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Building a Green Economy? Sustainability Transitions in the UK Building Sector

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Introduction

This paper explores the recent shift in interest by policy makers to encourage and develop a green economy, with a particular focus on UK government attempts to engender a paradigm shift in the building and construction sector through mainstreaming green building methods and techniques (Greenwood, 2012). The building sector has been the focus of endeavours to engender a shift towards greener ways of working and building, due to its high contribution to greenhouse gas (GHG) emissions and associated concerns over enhanced global warming and climate change. The paper outlines the recent development of UK policy on green building as exemplified in legislation for the Code for Sustainable Homes and in Building Regulations. These have given rise to a set of responses to green building requirements favouring technological solutions that are readily accommodated by the existing building regime. In critiquing these developments we draw upon socio-technical sustainability transitions research, one strand of which has focused on the ways in which niche developments can challenge and disrupt existing regimes of practice. Our empirical focus is upon the niche green building sector outside the dominant building regime, involving in-depth interviews with a range of actors, including architects, building companies, materials suppliers and policy makers. Respondents from within this green building niche are critical of current UK legislation, and argue that its narrow conceptualisation fails to adequately encourage the mainstreaming of what they consider to be green building. From this case study evidence, we argue that despite attempts by government to engender a paradigm shift in the mainstream building regime, the relevant legislation is framed in ways that will not engender any substantial changes to that regime. Beyond a critique of UK policy, we contribute to debates within the sustainability transitions literature regarding how niche innovations interact with, and influence, the wider regime (Smith and Raven, 2012). We question the extent to which the process of diffusion from niche to mainstream in socio-technical transitions occurs in a linear and unproblematic fashion and the assumption that niche actors aim to change the regime (Hielscher et al., 2011). In addition, we explore a related question regarding the internal cohesiveness of niches. Thus despite general agreement on the shortcomings of policy, respondents had conflicting views on how green buildings should be defined, and on the best ways to implement these, indicating that socio-technical niches are less homogeneous than has previously been conceptualised and that these might be better conceived of as a set of nested sub-niches (Hodson and Marvin, 2010; Seyfang and Longhurst, 2012). The structure of the paper is as follows. In the next section we outline the growing interest in the green economy and its adoption in the form of a 'low carbon transition' in the UK. The following section examines the green building agenda in the UK and maps out the main legislative framework. We then present the theoretical framework by which we seek to understand the potential for a green building transition in the UK, drawing on the sustainability transitions literature. A subsequent section outlines the methods used for our empirical

study and in the final two sections and our conclusions we draw on this evidence to critique government policy and to develop our theoretical arguments.

The Green Economy

Although a concern for integrating economic development with environmental protection stretches back to the Brundtland Report (1987) and the Earth Summit in 1992 (and beyond), in practical terms the two have largely remained separate. It is only recently that Brundtland's call for integration between the two has given rise to the idea that a 'green economy' can be developed and become a mainstream economic development policy. For example, UNEP (2011: 16) defines the green economy as "low carbon, resource efficient, and socially inclusive [where] growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services." For many policy makers, the idea of developing such a green economy has become an attractive one. Although this is rarely made explicit, such views draw upon ideas from ecological modernisation – the concept that we can combine environmental improvements with forms of economic development that do not differ radically from the current mainstream. For the most part, more radical conceptualisations of what might constitute a 'green economy' remain marginal (Bina, 2013). Indeed, for many politicians and policy makers, new environmental technologies, new ways of working and 'greener' consumption offer the opportunity for a renewed round of capitalist accumulation (Stern, 2006). However, this is not to claim that these motivations for the green economy are purely economic. Developing a green economy is also seen as a means to address concerns over enhanced global warming, climatic change and sea level rise. In the process, however, the *green* economy has often become transformed into the narrower conceptualisation of a *low carbon* economy – where the aim is to reduce carbon emissions as part of attempts to stabilise carbon levels in the atmosphere (While et al., 2010). Thus national governments have promoted the development of a low carbon economy linked to targets for cutting national carbon emissions. For example, the Climate Change Act (2008) committed the UK to an 80% reduction in GHG emissions by 2050 over 1990 levels. In order to achieve this, the then Labour Government produced a Low Carbon Transition Plan, setting out a 'road map' by which different sectors would contribute to this reduction target (HM Government, 2009a). For homes and communities (i.e. domestic buildings) the Plan aimed to cut emissions by 29% over 2008 levels by 2050 (ibid). The government also produced a Low Carbon Industrial Strategy (HM Government, 2009b) outlining how the UK economy could shift towards low carbon development, producing both economic benefits and environmental improvement. One important sector that contributes substantially to the national emissions total, and where opportunities exist to reduce this contribution, is the building and construction sector, and governments have also sought to encourage a shift towards a green and low carbon building industry.

The Green Building Agenda

The development and promotion of green building in the UK has a history that dates back to the 1970s, with early developments frequently driven by individuals and informal organisations motivated by deep green views and a perception of a need for radical social

change[1] (Smith, 2007; Lovell, 2008). A key point is that these pioneers did not see green building as simply about low energy use and reduced environmental impact. Rather, these were part of a broader critique of society and its values at that time. Although many of the ideas and technologies developed by these pioneers have subsequently entered the mainstream, green building was largely confined to the margins for much of the 1970s and 1980s. From the late 1990s onwards, green building entered mainstream debates, albeit reframed as low energy, or low carbon building, through the UK Government's response to climate change and the need to reduce GHG emissions, as part of the Low Carbon Transition Plan. Green building became a focus of attention under the low carbon agenda because the built environment is a key source of carbon emissions – globally the UN estimates that the building sector is the single largest contributor to global GHG emissions (UNEP, 2011). In the UK, private domestic consumers are responsible for 30% of all final energy use in the UK (DTI, 2006) and buildings account for 40% of UK emissions (HM Government, 2009b). Any low carbon transition would therefore, of necessity, have to include a shift towards green building.

The UK policy response has come through the revision of national policies on domestic building standards. The previous UK Labour government argued that the construction sector needed to undergo a 'paradigm shift', rather than the incremental shifts that had so far been characteristic of the sector (HM Government, 2009b). As part of measures to achieve this, the then Labour government introduced the Code for Sustainable Homes in 2006, which was intended to provide a "single national standard to guide industry in the design and construction of sustainable homes. It is a means of driving continuous improvement, greater innovation and exemplary achievement in sustainable home building" (DCLG, 2006a: 4). This was intended to complement the system of Energy Performance Certificates subsequently introduced in 2007 under the European Union's Energy Performance of Buildings Directive (EPBD). The EPBD required that all new homes have an Energy Performance Certificate (EPC) providing information about the energy efficiency/carbon performance of the home. The Code for Sustainable Homes[2] took a new 'whole home' approach based around nine key design categories – energy/CO_2, pollution, water, health and well-being, materials, management, surface water run-off, ecology and waste. The Code used a rating system from 1-6 stars, where 1 is the lowest (or 'entry level') and 6 the highest, reflecting exemplary development, based on performance against these design categories. Under the Code, a Level 6 home is deemed a zero carbon home, defined as having "zero net emissions of carbon dioxide (CO_2) from all energy use in the home including heating, lighting, hot water and all other energy use" (Panagiotidou and Fuller, 2013: 197). While based on performance, the Code was not prescriptive in how builders should reach these levels in an attempt to encourage innovative responses and cost-effective solutions.

The Government also announced a commitment that all new homes in England would be zero carbon by 2016 and that all new non-residential buildings would be zero carbon by 2019 (Fischer and Guy, 2009). Such measures were aimed at meeting the EU's Energy

[1] For example, Brenda and Robert Vale who published their seminal work 'The Autonomous House' in 1975.
[2] The Code for Sustainable Homes dealt with domestic properties, while BREEAM is a similar mechanism specifically for non-domestic properties. The Code was voluntary for the private sector, but local authorities were given powers to set mandatory Code targets for social housing.

Performance of Buildings Directive (2010/31/EU) requirement for Nearly Zero Energy Building (NZEB). What the UK's zero carbon target meant in practice was less clear, with definitions of 'zero carbon' being contested by builders, architects and policy organisations (McLeod et al, 2012). Under some definitions, zero carbon could include on-site micro generation of electricity at the level of a development rather than an individual dwelling, which would still attain a high level Code rating (DCLG, 2007; Fischer and Guy, 2009). In addition, offsetting, i.e. compensating for emissions from a dwelling by low carbon power generation off-site, was not ruled out, albeit left to a later date for a decision. Moreover, although this had been raised as an important issue in the consultation process for the new regulatory framework, government decided not to include embodied carbon (i.e. that embedded within the building materials used in construction) in the definition (DCLG, 2007; McManus et al., 2010). Despite this, the 2016 zero carbon target was ambitious compared to past policy and represented an attempt to 'mainstream' what had so far largely been niche green building practices (Greenwood, 2012). Government also developed an institutional framework to support and encourage changing practice within the existing building regime though the 'Zero Carbon Hub'[3], a public-private partnership to guide and support the zero carbon programme and to engage relevant organisations, and the Technology Strategy Board's Low Impact Buildings Innovation Platform[4]. In total, the government saw the Code for Sustainable Homes and its zero carbon targets as an opportunity for the building industry to engage with innovative responses to building sustainable housing seen in niche developments and as a means for firms to gain market advantage over competitors (DCLG, 2006a). Ironically, given subsequent developments, it was also intended to give the market much greater regulatory certainty and thus underpin the proposed paradigm shift in the building industry. Government reports claimed that "the levels of performance for energy efficiency indicate the future direction of building regulations, bringing greater regulatory certainty for home builders, and acting as a guide to support effective business and investment planning" (DCLG, 2006a: 8) and that "driving forward an ambitious agenda of change with our house-building programme also allows us to lead an emerging market in environmental technologies, pushing innovation and driving costs down" (DCLG, 2006b: 10).

In 2013 the Conservative-Liberal Democrat coalition government undertook a Housing Standards Review Consultation (DCLG, 2013). As part of the Government's aims to simplify building standards and to get rid of 'red tape', both of which were supposedly hampering the industry, the Consultation proposed 'winding down' the Code for Sustainable Homes. At the same time, however, in the 2013 Budget announcement the government reaffirmed its commitment to implement zero carbon homes from 2016. A key element in this policy shift came through changes to Part L of the Building Regulations, concerned with energy performance targets for homes and other buildings, where such changes were intended to continue with the 'road map' towards zero carbon standards originally set out by the previous Labour administration. Part L sets the minimum level required in order to meet Building Regulations and deals with specific areas, whereas the Code encouraged the consideration of issues beyond energy consumption and a holistic, whole-building approach. Under Part L, developers are required to achieve energy performance targets set through a National Calculation Methodology and to demonstrate that their buildings will meet those

[3] http://www.zerocarbonhub.org/
[4] https://www.innovateuk.org/built-environment

targets (McManus et al., 2010). The targets are expressed in terms of a Target Emissions Rate (TER) in kilogrammes of carbon dioxide per metre square per year ($kgCO_2/m^2yr$) and an energy demand target in kilowatt-hours per metre square per year (kWh/m^2yr). The Government's consultation paper argued that these revisions to Building Regulations effectively made the Code redundant. Despite substantial criticism from those involved in developing the Code (see BRE, 2013), the outcome of the consultation exercise led to a Ministerial Statement[5] in 2014 that the Code would indeed be 'wound down' and energy efficiency standards incorporated into Building Regulations, although at the time of writing the exact transitional arrangements were not clear[6]. However, the Coalition government was not proposing that the green building agenda should be abandoned, simply that there are other, in their view, more efficient ways of achieving the same ends. On the face of it, therefore, it could be argued that the 1970s green building pioneers had been vindicated and their views were now about to become part of the mainstream building regime, rather than being seen as alternative and radical. From this perspective, it could be suggested that green building had thus moved from the margins of acceptability in the niche into a mainstay of government policy. However, as we will illustrate, in the process the drive to mainstream green building forms has been stripped of its more radical elements. Before critiquing these arguments in more depth, in the next section we discuss sustainability transitions theory as a means to conceptualise the apparent shift to green building.

Socio-technical Sustainability Transitions

In this paper we draw upon a body of work within social studies of technology concerned with the transformation of technological regimes, which emphasises the role of innovative technological niches in effecting socio-technical transitions (Smith, 2003; Geels, 2005; Grin et al., 2010). Within this literature on sustainability transitions, the multi-level perspective (MLP) aims to encapsulate, and distinguish between, the relationships linking niches, regimes and the overarching landscape (Rip and Kemp, 1998). Within the MLP, innovation *niches* (e.g. the green building sector) are defined as small-scale experimental and learning spaces for new technologies, comprising either a single experiment or project, or clusters of several experiments (Kemp et al., 1998), offering protection from mainstream conditions and functioning as test-beds for the emergence of new socio-technical constellations. Socio-technical *regimes* operate at the meso-level (e.g. the building and construction industry) forming relatively stable configurations of institutions, techniques and artefacts, as well as rules, practices and networks that determine the 'normal' development and use of technologies (Rip and Kemp, 1998; Berkhout et al., 2003). Regimes are seen as largely physically and socially inert (Bulkeley et al., 2010), leading to path dependency and lock-in (Berkhout, 2002; Unruh, 2002; Genus and Coles, 2008). Regimes and niches are set within the broader context of the socio-technical *landscape*, encompassing cultural norms, values and persistent socio-technical structures (Späth and Rohracher, 2010), representing longer-term influences on niche and regime actors (Seyfang and Haxeltine, 2012).[7] Each of these categories are "analytical rather than ontological" (Raven et al., 2010: 63), offering a

[5] https://www.gov.uk/government/publications/building-regulations-housing-standards-review
[6] http://www.architectsjournal.co.uk/news/its-official-government-to-scrap-code-for-sustainable-homes/8660376.article
[7] See Raven et al., (2010) for a discussion of the ways that the terms 'niche', 'regime' and 'landscape' are interpreted within the transitions literature.

heuristic for understanding socio-technical change. Taking an MLP approach sees transitions occurring as a result of interaction between innovation processes at the different levels. New socio-technical configurations that may have matured in specific niches offer potential solutions to problems in the regime, either by conforming to regime conditions, or more radically challenging and transforming regime practices (Berkhout et al., 2003; Smith and Raven, 2012). These tensions are a product of changing circumstances in the regime itself or the wider socio-technical landscape, acting as a driver for regime transitions, where factors such as the UK government's low carbon transition policies and Code for Sustainable Homes offer a challenge to incumbent technological regimes (Smith et al., 2010). Thus, landscape level changes may put pressure on the regime and, if the regime is destabilised, opportunities may open up for niche innovations to be mainstreamed (Schot and Geels, 2008). From a sustainability perspective, this potentially leads to a transition towards, in the context of this paper, green building becoming the socio-technical regime (Truffer, 2008; Scrase and Smith, 2009).

The question of whether niches can be actively encouraged or created through policy is an open question in transitions research (Greenwood, 2012). For some, "the stimulation of different niche-based innovations is intended to nurture sustainable alternatives to existing practices" (Sondeijker et al., 2006: 18). This has been taken furthest in attempts to manage transitions and to actively promote niche developments through strategic niche management, particularly in Dutch government policies for transition management (Rip and Kemp, 1998; Kemp et al., 1998; Kemp and Loorbach, 2006). Those niche actors less compatible with the existing regime may find it more difficult to break through into the mainstream, whereas some niche activities may be better aligned and more easily incorporated (Smith, 2003). In the latter case, actors in the current regime may borrow convenient aspects of niche activity, in the process losing the more radical and transformative aspects (Smith and Raven, 2012), as well as potentially changing the character of niches.

Perhaps not surprisingly, actors in the existing regime will tend to defend and extend the regime through incremental change and innovation (Scrase and Smith, 2009). While niches are important sources of innovation that may offer solutions for tensions in existing socio-technical regimes, adaptation or translation processes may be constrained by structures within the existing mainstream regime (Smith, 2006; Smith and Raven, 2012; Hargreaves et al., 2013). Indeed, it may be that existing socio-technical contexts close down spaces for alternative approaches (Shove, 1998). Thus, niche innovations "can only diffuse more widely if they link up with ongoing processes at regime and landscape levels" (Schot and Geels, 2008: 547). However, as Smith and Raven (2012: 1026) argue "ideas and conceptualisations of how path-breaking innovations escape their protective spaces and interact with wider regime change processes are still poorly developed". In subsequent sections of the paper we use this theoretical framework to explore the extent to which UK government policy efforts to encourage green building has led to niche activities challenging the existing building regime. In doing so, we draw upon both secondary analysis and upon detailed empirical work with the green building sector. In the next section we provide brief details of the methods used for the empirical work.

Methodology

Our research involved 55 in-depth interviews with respondents from businesses in the green building sector and support organisations, including banks and other sources of finance and business advice (see Table 1), located across England and Wales. Potential research participants were identified from exhibitors at events such as EcoBuild and GreenExpo, online membership databases of organisations like the Association for Environment Conscious Building (AECB), internet searches and snowball sampling. Research participants were approached by letter or telephone, with the majority of interviews conducted face-to-face. Interview schedules were based around a set of core questions – given the variety of businesses involved in the research, interviews were semi-structured to allow flexibility. All interviews were recorded, transcribed and qualitatively analysed using Nvivo to structure analysis themes. The focus of the research was upon private sector small and medium sized enterprises (SMEs) and our interviewees were largely drawn from the residential, rather than the non-domestic/commercial sector. While we recognise that the UK building residential sector is dominated by a small number of large companies (which are a constituent part of the dominant regime) these have not been the subject of empirical investigation as from a theoretical perspective we are specifically interested in the role of niche actors in stimulating a transition to a green building regime. Two key issues emerged from these interviews with niche green building practitioners. First, there was a general agreement that much of the current interest and practice in green building in the UK was at a very superficial level, reflecting limited understanding by both householders and the conventional building regime. Second, despite agreement in this area, there was a considerable divergence of opinions as to what did constitute green building. In the next two sections of the paper we explore these themes in more detail.

Table 1. Categories[8] of Interviewees.

Sector	**No.**
Finance and policy staff	15
Consultants	4
Builders	4
Architects	4
Building material suppliers	7
Energy consultants/installers	7
Other green building entrepreneurs	14
Total	**55**

Government Policy: From Niche to Mainstream?

Respondents were especially critical of current UK regulations and green building legislation. This reflects the particular way that the UK government has interpreted green buildings into a form that focuses upon a low carbon agenda and the economic benefits that arise from adopting this within the mainstream building regime. As Lovell (2008: 624) suggests, framing this as a "low carbon discourse has been used partly as a way of distancing low energy housing technologies from the social and institutional context in which they were

[8] We recognise that these 'categories' are not fixed and that some participants operate across boundaries.

initially developed. The approach and language of the low carbon discourse coalition stands in strong contrast to the deep green values and beliefs of the original 1970s sustainable housing movement". The consequence of the dominance of a low carbon discourse to frame policy and this lack of attention to the broader context means that there have been particular outcomes that emphasise technological solutions which require no changes in behaviour or lifestyles by household occupants (Reid and Houston, 2013). Thus the effect has been to prioritise low energy technical innovations, such as wind turbines and photovoltaic panels, over broader administrative changes such as planning reforms or greater integration of sustainable development into house builders' decision making (Lovell, 2008).

The Code for Sustainable Homes came in for particular criticism by our respondents as it was seen as encouraging these kinds of high tech add-on technologies that they believed to be ineffective. In this they were in agreement with other research which shows that many practitioners believe "current policy inhibits, rather than facilitates, their efforts to take what they consider to be the most sustainable design decisions" (Greenwood, 2012: 167). As one of our respondents commented:

> "one of the silly things about the Code...is that it's not particularly well thought out because for example to reach certain Codes requires bunging on a solar thermal panel onto the house. Now really if they thought about that there would be other things that would be better to put on than just doing that but that's what they've stated so builders are coming along and saying 'well we just need to bung a set of panels on the roof' but what they're doing is they're going for the cheapest possible, and the smallest possible, which actually at the end of the day isn't really making much difference at all…It's not just a case of sticking something on the roof and away you go" (Interview, Renewable energy consultant).

Respondents were very critical of the installation of these kinds of renewable energy technologies both for new build and as an add-on to existing buildings. This was also seen to have been skewed by the UK government's feed-in tariff rate for renewable technologies, which it was thought had encouraged existing homeowners to invest in these technologies as a money saving (or even money generating) device and was seen to have led to conventional builders or new companies coming into the market with a poor understanding of the overall impact on energy consumption – "there will inevitably be a load of companies that are selling stuff that actually is really terrible for your building…and will cause more problems than it will remedy" (Interview, Materials supplier). Respondents argued that there should be a hierarchy of measures whereby low tech and inexpensive solutions such as insulation and low energy lighting should be tackled before renewable energy technologies and other high tech responses are considered.

Advocates of Passivhaus were also critical of the Code for Sustainable Homes[9]. A Passivhaus is defined as "a building, for which thermal comfort can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air

[9] Although Osmani and O'Reilly (2009) argue that the Code exceeds Passivhaus standards on the grounds that it requires domestic energy use in level 6 homes to be generated from renewable sources.

quality conditions – without the need for additional recirculation of air[10]" (see also NHBC, 2012). A Passivhaus is one that has excellent thermal performance and exceptional air-tightness with mechanical ventilation[11], but respondents argued that there are substantial differences between Passivhaus standards and those enshrined in the Code, such that a Passivhaus could receive a low rating under the Code. A related point was that the Code was designed for large-scale building companies which form the mainstream building regime and was not appropriate for those small companies or self-builders who are often involved with Passivhaus:

> "we're building very, very sustainable buildings…which will be more sustainable than anything that the major house builders do that meet Code 6 but it won't meet Code 6 because we can't be part of the Sustainable Contractor's Scheme and various other things that you get points for…you can't do it when you're a self builder or a very small company because it's too cost-prohibitive, so we're never going to meet Code 6, yet we'll be making something that's better, like in the spirit of the Code, that's better than anything else that would be built" (Interview, Green building company).

Moreover, clients for new build homes were seen as having very limited understanding of the need to consider the lifetime running costs of a building vis-à-vis the construction costs, and that (as with Passivhaus) the running costs could be low enough to offset the upfront additional building costs. Clients were seen (initially at least) to favour very visible green technologies, such as photovoltaic (PV) solar panels or wind turbines, in order to indicate their commitment to greener living, but were unwilling to make any behavioural changes in their use of domestic energy or lifestyle (cf Reid and Houston, 2013). Several respondents had experienced tensions between such demands from customers and developers, whose expectations reflected the Code, in contrast with their own views on what constituted a green building. Again, this was most obvious with regard to renewable energy technologies where clients expect a green builder to install these or offer them as options, while our respondents saw these as 'green wash' or 'green bling' and tried to persuade clients to think about alternative solutions. Thus one respondent gave the example of a client saying:

> "we want to build an eco house and they were saying…we want wind turbines and, what they imagined was a green house… we're possibly too purist about it in a way but I do find it fascinating because everybody you know, domestic customer or everyone I talk to says, you know, oh I'm putting solar panels on my roof isn't that good?" (Interview, Material supplier).

For our respondents, such technologies were seen as very low on the list of priorities for green building and were seen as the "very icing on the cake once you've done everything else" (Interview, Material supplier). By contrast, the aim of our respondents was to minimise energy demand at the outset and then look at how to further reduce that demand. The consequence was that they saw certain technologies as undesirable – "there's certain things that we probably wouldn't consider, which again are a bit greenwashy, like heat pumps particularly, air-source heat pumps particularly, they're evil!" (Interview, Green architect/builder). In this example, the respondent argued that air-source heat pumps could use more electricity than they saved at times of the year where there was a substantial

[10] http://www.passivhaus.org.uk/standard.jsp?id=122, Accessed 13.3.14.
[11] See www.passivhaus.org.uk for details.

difference between internal and external air temperatures (such as in the UK) meaning energy was required to heat the air. Respondents were equally vehement about other types of energy generation and their embodied energy:

> "green energy is totally pointless unless it has a lifetime saving, and by that I mean making a forty thousand pound wind turbine is not green at all, ever, never. If they pretend they're green entrepreneurs they are lying to themselves and lying to the public because it costs a heck of a lot more in terms of energy to make the wind turbines than it's going to pay back. So I'm a bit sceptical of people selling products because they are green unless it adds up on the lifetime calculations" (Interview, Renewable energy company).

Other research confirms this, with add on generating technologies having potentially high levels of embodied carbon, which was specifically excluded from the Code on the grounds that it is not currently realistic or practical to do so (McManus et al., 2010). Renewable energy technologies were thus seen as a very narrow definition of what green building involves, constituting high tech solutions to problems that respondents believed require more mundane solutions such as insulation and lagging – but for clients this was "not very sexy stuff that doesn't sparkle and inspire" (Interview, Green business support organisation). The consequences of a combination of client expectations and the Code for Sustainable Homes is that "a lot of what is being proposed…are quite high embodied energy solutions aren't they? And there is that perception that it's green architecture... even though all the insulation is petrochemical based" (Interview, Green architects). For some of our respondents who had been involved with the green building sector for a number of years, these were recent shifts in emphasis within the sector and represented the dilution in aims that had come about as elements of the green niche have entered the mainstream:

> "ten, fifteen years ago the emphasis would've been on the…you know the 'hairier' end of green building, which was much more kind of rustic, the emphasis was on natural materials and what they could achieve…and I think there's been quite a serious shift, like 180 degrees shift from that. So, it's, I mean people are still doing that but…it's become quite high-tech" (Interview, Green building company).

One response within the niche has been to ignore the Code for Sustainable Homes and to work to different sets of standards. In addition to the Passivhaus standards mentioned above, the Association for Environment Conscious Building (AECB) "have developed their own set of such standards, which seek to be less prescriptive than the Code about the particular technologies and appliances that designers are required to install. Their standards assess building performance in absolute terms and are intended to avoid assumptions about occupant behaviour" (Greenwood, 2012:175). The AECB's CarbonLite programme is designed to produce low carbon and low energy buildings, for those green building companies adopting this discourse[12]. However, these strategies effectively mean that firms remain within the niche, rather than engaging with the mainstream. While they may produce high quality buildings in environmental terms, these are likely to be one-off buildings or small scale developments that comprise local socio-technical projects rather

[12] See http://www.aecb.net/carbonlite/carbonlite-programme/ Accessed 18.3.14.

than comprising a niche level that challenges mainstream practice (Schot and Geels, 2008; Smith and Raven, 2012). The extent to which niche innovations engage with and impact upon the wider regime will therefore depend upon the degree to which niche actors define themselves as an alternative to, or outside of, the mainstream. Thus radical niches need not aim to displace the regime, indeed the aim of some niche actors might be to play a more significant role alongside it, or offer new ideas for incorporation into existing systems. Certainly some of our respondents were engaged in running countercultural businesses with the aim of making a modest living and combining this with other interests, such as their family or environmental campaigning. Based on their cultural and environmental values, these niche actors had little interest in bridging the niche-regime divide or attempting to engender a transition towards sustainability in the building regime. This contradicts other research where niche actors appear to be actively challenging the mainstream and lobbying for regulatory change (see for example Schaltegger and Wagner, 2011). Indeed even amongst our remaining respondents, only a small number were actively engaged in attempts to shift and challenge mainstream regime perceptions and ways of working, and most were fully engaged in keeping their businesses viable, with limited time and energy for such broader 'system building' activities (Smith, 2007; Horne and Dalton, 2014).

Defining Green Building: Divergence within the Niche

As we have outlined, the green building movement originally emerged from 1960s and 1970s countercultural movements concerned about resource use, environmental damage, wastage and energy intensity in conventional building methods, which were seen as divorced from the specificities of place. While there is recognition that this did not give rise to a coherent and fully formed alternative set of practices – "green building is not a monolithic school of architecture and building: practitioners disagree over trade-offs between various goals…there remains a sufficiently distinctive collection of overarching values, ideas and practices from which a socio-technical niche can be discerned" (Smith 2007:95). Niches are frequently presented as being homogeneous, with the assumption that there are agreed practices with a majority of niche actors working towards common goals, such as mainstreaming niche innovations into the dominant regime (Smith, 2006). With regard to this, there *were* some aims which the majority of our respondents agreed upon. Thus, there was general agreement that green building should comprise a 'whole house concept' that went substantially beyond that expressed in the Code for Sustainable Homes or the minimum imposed by Building Regulations. Overall there was a general view that green building was about making good quality buildings to last, which demand less of the environment and are connected with the locality, particularly through the use of appropriate local materials. Respondents also agreed that there were limits to the extent to which buildings could be said to be completely green or sustainable:

> "sometimes you'd struggle to say 'well, is this sustainable', because it's clearly not; it's a compromise; I think that's what we've always said. We'll try to do it slightly better than it's been done before, we're doing it often in excess of what's expected of us, say, in terms of Building Regulations or whatever. And again, that's always been our kind of ethos, we work beyond that, you know…the building industry works to the minimum not the maximum – Building Regs are minimum, as soon as they

hear that, they stop. Our ethos was to…ignore that and see how much we can get into a building and still make it viable" (Interview, Green building company).

Despite agreement on some issues, however, our argument here is that in reality the green building niche is heterogeneous and incorporates a wide range of (sometimes conflicting) views and practices, rather than comprising a cohesive set of agreed practices. Accordingly, green building can include a range of diverse approaches to reducing the environmental impact of construction and post-construction building use, from straw, hemp or rammed earth installations to the more conventional 'brick and block' buildings utilising the kinds of high tech solutions outlined in the previous section. Therefore, treating all green building practices as a *single* niche is misleading. Rather, the green building niche can be better described as a series of nested niches, or comprising clusters of experiments (sub-niches) (Kemp et al., 1998), rather than just one niche that is an alternative to the mainstream regime (Seyfang and Longhurst, 2012). Green building can therefore comprise a *variety* of niches (e.g. cob, rammed earth, straw bale building, retrofit and so on), each with conflicting ideologies of green building. Some of these are compatible with mainstream practice, while others substantively challenge conventional building methods and philosophies.

Amongst our respondents there were clear differences of opinion over what constituted green building. For one set of respondents the key factor involved thinking about whole building use, as opposed to the kinds of 'add-on' energy generation technologies outlined in the previous section. In particular they highlighted the differences between energy usage once a building is constructed and the energy embodied in the construction phase. With regard to this, one area of contention was building to Passivhaus standards. Some interviewees were in favour (at times almost evangelically so) of Passivhaus and argued that it is "the only kind of credible, measurable sort of way of building low energy" (Interview, Materials supplier) and constituted the "greenest of the green" architectural construction forms (Interview, Materials supplier). By contrast, other respondents were more cautious about its value. In part this was due to some evidence that poor installation of mechanical ventilation systems may be associated with poor indoor air quality and health impacts (Zero Carbon Hub, 2013). Respondents were also very critical of the high levels of embodied energy involved in Passivhaus building materials, arguing that although such buildings have very low energy use, it would take a long time for this to offset the energy embodied in initial construction. Another respondent was also sceptical of the value of the Passivhaus approach given that it requires the active involvement of its occupant (though note that this view rests on a partial understanding of Passivhaus and a popular misconception that windows cannot be opened[13]): "We don't do Passivhaus; we have reservations about whether Passivhaus is appropriate in this climate for a start. And our view is that if people decide they are going to open their windows then the Passivhaus thing is all up the creek anyway" (Interview, Green architect).

One architect characterised Passivhaus as comprising "unhealthy buildings wrapped in plastic" in order to achieve Passivhaus requirements for air-tightness; he questioned the benefits of such an approach, arguing that natural, breathing walls with intrinsic thermal

[13] See http://www.passivhaushomes.co.uk/myths-and-misconceptions-about-Passivhaus-1.html, Accessed 13.3.14.

properties are a better solution, (albeit acknowledging that Passivhaus final energy use is indeed low):

> "Passivhaus…I'm still not convinced because it means sealing it up super tight and then essentially managing the air within it, so again you're living in a plastic building kind of thing, and then all your air is, sort of moves around by this big fan unit, and the figures for the amount of energy they use is tiny, you know, and it's definitely something to aspire to, it's incredible but I'm just not convinced that I would necessarily want to live in that kind of building you know, I think there must be a way of doing it using... what they call breathing walls and having a more natural feel, it's about managing that air, it's the key, and I can't help thinking there might be a better way to do that, but yeah, Passivhaus, 15 watts per metre squared per year whatever, is nothing!" (Interview, Green architect/builder).

This view was reinforced by another respondent who believed that the same outcomes could be achieved through the use of more traditional designs, for example using natural materials such as straw:

> "it's unhealthy to live in a sealed box, you know part of our philosophy is to encourage our clients to open the windows. Not a fan at all, I am in favour of airtight buildings but not using all the tapes and stuff, just using good design – you don't want draughts round your windows and door frames and that's what I mean by airtightness, just go back to traditional designs" (Interview, Green building company).

This focus on more traditional designs and the use of natural and locally-based materials was a theme that emerged from other respondents. This involved the use of materials such as straw, lime, cob, wood waste and wool, which were perceived to be natural, breathable materials:

> "I do promote earth building materials for all of their beneficial properties because they've got brilliant, brilliant properties, so…we sell clay boards and clay plasters and they're very good for acoustics and moisture buffering and thermal mass and all sorts" (Interview, Green building company/materials supplier).

By comparison with designs such as Passivhaus, these materials were also seen as better for the health of occupants:

> "I was coming really from the building performance point of view and realised that it was much better for people's health, so when I built my own house I used low fibre clay blocks, self-insulating blocks, solid wall construction, hemp lime plasters, natural paints. So I believe in it, I think it's a good thing to do" (Interview, Materials supplier).

Some respondents also went on to argue that the use of these materials helped to sequester CO_2 within the building – "unless you're building with straw, or hemp or timber, it takes so much energy to make the flipping thing in the first place. Whereas obviously straw and timber are carbon sinks, so that's true low carbon building" (Interview, Green architect). Many of these materials could also be locally sourced which was also seen as a positive contribution to low embodied energy building, as opposed to the import of green building

materials from Europe or China[14]. Returning to the Code for Sustainable Homes, the Code specifically does not address embodied carbon and this was felt to be another shortcoming. Even here there was a divergence of views between those respondents who believed higher embodied energy is acceptable to build low energy use buildings, and those others who argued for both low energy use and low embodied energy in the building materials.

Conclusions

In this paper we have attempted to show that the process of changing current established regimes towards more sustainable forms is a difficult process, even where there have been attempts by government to engender the transformation through legislative action. At one level, it can be argued that, as with other areas of green practice, such as organic food or renewable energy, there has been a shift towards greater environmental consciousness in the building sector. Thus, as one of our respondents noted:

> "I think that's what the green movement, in a wider sense, has done; it's kind of made things that were seen as a bit fringe and not quite acceptable, they've made them more acceptable. They've made them more 'every day'…you know, it's not a strange thing anymore to talk about heating your house via the sun" (Interview, Materials grower/supplier).

However, the shift has so far been fairly minimal and taken on specific forms. Far from inducing a 'paradigm shift' the regulatory framework in the UK for green building has effectively encouraged the adoption of an ecological modernisation or 'eco-technic' approach with an emphasis on technological, rather than holistic, solutions. Our conclusions concur with Boschmann and Gabriel (2013: 10) who argue that "technological solutions to green building allows for a convenient business-as-usual approach to the use and design of buildings" that can be readily incorporated by the existing building and construction regime. Moreover, these fail to address the kinds of lifestyle changes advocated by early green building pioneers, leading householders to rely on 'smart house' solutions without having to engage in behavioural change (Reid and Houston, 2013). Indeed the Code for Sustainable Homes only provides an assessment at one point in time and fails to address post-occupancy behaviour, which may actually increase energy use (Greenwood, 2012). A failure to encourage and reward niche green designs has limited the extent of paradigm shifts in the established building regime and has meant only minor elements from the niche have become mainstream. At the same time, the mainstream building sector lacks both confidence in, and the capacity to adopt, niche methods and technologies and is unwilling to move away from traditional methods (Osmani and O'Reilly, 2009). Current mainstream sector responses were denounced by the former UK Housing Minister, Grant Shapps as 'Scandinavian-style, eco-bling' in a call for British design responses to preserve the 'Great British home'[15] and to find local responses to UK demands. The problem here though is that, ironically perhaps, the former Minister fails to recognise that it is Government's own building and housing regulations that have encouraged such cautious responses. We have also seen how, despite continued interest in encouraging green

[14] This also contrasts with Passivhaus standards where due to a lack of UK domestic capacity, windows need to be imported from Continental European suppliers (Lowe and Oreszczyn, 2008).
[15] https://www.gov.uk/government/news/eco-homes-dont-have-to-be-eco-bling, Accessed 13.03.14.

building, policy has not created the kind of regulatory certainty anticipated by the previous Labour government to drive change. Instead, UK zero carbon housing policy has been plagued by disagreement and inconsistency[16].

This situation seems unlikely to alter in the near future. Thus the whole concept of zero emissions buildings has been under review in the UK. Rather than the kinds of 'whole house concept' proposed by our respondents which would involve mitigation of energy use on-site, a revised definition of zero carbon involves the idea of 'allowable solutions' which would "include the use of, or investment in, renewable energy technologies which are not on-site, such as large-scale wind or tidal energy sources, community heating, or the installation of energy-efficient appliances and advanced energy control systems for buildings that encourage energy efficiency" (Greenwood, 2012: 169). This simply further waters down the impact upon the mainstream building regime, in part the result of lobbying by the sector in attempts to extend the regime (Panagiotidou and Fuller, 2013). While allowable solutions could potentially encourage the integration of energy and buildings policies, the 'allowable solution' most favoured by house builders consulted by government on zero carbon homes policy was for the sector to pay into a fund that invests in carbon abatement projects located elsewhere (DCLG, 2014). This would have the potential effectively to give mainstream house builders a buy-out clause to rely on third parties to deliver zero carbon outcomes through carbon offsetting while continuing to build to lower energy standards (McLeod et al, 2012). From other research into the green building sector, perhaps we should not be too surprised with this outcome. As Smith (2009: 98) points out the imposition of environmental aims in building regulations "are based on judgements of what is deemed a reasonable demand upon the mainstream socio-technical regime". He argues that we should expect this mismatch as a direct consequence of the failure to appreciate the different socio-technical contexts in operation in the mainstream and green building sectors. The result is that:

> "the kinds of practice that are sufficiently flexible to work under such divergent contexts may not be particularly green – they cannot embody the green context that produced them (i.e. underpinning values and performance criteria) too strongly, since this would limit their transferability. Transferability requires them to be able to 'slot into' the mainstream practices, or be susceptible to being added on, without too much disturbance" (Smith, 2009: 102).

A consequence may be that where some niche innovations, such as the add-on energy technologies outlined in this paper, become competitive and empowered to align with the mainstream regime, the result is actually disempowering in terms of sustainable outcomes (Smith and Raven, 2012). Rather than adopting these incremental changes to building regulations, a policy attempt to meet system transformation goals (such as zero carbon housing) would consider standards "in the light of practices in existing low carbon housing niches and would point volume house builders (and conventional householders) towards adopting practices found in those niches" (Scrase and Smith, 2009: 716). Given the level of expertise that exists in niche organisations such as the AECB, as well as the demonstration

[16] http://www.theguardian.com/environment/2014/feb/13/storms-floods-climate-change-upon-us-lord-stern, Accessed 13.03.14.

effects of large scale building developments to zero carbon and Passivhaus standards in countries such as Germany, Austria, Sweden and Switzerland, there is scope for a major government-funded demonstration programme and/or to mandate higher standards for carbon reduction, such as the Passivhaus standard in order to encourage niche practices in the extant building regime (Lowe and Oreszczyn, 2008; McLeod et al, 2012). As we have outlined, relying on niche actors to engender such changes is unrealistic and fails to account for the fact that they may have little interest in, or capacity to effect, changes in regime practices.

In policy terms, we should perhaps not be thinking of trying to create one single transition scenario, but to open up 'possibility spaces' for experimentation – which might fit with the ideas outlined here of multiple views within the niche and the possibility of multiple transition scenarios (Sondeijker et al, 2006). Thus there will be no 'one best way' to a green building sector, but a multiplicity of scenarios, which may cohere into something that incorporates elements of the various sub-niches we outline here and which responds to geographical specificity. Rather than rigid legislation, the role of policy should be to create the space for possibilities to emerge and for experimentation through collective enactment by a range of actors as well as encouraging engagement by the occupants of buildings rather than removing them from the process (Schot and Geels, 2008). In so doing, this would recognise that the process of transition involves real world contestation, complexity and chaos rather than the more linear progression envisaged in UK Government policies for the building sector (Raven et al, 2011).

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