Original research article

Homes as machines: Exploring expert and public imaginaries of low carbon housing futures in the United Kingdom

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ABSTRACT

Low carbon housing policies embody visions of the future that shape and constrain current choices between different technological pathways. These socio-technical imaginaries include expectations around new ways of living and interacting with technology, with implications for everyday lives. This paper investigates existing expert visions of low carbon housing, and explores these futures with members of the public; utilising empirical data from policy documents, expert interviews and public focus groups. Two competing expert visions of low carbon housing were identified: Passivhaus and Smart Homes. Whilst portrayed as divergent futures, both visions aimed to 'design out' the role of occupants, achieving emissions reductions through changes to the built environment and maintaining current lifestyles; a position that was reinforced by an imagined public that was unable or unwilling to accept the need for lifestyle change. This construction of the public did not consider the complex personal and cultural dimensions that influenced public acceptability of future housing: specifically surrounding themes of comfort, control and security that arose within the focus groups. The tensions arising between expert and public imaginaries highlight the difficulties that may surround any transition towards a low carbon future and demonstrate the need to work with, rather than around, the public.

1. Introduction

Accounting for 23% of national carbon emissions [1] and 29% of total energy consumption [2], housing is a crucial site for achieving emissions reductions if the ambitious 80% target set out within the UK Climate Change Act 2008 is to be met. Due to the relative difficulty of achieving emissions reductions in other sectors (such as aviation), it is predicted that the domestic sector will need to reduce emissions to nearly zero by 2050 [3]. As such, radical demand reduction strategies will be required, in addition to the provision of low carbon energy. Over recent years, a range of approaches, policies and standards have aimed to reduce energy demand within the sector, through improving the energy efficiency of existing homes, increasing uptake of domestic renewable energy sources, or improving the sustainability of new build housing. Combining new technologies, social structures, institutions and discourses, these policies embody visions of a low carbon housing future; 'socio-technical imaginaries' that will shape and constrain future choices between different technology pathways [4].

Over the last decade, the precise vision of low carbon housing embedded within UK policy has shifted. The concept of a zero carbon house rose to prominence around 2006 with the Code for Sustainable Homes and Zero Carbon Homes Target, both advocating sustainable, carbon neutral housing that is highly energy efficient, makes use of renewable energy sources and is acceptable to eco-conscious consumers who would purchase them. However, by 2015, this vision of the future had fallen into disfavour, with national policy shifting towards energy security and affordability. Despite this, the urgency of the challenge to reduce carbon emissions from UK housing stocks remains unchanged. Beyond the material and technical challenge of reducing carbon emissions associated with housing, low carbon houses are also homes, where complex material and social elements interact (relating to both how the building is made and how it is used) to determine household energy use [5,6]. As such, low carbon housing imaginaries will include visions of new ways of living and interacting with technology, which have implications for everyday lives. The ways that scientists and experts imagine the future and users is known to

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have a significant influence on the material technology and design, the 'scripting' of user behaviour, and policy development [7–10].

The ways in which occupants are constructed as 'imagined publics' [11] will play a key role in the visions of a low carbon housing future held by housing and energy professionals and will be crucial in shaping the future of UK housing. As such, low carbon housing presents an ideal case study through which to explore visions of a low carbon future from a range of different perspectives. The first aim of this paper is to explore the socio-technical imaginaries of a low carbon housing future, paying particular attention to the links between these visions of the future and the imagined publics that inhabit them. In a novel addition to this approach, the paper also seeks to explore these expert derived visions of a low carbon housing future with members of the public themselves, investigating their acceptability alongside the values and concerns which shape their perceptions of these possible futures. Before considering such questions, we provide a discussion of the theoretical and empirical literature that informs this study, as well as an account of low carbon housing policy in the UK, exploring how visions of a low carbon housing future have developed within UK Government over the past 15 years.

2. Socio-technical imaginaries and imagined publics

Expectations and visions of potential futures are co-constructed from both social and technological dimensions; embodying innovative technologies, emerging industrial and institutional structures, and broader social and political discourses [12,13]. These visions shape technology, policy and society through dynamic processes that maintain and create socio-technical networks [13]. Termed 'socio-technical imaginaries', Jasanoff and Kim [4]:120 define these visions as 'collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technical projects, [which] at once describe attainable futures and prescribe futures that the state believe ought to be attained'. Reflecting normative prescriptions of what is socially and technically possible, desirable and morally right, imaginaries can be understood as performative; these imagined futures have power to shape both the present and the future when evoked and discussed [14].

Various studies have explored socio-technical imaginaries at different scales and in relation to different socio-technical systems *e.g.*, [15–17,14,18,9], demonstrating how they act to shape and constrain choices between different socio-technical pathways. Imaginaries are therefore not neutral and act as frames, or rhetorical tools, to include and exclude different rhetorical and material aspects of the debate and promote a specific vision of the future. As such they can be used to: guide and co-ordinate action; justify decision making and the inclusion of different actor in this process; and establish the need for political action [18]. A longstanding strand of Science and Technology Studies which explores the relationship between technological design and future users, highlights the way in which designers and engineers imagine users exerts performative function on the development pathways of technology, and 'scripts' user behaviour [7,8,19]. In addition, the ways in which publics are constructed within broader socio-technical imaginaries has also been shown to have a significant influence on policy development and material technology and design *e.g.*, [10,20,14,9].

Based on Maranta et al.'s [11] notion of 'imagined laypersons', describe how publics 'exist as imaginaries given agency and invoked for strategic purposes' [10]:932, assigned a presumed subjectivity within shared discourse that can be invoked during decision making that may frame continuing layperson-expert interactions. Barnett et al. [20] thus highlight the role of experts as 'layperson makers', whose perceived subjectivities shape the roles

and opportunities for public participation and engagement, with these conceptualisations of the public used to define and support the underlying normative rationales of these interactions. A recurring theme throughout such research has been the construction of the public (by professionals and scientists) as deficient in some way, in terms of their knowledge, skills, rationality or sense of environmental responsibility [21]. As such, they are often seen as a barrier to achieving technological potential; a view which has become tantamount to common sense in many professions [22]. Research into innovative nano- and bio- technologies, also demonstrates this othering of publics by scientists, who see them as ignorant and ill-informed [23,24]. As such, these imagined publics may actually have more influence than the 'real' publics they purportedly represent [10].

Together these approaches have been used to explore the expectations and visions of the future that are tied to sustainable technologies and the imagined publics that are embedded within them, including: renewable energy siting [10,25], solar panels [26], hydrogen fuel cells [27] and smart grids [28,18,29]. Skjølsvold's [14] research in Norway is of particular interest, demonstrating the importance of exploring the performativity of visions of the future retrospectively. The way in which the smart grid was imagined influenced policy development over the preceding 15 years; occurring first through stage-setting (encouraging debate and enrolling new actors) and second through acting as a regulative tool (establishing the need for political and technical change). Beyond this, imaginaries also acted through a more subtle process, leading to an evolution in the vision of what the smart grid was and could be in the future.

Two competing imaginaries of publics were identified within expert visions of the smart grid [28]. An active public that was engaged with new smart technologies was considered an essential component of demand management within the broader socio-technical imaginaries of the smart grid. Paradoxically, this vision of the economically and technically rational 'Resource Man', who will both benefit from and make possible this transition [30] was opposed (and eventually defeated) by an imagined public that was seen as irrational and deficient in knowledge. This contradiction eventually led to the development of a set of idealised rational publics through which to script the technology, effectively bypassing the public input that had originally been desired. This finding is echoed by research in other areas, where experts attempt to design out the role of the public through a combination of technical optimism and cultural pessimism [26]. How experts communicate on and engage with members of the public has thus also been seen to be dependent on imagined publics. Ballo [18] highlights how an almost utopian vision of the future smart grid led experts to cultivate a glossy vision of the technology within public messaging, omitting legitimate concerns and likely to alienate rather than enrol the public.

3. Case study: the rise and fall of low carbon housing futures in UK policy

This section retrospectively traces the transformation of low carbon housing imaginaries over the last 15 years. Prior to 2001, housing policy debates were largely silent on issues surrounding climate change and sustainability [31]. At this time, links between energy and housing policy focused heavily on fuel poverty and the energy efficiency of public sector housing developments. Whilst a sustainable housing movement had grown in the UK since the 1970s [32], the concept didn't arrive on the policy agenda until around 2003. In addition to the rising importance of climate change, which was fundamental to the development of low carbon housing policy, the EU Parliament (through the Energy Performance in