

Irrational homeowners? How aesthetics and heritage values influence thermal retrofit decisions in the United Kingdom

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1. Introduction

The housing sector produces approximately 27% of UK CO₂ emissions, of which about 75% comes from space heating [1]. To meet the UK's legally binding commitment of 80% reductions by 2050, there is strong policy commitment to reducing these emissions. While some reductions are expected to come through fuel switching to renewable energy and replacement of old homes with newer, energy efficient dwellings, the greatest potential for emission reductions lies in thermal retrofitting of existing homes [2, 3]. Recently there has been much discussion about 'hard-to-treat' homes, usually meaning dwellings with solid walls, which cannot be treated with cavity wall insulation [4, 5, 6]. The assumption is often that most of these homes can be thermally upgraded with a layer of external wall insulation covered by a new façade material.

This intersects with a wider and more prevailing issue in the UK housing stock: the heritage value of many homes, where this lies outside statutory protection orders.

Many solid walled dwellings have brick façades, which are often seen as attractive and worthy of preservation. Streets can have architectural value due to uniformity of dwellings, even if buildings themselves may not be architecturally significant [7].

Of the 27.7 million homes in the UK, about 40% were built prior to 1939 [8]. In England there are 23.3 million dwellings but only 374,000 buildings have listed building status [9, 10]. A large number of old buildings have heritage features that are

likely to be appreciated by homeowners but are not deemed worthy of listed building status, nor in a conservation area (often called ‘heritage by appropriation’, rather than ‘heritage by designation’).

As energy prices increase and policies such as the Green Deal aim to stimulate large-scale retrofits in the UK, for most homes there may be no legal obstacles to covering solid brick walls with insulation or substituting PVC double glazing for wooden framed Victorian windows. The Department of Energy and Climate Change (DECC) introduced the Green Deal Communities Fund in 2014, with a total capital funding of £80 million. Cambridgeshire was identified as one of the first of the six priority areas for this scheme. Grants (up to £6,000 per household) provided by the Green Deal Communities Fund aim to increase the uptake of solid wall insulation. The planning laws have been revised in such a way that if a property is not in a conservation area, the installation of external insulation is now considered as a ‘permitted development’ and does not require a planning permission. But is this a course that homeowners want to follow?

Currently this question tends to hover round the edges of the policy and academic discussion of thermal retrofitting. There is much research on retrofitting as embedded in a socio-technical system [11,12] or as a social practice [13]. This paper, however, considers retrofitting from a different perspective. It attempts to bring aesthetic/heritage values into centre-stage and offer a preliminary assessment of the issues at stake. Fouseki and Cassar [14] argue that the approach to energy efficiency in heritage buildings reflects predominantly the perspectives of experts, neglecting other values that may be more relevant to non-expert users of buildings. They identify an obvious lack of knowledge regarding occupants’ perceptions, while policies tend to reflect professional expertise and often fail to address the needs of the wider public.

Fouseki and Cassar [14] propose that the driving question for energy efficiency projects should also be ‘what does this building mean for those who use it’ and ‘what interventions can be implemented that could co-exist harmoniously with those meanings?’

Although the paper is concerned with a UK case study, the issue has wide international implications. As thermal retrofitting has become common due to concerns about climate change, fuel costs and energy security [15], governments have recognised that general regulations on thermal retrofitting may not be suitable for buildings with official conservation protection. For example, German federal building regulations specifically exempt such buildings from the stringent demands of the Energy Saving Regulations (*Energetische Einsparverordnung* – EnEV) [16].

Nevertheless, a large number of Germany’s buildings with no official conservation designation are seen by their owners and some local authorities and organisations as having heritage value, mostly due to their traditional façades. Bodies such as Hamburg City State, Stadtbild Berlin (a building conservation organisation) and Bauen.de (a national building advice agency) have expressed concern that hundreds of historically significant buildings are being damaged through the EnEV rule that any retrofitting or restoration of these buildings must achieve high thermal standards [17, 18, 19]. As expressed in a report by Stadtbild Berlin:

Sadly, too little consideration is being given to the aesthetic and city-enhancing features of these buildings, with catastrophic consequences for the face of the city... Traditional local architectural features are disappearing under 30cm thick wads of insulation... Germany already suffered a heritage wipeout in the destruction wrought by the Second World War, and now our remaining attractive façades are falling

victim to an onslaught of insulation. (Stadtbild Berlin, 2015 [19]; authors' translation from the German)

This reaction has coalesced with other misgivings in Germany about insulation, particularly mould, fire risk and inflated claims as to projected energy savings, and this kind of anti-insulation movement has gained support from architects, building organisations and media groups [20]. It would seem that there is a need to take account of concerns for the preservation of heritage beyond officially protected buildings, if thermal retrofitting is to proceed without controversy. Examples of attempts to do this can be found internationally. In the US, for example, the Environmental Protection Agency gives detailed advice on thermal upgrade options for what it loosely calls 'historic homes' [21], and the National Parks Service for 'historic buildings' [22]. In the UK, technical-regulatory advice is given by the Department for Communities and Local Governments [23], and more practice-oriented advice by English Heritage [24]. The European Commission has also initiated research into appropriate methods and technologies for improving the energy efficiency of historic buildings [25].

While a great deal is known about the technical issues in thermally retrofitting homes with traditional architectural features, it is also important to explore how home owners actually frame and deal with any heritage or aesthetic issues associated with their homes, when they plan and carry out a thermal retrofit. The question as to what actually counts as heritage or aesthetic value does not have a simple answer, and it is important to see what the homeowners themselves think about this and how it can influence the way they retrofit. Hence this study covers three main areas:

- A theoretical dimension: What actually *is* heritage/aesthetic value in this context, and why is it important?

- A practical dimension: Based on the interviews in retrofitted homes in Cambridge, UK, how do aesthetic and heritage values influence these homeowners in relation to a possible thermal retrofit of their homes?
- A policy dimension: How should a local thermal retrofit policy approach buildings that are not deemed worthy of listed building status, nor in a conservation area, but are perceived to have aesthetic value (‘heritage by appropriation’)?

It may be observed that heritage and aesthetic issues can arise when any kind of retrofit is planned for an existing home, be it thermal, acoustic, internal layout, extensions, etc. However, aesthetic issues are likely to arise with thermal retrofits in particular because these can involve extensive changes to very visible features of a building, such as the façade, and because of the strong energy policy impetus toward mass retrofitting of homes throughout the UK. Energy saving in buildings can be approached as a purely technical issue but it is also well recognised that there is large untapped potential for energy saving through occupants’ behaviour change [13].

While it is recognised thermal retrofits need to be technically and economically feasible, this paper focuses on the under-researched area of homeowners’ motivations rather than technical performance and costs of these projects.

The concerns addressed in this paper arose out of unexpected findings in an empirical study of the role of homeowner-occupiers as innovators in the process of thermally retrofitting their homes [12]. Although heritage and aesthetic considerations were not necessarily to the fore in these homeowners’ motivations or concerns regarding thermal retrofitting, they had tended to emerge as the retrofit discussion, planning and design proceeded. When these issues became apparent the empirical work was extended, with additional interviews and a wider range of questions.

This paper begins by surveying literature relevant to the theoretical dimension of how heritage and aesthetic value are currently conceived in sections of the built environment that may be candidates for thermal retrofits.

The empirical section reports on qualitative interviews with a targeted sample of Cambridge homeowners who had thermally retrofitted their properties. These interviews with homeowners were supplemented with interviews with architects within the same local community who were involved in some of these (and other) retrofits, and with leaders in citizens' initiatives who network homeowner-retrofiters in the same community.

On the basis of the interview findings a first attempt is made to understand some of the ways heritage and aesthetic concerns can influence what homeowners choose to do in retrofitting. The paper aims to increase understanding of what actually motivates homeowners who, from a policy point of view, are often seen as irrational in their decision-making.

Section 2.1 surveys the relevant literature and section 2.2 describes the method.

Section 3 gives the results of the interviews, followed by a discussion in section 4.

Section 5 concludes.

2. Method

2.1 Research context

A number of studies of thermal retrofitting in the UK acknowledge that heritage or conservation values need to be respected in planning and implementing retrofits. Most studies are engineering-based, simply offering costs and benefits of various retrofits of UK heritage properties [26, 27, 28, 29] or explore how planning processes in Britain can constrain effective retrofitting of heritage homes [30]. These studies

assume, but do not argue the case for, the imperative of preserving built heritage value.

Beyond the UK, international studies like the Energy Efficiency for EU Historic Districts' Sustainability (EFFESUS) project recognize that improving energy performance in historic buildings is a balancing act between building preservation and the installation of retrofit measures [31] but most projects are focused more on the decision-making process than human-centered approach. On the other hand, some researchers such as López and Frontini [32] argue that heritage value should give way to photovoltaic installations since ground space is limited for building new, energy-efficient dwellings, and they develop a model for multi-stakeholder decision making in requests to install photovoltaic cells on heritage buildings.

Some thermal retrofit studies introduce a normative dimension, beginning to argue the case for heritage protection. Alev et al. [33] for example, who explored thermal retrofit options for historic rural houses in the Baltic region, observe that 'cultural heritage buildings deserve a special approach in addressing the energy performance of buildings in order not to lose their value' (*op. cit.*, 63). The approach of these studies varies from assessing the social and cultural consequences of inserting new buildings into districts of traditional architecture [34] to arguing for 'the adaptive reuse' of heritage buildings [35]. Effectively, they assert the value of heritage as a given, but do not present a structured, grounded case for it.

The special issue of *The Historic Environment: Policy & Practice*, 5(2), July 2014 (pp. 95-228) on energy efficiency and heritage values in historic buildings presents papers that make the first systematic attempt to explore the relationship between heritage values and energy efficiency, and in the editorial, Fouseki and Cassar [14]

identify a gap in understanding the views of the people on whose behalf energy-efficiency measures are adopted.

Some UK retrofit studies accept or assume that homeowners have aspirations for heritage protection, and ask what this might mean. Haines et al. [36] explore retrofit-related attitudes of homeowners via a framework of ‘practice theory’ [37], touching on buildings’ aesthetics as one of a number of factors that guide retrofit practices.

Pelenur [38] includes heritage values among attitudes of homeowners that need to be taken into account when retrofitting. More specifically, a study by Behar [39] on the Grade II listed Barbican Centre in London explored how occupant surveys could be used to identify energy saving strategies, although it did not question how the inhabitants experienced the heritage value or how that could influence the adoption of a suitable retrofit strategy.

To date we find no structured attempt to understand homeowners’ concerns of heritage protection where thermal retrofits are envisaged. One has to look beyond the specific theme of retrofits, to planning on an urban scale. In this field Tweed and Sutherland [40] and Beradi [41] each argue a structured, coherent case for preservation of built heritage, bringing together several strands of thinking. Tweed and Sutherland [40] draw firstly on Maslow’s [42] hierarchy of human needs, which locates physical, utilitarian needs in the lower stratum of human need, and the need for actualisation, creativity and fulfilment at the highest level. They argue that the sense of fulfilment and satisfaction people feel through contact with an aesthetically pleasing environment that resonates with their cultural identity belongs at the highest level. They then modify Maslow’s schema, arguing that fulfilment of lower level physical needs does not have to come first, and people may accept lower physical benefits from buildings in order to continue to enjoy their aesthetic and cultural

appeal. Secondly, these authors set this psychological model in the context of sustainable development, as configured in the Brundtland Report [43], arguing that heritage or aesthetic values in the built environment straddle its three pillars of *economic, environmental* and *social* wellbeing. The *environmental* dimension includes not just material issues of building fabric, but also qualitative features such as ‘perceived value’. Drawing on Bourdieu [44], they argue that the *social* dimension includes ‘cultural capital’, the cultural identity which is mediated through traditional features of buildings. Further, they argue that even the most mundane buildings ‘...are never *purely* functional and so they also contribute to satisfaction of higher needs’ (*op. cit.*: 64, emphasis in original).

Thirdly, drawing on Gibson’s [45] notion of ‘affordances’, these authors ask whether building’s features are aesthetically valuable in themselves and therefore predictable, or whether their appreciation is subjective and ‘afforded’ by the observer. In addressing this question they draw on Lynch [46], Ingold [47, 48] and Csikszentmihalyi and Rochberg-Halton [49], arguing that a sense of meaning is often created by occupants’ interaction with the buildings they live in or interact with. One’s locality is ‘soaked in memories and meanings’ (*op. cit.*: 65, quoting Lynch [46]). The perception of aesthetic value may differ from culture to culture, because ‘meaning is created through interactions between individuals and objects and is heavily influenced by cultural background’ (*op. cit.*: 65). Hence it may be difficult to prejudge what particular features of a building its occupants find significant.

A further dimension is explored in Sadalla’s [50] study of the symbolic significance of six different building materials (brick, concrete block, weathered wood, stucco, flagstone, and wooden shingles). Dwellers can have varied attachments to different building materials, depending on factors such as interpersonal style, social class, and

past experience. Preferences and people's psychological wellbeing can be significantly affected by their personal or cultural feelings for one material or another. Bourdieu [44] argues that the different aesthetic choices people make are all distinctions, choices made in opposition to those made by other classes. Judgments of taste and aesthetic preferences are related to social position and acts of social positioning. Bourdieu also argues against Kantian view of pure aesthetics, rejecting the idea of 'good taste', as to him, the legitimate taste is merely a class taste. Contrary to Rational Choice Theory, social agents do not calculate according to explicit rational and economic criteria. Rather, they operate according to an implicit practical logic.

Beradi [41] argues that a 'sustainable building should increase social equity, cultural and heritage issues, traditions, human health, and social infrastructure, as well as safe and healthy environments' (*op. cit.*, 76). Drawing on Kibert [51] he sets this against a narrowly 'green' approach which privileges physical environmental protection above broader cultural concerns.

We argue that there is a gap in the current research in understanding the aesthetic and heritage aspirations of homeowners and occupiers who feel positively about the physical features of the buildings they live in. For homeowners, houses are not just spaces for thermal optimisation. They are cultural objects that carry significant value and exist in a social context. Hence the normative claim for energy saving needs to be balanced alongside the normative claim to protect this cultural heritage and the interests of social agents living in them, even if their building has not been officially designated as 'heritage' or 'conservation' building stock. This issue has also a policy dimension. Gram-Hanssen [52] argues that unrealistic renovation policies tend to focus on rational economic reasons for thermal retrofits and fail to understand other

values such as aesthetics or the idea of home-making and are thus failing to take into consideration the complexities of owner-occupied houses.

It has been recognised that human-centred methods that investigate how consumers act and make decisions in particular are essential to understand energy use [53].

Excluding human-centred research methods limits an understanding of actual behavioural patterns and therefore also limits an accurate forecasting of energy demand. Lutzenhiser [54] argues for human-centred methods that can offer more accurate understanding of lifestyles, instead of being limited to crude demographic variables. By adopting a human-centred research approach to thermal retrofits, this paper aims to provide new knowledge on the attitudes and motivations of UK homeowners and uncover possible resistances to thermal retrofits. This paper also engages with a broader research question proposed by Sovacool [53] on how complex and time-consuming human-centred research can be carried out, combining interviews with objective observations on site, and includes a discussion on how findings that are based on a limited sample could be generalizable beyond the respondents.

2.2 Material and methods

Views and understandings on dealing with aesthetics and heritage in retrofits were investigated through semi-structured, qualitative interviews with homeowner-retrofiters in Cambridge, UK. For reasons explained below, several local architects and leaders in relevant citizens' initiatives were also interviewed.

Qualitative data tells *what* is happening and *how* and *why*, whereas quantitative data would indicate *how much* of each thing is happening [55, 56]. The aims of this study were qualitative: it sought to discover whether aesthetic and heritage concerns played a significant role in shaping thermal retrofits among a target population, and if so, to

identify some of the ways this plays itself out.

The interviews were semi-structured rather than comprising a simple list of questions and answers. This enabled respondents to describe their retrofit goals and experiences in their own terms, and thereby to redefine the scope of the interview questions where appropriate. In this way, information was given which might not have emerged from questions based entirely on the interviewers' notions of the subject matter. This type of in-depth, exploratory investigation is possible with a small sample where a generous amount of time is spent with each household.

Nine households were interviewed in this way. Additionally, two interviews with relevant architects and two interviews with leaders in citizens' initiatives were conducted. The architects' descriptions of supplementary projects provided a cross-check as to how aesthetic and heritage issues tended to play out among the target population of retrofitting homeowners.

Issues of the validity of qualitative findings from small sample interviews were checked against formal criteria as expounded in Galvin [57], an exposition of the statistical theory of small sample qualitative research. This shows how the findings from a small qualitative sample can give a reliable indication of the proportion of a target population which is likely to hold opinions which are expressed by various proportions of the interviewees in the sample.

The target population in this study was homeowners in Cambridge, UK who had recently thermally retrofitted their homes. Cambridge is an economically buoyant city of 120,000 people. As a University town with a large base for high-tech industries, a large number of households in Cambridge are middle-income and well educated, so the sample group with these characteristics represents a large sector of the population. Middle class homeowners are also a primary target population for government

policies such as the Green Deal. Housing in Cambridge is diverse, including pre-Victorian homes and a full range of Victorian, Edwardian, post-World-War I and post-World-War II homes. Dwelling size ranges from very small to very large in all these categories. The city has a strong network of citizens' groups focused on environmental and climate issues, such as Cambridge Transitions (CT) and Cambridge Carbon Footprint (CCF). CCF is a charity that provides support for people to reduce their carbon emissions. Their activities include Carbon Conversations programme that engages small groups in sessions addressing the reduction of greenhouse gas emissions, energy saving workshops, clothes swaps and eat-local challenges. Some of the homes presented in this paper take part in Open Eco Homes event where homes with energy saving features open their doors to the public. CT has similar aims and their projects include a community supported agriculture scheme and forums on renewable energy and home energy topics, where experts answer households' questions. Both CCF and TC have links with the local council and run events on home retrofit and solid wall insulation, where representatives from the local council explain the Green Deal grants available.

As the interviewee sample was limited to Cambridge middle-income homeowners, the findings are robust only for this target population. However, the content of the interviews gave no reason to suppose this population is not comparable to a significant proportion of homeowners throughout the UK. Clearly, however, it may have little relevance to groups who are markedly different from this, such as households suffering fuel poverty, or low income households whose budgets limit their retrofit possibilities to the bare essentials necessary for thermal comfort. It may be asked, then, why focus a study on this target population?

One reason is that UK thermal retrofit policy seems to fail to engage this group of

relatively affluent and highly educated middle-income homeowners, who in theory should be very responsive to environmental concerns. Recent work on behavioural aspects of energy saving argues that this type of segmentation, or persona approach (for example identifying ‘Leading Achievers’ who are likely to take up energy measures and how they can be used as “allies” in reaching out to others) can be used to better calibrate policy efforts and specific policy recommendations [58, 59, 60].

Another reason is that these people tend to have the means to make their own choices in how their thermal retrofits are designed. This enables issues such as aesthetics and heritage, which are not essential to the purely material, thermal quality of a house, to come more readily to the surface.

In selecting the households to interview, efforts were made to ensure these covered as full as possible a spectrum of characteristics within the target population (range of house sizes, ages, styles and orientations to the sun; range of homeowner occupations, provenance and social network affiliations; range of retrofit types and extents). The choice of interviewees was also guided in part by advice from leaders in CT and CCF, which network and support retrofitting households. A cross-check on the degree of coverage was also provided by the architects who were interviewed, who work with thermal retrofits in the local community. There were 11 interviews (labelled Interviews A –K) of which 2 were with architects working for local practices that are specialised on domestic retrofits and extensions, 2 with leaders in citizens’ initiatives (CCF and CT) and 9 with homeowners who had retrofitted or were in the process of doing so (these included the 2 architects). Because most of the retrofit homes were jointly owned, 17 persons were interviewed, including 6 couples that were mostly middle-aged professionals, some of them with children. 7 interviews were conducted in interviewees’ homes, preceded or followed by a guided tour of retrofit measures

and general conversation as to the conception, planning and progress of the retrofit. Homes included two that were judged by the researchers to have had minimum heritage value prior to retrofitting¹ (Interviews I and F); two with considerable heritage value (A and J); and a range of others in between. Interviewees were aged from approximately 40 to 75. Homeowners were man-woman pairs except one, a man whose partner was away. The architects and citizens' initiative leaders were middle-aged professional women. Interviews took place in February-May 2014. A list of interviews, with aliases for interviewees, basic information on household characteristics and the property, is given in Table 1.

The interview analysis method was 'realist' [55] rather than 'grounded theory' [61, 62]. In the grounded theory approach, the researcher analyses the interview transcripts on the assumption that he or she has no preconceived notions as to what its content and emphases might be. It is assumed that a detached examination of the interview data will identify these 'from the ground up'. In the realist approach, the researcher approaches the analysis with specific, pre-formed research questions in mind, and examines the data with a view to seeing how these might be addressed or enlightened by the interview data (for further discussion on this issue see Smith et al. [63]).

Although the research question was highly focused (see Section 1, second of the three research questions listed), the interviewer refrained from using terms such as 'heritage' or 'aesthetic' until interviewees raised these themes. Questions sought to explore what factors significantly influenced retrofit strategy and, where aesthetic/heritage issues emerged, to discover in what ways these played out. As noted in Section 1, this study grew out of a previous study investigating homeowners' own

¹ These homes had flat façades on all sides, no dormers, and purely functional windows and doors without latticing or stained glass. They therefore lacked features which are generally associated, in grey literature and popular discourse, with British built heritage value.

innovations in their retrofit design. Within that study, the notions of aesthetics and heritage emerged consistently, even though this was not a focus of the study. It was because this theme appeared to be so generally present, that further interviews with other householders were arranged, to see whether this would fill out the emerging picture.

A typical length of interview was 60 minutes and all but two interviews was carried out in the homes of the interviewees, preceded or followed by a tour of the retrofitted house. After a 60 minute semi-structured interview the researcher brought each interview to an end, as we wanted to ensure comparability the interviews. The tour of the house was particularly helpful as it helped the interviewees to articulate any further concerns and to explain their retrofit measures, giving the interviewer a more complete view of the retrofit process and what level of understanding the homeowner had of the technology. It also made interview situation more effective. The professionals were interviewed in their offices and the interviews were limited to 60 minutes. All retrofits were funded by the homeowners except for one couple who were entitled to a subsidy.

The interviews were digitally recorded, transcribed, coded thematically and analysed in light of the research questions.

< Table 1 about here >

3. Results

All homeowner interviewees indicated that aesthetic/heritage concerns significantly influenced how they planned and executed their thermal retrofit. Analysing the

interview transcripts in the context of the main research question enabled it to be structured under three main headings:

1. The internal logic of homeowners' heritage values: what homeowners see as worth preserving;
2. How aesthetic values affect the way people do thermal retrofits;
3. How building professionals recognise and react to homeowners' aesthetic concerns.

3.1 The internal logic of heritage values

There was no simple, consistent logic of aesthetic values in relation to interviewees' homes or how heritage is appropriated. Every interviewee regarded at least one aspect of their home as important to preserve, on aesthetic or heritage grounds, and some saw a deep retrofit as an opportunity to improve the architecture.

With regard to external wall insulation, interviewees expressed a range of views on traditional brick facades. Christopher (Interview G) had no problem in covering his locally made Cambridge White brick facade with external wall insulation – apart from the front façade, which he left as is, so as to continue to be uniform with other houses in the street. Alan, however, had rejected external wall insulation because he liked the appearance of his house's 80 year old Cambridge White bricks (Interview E).

Terrence's house has a façade with 100 year old Cambridge White bricks but actually he did not find them particularly beautiful:

My late neighbours claimed that the bricks were made from a brick pit only a few hundred yards away. There is heritage there, there's no doubt. But as they stand at present, they are not a beautiful pale yellow, they are a rather grubby grey, presumably as a result of soot in the air over the years. (Interview K)

The feature that homeowners most commonly saw worth preserving, regardless of the household characteristics, was bay windows (all interviews except E, F and K).

Architect Erica (Interview H) summed this up when asked what thermal improvement measures she would recommend for such bays. She replied, *'Well I wouldn't touch them. They're part of Cambridge.'*

Cambridge has entire streets of houses with nearly identical bays and most homeowners who were interviewed in this research do not want their building to stand out. Patrick (Interview G) wished to preserve his bay so that it continues to fit in with other houses in the same street; and Alice and Bob (Interview J) repeatedly mentioned *'the look'* of their bay and dormer in the context of their street's uniformity. If a technically failing bay window was demolished as a part of a retrofit, as in the house of Rod and Iris (Interview A), they wanted the reconstruction to geometrically echo the bay next door.

Other architectural features considered worth preserving were leadlight windows, indoor plaster details such as cornices and architraves, and traditional slate or lead roofing. Rod and Iris (Interview A) wanted their roofer to retain their old lead roof construction as much as possible:

He said you can have this or you can have this, the two standard sort of things that Victorian houses [have]. So we chose the one we liked and he just again did it exactly the same way as the Victorian lead roofer would have done it.
(Interview A)

However, Terrence did not find his old slate roofing worth preserving at all:

It's not particularly attractive, a leaden grey colour [laughs]. It can be depressing, if the weather's not good for example. (Interview K)

Instead, Terrence found solar panels *'beautiful'*. He and his partner Ellen were thinking of shifting a date stone, one of their house's few traditional features, from their front, south-facing wall to make way for a solar collector:

It might be a lovely place to put another solar collector, a vertical one, which would actually perform better as you go into winter, because of the low angle of the sun. But I would be interested in doing that in a way that is beautiful, in order to demonstrate that solar energy can be attractive as well as highly functional. (Interview K)

In some cases aesthetic values were less related to materiality but more to the spatial quality of the house. Laurence and Yolande's three-storey end of terrace house was built cheaply in the 1960s, but its spaciousness and high ceilings motivated them to invest in modernisation with external insulation and elongated main windows:

The internal spaces are quite good. You know, this is a nice room ... very spacious, decent ceiling heights, much better than some of [today's] pretty high cost stuff. (Interview I).

This quality of the inside space contrasted with the outdated and unattractive façade, which they found lacking in aesthetic appeal:

The external design was clichéd really. And 2000, 2010 it begins to look dated, not antique quality dated, but utility dated. (Interview I)

The distinction Laurence made between heritage and datedness accords with a more general feeling among interviewees that features are not appreciated just because they are old. No one wanted to preserve Victorian kitchens or bathrooms although they could also have *'period'* characteristics. A traditional open fire was seen as impractical and wasteful of energy, but old fireplace surrounds and mantelpieces were valued. In Alice and Bob's home, where an original surround had previously been

removed, a replica was made (Interview J). Also in other cases there was an overriding sense of nostalgia, as the new feature was designed to replicate the past rather than preserve it, such as making a replica leadlight window:

we knew we had to go for double glazed, and therefore – the panes are much bigger double glazed but we tried within the constraints of having double-glazed windows we tried to keep to the style as much as we can. So it looks similar to how it originally looked. (Interview J)

For homeowners Rod and Iris, only careful restoration of the original feature, including its original materials, was acceptable and a precondition to accept insulation measures:

But we do like the old Victorian plaster work inside. And we'd have lost it on two walls and had it remaining on two walls, which would look very odd. So the fact that they could actually rebuild it – and the modern stuff you cannot distinguish from the old stuff. (Interview A)

There were limits, however, to the extent to which substitutes or replicas were acceptable. Terrence and Ellen's architect suggested they use pargeting (traditional embossed patterning) to give visual appeal to external wall insulation which, if used, would cover their Cambridge White brick façade. The insulation, said the architect, would make the façade 'like a blank canvas'.

Interviewer: *If you cover the brick with insulation, and then put the pargeting on it, what has it to do with heritage?*

Ellen: *NOTHING [emphasised]. Not in this area. I mean I'm quite dubious. The architect brought up this idea last week. It's coming from Hubbing List in Essex, where it is classical, it's a rural area. It's nothing to do with Cambridge town buildings. (Interview K).*

The interviews illustrate that heritage by appropriation, i.e. which features homeowners see as worth preserving, is not easy to predict even within the same city, such as Cambridge. Sometimes aesthetic values are identified with heritage, but not always. Further, sometimes the interviewed homeowners' nostalgia can be satisfied with replicas and substitutes, rather than preservation. There was no single thread of logic linking aesthetics, heritage, tradition and utility, but each homeowner needed to be individually understood. The interviewees repeatedly used definitions such as beauty, tradition and nostalgia and these terms carried significant meaning for them.

3.2 How aesthetic values affect the way people retrofit

In all cases, however the homeowners perceived what was worth preserving, their aesthetic values influenced the type of retrofit they chose. For some, aesthetic values strongly influenced their retrofit strategy from the beginning, while in some instances they surfaced as the details of the work unfolded.

In some cases the willingness to preserve building characteristics brought a retrofit to a halt. Environmental concern had been Terrence's overriding motivation to retrofit ever since he began the process in the 1970s (Interview K). As a physicist he developed a method of internal wall insulation for his kitchen-dining room in 1979. Later he and Ellen combined their adjacent semi-detached houses into one and developed a nuanced heating system to create different heating zones tailored to each room's uses. The question of aesthetics arose after a local Green Deal initiative offered subsidies for external wall insulation. The decision to opt for external insulation for the back and sides of the house was straightforward. The project stalled, however, with indecision about the front façade. In response to the question as to whether this was because of aesthetic or heritage values, Ellen replied:

For me it's a bit of both, but it's mainly the heritage bit, because I don't think it is particularly beautiful. Doesn't look to me anyway. And it's also quite wonky. I mean the house has practically split in half, we've had to put iron bars through to keep it knitted together, because the foundations are quite dodgy... But it's an important bit of history, and the suburb's lost most of its old houses already (Interview K)

This was also identified in Alan's (Interview E) and especially Christopher's (Interview G) retrofit, which was nearly completed, with external insulation on the side and back walls, when he started to have doubts over the front façade and left it untouched. He commented:

No, there's no heritage value, but it's just that I don't want it to be sticking out like a sore thumb because it looks completely different from the other houses on the [street].(Interview G)

Some of these households had to become inventive, developing their own variations on secondary or double glazing for traditional windows to preserve heritage while improving thermal comfort (Interviews C, D, and a rental property of Interview I).

The leader of the citizen's initiative group told of a homeowner who:

...just reacted completely negatively to the idea that you should take out old fittings and replace them with high performance fittings. He just was not going to do that to Edwardian joinery. So he has worked very carefully in lots of clever ways. Sometimes he puts Perspex on the inside of the windows with magnets, that he can take off in the summer. And sometimes he puts it on the outside, so that when you're inside you see the joinery. It depends on where he – it's an aesthetic decision. (Interview B)

Lydia, an architect working on local retrofits, told of a homeowner who had developed a top plate for external wall insulation that would avoid having to lengthen the eaves and change the traditional shape of the roof (Interview D). Rod and Iris (interview A) and Bob and Alice (interview J) had talked persuasively to their building professionals to convince them to do the extra work and problem-solving required to preserve or replicate features they desired to keep or install.

There were also clashes and trade-offs between heritage features, thermal comfort, and energy saving. In all cases there was at least one instance where building preservation had been prioritised over energy and cost savings. Bob and Alice (Interview J) had opted for newly built replica 1930s bay windows with thin double glazing to restore their home's front façade to its original appearance, even though the efficiency of such windows is much lower than new models. However, they stopped short of dividing the panes in to lattice sections, which would have more fully replicated the originals but reduced the thermal efficiency further. To compensate for lower thermal efficiency they installed heavy curtains.

Laurence and Yolande, in a thermal retrofit of a previously unattractive 1960s terraced house, omitted applying insulation to the two prominent load-bearing pillars at the front of the house, so that these would not stand out on the façade. They knew this would cause cold-bridging at the two front corners of the house:

And the driver of what we were doing actually was the aesthetics. Or the initial objective was an aesthetic objective. (Interview I)

For Oliver and Annette, like other houses in the street, their otherwise plain looking 1960s house had a one-metre wide band of patterned tiles across the outside walls, between the top of the downstairs windows and the bottom of the upstairs windows. These tiles, said Oliver:

... give a style to the whole area of houses. Some of them are black and some of them are red tiles. So, they are sort of, yes, in terms of beauty, I think it's one of the less, less fair type of houses. Sort of the tiles make it, give it character (Interview F).

The handworkers who applied their cavity wall insulation refused to fill the cavities in the metre-wide strip of wall behind the tiles. They were not confident, they said, to remove and replace tiles without irreparably damaging the pattern.

The interviews suggest that Cambridge homeowners' concerns for preserving building characteristics greatly affect their retrofit plans in ways that may compromise energy saving or economic efficiency. In attempting to balance energy improvements with building characteristics, often homeowners are dealing with imponderables for which there is no standard solution and that may reduce retrofits' energy savings potential.

3.3 Building professionals' interface with homeowners

The way architects and builders responded to homeowners' aesthetic and heritage values, as these emerged, was crucial to how retrofits proceeded. For Alice and Bob the motivation to retrofit was overwhelmingly thermal:

The house was absolutely freezing cold. I have never been as cold as the first winter we were in this house. The house was incredibly cold, the central heating didn't seem to do much to get the house warmer, certainly not up to a reasonable temperature, and there was condensation and mould. So we decided we MUST insulate this house. (Interview J)

The couple found their architect and builder open to their ideas. For example, the builder discovered that the architect's design for the front entrance would entail

disproportionately large expense, while Alice was concerned it would not enable a replica leadlight window to be installed. The problems were worked through effectively:

So the builder and I then discussed a whole range of options as to what he thought was possible, and then once we'd come up with an option that he thought was possible and that I agreed that we would be willing to accept, we then went to the architect and said can we alter the plans. But it was the builder saying, this is a problem, and us saying, ok what are the possible solutions, and the builder running through them and we saying, how about this, how about that. And so all the way through we were using the architect's and the builder's expertise. (Interview J)

Bob and Alice (Interview J), and Laurence and Yolande (Interview I), praised their builder for his acceptance of their preferences. Laurence specifically chose him because he had seen how well his previous work combined aesthetics with thermal upgrading.

Conversely, Alan's experience with an energy advisor was '*completely negative*' (Interview E). The advisor seemed fixated on the theoretical thermal potential of the building and was not able to thoughtfully discuss deviations such as the desire to preserve the brick façade, or the household's specific needs and habits.

Relationships with builders were ambivalent. The most difficult situation was where work was subsidised, with handworkers on strict time budgets and only willing or able to do jobs in standardised ways (Interview F). In other cases preservation created problems for builders or led them to take shortcuts (e.g. Interview A). Some issues were solved through discussions if homeowners were able to be on site at the right moments.

A further complication was that most of the retrofits investigated here were gradual or incremental, taking place over time ranges from 2 to 35 years. Lydia, an architect, suggested there is *'not enough talk about incremental [retrofits]'* among suppliers and building professionals (Interview D). A common example of an initial measure is draft stripping, often used as a non-intrusive, interim means to improve the thermal quality of windows. Local citizens' initiative leader Ingrid (Interview B) pointed out that suppliers and the building trade underestimate the importance of draft stripping products because these are cheap, and therefore there is very little professional advice available to customers. This effectively deprives many homeowners of a simple, inexpensive means to get more thermal comfort while retaining their existing windows fully intact.

It was also observed that houses on the north side of terraces or semidetached pairs can bring peculiar issues. Two semidetached houses and one terraced house in this study were of this type, and had suffered cold and moisture problems. The thermal solutions for all three were very intrusive, and leading to a degree of agonising by homeowners as to what characteristics to keep or let go of. It also led to creative solutions, where, for example, an extension with a new double-skin wall turned the former northwest solid wall into an inside wall and therefore a heat sink.

However, some homeowners noted the shortfalls in professional knowledge.

Christopher and Linda commented:

...there was all this arguing, or discussion, between me and the builder and the architect about the suppliers, and at one point I said, 'Surely this isn't all new. Surely other people have done this before.' And I would have thought that external insulation, for instance, would be a mature market by now. And the answer was 'No.' To my surprise, although these products are in theory

out there, there really isn't all that much knowledge on the ground about them. And so it seems that from the builder's point of view it's new technology and they're still on the learning curve. So I suppose it would be good to advise builders to get adequate training on these things. (Interview G)

The builders are sort of doing what they're told, so they don't have to actually understand it, they just have to know how to do what they're told to do.

(Interview A)

The homeowners interviewed for this research had not found the government material particularly useful. Instead, Rod and Iris would recommend German Passivhaus material for a household considering to retrofit (Interview A).

Ingrid, the citizens' initiative group leader also recognised that building professionals tend to keep to their own roles so there can be a lack of overview on site that can lead to moisture problems:

None of the industry has taken on the fact that insulation has to be linked to ventilation. Two different guys: the ventilator does the, you know, electricity, puts in a vent, doesn't have any idea about the airtightness of your house or anything else, he's just putting a vent in because you asked him to vent it.

Same with the guy with the insulation; it makes it airtight, he doesn't know whether there's any ventilation, that's not his business. (Interview B)

She continued:

And is the knowledge that that's needed there? No, I don't think so. I don't think most people are anywhere near that. (Interview B)

The interviews suggest that retrofits studied in this paper were likely to proceed best where building professionals – including architects, handworkers and suppliers – had

a nuanced understanding of homeowners' specific needs and let them judge what counts as worthy of preservation, restoration, replication, reinvigoration or renewal. Building professionals' depth of prior experience also played a role, as did the quality of coordination between professionals. However, the lack of knowledge was commented on and this again suggests that thermal retrofit market is not yet working properly, at least not in Cambridge.

4. Discussion

Sustainability includes, *inter alia*, cultural and heritage issues and traditions [41] as discussed in section 2.1. The interviews revealed that the interviewed homeowners' heritage concerns were sometimes grounded in their identification with traditional features of their dwellings' building fabric (e.g. Cambridge White bricks) or other architectural features which connected them to the past (e.g. leadlight windows in the style of a particular era). The mixing of nostalgia, often expressed in the use of replicas, and a desire to preserve period features, can also be explained in terms of identification with cultural symbols from the past, at least in the sample group that mainly consisted of middle-aged, middle-income professional couples. This is in contrast to current thermal retrofit policies that tend to see homes as physical structures that can be technically optimised, ignoring the values of homeowners who have invested heavily in their homes and may be reluctant to change them, especially middle-class homeowners who can afford to heat even thermally poor homes. Further, the UK's thermal retrofit policy culture has been heavily influenced by that of so-called 'front-runner' countries in the EU and the economic viability criterion of the Green Deal, for example, was adapted from Germany's policy culture and thermal retrofit regulations [64, 65]. The architectural features of Germany's mass housing,

however, are very different from the UK, especially in cities like Cambridge that has a diverse existing housing stock and uniform residential streets, even when they are not protected under conservation requirements. The research reported in this paper suggests that it would be worth investigating why in Britain this policy approach has had limited success. At least in cities like Cambridge, this could be due to the housing stock's widely perceived heritage value and homeowners' reluctance, sometimes nostalgically, to intervene with it.

The interviews indicate potential conflicts between energy and heritage values that need to be addressed in local policy. This is not to speculate, of course, on whether the perceived heritage value of properties has a greater or lesser influence on retrofit decisions than other relevant issues. Nevertheless, this tension may increase in the future, as the introduction of the Green Deal Communities Fund in Cambridge has seen a boost of Green Deal applications. The Fund promotes solid wall insulation that can radically change the look of a building, and if a building not listed nor in a conservation area, the external insulation is considered as a 'permitted development'. Even if a retrofit project would require planning permission, a local civil servant has no official guidelines as to whether to prioritise heritage or energy values, leaving local authorities to make subjective decisions based on their own knowledge and values [66].

Examples from Germany suggest that if homeowners' concerns are not addressed, a retrofit policy can backlash with public opinion against thermal insulation. Although the paper by Galvin and Sunikka-Blank [64] appear to contain the only existing peer-reviewed investigation of this, evidence of backlash in Germany is growing. In addition to Stadtbild Berlin's anti-insulation rhetoric (see Section 1), German television documentaries have recently put the case against insulation [67] and

prominent state-level officials such as Scheppelmann [68] publically discredit insulation in the Internet and in public forums. The German architectural magazine *Deutsches Architektenblatt* (dabonline.de) publishes highly critical articles on thermal insulation, one even comparing the insulation of traditional façades throughout Germany to a second holocaust [69]. A search on google.de (the German Google site) gives 22,300 occurrences of the negatively perceived word '*Dämmwahn*' (insulation craziness). Not all these comment on heritage issues, but there appears to be a convergence of anti-insulation rhetoric around the themes of heritage, mould problems, misleading claims as to the level of energy savings, and technical problems. Other studies have identified the need for policy initiatives that go beyond regulation and incentivising, engaging instead with 'the specific peculiarities and situations homeowners face' [70] in order to make retrofitting more accessible and appropriate for a specific household's dwelling and situation. Similar points are made in Risholt and Berker [71] and Stieß and Dunkelberg [72].

It has been argued that non-energy benefits like comfort can create a much vaster market penetration than selling based on energy benefits alone [73]. The tension between building preservation and the need for thermal comfort has been recognised as one of the biggest challenges in balancing retrofits with heritage values [14]. It is worth noting that among the interviewees for this study, a lack of thermal comfort was what initiated a retrofit in most cases, regardless of the general building characteristics.

It was suggested by citizens' initiative leader Ingrid (interview B) that there seems to be a group of homeowners in Cambridge who tend to go for a Passivhaus retrofit as it gives a clear label, a kind of brand to their house, and can increase the resale value. Similarly, at the local level there may be potential to develop an alternative retrofit

policy stream where a homeowner could have an energy and thermal comfort assessment from a special heritage advisor (a ‘warm heritage’ label), prioritising architectural characteristics of the building, even if the suggested measures to improve thermal comfort and reduce energy use are sub-optimal. A heritage advisor would also be able to consult a homeowner on likely planning restrictions.

5. Conclusions and policy implications

Based on semi-structured interviews of middle-income Cambridge homeowners who had recently retrofitted their property, this study explored how their views on aesthetics and heritage affected how they thermally retrofitted their homes. While there is a general assumption in retrofit literature that officially sanctioned heritage should be protected (‘heritage by designation’), no structured arguments have previously been offered, in relation to retrofitting homes, as to what heritage is in this context and how this intersects with subjective aesthetic values (‘heritage by appropriation’).

The literature reviews in section 2.1 suggests that homeowner aspirations for the heritage value of their houses are of fundamental importance to a broad and balanced understanding of sustainability, which includes the social as well as the environmental dimension. These aesthetic aspirations should be protected alongside aspirations to protect the environment by thermally retrofitting the housing stock.

The analysis of the interview transcripts indicates that the internal logic of homeowners’ heritage and aesthetic values, even within the same city like Cambridge, is not easy to predict. Interviewees, who mainly represent middle-income professional couples, repeatedly use definitions such as beauty, tradition and nostalgia, and these terms carry a significant depth of meaning for them. There does not seem to be a

shared concept of “good taste” amongst the interviewees, although there could be some convergence. For example, regardless of whether interviewed homeowners’ found a feature (such as external brick façades) beautiful or not, there was reluctance to change it if this would make their house “stand out” in the street. Sometimes aesthetic values are identified with heritage, but not always. There was a recognisable trend of nostalgia among these interviewees, but this could sometimes be satisfied with replicas. The interviews also suggest a need for incremental, less intrusive retrofit measures rather than a ‘deep retrofit’ approach where a household is expected to do a complete thermal retrofit all at once.

Further, even if the features homeowners’ saw worth as preserving varied widely, their concern for preserving building characteristics greatly affected their thermal retrofit strategies in ways that could compromise energy saving or economic efficiency, regardless whether the property was Victorian, a 1930s semi-detached house or a 1960s townhouse with plain facades. For example, retrofits may stall in their later stages because there are no examples of how to balance heritage values (façade of locally made bricks) against concerns for thermal comfort or energy saving. Homeowners are often seen as irrational actors from a policy point of view but the interviews suggest that in reality, at least in this sample group and in similar demographic and physical areas, the decision-making criteria behind a retrofit may be influenced at least as much by aesthetic choices as economic (or environmental) aspirations. There is logic behind the interviewed homeowners’ decision-making, but it is not necessarily economically ‘rational’.

The interviews suggest there are potential conflicts between energy and heritage values in thermal retrofits in Cambridge, including in buildings that do not have specifically designated architectural value but have period characteristics such as bay

windows, cornices or local materials. This may intensify with new measures such as the local Green Deal Communities Fund, but amidst a lack of structured public discussion homeowners are left to seek to balance competing aspirations: thermal comfort and energy saving, against preservation of building characteristics. If local policy fails to recognise the concerns of homeowners, the policy could backlash with public opinion against thermal insulation.

It may be that distinctive socioeconomic and attitudinal characteristic of the particular target population in this study are correlated with particular sets of attitudes to and awareness of energy issues. A different type of research undertaking would be needed to compare this group's attitudes and knowledge with that of other groups, and this may be a useful avenue for subsequent research. Nevertheless, the study suggests that issues like homeowners' familiarity with their property may be relevant to a wider sample group in the UK and it is worth investigating whether concern for the tradition and heritage embodied in the UK housing stock can be one reason the simple, optimised efficiency approach of the current policy does not always engage homeowners in retrofitting.

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Interview label	Alias	Household / interviewee characteristics	Position or role	Property characteristics / organisation details
A	Rod	Middle-aged male, professional, living as a couple, no children	Homeowner	A 3-storey Victorian semi-detached house, internally insulated brick
A	Iris	Middle aged female, self-employed professional, living as a couple, no children	Homeowner	facades with bay windows and period details, new roof, double glazed windows, a contemporary bay window and a garden side extension, located by a busy thoroughfare road
B	Ingrid	Middle aged female, self-employed professional	CCF leader	Cambridge Carbon Footprint is an environmental charity, in charge of organizing the Cambridge Eco Homes event
C	Gail	Middle aged female, self-employed professional	CT leader	Transition Cambridge is a federation of volunteer groups

				working on practical projects and the increase of awareness on carbon reduction
D	Lydia	Middle aged female, self-employed professional	Architect	Local architectural practice specialised in domestic retrofits and extensions
E	Alan	Middle aged male, professional, partner absent at time of interview	Homeowner	A 1930s semi-detached house with external insulation on featureless brick facades, floor and loft insulation modernised windows and doors
F	Oliver	Middle-aged male, self-employed professional, living as a couple with one child with special needs	Homeowner	A 2-storey 1930s semi detached house with a garden side extension, insulated loft and cavity walls (entitled to a subsidy), almost featureless brick facades, located in a uniform residential street with similar houses
F	Annette	Middle-aged female, self-employed professional, living as a couple with one child with special needs	Homeowner	
G	Christopher	Middle-aged	Homeowner	A 2-storey

		male, professional, living alone during the week and as a couple during weekends		1930s semi-detached house, brick facades with external insulation excluding the front façade
G	Linda	Middle-aged female, professional, living in the house during weekends	Partner of homeowner	with bay, insulated floor, double glazing, solar panels on the roof, located in a residential street with similar properties
H	Erica	Middle aged female, self-employed professional	Architect	Local architectural practice specialised in domestic retrofits and extensions
I	Laurence	Middle aged male, retired professional, living as couple without children	Homeowner	A 1960s 3-story end of terrace house with plain, externally insulated
I	Yolande	Middle aged female, self-employed professional, no children	Homeowner	façades (with the exception of brick pillars) with white render, large windows with double glazing, located in a residential street with a variety of building types

J	Bob	Middle aged male, professional, living as a couple with children	Homeowner	A 1930s semi detached house, brick facades with internal insulation, a garden side extension and a side extension that acts as a thermal buffer, bay windows with double glazing, located in a busy residential street with similar properties
J	Alice	Middle-aged female, professional, living as a couple with children	Homeowner	
K	Terrence	Middle aged male, academic, living as a couple without children	Homeowner	Two 1930s 2-storey semi-detached houses joined together, with some internal insulation, Cambridge white brick facades, located in a quiet residential street with similar properties
K	Ellen	Middle-aged, professional, living as a couple without children	Homeowner	

Table 1. Household and property characteristics of the interviewees