where you are in life. From council tax to energy bills and to utilities. And as you do get to fixed incomes, you get older, it’d be nice to mitigate some of those costs.

A full integration between an individual and their environment describes a situation when one’s home becomes one’s primary anchor in space and time. This is achieved through the diversity of relations the home setting offers to an individual across different physical and temporal dimensions. The following emotional responses characterise the unifying

outcome of the last three themes described above: (i) feelings of *joy, happiness and comfort* in a cosy, warm place with a healthy indoor environment, e.g. described as “better, nicer environment to live in” in case C3; (ii) feelings of *belonging and continuity*, as the identity of one’s home becomes interlinked with the identities of its inhabitants with time, e.g. the owner in case C4 explained: “I’ve put my stamp on it. I have certainly not built it, but I have, to a certain extent, created it”; (iii) feelings of *safety and security* in a place that one thinks is future-resilient, e.g. the owners case C8 spoke of “economic security in the future” due to significantly reduced energy use and associated energy bills.

For the analytical purposes of the paper, we distilled the aspects of home-meanings that particularly resonate with the benefits of low-carbon dwellings. However, the owners themselves made no such distinction. For them, it was their homes, they thought of them in a holistic manner with both low-carbon-related and non-low-carbon-related aspects forming a part of a single whole. The owner in case C7 used the following statement to highlight this holistic nature: “We have tried to make it so it’s just like a normal home, it is not an eco-facility, if that makes sense.”

4.2. Home for the Common Future (HCF) as a cognitive frame

The authors have constructed a Home for the Common Future (HCF) heuristic to help stakeholders to promote the benefits of low-carbon dwelling to homeowners by building compelling narratives. The heuristic captures only three out of five themes of emotional and cognitive experiences described in Section 4.1., as the themes of ‘control over one’s environment’ and the ‘a full integration of an individual and their environment’ are implicit in achieving positive experiences associated with low-carbon dwellings. The simplification also helps to crystallise the core argument and aid communication of the idea. To convey the



Fig. 4. Home for the Common Future (HCF) heuristic to promote low-carbon dwellings.

underlying rationale, emotional and cognitive reasoning are separated out. Emotional experiences include: (i) Happiness in everyday life, (ii) Caring identity, (iii) Future-resilience. Cognitive experiences include: (i) Health and well-being, (ii) Climate concerns, (iii) Financial considerations. The three themes are synthesised into a single heuristic – Home for the Common Future (HCF). The acronym HCF can simultaneously be used to refer to the heuristic itself, or to separately describe motivations involving emotional and cognitive reasoning (Fig. 4). The inspiration for the heuristic title was taken from the project workshop, where one of the participants suggested “Home of the Future” as a heuristic to talk about low-carbon dwellings, as a “next model up” from non-low-carbon dwellings (WP13_int).

To build emotionally and cognitively compelling narratives to encourage domestic energy retrofit, we suggest showing how one of the three positive *emotional and cognitive experiences* in HCF emerges in the interaction between one’s *environment and activities*, and results in a *full integration with it, given control over one’s environment*. Ideally, all five dimensions of the home-meanings framework (Fig. 1) should be considered when building a narrative. Project workshop participants used the earlier version of the home-meanings framework, which featured concepts of perezhivanie, affordance and practice, to create a variety of narratives. See Box 2 for an example of such a narrative.

5. Discussion

The authors make a number of contributions in this paper. We introduce the method of associative experiments to energy research (see Section 3.1.3. Associative experiments), which is a methodological contribution. We contribute to widen the theoretical choice in energy research by introducing the concept of perezhivanie and applying it to formulate a conceptual framework of home-meanings. We contribute to the literature arguing that a successful promotion of domestic energy retrofit should look beyond techno-economic influences and consider socio-cultural ones [20,22,85–87]. In particular, we contribute to the

growing debate on the importance of understanding the multidimensional meanings of home to fully grasp the diversity of such socio-cultural influences on domestic energy retrofit decisions [19,27].

The choice of perezhivanie as an integrative concept to understand home-meanings and retrofit decisions finds support in the literature, which recognises that retrofit decisions entail high emotional and cognitive involvement [88]. This conceptual choice also resonates with innovation and technology literature that highlights the importance of both emotion and cognition in evaluating and choosing various technologies, including energy-related ones [7,89]. The range of positive emotional and cognitive experiences associated with low-carbon dwellings identified in this paper corresponds with the insights from the literature on energy retrofit motivations, which are historically framed as drivers and barriers to retrofit [86,90–93], but have recently embraced a more holistic approach [19,20,85,87,94–100].

The use of cognitive framing to understand and shape the trajectory of homeowner domestic energy retrofit motivations finds support in the literatures of innovation and technology, discourse and social marketing. *Innovation and technology* literature uses the concept of ‘technological frame’ to explain its role on the way actors make sense of a technology and evaluate its usefulness, before taking an action to adopt the technology [101]. Technological frames influence how various technologies get imbued with specific meanings (e.g. comfort, identity or status), and subsequently, influence the willingness of individuals to use existing technologies or shift to new ones [7,102,103]. Energy research and climate change literature acknowledge the importance of *discourse* for explaining the current carbon lock-in and facilitating change [104]. Novel narratives are seen as a key enabler to break away from the established values, norms and status quo, and encourage societal transformation [105–108]. For instance, discourses that portray plant-based diets as healthy help to increase the share of such diets in the population [7]. Finally, *social marketing* approaches have gained prominence among governmental actors seeking to engage the public on climate change [109]. They predominantly focused on shaping the

Box 2

‘Retiree pension pot lump sum’ narrative, created during one of the breakout sessions of the project workshop by WP21_dem, WP19_int, WP22_ind and WP20_aca.

WP22_ind: I like the retiree, retiree pension pot lump sum, worried about getting colder in their own home. I’m going to get weaker and more sedentary, so, I am planning for the future.

WP21_dem: And they don’t want lots of hassle. You know, their home is probably fairly settled as to how they want it. So, if you are coming in and promising something very disruptive, you may not have a high tolerance of that in that age group. So, you are looking at promises over the nature of the activity being suitable and fitting within your lifestyle in terms of the actual physical retrofit.

WP20_aca: So low disruption... is there a way to have new practices with the non-gas future?

WP22_ind: We could say that the heating system would retain radiators because it’s familiar, and they use what’s familiar. But we might change the heat source, which they probably wouldn’t need to know or worry about. If we move to the point of retirement, maybe there is a point of change there, which is quite useful. Even if you are at the same house, actually...

WP20_aca: So, maybe also staying longer indoors, so you want an environment that allows constant temperatures.

WP21_dem: Yes, and that sort of connects to... You’re changing your identity, going from a “worker” to a “retiree”. And, so, capturing the ideas and changes that experience will bring to you and what positive things you’ll get as a result of that change. That seems like a useful thing. I’ve had experience of retrofit clients in the past, who’ve been exactly that category — bought a place to retire. So, they wanted to make it comfortable for their retirement and they didn’t want to pay energy bills. So, we kind of did everything around that.

WP20_aca: Yes, I think, having lower running costs is a value for them. They are probably scared of having a lower budget...

WP22_ind: Yes, it’s that pot of money, as we said. You’ve got this pot, you don’t know how long you’re going to live, so you have to “eek it out” as much as possible...

WP20_aca: Sounds good, so you have control of your future...

WP22_ind: So, the familiar controls, this sort of practice. Rather this sort of familiarity with your environment

WP20_aca: Yeah, so you’re not making it more complicated, you’re... you feel greener, you feel more related to the future, because you have something that is not going to be obsolete, but you don’t have difficult new practices to learn.

WP7_supply: And we’re not required to put in that extra effort just to be greener...

WP20_aca: And as you’re going to be more comfortable, you can probably have more activities at home, you feel more inclined to have more people around, because it’s not a cold and damp place.

context within which decisions are made, i.e., ‘nudging’ individuals [110]. It has been argued that this is not enough, that we cannot simply ‘nudge’ our way to sustainability [111], and that ‘deep framing’ approaches are required [109].

The authors argue for a more holistic approach to promoting domestic energy retrofit, which draws attention to individuals’ emotions, such as the feelings of comfort, joy, happiness, belonging, continuity, control, safety and security. The idea itself is not new. Especially occupant health and comfort has long been recognised as a strong benefit of low-carbon dwellings and a powerful reason to carry energy retrofit (e.g. [112]). The contribution of the paper to policy lies in bringing together the diversity of possible benefits associated with low-carbon dwellings into a single framework (Fig. 3), grounded in a broader literature of meanings of home, and the development of a heuristic that can be used by different actors to create motivation narratives (Fig. 4). Currently, stakeholders relevant to the success of the widescale energy retrofit programmes often have different and sometimes conflicting understandings on how the homeowners themselves perceive the benefits of low-carbon dwellings. For instance, it has been consistently reported that building practitioners can assume a very narrow set of homeowner motivational priorities, primarily focused on energy bill reduction [113]. Given that the return on investment for many measures is long-term and uncertain, the practitioners can choose to pro-actively protect their customers, and not suggest or even discourage them from energy retrofit, arguing that it is not cost-effective [114–116]. For such practitioners, the suggested frameworks will provide a powerful aid to broaden their understanding. Undoubtedly, there are many practitioners who understand the emotional benefits of low-carbon dwellings and use them to encourage energy retrofit (e.g. [117,118]). For such actors, the suggested frameworks can serve as a common point of reference. Indeed, if the frameworks get accepted as a common point of reference and become widely used, they have a potential to usher a paradigm shift, accelerate the rate of domestic energy retrofit, minimise operational energy use and associated carbon emissions, and mitigate global environmental change.

6. Conclusions

The authors developed a framework of home-meanings (Fig. 1) around the concept of *perezhivanie* (emotional and cognitive experience) to capture various dimensions of the notion of one’s home. It was used to identify five themes of positive emotional and cognitive experiences associated with low-carbon dwellings (Fig. 3). The home-meanings framework together with the identified five themes can be used conceptually to direct further research on motivating domestic energy retrofit. The authors also illustrate the use of the framework to create narratives for energy retrofit promotion, which resonate with homeowner cognitive and emotional reasoning. Three out of five identified themes of positive emotional and cognitive experiences associated with low-carbon dwellings are combined into a single heuristic that is aimed to shape homeowner cognitive frames — Home for the Common Future (HCF) (Fig. 4). The acronym can simultaneously be used to describe motivations involving *emotional* reasoning – Happiness in everyday life, Caring identity, Future-resilience, as well as *cognitive* reasoning – Health and well-being, Climate concerns and Financial considerations. To build compelling narratives, it is suggested to show how *control over one’s environment* can afford the experiences in the HCF framework, and how such experiences lead to *a full integration between an individual and their environment*. All these experiences should be shown to arise from one’s *environment and activities*.

Several possibilities for future research exist. First, the diversity of possible communication strategies for a successful implementation of the HCF framework could be explored. For instance, visuals can be used alongside text for greater success in motivating positive cognitive frames, as images require less cognitive effort than text and can generate a stronger emotional appeal [119], and text and visuals function best in

combination [120]. Appendix K provide examples of the illustrative images for some of the narratives generated during the project workshop. Second, the empirical data for this research is UK-based, while the literature on home-meanings utilised in the paper draws heavily on the insights from the white male population of the Western world. Future research can explore the meanings of home and low-carbon home among a more diverse set of groups and contexts. The thoroughly detailed methodological steps documented in this paper will aid researchers in this pursuit. Third, future research can look at tenure types other than homeowners and take a market segmentation approach to make meaningful narrative specific to different population categories. Finally, future research can investigate the formation of negative experiences associated with low-carbon dwellings and outline strategies to avoid them.

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CRedit authorship contribution statement

Yekatherina Bobrova: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing. **George Papachristos:** Conceptualization, Methodology, Supervision, Validation, Writing – review & editing. **Lai Fong Chiu:** Conceptualization, Supervision, Writing – review & editing. **Svetlana Tikhomirova:** Conceptualization, Methodology. **Thomas M. Coon:** Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data

Data from the project workshop is available at <https://doi.org/10.5255/UKDA-SN-855219>

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Appendices A-K. Supplementary data:

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