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Citation: Hipwood, Tara (2022) Adapting owner-occupied dwellings in the UK: lessons for the future. *Buildings & Cities*, 3 (1). pp. 297-315. ISSN 2632-6655

Published by: Ubiquity Press

URL: <https://doi.org/10.5334/bc.186> <<https://doi.org/10.5334/bc.186>>

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# Adapting owner-occupied dwellings in the UK: lessons for the future

TARA HIPWOOD

## ABSTRACT

With 80% of the 2050 housing stock already built, the UK has at least 19 million existing homes in need of low carbon retrofit. Practice–theory-based studies have argued that these retrofits must be understood in the context of wider home adaptations and routine practices of dwelling. Therefore, changes in practices caused by the Covid-19 pandemic create a gap in the knowledge regarding the impact on home adaptations and integration of low carbon retrofit. This research compares two stages of interviews: the first undertaken in 2015–16 (30 households), investigating home adaptations and the practices of dwelling they supported. The second stage undertaken in summer 2021 (nine re-interviewees) asking participants to reflect on how their practices of dwelling had changed and how their homes had accommodated this. Rigorous line-by-line coding of the relationships between attributes of the home and practices of dwelling allows comparison between stages, offering original practice–theory-based insights into the implications for home adaptations. The findings show that practices of homeworking in particular placed great spatial and environmental pressure on the homes of growing families. If continued, these practices would create increased demand for dedicated workspaces, and significant opportunities to integrate fabric improvements and low carbon technologies into these adaptations.

## PRACTICE RELEVANCE

Long-term adoption of home-working practices could trigger home adaptations among households of growing families. Analysis of pre-pandemic adaptations to support homeworking suggests, first, this is likely to manifest in loft conversions; and second, these present a significant opportunity to integrate renewable energy in the form of solar panels. Furthermore, higher rates of homeworking have facilitated a stronger appreciation by owner-occupiers of the benefits of energy efficiency measures in creating normative standards of comfort that support practices of dwelling. These findings are significant for practice because they identify the opportunity that home adaptations to accommodate altered practices of dwelling present to integrate low carbon retrofit technologies into these homes. This will require action from policymakers and industry to increase practical understandings of these technologies among owner-occupiers; increase the availability of specialist installers; and implement appropriate regulations and financial procedures to support the integration of low carbon technologies into practices of home adaptation.

SPECIAL COLLECTION:  
HOUSING ADAPTABILITY

RESEARCH

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## KEYWORDS:

adaptation; Covid-19;  
energy efficiency; flexibility;  
homeworking; housing; owner-  
occupiers; retrofit; working from  
home; UK

## TO CITE THIS ARTICLE:

Hipwood, T. (2022). Adapting  
owner-occupied dwellings in  
the UK: lessons for the future.  
*Buildings and Cities*, 3(1),  
pp. 297–315. DOI: [https://doi.  
org/10.5334/bc.186](https://doi.org/10.5334/bc.186)

## 1. INTRODUCTION

Housing in the UK contributes 28.9% to national energy consumption (BEIS 2018), and at least 80% of the 2050 housing stock is already built (Boardman *et al.* 2005). Consequently, adapting the existing housing stock to become more energy efficient and introducing low carbon forms of energy will play a significant role in reducing UK CO<sub>2</sub> emissions. However, despite the significant spending power of many owner-occupiers (Swan *et al.* 2013), measures designed to encourage them to make their homes more energy efficient, such as financial incentives, and Energy Performance Certificates, have had limited success (Baumhof *et al.* 2018). Instead, there is growing understanding that low carbon retrofit must be incorporated into more mainstream housing adaptations (Haines & Mitchell 2014; Wilson *et al.* 2015).

Practice–theory-based studies of home adaptations have questioned the assumptions of rational choice on which many schemes designed to encourage low carbon retrofit are based (Bartiaux *et al.* 2014; Maller *et al.* 2012). These studies argue that home adaptations can instead be understood as emerging from routine practices of dwelling. However, since the UK went into ‘lockdown’ on 23 March 2020 (Public Health, England 2020), in response to the global Covid-19 pandemic, practices of dwelling have been significantly altered. Therefore, this research seeks to address the emerging research gap questioning the impact this will have on future home adaptations.

Adopting an interpretivist approach that seeks to understand housing adaptations from the perspective of the occupants, this research was undertaken in two stages:

- Stage 1 (2015–16) adds to our understanding of common adaptations before the pandemic; how low carbon retrofit measures are incorporated within them; when they are undertaken; and what practices of dwelling these changes to the fabric of the home support.
- Stage 2 (2021) explores how practices of dwelling have changed during the pandemic; how the material fabric of the home supported or challenged these changes; and what the implications might be for future home adaptations.

## 2. LITERATURE REVIEW

### 2.1 A PRACTICE–THEORY UNDERSTANDING OF HOME ADAPTATIONS

Practice theories advocate that rather than abstract signs and symbols, ‘doings’ should be at the centre of analysing the social (Schatzki *et al.* 2001). This also implies a shift away from the study of conspicuous consumption and abstract ideas towards routine consumption and everyday activities (Gram-Hanssen 2010). Theorists propose varying interpretations of the elements that practices comprise (as outlined in Table 1). However, each of these interpretations broadly includes components of *understanding*, *rules* and an *affective* component. Furthermore, all these variations systematically take *materiality* into account as part of social theory, either as a component of practice itself or, in Schatzki’s (2010) case, as ‘material arrangements’ that interconnect with practices to form the practice–arrangement nexuses that comprise social life. It is through the regular performance of a practice, and consequent reinforcement or severing of links between these components, that the practice is maintained or changed (Shove & Pantzar 2005).

It is the material component of practice–theory that is the focus of this research. As discussed by Schatzki (2010), material objects can be altered by practice:

technological objects are either alterations of natural things, transformations of natural things into artifacts, or reworkings of artifacts already derived from nature.

However, the material world also shapes practice: from physical and biological entities such as viruses, to the:

way physical composition affects the course of practices [is] by rendering combinations and sequences of action physically impossible, physically easier or harder, physically painful or pleasing [...].

(137)

THEORIST					
	SCHATZKI (1996)	GRAM-HANSEN (2009)	WARDE (2005)	SHOVE & PANTZAR (2005)	RECKWITZ (2002)
'Understanding' component	Practical understanding	Know-how and embodied habits	Understandings	Competences	Body Mind The agent Structure/ process
'Rules' component	Rules	Institutionalised knowledge	Procedures		Knowledge discourse/ language
'Affective' component	Teleo-affective structures	Engagement	Engagement	Meanings	
'Material' component		Technologies	Items of consumption	Products	Things

**Table 1:** Variations on the components considered to comprise practices, as described by different theorists.

Note: Adapted from Gram-Hanssen (2009).

Schatzki goes on to describe how material arrangements may influence the longevity of practice, and once again the reverse is also true, with practices prefiguring the longevity of material arrangements. Attempts to understand building adaptation are often rooted in Brand's (1994) classification of a building into six layers, each with differing degrees of longevity, from site (which he described as 'eternal'), through structure, skin, services, space plan and stuff (fixtures, fittings and furniture which are replaced rapidly in order to accommodate changing activities).

Several authors have sought to apply practice-theory to the study of home adaptations, either by conceptualising these adaptations as practices themselves or by seeking to understand them within the context of daily practices of dwelling (e.g. Bartiaux *et al.* 2014; Horne & Dalton 2014; Maller *et al.* 2012). The present author acknowledges that materiality forms just one component of practice-arrangement nexuses. However, the aim of this research is not to offer a detailed anatomy of each practice, but to focus on how a change in daily practices (perhaps brought about by changing meanings of family or changing rules regarding social distancing) may demand a change, or adaptation, to the attributes of the material arrangement of our homes. Furthermore, by understanding the practices of dwelling supported by common pre-pandemic home adaptations and comparing these with altered practices of dwelling resulting from the pandemic, this research elucidates *how* and *why* these practices could influence demand for home adaptations going forward.

## 2.2 COVID-19 AND ALTERED PRACTICES OF DWELLING

In April 2020, 40.1% of people in employment in the UK were undertaking some work at home as a direct result of the Covid-19 pandemic (ONS 2020). However, a survey of 1500 UK

homeowners aged 24–64 years carried out by RIBA (2020) found that spending more time at home had caused people to be less productive (6%), feel more stressed (11%), anxious (10%) and depressed (10%).

Studies examining attributes of the material environment that support homeworking identify the importance of access to digital facilities (Alonso *et al.* 2021; Cuerdo-Vilches *et al.* 2021) and having a dedicated workspace rather than a multipurpose space (Cuerdo-Vilches *et al.* 2021). Meanwhile, access to open space such as a garden or balcony was important to support occupant health and wellbeing during lockdown (Christner *et al.* 2021; Fristedt *et al.* 2021). Furthermore, studies have identified a range of environmental attributes that support homeworking and occupant health and wellbeing, sometimes also minimising the impact on energy consumption. These characteristics include adequate ventilation, noise insulation, temperature and lighting levels (Alonso *et al.* 2021; Cuerdo-Vilches *et al.* 2021).

The RIBA (2020) survey found that 79% of respondents identified at least one adaptation that they would like to make to the design of their home after lockdown. These adaptations are summarised in Table 2, which shows that improved environmental design features were most desired by respondents. While this large-scale, quantitative survey provides an understanding of current appetites for home adaptations, it does not elucidate how demand for these features arose, and if this represents a significant shift away from practices of home adaptation before the pandemic.

ADAPTATIONS	%
Reconfiguration of existing spaces	23%
Extending their home	20%
Change the open-plan design to create separate rooms	9%
Make home more open plan	14%
More environmental design features (e.g. natural daylight, energy efficiency and soundproofing)	40%
Flexible living (e.g. rooms that can easily be divided)	8%
Create an office space to support working from home	17%
Ability to accommodate an extended family, including parents, grandparents and grown-up children	7%
More personal space	12%

**Table 2:** Number of homeowners desiring adaptations.

Note: Based on data from RIBA (2020).

### 3. METHODS

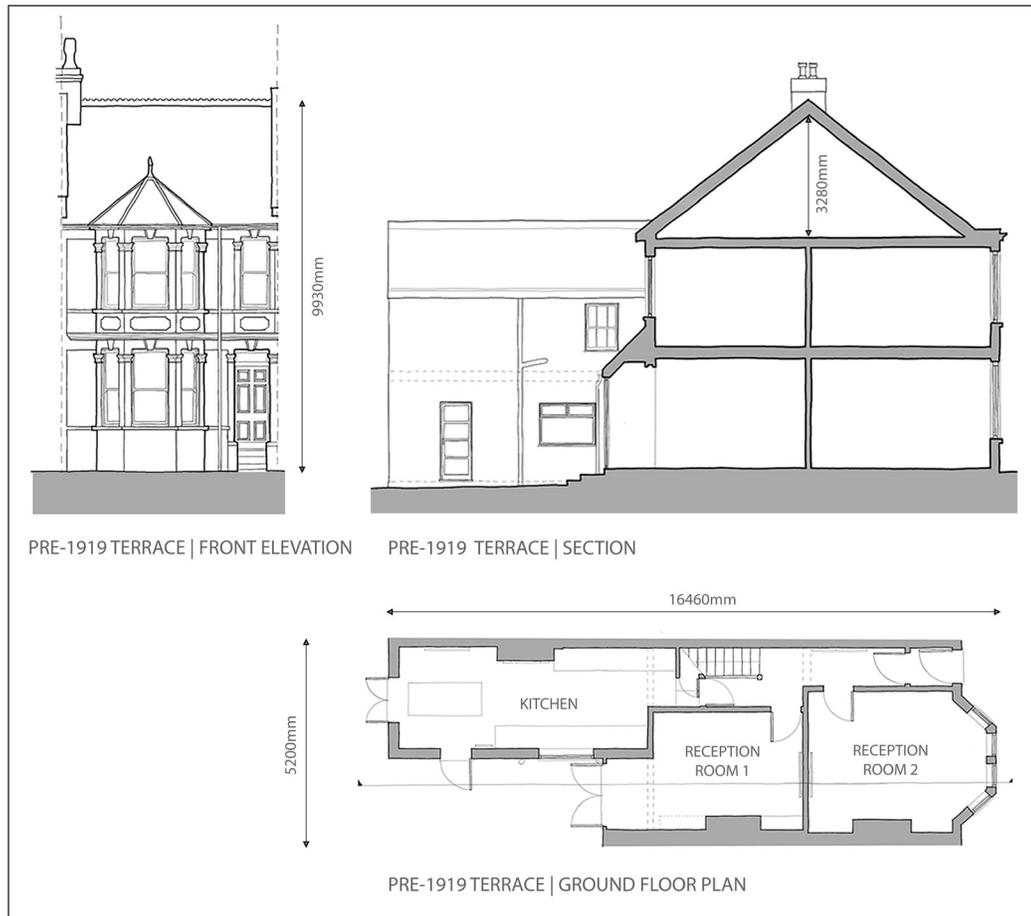
To facilitate a qualitative, interpretivist understanding of the changing practices of dwelling that gave rise to home adaptations, in-depth interviews and walk-through tours were undertaken with 30 owner-occupied households between September 2015 and July 2016. Follow-up interviews were then undertaken, online or by telephone, with nine of these households in July–September 2021. This qualitative research philosophy prioritises a contextual understanding of *meanings* from the participants’ point of view, rather than looking for explanations of *behaviours* that can be generalised to a wider population (Bryman 2008).

#### 3.1 SAMPLING STRATEGY

Households were invited to participate in the first round of interviews, based on a review of planning applications for home adaptations submitted to the wards of Bishopston, Henleaze and

Redland, to the north of the City of Bristol, UK. These wards were chosen based on their high levels of homeownership (ONS 2015) and home adaptation. The wards were also comprised of relatively homogenous housing stock, allowing the research to focus on two of the most common housing archetypes in need of low carbon retrofit in England: pre-1919 solid-wall properties, and cavity-wall properties dating from 1919 to 1944 (MHCLG 2020). An overview of these two typologies is provided in Figures 1 and 2, Tables 3 and 4.

### 3.1.1 Dwelling typology 1: pre-1919



**Figure 1:** Typical pre-1919 terraced property. Source: © Author.

CHARACTERISTIC	
Proportion of the English housing stock	20% (MHCLG 2020)
Housing type	Terraced
Construction	Solid wall
Decorative features	Bay windows, mouldings such as corbels, sills, pilasters and keystones to front facades. Decorative architraves, doorframes, skirting boards and ceiling roses to the interior

**Table 3:** Characteristics of typical pre-1919 housing.



**Figure 2:** Typical 1930s’ semi-detached property.

Source: © Author.

CHARACTERISTIC	
Proportion of the English housing stock	15% (MHCLG 2020)
Housing type	Semi-detached/detached
Construction	Cavity wall
Decorative features	Minimal

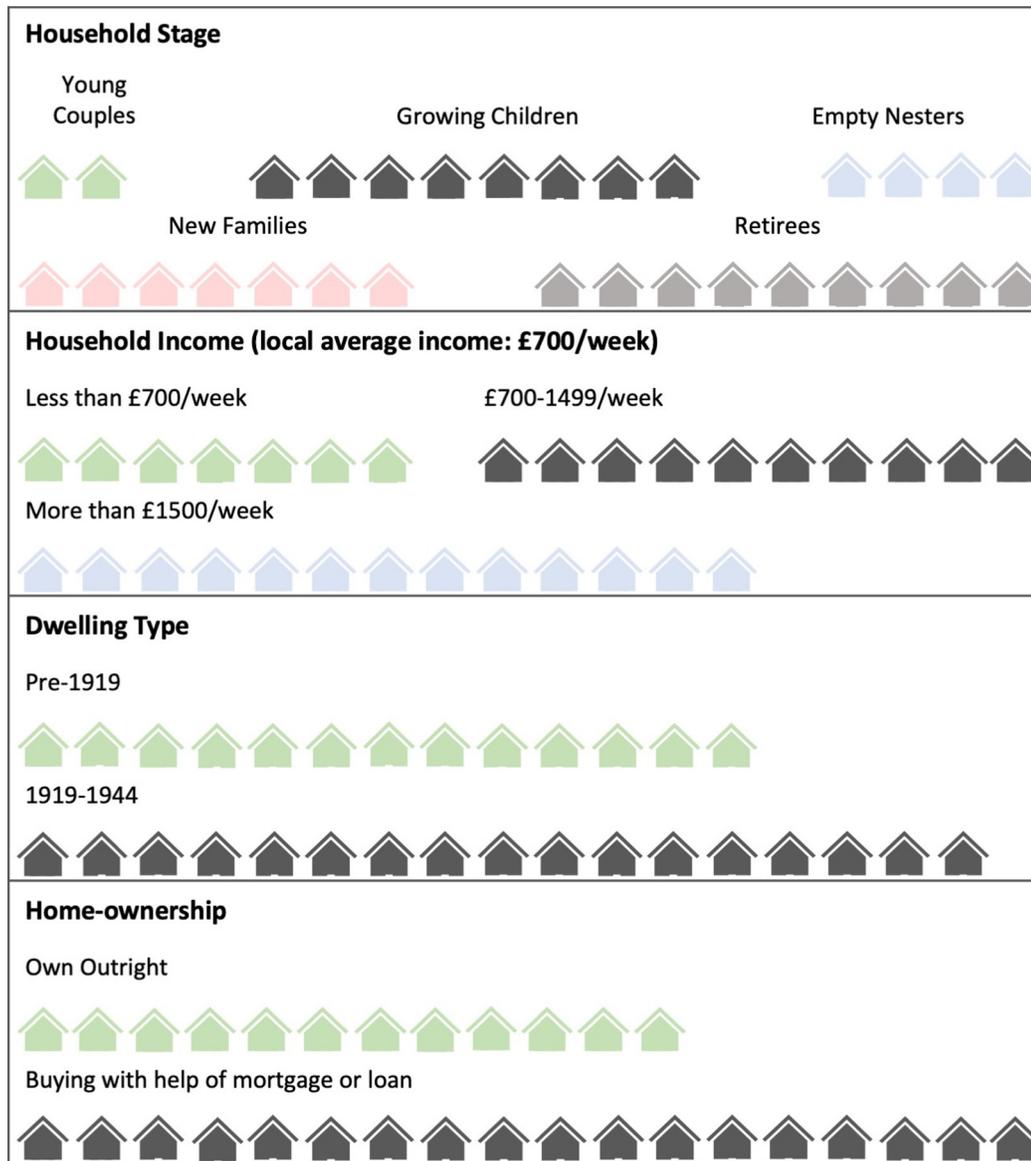
**Table 4:** Characteristics of typical 1919–44 housing.

### 3.2 PROFILE OF PARTICIPANTS

Through the review of planning applications, combined with spending time in the area to identify adaptations not subject to planning approval, a total of 325 households were identified and invited to participate. This resulted in interviews with participants from 30 households, whose characteristics are outlined in Figure 3.

By investigating those households who have the financial means to undertake significant home improvements, this research implicitly focuses on owner-occupiers of above-average affluence (Figure 3). Despite this, the proportion of interview participants owning their home outright, rather than subject to a mortgage, was 40%, compared with a national average of 48% (DECC 2013). This could be due to the sample’s focus on people who have recently undertaken significant home improvements, many of which may have been funded through extensions to mortgage agreements. Alternatively, this may be due to purposively sampling for a range of household stages, resulting in a relatively high proportion of younger owner-occupiers. Recruiting participants across a range of household stages was considered important as one of the most common factors that has been shown to influence home adaptations is household size (Plaut & Plaut 2010), or more accurately, changes in household size, associated with the lifecycle of the household (Baum

& Hassan 1999). Household stages used in the study were based on those adopted by the Energy Saving Trust (EST) in its *Trigger Points* (2011), but adapted to combine the categories ‘families with non-dependent children’ and ‘empty-nesters’ into a single group where non-dependent children no longer considered the family home to be their main residence. An additional group was also added to reflect the considerable home adaptations undertaken by individuals in retirement. The sample was dominated by heterosexual couples, and was almost entirely of white ethnicity and British nationality, with just two participants coming from other European countries. Nonetheless, despite the limitations of the sample with regards to family structures and ethnicities, the sample includes variation in household incomes, sizes and occupants’ life stages, ensuring diversity within the selected sample target and housing typology.



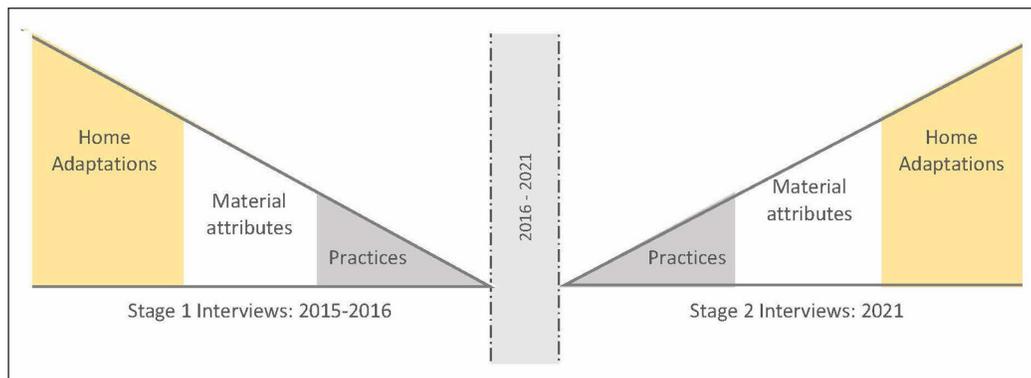
**Figure 3:** Profile of participating households.

### 3.3 RESEARCH METHODS

A laddered interview technique, developed by Gutman (1982), was adapted to explore the non-linear interconnections of practice-material arrangements. In this adapted version of the laddering technique, interviews begin by identifying the housing adaptations that had been undertaken. Taking one adaptation at a time, interviewees are then encouraged by the researcher to unpack and reflect on the material attributes of the home that were changed, and the practices that this change to the material attributes enabled. This technique provides an overall structure for the interview rather than a discrete set of questions, and where multiple adaptations have

been undertaken, or adaptations have resulted in multiple changes to the material attributes of the home, or material attributes have supported multiple new practices, the process is repeated several times during the interview. These interviews took place in the participant’s home and were complemented by a walk-through tour of the home which helped to place the material adaptations within the wider context of practices of dwelling.

These same participants were invited to take part in a second round of interviews, undertaken in July–September 2021, resulting in a further nine interviews, which were mostly online, but two were over the phone with participants who felt less comfortable with video-calling software. On this occasion, the methodology was reversed (Figure 4). The interviews began by discussing how practices of dwelling had changed as a result of the pandemic, before reflecting on what material attributes of the home had made it easier or harder to accommodate these altered practices. Finally, the interviews explored any adaptations to the material arrangement of the home prefigured by these changes to practices of dwelling.



**Figure 4:** Interview design over stages 1 and 2.

Interviews were the primary means of collecting data in this case due to the focus of the research questions, which concerns events that are episodic and require the reconstruction of previous actions. However, interviews are still reliant on self-reporting and, as observed by Nolan *et al.* (2008) and Christensen *et al.* (2014), participants often underestimate the effect of some influences on their actions or may not recall them. Furthermore, as a single interview was undertaken with each household, the findings may not account for differences in practices between different members of the same household. The ‘walk-through’ tours of the home were included to help overcome any interference the more ‘contrived’ nature of the interview creates. However, caution was exercised when interpreting these observations because not all observations may be representative of other times of the day or week.

### 3.4 RESEARCH ANALYSIS

The research analysis adopted many aspects of Charmaz’s (2006) Constructivist Grounded Theory Method (CGTM), aiming towards an inductive, interpretivist understanding of concepts emerging from the data. However, Charmaz contests the argument that an inductive approach is facilitated by delaying engagement with previous research until after data collection, stating that the researcher:

may enter it [the field] with a fresh mind—or not. You [the researcher] might enter the field with unexamined preconceptions about the topic that you have long held.

(59)

Therefore, while each interview was transcribed in full to avoid early elimination of data on the basis of the researcher’s assumptions or preconceptions, the first stage of coding (using the computer-aided qualitative data analysis software (CAQDAS) NVivo) involved coding chunks of text under the home adaptations being discussed, allowing this to be used as the unit of analysis. This was then followed by two main phases of grounded theory coding: an initial line-by-line phase of coding in which codes are kept short, precise and close to the data, followed by a more

focused, selective phase that consolidated the most frequent initial codes (Charmaz 2006). While some researchers consider the quantification of qualitative data negatively, this approach increases rigour by facilitating the triangulation of interview data with observation fieldnotes and by reducing the overuse of anecdotes. Category codes of *understandings*, intentions or *meanings*, and *material* attributes (all in their broadest sense) emerged from this consolidation of frequent codes. However, it was the extensive use of ‘relationships codes’ to record the interconnected relationships between these that indicated practice–theory would offer an appropriate and insightful interpretation of the data.

## 4. RESULTS AND DISCUSSION

### 4.1 PRE-PANDEMIC HOME ADAPTATIONS

The length of participants’ occupancy in their current homes ranged significantly from one to 40 years, and as shown in Figure 5, typically spanned at least two stages in the lifecycle of the household. This demonstrates that despite high levels of residential mobility among participants, there remains a need for homes to accommodate multiple stages of the household lifecycle.

#### 4.1.1 Adaptations

Analysis of the interview data identified five common types of home adaptations among the 30 households (Figure 5), with the most common being extensions ( $n = 19$ ) followed by fabric improvements such as new windows or insulation (17), reconfiguration of existing spaces (14), installation of renewable energy (13) and finally loft conversions (9).

Both extensions and the reconfiguration of internal spaces (e.g. adding or removing internal partitions to change the layout of the home) occurred at all stages of the household lifecycle, and were one of the most disruptive adaptations requiring changes to each of Brand’s (1994) six layers of the building fabric. Meanwhile, loft conversions, requiring alterations to space layout, services and skin (though with minimal structural intervention), occurred almost exclusively in the homes of new and growing families. More than a third of these loft conversions were accompanied by the installation of solar panels (either solar thermal or photovoltaic—PV). One participant from household 5 described how once the scaffolding was in place due to the loft conversion, the additional cost and disruption of installing solar PV was relatively minor:

A chunk of the cost of installing panels is the scaffolding and all of that sort of thing and it was a case of that’s all going to be up there anyway.

(household 5)

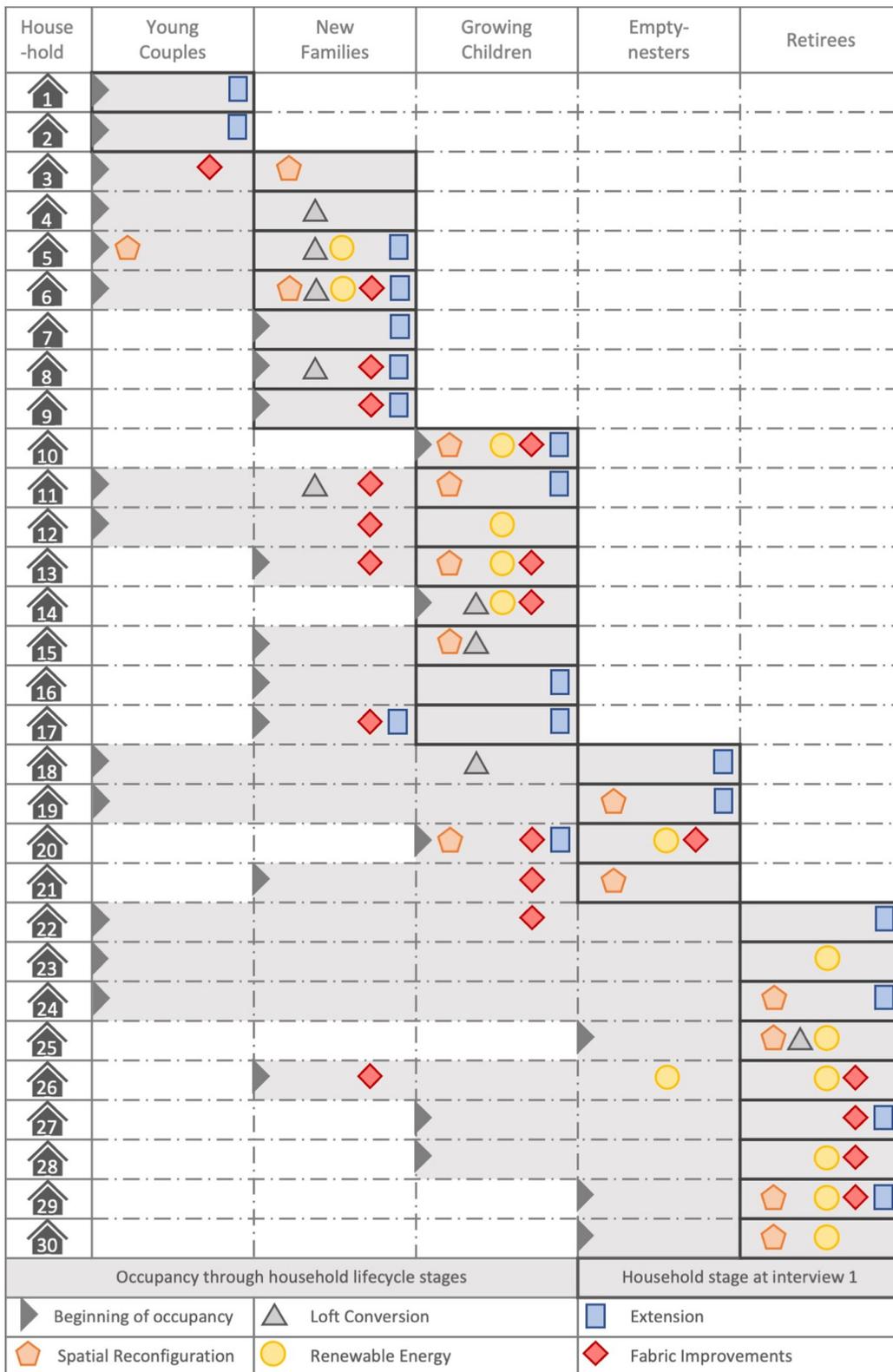
Fabric improvements were also common among new families and those with growing children, but usually limited to new windows (12 households) and loft insulation (14 households). While only five households had installed more expensive fabric improvements requiring a significant change to the building ‘skin’ (Brand 1994) such as external wall insulation (EWI), a similar phenomenon of installing solar panels at the same time, while scaffolding was in place, was described by participants.

#### 4.1.2 Material attributes of the home

Loft conversions were common adaptations to the material arrangement of homes occupied by young or growing families, providing additional bedrooms, as previously identified by the EST (2011) and described by one participant:

straight away, we thought right [...] we need to get the boys some bedrooms at some point, it’s going to take however long to build them. So, we kind of need to get going with that really.

(household 4)



**Figure 5:** Participants' adaptations by household stage, 2015–16.

Meanwhile, improvements to the fabric of the dwelling, such as new windows or loft insulation, were commonly associated with attributes of efficiency, and normative teleologies of improved thermal comfort (13 households), as documented widely in existing research (including Klockner & Nayum 2016; Wilson *et al.* 2015). The most common challenge to these adaptations was where the existing material arrangements of the home were also strongly associated with concepts of heritage and desired aesthetics as shown previously (*e.g.* Crockford 2014; Sunikka-Blank & Galvin 2016). For example, in pre-1919 solid-wall properties where period features such as ‘all the architraving

and so on would be destroyed' (household 12) by installing internal wall insulation, or where the external appearance of the dwelling would be changed by installing external wall insulation or more efficient windows. In contrast, the teleologies associated with solar panels, which were more commonly adopted in older households, were those of environmental responsibility, as previously shown by Stieß & Dunkelberg (2012) and Christensen *et al.* (2014), as well as financial security by reducing future running costs (Galvin 2012; Stieß & Dunkelberg 2012). The disruption associated with renewables was seen to be significantly lower:

The solar panels took all of two hours to fix and it was like 'woah', this is quick. And there was a bit more linking up the electrics inside but that didn't take ages [...].

(household 28)

A total of 21 out of 24 extensions or reconfigurations of existing spaces had created a large open-plan, multifunctional, kitchen-dining-living space, illustrating the open-plan living identified as desirable by the RIBA (2020) survey, was prevalent already before the pandemic. At the smaller end of the scale, this might be limited to removing an internal partition; however, where financial and planning procedures allowed, extensions increased the size of these multifunctional spaces further. Important attributes of these spaces, as described by participants, included good levels of thermal comfort, natural light and, in some projects, a separate utility room (17 households) and more accessible bathroom or toilet (11 households). In nine households, extensions pre-dating the current occupants of the properties, described by participants as 'narrow and dark' and 'a waste of space', were demolished to make way for these extensions. The relationship of these spaces to the garden, incorporating large areas of glazing looking out, was cited by 11 households as a beneficial attribute:

when you can't have the doors open, you can still have the outside feeling. It feels like the garden comes in even when the doors are shut.

(household 16)

Several households described the thermal comfort afforded by these extensions as inadequate, with some south-facing examples prone to overheating, while their north-facing counterparts did not meet normative expectations of warmth. This is perhaps unsurprising, given that in responding to the existing dwelling, which was a mirror image of the properties on the other side of street, this logic was extended into extensions to the home, with similar amounts of glazing applied to the rear of extensions of both orientations. As such, the physical-material arrangement of the home is adapted to support practices of dwelling and the normative teleologies of thermal comfort associated with this, but this does not take sufficient account of the wider physical and biological landscape (Schatzki 2010), or 'eternal' layer of the site (Brand 1994).

#### 4.1.3 Practices of dwelling

While loft conversions occurred most commonly in households with growing families, many of the homes already had sufficient bedrooms for all members of the household. The need for additional rooms arose from the daily practices of accommodating this growing family occurring concurrently with practices of hospitality that required a guest bedroom (see household 15 below) and/or practices of homeworking that necessitated a home office (see household 11 below), as previously discussed by UKERC (2013).

we've got three bedrooms anyway and we've only got two children so there was enough space for everybody to have a bedroom but we just wanted, basically we wanted a study, we wanted a spare room.

(household 15)

my husband works from home too, but he's up in the loft. He doesn't like to work down here, he likes to be completely out of the way and stuff, because he's on the phone a lot.

(household 11)

The large, open-plan kitchen–dining–living spaces created by reconfiguring or extending the existing space were by their nature multifunctional and associated with a broader range of practices, often taking place simultaneously. In the case of new and growing families this often referred to supervising homework while cooking. For young couples, empty nesters and retirees, this referred to concurrently entertaining, as previously described by Horne & Dalton (2014) and Maller *et al.* (2012), while also preparing meals. These adaptations demonstrate how changes in normative practices of entertaining can prefigure the material arrangement of even the structure ‘layer’ (Brand 1994) of the home, considered to have longevity.

The inclusion of wet rooms and toilets into these projects was often accompanied by an upgrading of the boiler in order meet the increased demand for hot water. In older households, increased levels of natural light in these spaces were seen as necessary to support hobbies such as painting, sewing, lacemaking and reading. Fabric improvements such as insulation or new windows, and renewable energy were not regularly associated with specific practices of daily life, with the exception of a small number of retired households. For them, these measures adapted the material arrangement of the home to provide normative teleologies of comfort that underpinned more sedentary practices of dwelling, such as working at the computer or watching television. This limited integration into daily practices of the dwelling may be why incentive schemes designed to encourage the adoption of energy efficiency measures have been met with mixed success (Dowson *et al.* 2012; Hamilton *et al.* 2016).

#### 4.2 PANDEMIC ADAPTATIONS

The nine households who took part in stage 2 of the interviews in summer 2021 were representative of the later stages of a household lifecycle, as outlined in Figure 6. This may be in part down to the increased stress and pressure experienced by many younger households during homeworking (Jakubowski & Sitko-Dominik 2021; Tavares *et al.* 2020), but is also a function of the elapsed time between the two interviews. The sample for the second stage of research comprised of two households (10 and 12) that now contained older adolescents, two ‘empty-nester’ households whose children had all left home (with household 17 transitioning from a family with growing children to this group since the last interview), and five households where all occupants were now retired (with households 18 and 21 transitioning from empty-nesters to this group). All participants were living in the same properties as in 2015–16, and, with the exception of household 17, undertaking a spatial configuration to create an open-plan kitchen–dining–living space before the pandemic; further changes to the home were mainly limited to landscaping works to gardens (four households).

Household	Young Couples	New Families	Growing Children	Empty-nesters	Retirees
10			● ● ● ●		
12		◆	●		
17		◆ ●	●	●	
18			▲	●	■
19				●	■
21			◆	●	■
22			◆		■
25					● ▲ ●
30					● ●
Occupancy through household lifecycle stages				Change in Household Stage by Interview 2	
▶	▲		■		
●	●		◆		

Figure 6: Participants’ adaptations by household stage, 2021.

#### 4.2.1 Altered practices of dwelling

Unsurprisingly, all households reported spending more time at home, resulting in several changes to the practices that the home was required to accommodate. Five out of the nine participants had experience of working from home (household 21 worked from home briefly at the beginning of the pandemic before retiring). Both households with growing children had also experienced home-schooling, although children were old enough to study independently, and did so in their bedrooms. Household 12 had one daughter previously away at university who returned to the family home to continue studying after lectures were moved online.

Even those households who were not working from home described how a diverse range of hobbies, activities and gatherings were moved online, including Spanish lessons, choir practices, fitness classes, meetings for volunteer organisations and church services. More time at home also saw an increase in some offline social activities such as participation in local walking groups and more traditionally home-based hobbies such as gardening and sewing. Meanwhile, other previously common practices such as entertaining friends in the home, which many of the extensions and spatial reconfigurations previously accommodated, almost completely ceased in line with social distancing requirements.

#### 4.2.2 Material attributes of the home

When describing features or attributes of the home that supported or challenged practices of homeworking, households with experience of this cited the importance of digital facilities, including internet access (four households) and having a dedicated workspace (four households), supporting previous findings by [Alonso \*et al.\* \(2021\)](#) and [Cuerdo-Vilches \*et al.\* \(2021\)](#):

Just to be able to retreat from what has become increasingly work focused home, you know [...] with having the home as your place of work, it's finding a space within that home that is not touched by that.

(household 12)

While two-thirds of households stated that they felt fortunate to have had a lot of space and that this had been a benefit when spending so much time at home (as previously reported by [Jacques-Avino \*et al.\* 2020](#)), this was largely a function of the low levels of occupancy in households of empty-nesters and retirees. For growing families, with higher occupancy levels, and greater incidence of homeworking, identifying dedicated workspaces presented greater challenges:

the girls were holed up in their bedrooms, and then me and Katie [wife] were left to fight for this room. So, the tension revolved around what we would call our study [...] especially as most of my work is just quiet writing or work on the computer, but Katie is always on the phone, so she needs a quieter environment, and does create a lot more noise.

(household 12)

However, participants described how it was not just the amount of space they had, but also the subjective sense of space that made lockdown easier. While the multifunctional nature of open-plan kitchen-living-dining spaces was not considered a benefit when trying to work, and new rules and procedures concerning social distancing meant they were no longer used for entertaining, the 'openness' associated with these spaces, attributed to their size, access to natural light and connection to the garden, was still valued (five households). This supports previous findings regarding the importance of access to outside space on wellbeing ([Christner \*et al.\* 2021](#); [Fristedt \*et al.\* 2021](#)).

Finally, seven households described how at least one aspect of the environmental comfort afforded by the house had made it easier or harder to adapt to spending more time at home. Two households who had already undertaken improvements to the thermal fabric of their home (households 10 and 25) expressed renewed appreciation of the comfort their home afforded. Meanwhile, a further three households (17, 19 and 30) found the lack of thermal comfort afforded

by the material arrangement of the existing building fabric did not support working from home (Alonso *et al.* 2021; Cuerdo-Vilches *et al.* 2021; Jacques-Avino *et al.* 2020):

It was very hot yesterday afternoon. I'd have to just pick the laptop up and go downstairs if I was working in a full-time job at the moment [...].

(household 19)

Three households (10, 18 and 21) described how their homes afforded high rates of ventilation that facilitated practices of cooling and purging of pollutants, creating material environments associated with normative teleologies of thermal comfort (as previously reported by Alonso *et al.* 2021) and practical understandings of safety in the context of the pandemic. Meanwhile, two households (10 and 12) who had been working from home observed that they had become more aware of acoustic transfer between rooms in the home, and household 25 expressed appreciation for the acoustic comfort afforded by earlier home adaptations. These findings demonstrate a broader awareness of environmental comfort, in terms of both the number of households discussing it and the different aspects being considered, that illustrates the increased interest in environmental design features identified by RIBA (2020).

#### 4.2.3 Adaptations to the home

Given the temporary nature of social distancing rules, it is perhaps unsurprising that many of the adaptations to the material arrangement of the home to accommodate these altered practices were similarly impermanent. This included choreographing sequences of practices into which the existing material arrangement of the home could be integrated, e.g. by adjusting family mealtimes so that the kitchen could be used first as a workspace and then as a family space (household 10). Participants also described how adaptations were made to what Brand (1994) classifies as the material layers of the home with the least longevity, beginning with replacing 'stuff' to accommodate exercise equipment or furniture for homeworking (El-Husseiny 2021) or making changes to their internet provision (households 10, 12, 19 and 25). However, in addition to changes to furniture and digital facilities that echo the findings of previous studies, three participants also described how spending more time at home had led to works to the building envelope or 'skin' (Brand 1994). This could be repair and maintenance work to roofs, walls and windows that was instigated by spending more time at home, leading to an increased practical understanding of the condition of the home, and possibly changing normative teleologies regarding its state of repair:

This work was instigated largely because of COVID; looking around at the place we call home and realising, due to the extra time we were spending here, how shabby in places it looked and how many small repairs were needed. It seemed to be a pattern that was being replicated elsewhere—the builder said that after a quiet period in the first lock down many people were looking at their homes in a new light and he'd rarely been as busy.

(household 12)

For household 30, spending much more time at home due to restrictions on their ability to travel had resulted in them also getting financing approved to invest in external wall insulation (scheduled for installation in December 2021) that would improve the energy efficiency of the building:

I mean this is one of the reasons for the idea of cladding. [...] And we also got a bit conscious of burning wood, so we didn't like the wood burning stove because of pollution [...] we stopped that because we were worried about the air quality. So that means that the central heating is on more [...].

(household 30)

While this is only one case of a household where adaptations were already underway to improve the efficiency of their home, it is an example of how the increased demand for adaptations to improve sustainability, identified by RIBA (2020) and Monzón-Chavarrías *et al.* (2021), might manifest.

Adopting a practice–theory approach, this research used interviews to compare practices of dwelling facilitated by common pre-pandemic home adaptations (30 interviews), with altered practices of dwelling resulting from the Covid-19 pandemic (nine households). The research findings regarding the practices giving rise to pre-pandemic home adaptations support those of previous practice–theory studies of home adaptations (e.g. Horne & Dalton 2014; Maller *et al.* 2012; Wilson *et al.* 2015). However, the original contribution of this study lies in applying this understanding to determine the likely implications of the Covid-19 pandemic on future home adaptations, and low carbon retrofit particularly. Furthermore, the research complements existing large-scale studies quantifying the demand for home adaptations (e.g. RIBA 2020) through a process of rigorous qualitative analysis elucidating *how* and *why* these practices could influence demand for home adaptations going forward.

Pre-pandemic interviews revealed how loft conversions allowed growing families to maintain a dedicated workspace at home, a feature identified as important as the prevalence of homeworking increased during the pandemic (Cuerdo-Vilches *et al.* 2021; RIBA 2020). Higher densities of occupation and the need to accommodate working from home made adapting altered practices of working and dwelling more challenging for growing families than for empty-nesters and retirees. The temporary nature of social distancing rules led to equally impermanent adaptations to the choreography practices supported by the existing material arrangement of the home. However, should the prevalence of homeworking continue following the pandemic, these findings would suggest this would lead to an increased demand for loft conversions, especially among households with growing families.

The research findings suggest demand for environmental design features, as reported by RIBA (2020), has risen during the pandemic. Despite social distancing rules prohibiting the practices of entertaining closely associated with large kitchen–dining–living spaces, the high levels of natural light and access to the garden these spaces facilitated continued to be valued throughout the pandemic. While more efficient windows and loft insulation were common adaptations in the homes of young and growing families before the pandemic, they were linked to specific practices of dwelling such as watching television or working at the computer only by retired occupants. However, having spent more time at home during the pandemic, younger households discussed how their homes did not afford sufficient thermal and acoustic comfort, or ventilation to support practices of homeworking. This would indicate that increased homeworking could also cause an increased appetite for more extensive adaptations to improve environmental comfort.

The chains of action (Schatzki 2010) through which adaptations to the material arrangement of the home prefigure one another are also illustrated in these findings. For example, the loft conversions that support practices of working from home temporarily create a material arrangement that renders the installation of roof-mounted solar panels physically easier. Therefore, an increase in loft conversions or remedial works to the building ‘skin’ (as described in Section 4.2.3), could lead to an increase in installations of solar energy in what is sometimes referred to as ‘piggybacking’ (UKERC 2013). However, a practice–theory conceptualisation of this phenomena implies that for this piggybacking to be successful, the material arrangement being piggybacked onto an existing adaptation must be engaged with normative teleologies and practical understandings that support practices of dwelling. In the case of less familiar technologies such as external wall insulation, these relationships may not be evident. As these practical understandings are constructed through practice in a process of enablement (Alkemeyer & Buschmann 2017), opportunities to engage with these technologies are essential to developing such understandings. Similarly, the proliferation of bathrooms within the home often prefigured the installation of new boilers to meet increased hot water demand. However, with the integration of new rules phasing out the installation of new natural gas boilers (HM Government 2021), this presents an opportunity to integrate low carbon technologies such as heat pumps into daily practices of heating and washing. However, as Schatzki (2010) acknowledges, human labour does play a role in drawing materiality into social life, and sufficient availability of actors familiar with practices of installing such technologies will be necessary to enable this.

These findings reinforce the importance of training skilled installers of low carbon retrofit technologies. However, they also highlight the need for more widespread practical understandings of, and affective relationships with, low carbon technologies. These cannot be acquired through information campaigns, but regular practices of engaging with these technologies (e.g. open-home events, exemplar installations in well-used public buildings or discourse with construction professionals) can create the opportunity for such relationships to form. Furthermore, changes to rules and financial procedures such as increased requirements for consequential improvements (HM Government 2018) and reduced value-added tax (VAT) for 'retrofit led renovations' or green mortgages (CLC 2020) will further support the integration of low carbon retrofit technologies into practices of home adaptation.

While this research provides rich, qualitative insights into this target group of owner-occupiers, these findings cannot be extrapolated to other populations or alternative dwelling typologies. Further research is needed to establish appropriate home adaptations in other housing typologies and the support required to implement them. Nonetheless, these findings suggest that among households with growing families and financial means, a long-term increase in practices of working from home could trigger a wave of home adaptations and associated opportunities to integrate low carbon retrofit measures into these homes. The significance of this research lies in identifying these households, as well as the need to support programmes and events to foster practical understandings of these technologies; to ensure the availability of professionals appropriately skilled in practices of installation; and to implement rules and procedures that support the integration of these technologies into home adaptation practices, if this opportunity is to be realised.

## ACKNOWLEDGEMENTS

The author would like to thank the participants who gave up their time to be interviewed for this research, as well the three reviewers for their very helpful comments, which greatly improved the paper.

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## COMPETING INTERESTS

The author has no competing interests to declare.

## DATA AVAILABILITY

Interview transcripts and fieldnotes cannot be made publicly available because these contain information that would compromise the research participants' right to anonymity and confidentiality.

## ETHICAL CONSENT

The first round of interviews was granted ethical approval by the Research Ethics Committee at the School of Geography and Planning, Cardiff University; and the second round by the Research Ethics Committee at the Department of Architecture and Built Environment, Northumbria University.

## FUNDING

Many thanks also to Cardiff University, which funded the first round of fieldwork.

Supplemental data for this article can be accessed at: <https://doi.org/10.5334/bc.186.s1>

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#### TO CITE THIS ARTICLE:

Hipwood, T. (2022). Adapting owner-occupied dwellings in the UK: lessons for the future. *Buildings and Cities*, 3(1), pp. 297–315. DOI: <https://doi.org/10.5334/bc.186>

**Submitted:** 11 October 2021

**Accepted:** 15 April 2022

**Published:** 11 May 2022

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