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Rethinking socio-technical transitions and green entrepreneurship: the potential for transformative change in the green building sector

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Abstract

This paper explores the development of green entrepreneurship and its potential role in transformative change towards a green economy. It achieves this through a study of the green building sector in England and Wales, based on qualitative empirical data from 55 semi-structured interviews with businesses in the green building sector and with support organisations, including banks, financial sources, business advice and support. The paper both critiques and synthesises two bodies of literature, entrepreneurial research and socio-technical transitions theories, specifically the multi-level perspective (MLP), to better understand the role of green entrepreneurs in facilitating a shift towards a green economy. This analysis embeds green entrepreneurs in a wider system of actors rather than reifying the lone entrepreneurial hero, in order to explore how green entrepreneurs facilitate sustainability transitions. The paper challenges the notion that green entrepreneurs are an unproblematic category. We discovered that individuals move between 'green' and 'conventional' business, evolving over time, such that this is a fluid and blurred, rather than static, state. Moreover, while the green economy and the green building sector are often referred to as coherent sectors with agreed and consistent practices, our evidence suggests that they are far from agreed, business models vary, and there are significant contradictions *within* so-called green building practices. The paper contributes to the development of socio-technical transitions theory and suggests that the MLP needs to incorporate complexity and multiplicity within niches, that niches may be inherently conflictual rather than consensual and that the concept of 'protection' for niches is problematic.

Keywords: Green economy, green entrepreneurs, green buildings, socio-technical transitions, sustainability

Introduction

In this paper we explore the development of green entrepreneurship and its potential role in transformative change towards a green economy. Although the green economy is not consistently defined and is still an emerging concept, a widely used and authoritative definition is that "a green economy is low carbon, resource efficient, and socially inclusive. In a green economy, 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" (UNEP, 2011: 16). This contrasts with current economic development strategies which remain wedded to a high growth, carbon-based, consumption-led economy where success is measured by increasing Gross Value Added and higher levels of personal consumption (Jackson, 2009). While developing a green economy offers the potential to change existing socio-economic development pathways, there are a range of opinions as to desirable outcomes (European Commission, 2011). From one perspective, the basis of capitalist, consumption-led economies will remain much the same, but involve a different range of goods, services and production methods. Such a vision lies at the heart of government-backed initiatives to encourage green industries, with perceived benefits from increased international competitiveness and new export markets (see Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2008; HM Government, 2008). Another, more radical, perspective on the green economy is that it should involve greater localisation of production, substantially reduced consumption and greater social and environmental justice (North, 2010).

One of the key drivers towards a green economy is claimed to be the emergence of a new type of business leader – the 'green entrepreneur' (see the collection of papers in Schaper, 2010). Proponents define green entrepreneurs as combining environmental *and* business aims, with the intention of achieving the social and ethical transformation of their business sectors (Isaak, 1998). Willis et al., (2007), drawing on Christensen (1997), call such green entrepreneurs 'disruptive innovators' who supersede and transform established business models and user expectations. In classic Schumpeterian terms, an environmental gale of creative destruction is said to be creating the basis for a green economy based on new innovative activities in sectors such as renewable energy, fuel cells, green building and organic foods (Larson, 2000; Dean and McMullen, 2007). However, this literature sees green entrepreneurs as an unproblematic ontological category and

assumes they can readily be identified[1]. By contrast, we believe there is scope for a range of interpretations and actions by entrepreneurs, from building radical, alternative businesses through to a more straightforward focus on environmental market opportunities. Our concern is to investigate empirically whether we can identify green entrepreneurs as a distinct category.

Our approach to investigating green entrepreneurship and the green economy in this paper is from the theoretical perspective of socio-technical and sustainability transitions, focusing on the UK green building sector. This approach is relevant for research into green entrepreneurs as the transitions literature has focused on the evolution of niche developments, which offer protected spaces for experimentation with new business forms and technologies. We utilise this theoretical approach to address three aims. First, we move beyond a focus in much of the entrepreneurship literature upon entrepreneurs as lone actors and (re)consider them as part of a broader network of actors and institutions involved in the shift towards a green economy. Second, we problematise the ways that the socio-technical transitions literature conceptualises niches and the role of entrepreneurs within these. In particular we explore the nature of niche protection, how niches may be nested and the conflict and fractions that may be evident within niches. Third, we argue that 'multiplicity and messiness' need to be incorporated into these theoretical models to overcome a tendency for simplistic linearity. In addressing these three aims we also indicate the tensions inherent in the term green economy and differences in its interpretation.

The paper is structured as follows. We outline the limitations of the green entrepreneurship literature and then introduce concepts from socio-technical transitions research to provide a theoretical lens through which to examine green entrepreneurship. Following an outline of the empirical research methodology, subsequent sections of the paper draw upon empirical research with green entrepreneurs in the UK green building sector, structured around our three aims. In the conclusion we reflect on the utility of the socio-technical transitions approach to investigate green entrepreneurship and upon the role of state policy in promoting and developing a green economy.

Green entrepreneurs

[1] Much of the literature is based on limited empirical or anecdotal evidence which is used to construct typologies of green entrepreneurs (see Schaltegger and Wagner, 2011).

There is an expanding literature on green entrepreneurship (Beveridge and Guy, 2005: Schaper, 2010) which argues that individuals combining environmental awareness with entrepreneurial action are "a major force in the overall transition towards a more sustainable business paradigm" (Schaper, 2002: 27), providing "exemplary solutions for a social transformation" (Isaak, 1998: 88) towards a green economy. Entrepreneurship *per se* has been defined as "the creation of new economic activity" (Davidsson et al., (2006:27) in Canina et al., (2012); Gartner (1988) in Callaghan & Venter, 2011) and traditionally entrepreneurs have been conceived as risk bearers (Carland et al., 1988) and innovators (Schumpeter, 2002). However, this more conventional perspective is frequently focused upon businesses seeking maximum profit generation as their main outcome, rather than upon environmental and social aims, where profit motivation may be secondary.

It is claimed that green entrepreneurs operate their businesses in ways that run counter to conventional perceptions of entrepreneurial behaviour (Tilley and Parrish, 2006; Hart, 2006). They may reject the entrepreneurial label as possessing connotations of profit maximisation, materialism and aggressive behaviour (Friedman and Phillips, 2003; Nicholson and Anderson, 2005). As opposed to the ruthless profit seeking capitalists of popular imagination, Harvey (2007) claims that green entrepreneurs display a different mentality, evidenced through donations to environmental causes, employee-friendly working conditions, an interest in wider social and environmental issues beyond bottom line profits and a concern for the longer term implications of their business activities. Certainly, many green entrepreneurs are happy to advertise their 'alternative' credentials through their own publicity, promotional material and websites and may cultivate an image of being outside the business mainstream (Isaak, 2010). There has been an increasing celebritisation of business personalities through television and online media (see Rindova et al., 2006). Of importance here is the performativity of green entrepreneurs, or what Schauch (2009) terms the 'identity of enactment', whereby they stress their individuality and their alterity, often over their business acumen (Prudham, 2009; Boykoff and Goodman, 2009; Allen and Malin, 2008).

One of our concerns in this paper is to examine whether we can identify green entrepreneurs as a distinct set of actors trying to promote alternative ways of doing business and attempting to shift the basis of social relations in their sector. However, a common approach to green entrepreneurs is to see them as lone actors rather than linked into wider economic and social contexts, indicative of a wider gap in entrepreneurship research which reifies the individual (Devereaux-Jennings et al.,

2013). Entrepreneurs do not operate in isolation but have a symbiotic relationship with the evolving economic, social and political structures around them (Walley and Taylor, 2002). Although there is increasing attention in conventional entrepreneurship research to link the multi-levels of individual, firm/organisation and the aggregate or macro-level, there is still a pervasive focus on the micro-level of individuals and firms, which may not fully take environmental or contextual factors into account (Canina et al., 2012). For a study of green entrepreneurs this seems problematic given the emphasis upon them as a force for change in the wider economy.

Sustainability Transitions and Green Entrepreneurship

In order to address these theoretical shortcomings, 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 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* are defined as small-scale learning spaces for new technologies, comprising either a single experiment or project, or clusters of several experiments (Kemp et al., 1998), offering protection and functioning as test-beds for the emergence of new socio-technical constellations. Niches offer innovative socio-technical configurations, responding to tensions within incumbent regime activities (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 trends such as policies for developing green economies challenge incumbent technological regimes (Smith et al., 2010) and may create space for green entrepreneurs. 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 (Smith and Raven, 2012). Niches may affect broader regime change through processes of diffusion, scaling up, and replication. Under certain circumstances, these niches can then replace the old regime and establish a new regime with its own specific conventions and characteristics (Truffer, 2008). 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, but in the process lose the more radical and transformative aspects (Smith and Raven, 2012).

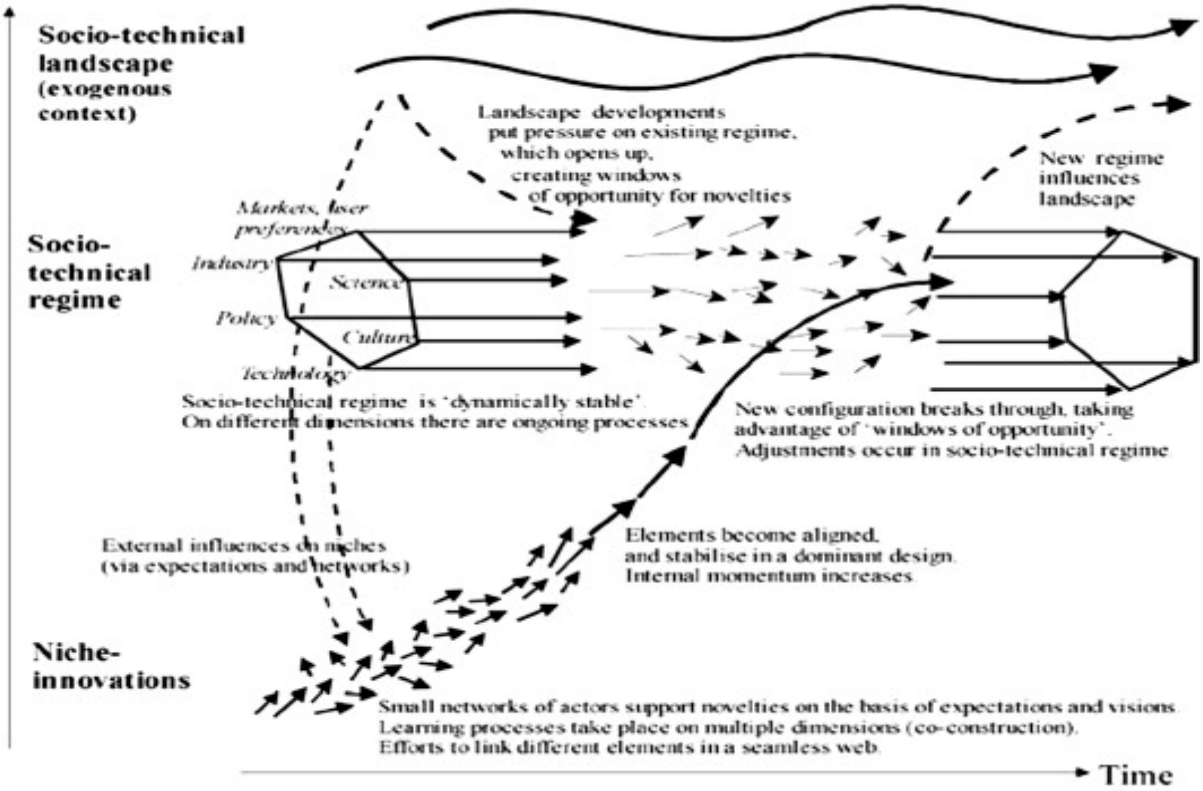
Socio-technical *regimes* operate at the meso-level (e.g. energy systems) forming relatively stable configurations of institutions, techniques and artefacts, as well as rules, practices and networks that determine the 'normal' development and use of technologies (Rip and Kemp, 1998; Berkhout et al., 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).[2] Each of these 'categories' are "analytical rather than ontological" (Raven et al., 2010: 63), offering a heuristic for understanding socio-technical change. Figure 1 illustrates the processes and dynamics of the MLP and how niche innovations may broaden out to challenge the regime, with the landscape both influencing and being influenced by the regime, although this assumes a degree of linearity and automatic forward progression (see Genus and Coles, 2008 for a critique).

However, while the reflexive nature of the socio-technical transitions approach helps address the shortcomings of a focus on individual actions by green entrepreneurs, it often lacks any real sense of the politics and power relations involved between the different actors and institutions that may facilitate or hinder the transition. Transition is not inevitable, but the result (or not) of struggle, agency and power relations (Smith, 2004; Shove and Walker, 2007). If "recommendations for radical shifts to sustainable technological regimes entail concomitantly radical changes to the socio-technical landscape of politics, institutions, the economy and social values" (Smith, 2003: 131), they are unlikely to proceed (if at all) without parallel political actions. Murphy and Smith (2013) argue that the MLP can be criticised for the limited understanding of society and politics compared to its emphasis on technology – also noting that the MLP stresses long-term change at the expense of local processes and changes. Thus while niches are important sources of innovation that may offer solutions for tensions in existing socio-technical regimes, adaptation or translation processes may be confined by structures within the existing mainstream regime

[2] See Raven et al., (2010) for a discussion of the ways that the terms 'niche', 'regime' and 'landscape' are interpreted within the transitions literature.

(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). A key question here is whether current environmental concerns and a policy shift to a green economy represent tensions, and thus a window of opportunity, when new trajectories are actively being sought (Hockerts and Wüstenhagen, 2010)?

Figure 1. The Multi-level Perspective on Socio-technical Transitions (Geels, 2002)



Green entrepreneurs and socio-technical transitions

Green entrepreneurs may act as drivers to disrupt regimes, both through their own business activities as well as through lobbying for wider system change. Geels (2010: 498) suggests that "a common pattern is that outsiders and entrepreneurs nurture and develop radical innovations in niches 'below the surface' of incumbent regime actors", leading some green entrepreneurs (and other actors) to act as 'system builders' who aim to engender changes in the wider economic system. System builders may lobby for regulatory changes, create new partnerships and try to establish new habits, standards, norms and practices as part of strategies to change the system

context (de Boer et al., 2009). Entrepreneurs may act as system builders by carrying ideas from one field (or niche) to another (regime) (Devereaux-Jennings et al., 2013). They may attempt to shift institutional arrangements, either in order to widen the niche and/or to engender a more substantive shift in the conditions in which they operate (Schaltegger and Wagner, 2011).

Such efforts may be particularly effective if economic growth results in increased political influence and bargaining power by green entrepreneurs and their industry associations to lobby for regulatory change (Geels, 2010). This may enable incorporation into the existing mainstream or, more substantively, green entrepreneurial activities may *become* the new mainstream (Meek et al., 2010). It is, however, too simplistic to assume that regime change begins in niches and simply works its way up hierarchically to create broader changes (Hodson and Marvin, 2010) – rather, it is more likely to be a chaotic and iterative process (Bulkeley et al., 2010). Indeed, whether niche building subsequently engenders a major shift towards more sustainable outcomes is a moot point. Niche innovations can take various forms: they might be a source of synergistic reforms to be absorbed into regimes; they might compete with and potentially displace the regime; they might expand and work alongside a regime without changing it fundamentally; or they could expand to fill a void caused by regime collapse (Geels and Schot, 2010). Radical niches need not aim to displace the regime, 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. Regime destabilisation and landscape pressures are also important in creating space for innovative niches to diffuse (Seyfang and Longhurst, 2012). Much may depend upon the extent to which green entrepreneurs define themselves as an alternative to, or outside of, the mainstream. Conflicts may arise between those green entrepreneurs wishing to remain purist, while those seeking wider influence (system builders) may be regarded as sell outs (Seyfang and Smith, 2007). Niche pioneers can also be subsumed by larger, more powerful commercial ventures as elements of the niche become incorporated into the mainstream, or where the mainstream technological regime transforms the niche rather than the reverse[3] (Smith, 2006; Hockerts and Wüstenhagen, 2010).

Overall, the value of socio-technical transitions approaches for green entrepreneurship is that they stress not just individual actions by entrepreneurs, but also "the networks and support structures that have built up to facilitate these alternative forms of sustainable practice" (Smith, 2003: 128;

[3] As with several 'exemplar' green entrepreneurs – e.g. Anita Roddick's Body Shop was purchased by L'Oréal, Ben and Jerry's ice cream by Unilever.

Jorgensen, 2012). This connects the activities of individual green entrepreneurs to wider economic and social structures and indicates the kinds of broader changes that may be necessary to develop a green economy. However, socio-technical transitions approaches often portray the process of translation from niche to mainstream in a linear and unproblematic fashion. In the following sections we explore these issues and suggest that niche innovations may take a variety of forms and that interactions between regime and niche are likely to be 'messy' and diverse.

Methodology

In order to address the limitations of the green entrepreneurship literature, where arguments are frequently based on limited evidence or anecdotal comments, our research involved 55 in-depth interviews with respondents working in businesses in the green building sector and support organisations, including banks and other sources of finance and business advice (see Table 1). Respondents were located across England and Wales, with some regional concentrations, for example the Welsh borders area and the South West of England.

Potential research participants were identified from exhibitors at events such as EcoBuild and GreenExpo, online membership databases of organisations like the Association for Sustainable Building, 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 primary focus of the research has been upon private sector small and medium sized enterprises (SMEs).[4] While we recognise that (green) entrepreneurialism is not limited to the private sector and that social and community enterprises operate with commercial principles, this has not been our focus (Seyfang and Smith, 2007; Seyfang and Longhurst, 2012; Davies, 2012) as we are specifically interested in the role of private sector based entrepreneurs in stimulating a transition to a green economy.

[4] Our focus is on green entrepreneurs rather than 'intrapreneurial activity' within large firms, such as Marks and Spencer's Plan A, or what many respondents saw as 'greenwash' from larger companies seeking to 'jump on the bandwagon'.

Table 1. Categories[5] 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**

The Green Building Sector

The UK's green building sector provides a useful case study for exploring the relationship between socio-technical transitions theory and green entrepreneurship. Buildings comprise 45% of UK carbon emissions and are a priority action area for carbon reduction by the UK government, the European Commission and the United Nations[6] (CBI, 2007; Vickers and Vaze, 2009; King, 2010; European Commission, 2011). The current building regime developed post-World War II, when construction techniques and design dramatically changed. With inexpensive and abundant energy, buildings were constructed more quickly, from less expensive and lower quality materials, and traditional construction methods and materials gave way to technologically complex systems (Elefante, 2007; Curtis, 2008, both in Boschmann and Gabriel, 2013). Subsequent technological developments allowed building design to become devoid of place specificity, with a 'triumph over nature' approach to building negating consideration of geographical context (Boschmann and Gabriel, 2013). In the UK, with the recent government agenda to cut carbon emissions, there has been a growing interest in low carbon and environmentally friendly building practices, albeit not necessarily based on local or traditional techniques. Indeed, *greater* use of technological solutions, in part encouraged by the codification of building standards[7], allows for a convenient business-as-usual approach to the use and design of buildings (Faulconbridge, 2013) that does not challenge the dominant regime. Thus despite a growing interest in green building methods,

[5] We recognise that these 'categories' are not fixed and that some participants operate across boundaries.
[6] See http://www.unep.org/sbci/ United Nations Sustainable Building and Climate Initiative.
[7] For example, BREEAM in the UK and LEED in the USA.

masonry construction methods remain the dominant method of UK house building (Barlow, 2000 in Lovell and Smith, 2010; Ross, 2002), accounting for most of the existing stock and as much as 85% of new build (Building Talk, 2006). Little progress has been made in changes to the mainstream, beyond incorporating bolt-on technologies such as renewable energies (cf. Smith, 2007; Lovell and Smith, 2010; Porritt, 2011).

Challenging this dominant regime is a set of perspectives on green building which reflect alternative ideologies of green construction practices, not all of which are compatible with the current regime of building regulations and planning policies (Boschmann and Gabriel, 2013; Smith, 2006). These emerged from countercultural movements concerned about resource use and wastage, and the energy intensity of mainstream masonry building methods, leading to innovations and experiments with materials and designs to reduce environmental impact. However, green building is heterogeneous, incorporating a wide range of practices, rather than comprising a cohesive set of agreed practices. Green building might include diverse approaches to reducing the environmental impact of construction and post-construction building use, from straw, hemp or rammed earth installations to more conventional 'brick and block' buildings utilising technologies such as biomass boilers, ground heat source pumps, rainwater harvesting, passive solar design and solar panels.

Niche green building methods may be seen as a threat to existing practice and developers are encouraged to ensure their 'products' fit the existing socio-technical system rather than the other way around, for example in relation to gaining mortgages for different building styles through mainstream lenders (Ross, 2002). We consider that green building entrepreneurs and their businesses constitute a niche (or set of niches) supportive of experimentation in building styles and materials compared to the mainstream regime of brick and block building, with its associated practices of materials suppliers, labour supplies, insurance and finance. However, as subsequent sections of the paper will demonstrate, treating all green building practices and entrepreneurs as a *single* niche is misleading. The green building niche is heterogeneous and is better described as a series of nested niches. Thus there is not just one niche that is an alternative to the mainstream regime (Seyfang and Longhurst, 2012), but a *variety* of niches (e.g. rammed earth, straw bale building, self build, retrofit and so on), each with conflicting ideologies of sustainable building. Some of these are compatible with mainstream practice, while others substantively challenge conventional building methods and philosophies.

Rethinking Socio-technical Transitions Theory: Evidence from the Green Building Sector

In the following sections we address the three main aims of this paper drawing on our empirical research. We first explore the role of green entrepreneurs as system builders and as agents of change in transitions towards a green economy. Second, we problematise the degree of protection afforded by niches, suggesting instead that niche activity itself may be subject to instabilities and threats in much the same way as other areas of socio-technical regime practices. Third, we develop thinking on the characteristics of niches, in particular the assumptions that neat, linear and hierarchical progression takes place, instead suggesting that messy and complex relationships and translations occur between the different elements.

Green Entrepreneurs as System Builders

The notion of system builders implies that some actors within niches can transgress niche settings to embed niche innovations into a regime, thus displacing and transforming the regime. This implies that the ultimate goal of niche actors is to extend the practices and products of a niche out into the mainstream. However, such niches are often countercultural and self-consciously formed in opposition to unsustainable regimes, reducing the ease with which ideas and practices transfer between niche and regime (Seyfang and Haxeltine, 2012). More radical initiatives are less likely to want to engage with, or align themselves to, policy agendas. Hielscher et al., (2011) suggest that niche actors engaged in 'oppositional' social movements might genuinely wish to grow their movements, but not to the degree of 'selling out' and incorporation into mainstream contexts, leading to conflict among niche actors about how to proceed. We did identify a small group of business respondents who had little or no interest in extending operations outside the niche. Such entrepreneurs were specifically aiming to run countercultural green businesses providing enough financial support to enable them to live, but which did not occupy them on a full-time basis, as they were interested in creating a balance between work and other concerns, including environmental campaigning or looking after family members (Rodgers, 2010). Such entrepreneurs viewed diffusion of niche practices as a dilution of principles, yet sticking to these principles had led to underemployment in some situations. Thus within a niche there is a wide diversity of activities, practices and motivations at work.

Disruptive innovations (and innovators) are posited as being required in order to radically alter the regime with its business-as-usual building methods, with substantial changes needed to meet low carbon and low energy building requirements. We found examples of green building businesses specifically targeting the mainstream construction regime to challenge and disrupt existing practices. The website of one respondent involved in straw bale building construction states:

> '[i]n the commercial construction industry, materials such as straw and hemp may be seen as quaint – more "little house on the prairie" than mainstream construction. Our concept takes a material perceived as "deep green" and combines it with modern methods of construction. By combining the best from both worlds, we have developed a sustainable, carbon-neutral cladding system that can help meet the challenges of climate change in the 21st century' (Green building company).

This company was deliberately system building, translating 'deep green' materials to the mainstream, but at the same time accommodating modern building practices of low-skill requirements, easy and quick construction and modern aesthetics, as well as consumer expectations about housing appearance. Thus niche practices can be translated to the mainstream, albeit incorporating significant modifications. Figures 2 and 3 illustrate the diversity of straw bale building styles which can arise from the same basic technology.

Figure 3 Modcell's Balehaus@Bath[8]

Figure 3 TBC another straw bale building

Many of the green building businesses surveyed were involved in strong system links and networks with other actors, including architects, materials suppliers, product developers/innovators and green construction practitioners, as well as building clients or

[8] http://www.modcell.com/balehaus-at-bath/

'consumers'. These actors often used the term 'niche' to describe themselves and their businesses, and most identified with conditions which meet Hoogma et al.'s (2005: 223-4) description:

> A niche can be defined as a discrete application domain (habitat) where actors are prepared to work with specific functionalities, accept such teething problems as higher costs, and are willing to invest in improvements of new technology and the development of new markets.

For example, green building companies described situations of trying out new products in different circumstances as a process of trial and error, acceptance of products which cost more upfront compared to conventional products, but which have superior performance characteristics, providing in-depth support to customers to ensure effective implementation, as well as working with product suppliers to refine and improve products. Thus there was certainly evidence of green entrepreneurs working with others *within* the niche(s) to build a 'network of interest' to promote green building practice and experimentation. Some respondents were actively working to promote green building practice more widely – one respondent combined working part time with learning about and campaigning for renewable energy to contribute to green issues beyond his business.

However, for the majority of respondents the need to focus on the commercial viability of their business and future growth prospects meant that acting as an advocate for green building more widely conflicted with business aims:

> But I think we realised, certainly I realised that enthusiasm doesn't run a business, you know, and basically you need to be a bit more disciplined about what you do and...how you do it, and so we kind of learnt the hard lesson, which was pretty painful (Interview, Energy consultancy).

This emphasis on business viability marks a shift from the 1970s alternative technology movement roots, and an attempt to gain acceptance by the mainstream, where terms such as 'alternative' are viewed pejoratively (Rodgers, 2010). While many of the ideas and practices adopted by current green builders stem from the social movements of the 1970s (as did some of our

respondents), other respondents sought to dissociate themselves from this by disparaging the original green movement (often referred to as 'hippies') compared to their own business-oriented approach:

> you had the old green welly brigade who were into it because of the...qualities, the breathability, it feels so good man! (Interview, Green building materials supplier).

Finally, in relation to the potential for formal institutional or regulatory change, many of our respondents had little or no contact with government or other policy makers. Some businesses expressed concerns about this lack of connection, and that as a result their sector is losing out to larger businesses which have 'jumped on the bandwagon' – for example regarding the negotiations of the Green Deal, the UK government was reported as having only consulted with large companies like B&Q[9] to the exclusion of smaller green building firms. By negotiating only with regime companies like B&Q, government policy has the potential to follow a business-as-usual path, as opposed to the green businesses involved in this research who promote more holistic approaches whereby solar panels and other high-technology solutions are 'the icing on the cake'. Government policy was criticised by one green builder who commented that the UK Green Investment Bank may prioritise funding for larger companies but that he 'would like to see investment going to towards smaller companies, which are growing fast and creating jobs. It is easier for large companies to speak to Government and harder for small and medium sized enterprises like ours to engage, but we are more agile.'[10] Scope for green businesses to influence government policy may be limited – while Lovell (2007; 2008) suggests that niche innovations have retrospectively influenced policy, as one of our respondents suggested it may be that only *certain* high-profile demonstration or pilot examples of green building (BedZed in London and Hockerton in Nottinghamshire were both mentioned[11]) have a substantial impact on government policy. Moreover, it is difficult to disentangle what might be seen as system building activities from more narrow self-interest to expand market opportunities. Overall though, our research suggests that system building into the policy world is rare and even atypical. As well as the need to focus on business viability, many green building respondents indicated that they did not have the time or resources to engage in such system building activities, or were even dubious of the value of such

[9] A large UK multiple retailer of do-it-yourself building and gardening products.
[10] http://www.modcell.com/news/modcell-the-times-budget-2012/ (accessed 19 June 2012).
[11] Beddington Zero Energy Development (BedZed) in London and Hockerton in Nottinghamshire are both pioneering examples of green building frequently cited in both the academic and policy literatures.

activities. Such views may be framed by the complexity both within niches and within institutional frameworks and social contexts, leading to heterogeneous interactions and relationships between these actors. Such divergence makes interaction with policy makers and other support institutions potentially fragmented, with certain ideas being adopted more readily than others depending on current contexts and priorities.

Niches as Protected Space

In the MLP, socio-technical niches offer 'protected' space where new socio-technical assemblages and practices can be experimented with, and where they are able to develop without the selection pressures of the regime. Niches are conceptualised as tolerating less competitive performance, poor returns and uncertainty as designs evolve. They provide supportive networks for experimentation and advocacy, where radical rather than incremental change can originate (Smith et al., 2010; Geels and Schot, 2008), acting as 'incubation rooms' for radical novelties (Geels, 2002; Schot, 1998). Niches are broadly accepted as 'curiously harmonious' and 'protected' sites, relatively free from conflict, despite the innovatory changes that are seen to take place within, and emerge from, niches (Lovell et al., 2009). Lovell (2007; 2004) suggests low energy housing niches are consensual sites of innovation and learning, as they have largely been developed by strong entrepreneurial individuals working in nongovernmental organisations. However, Lovell et al., (2009) argue that niches can simultaneously be sites of conflict *and* consensus. Our research supports this contention and we problematise the notion of consensus within niches, suggesting that there is instead simultaneous conflict and consensus which varies spatially and temporally (Seyfang and Haxeltine, 2012).

Thus niches are frequently presented as being homogeneous (see Smith (2006) on organic food), with the assumption that there are agreed practices and that all niche actors work towards agreed targets, such as getting niche innovations adopted by the mainstream regime. However, niches may be multiple and are often not consensual, forming a 'fractal niche system' (Seyfang and Longhurst, 2012). Continual development of new hybrids further ruptures the niche system, disrupting efforts to unify designs and communicate a consistent message. Assumptions are frequently made about the singularity of the green economy, and the green building sector is often referred to as a coherent sector with agreed and consistent practices (e.g. schemes such as the Code for Sustainable Homes treats all properties as the same (Forum for the Future, 2011;

Aldersgate Group, 2012)). We found that green building techniques are far from agreed,[12] and there can be significant contradictions within so-called green building practices and between practitioners.

For example, the German concept of Passivhaus was one particular area that provoked divergent views. A 'Passivhaus' is one that has, according to the promoters, excellent thermal performance and exceptional air-tightness with mechanical ventilation.[13] Some interviewees believed Passivhaus is:

> the only kind of credible kind of measurable sort of way of building low energy and that's sort of cutting through the flimflam ...'cause there's so much flimflam around. You know people are saying this is a really green building and it's just got loads of sun things on the roof and it's leaky as hell or whatever (Interview, Green building materials supplier).

Others were more cautious due to the construction techniques involved, the sustainability of the materials used and the associated high costs. One architect saw Passivhaus 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 properties are a better solution. This divergence of building techniques and styles means that we should conceptualise green building, as well as other niches, being composed of a set of 'nested niches'.

For grassroots innovations the main challenge is the struggle to maintain a viable socio-technical space within a wider unsustainable regime – this is unlikely to be significantly different for green building businesses developing radical niche innovations (Seyfang and Haxeltine, 2012). For instance, as niche practices attract the attention of mainstream businesses, the original intentions of the green innovators may be lost or diluted thus eroding the 'niche-ness' which many respondents saw as defining their business practices. As the previous section on system building suggested, our evidence indicates that some businesses strive to remain niche, constantly

[12] Indeed, globally green building is intrinsically spatially variable as people utilise locally available building materials (see Pickerill, 2011).
[13] See www.passivhaus.org.uk for details.

innovating to retain their niche status. Although mainstream operators were said to follow such developments with interest, for our respondents this was not always seen as desirable:

> ...the [sustainability] award ... was for being at the cutting edge and for always moving things. I mean that's...a plus and a minus as well 'cause...the big boys always follow us and, and then we, you know, we're always having to keep at the cutting edge but also you know, we kind of open out the market for everyone (Interview, Green building materials supplier).

The concept of niches as being protected spaces can therefore be questioned, as some businesses indicate that being in a niche is a space of 'attack', where larger businesses can appropriate innovations and practices for the mainstream, thus losing the unique aspects for niche businesses.

In addition, our interviewees suggested that far from being supportive, funding and policy frameworks can exclude or hamper business development in green building niches. As already suggested, policies for green building promote particular forms of green building, especially emphasising energy efficiency linked to carbon reduction targets. As niche ideas are less well understood and involve a divergence from mainstream accepted processes, it can be harder to secure funding or gain policy support – businesses which had been successful in receiving funding commonly attributed this to forward-thinking individuals in support organisations, rather than a broader policy commitment. Finally, the position of individuals and their businesses was fluid, with blurred distinctions between being in a niche and in the mainstream regime. In contrast to much of the literature 'green entrepreneurs' are rarely a neat, well-defined category. Many architects, for example, combined green and conventional commissions at the same time (to do otherwise was seen as 'financial suicide'). In some cases entrepreneurs have not developed their 'green' business on a full time basis so (in some cases reluctantly) undertake other mainstream work. For others (even with the original intention of being 'green' full-time), the lure of the mainstream ("having a nice car and earning a good salary") was hard to resist. Overall then, the concept of niches as protected spaces is problematic, as a range of influences, including policy, funding, business viability and disagreement over methods, all combine to make niches contested and fractured spaces.

Translation Between Niche and Regime

Transitions theory assumes a smooth diffusion of niche ideas into regime settings, whereas in practice innovations which display oppositional values to the incumbent regime may find translation difficult (Hielscher et al., 2011). Translations between niche and regime require careful negotiation by intermediaries (Smith, 2007) conducting 'regime-interfacing' activities. The niche-to-regime model reduces the complex plurality of socio-technical configurations into unlikely homogeneous niches trying to effect change in similarly problematic homogeneous regimes (Hielscher et al., 2011; Shove and Walker, 2007). Relations between socio-technical configurations are under-theorised leading to the emergence of an abstracted, niche-level identity, based around stylised socio-technical practices (Hielscher et al., 2011; Seyfang, 2009). Niche 'boundaries' are equally debatable, as are the definition of niches and the nature of boundaries between socio-technical regimes (Genus and Coles, 2008). We suggest that the mode of translating ideas, innovations and practices between niches and regimes cannot be assumed to be straightforward and progressive, rather it is a complex process of going back and forth, with hybrids emerging as practices collide and technologies evolve and involving complicated processes of translation, and embedding of 'best practices' (Blok, 2012). Local building contexts influence the types of buildings in particular places, as well as how new ideas and innovations are adopted and adapted. For example, the UK construction industry is familiar with and committed to cavity wall construction, representing a hurdle for different methods which challenge such practices.

Interviewees suggested that translating innovations and ideas within the green building sector is less than straightforward and the relationships that develop can be complex and time-consuming. For example, one architect suggested that explaining that "glass can be a green thing if you're controlling the solar gain with it" stood "absolutely no chance" with the planners, despite being a proven technology, illustrating the chasms which may need bridging between niche practices and the institutions and practices of the mainstream regime. This messiness of interactions between niches and the mainstream has led some to realise that success isn't necessarily going to come from niche originators, who one architect called the "seventies hippies movement". For him, the people who did the hard work are never going to realise significant change until it became financially viable and the 'big players' in the sector move in. Green housing niches do not exist in a vacuum; they have complex interactions with the mainstream regime, and emerge from pre-

existing allegiances, commitments and communities of interest all further exacerbating messiness and complexity (Seyfang, 2010; Seyfang and Longhurst, 2012).

Broader regime frameworks, such as policy initiatives and funding programmes, therefore influence whether particular niche practices or technologies are adopted, and in what form. Hybrids also emerge as ideas move into mainstream construction, and particular types of technologies are encouraged into the mainstream by schemes such as the UK's Code for Sustainable Homes or the Feed-in-Tariffs (FITs). The multiplicity of initiatives was argued as being confused and distracting:

> ...there's been so many initiatives, and people have got distracted by you know this Code for Sustainable Homes, and Code for Sustainable Homes keeps getting revised (Interview, Green building materials supplier).

Such initiatives are an essential part of niche diffusion, as niche innovations are adopted by the regime, albeit in a piecemeal fashion initially, leading to further evolution and change, but perhaps losing some of the aspects which originally made them innovative and attractive to the pioneers, yet conversely gaining other characteristics which broaden their appeal to wider markets (Seyfang and Haxeltine, 2012; Smith, 2006).

The policy framework for green building practice is therefore of crucial importance for potential transitions between niche and regime. Thus, while many respondents welcomed the UK's FITs for encouraging mainstream interest in green building practices, at the same time they were critical of them. Many respondents argued that solar photovoltaic (PV) and other renewables should only be added to a property once other issues such as insulation and draughts have been addressed. For respondents, these renewable technologies are not seen as being particularly sustainable, whereas for UK policy makers solar PV and other green energy technologies are the cornerstone of a green economy. Some businesses recognised that they are more purist which results in frustration:

> every domestic customer or everyone I talk to says, you know, 'oh I'm putting solar panels on my roof, isn't that good?' And I'm like, it's not very well thought through really...the whole you know, the priorities. There should be a list of priorities for, for doing your house

> up and [solar panels are] the very, very icing on the cake when you've done everything else (Interview, Green building materials supplier).

These broader frameworks therefore encourage *particular* forms of greening and certain niche activities, to the exclusion of more radical, and potentially more sustainable, alternatives. We therefore need to bear in mind what is left out when practices become codified and regulated (Lovell, 2008). For example, the UK Code for Sustainable Homes accords a higher weighting to certain practices, whilst not valuing other green building technologies:

> the way you can score points to hit certain targets is slightly dubious I would say, depending on where you are in the country, or in the city or rurally, or wherever. So I don't think it's an accurate way of you know awarding people points for building in a green way. I mean for instance Passivhaus, which has become quite popular in inverted commas recently...doesn't get anywhere near the Code for Sustainable Homes, but it performs far better in terms of energy use (Interview, Green builder).

Greenwood (2012) argues that the Code has a distorting effect on green building. The codification of knowledge does not necessarily guarantee the diffusion of projects and practices (Seyfang and Longhurst, 2012) – niche practices can be deeply embedded in local socio-economic contexts, and require some recontextualisation before being more widely accepted – this may be difficult if institutions are under-resourced or uninterested, thus limiting the spread of ideas and practices. Additionally, the variability in certification schemes between countries leads to difficulties in translating practices from one country to another, so that supposed 'best practice' cannot simply be transferred (Blok, 2012; Faulconbridge, 2013). Another distortive effect reported by some respondents is the asymmetry in policy processes, whereby large companies which display regime characteristics, like B&Q, are involved in negotiating the design of policies like the Green Deal, excluding smaller companies from having an opportunity to shape policies. There are therefore a variety of factors shaping the relationships between niche and regime resulting in outcomes - multiplicity and messiness are far more common outcomes than linear translation.

Conclusions

Our research suggests that we can identify green entrepreneurs who seek to combine environmental and business objectives and who are not simply economically-motivated. In some cases they are seeking to develop new business models and to educate customers, suppliers and the wider building sector about green building practices. However, in contrast to much of the literature on green entrepreneurs this is not an unproblematic category – individuals moved between 'green' and 'conventional' business, evolving over time, such that this is a fluid and blurred, rather than static, state. For some respondents maintaining 'green-ness' has been difficult and they have had to compromise by undertaking more conventional projects at the same time. Others were content to maintain their niche status and to be underemployed, but had little interest in effecting wider change in the sector. Moreover, while the green economy is often referred to as a singular entity, and the green building sector is also referred to as a coherent sector with agreed and consistent practices, our evidence suggests that green building techniques and practices are far from agreed, business models vary, and there are significant contradictions *within* so-called green building practices.

We have argued that concentrating on the entrepreneur as a lone actor is a flawed approach; rather, more attention should be focused on exploring their wider networks. This emphasis on wider support networks and other actors is necessary to situate the actions of individual green entrepreneurs within their wider political and social context, and explore how green entrepreneurs are linked to other actors in facilitating sustainability transitions. Focusing solely on the individual green entrepreneur leads to an impoverished theoretical understanding; the wider network is important as, without this framework the scope for individual entrepreneurs to be influential and challenge regimes (i.e. beyond the niche) may be somewhat limited. There is, therefore, a need to examine not just the activities of green entrepreneurs and their firms as constituting potentially sustainable technological niches, but also to place these within the extant socio-technical regime within which they operate. As Parrish (2006: 6) states "to understand the contribution an enterprise can make to sustainable development, attention must be directed to the interaction between the enterprise and other components of the social-ecological system". We argue here that the socio-technical transitions literature offers a rich source from which to theorise green entrepreneurship in more detail than has so far been undertaken.

Certain aspects of niche activity can be more easily appropriated by the mainstream and may represent a first step towards more embedded sustainable transitions (Smith, 2006: 455). The extent to which this occurs involves not just action by green entrepreneurs, but also broader actions from the state and other actors to ensure supportive institutional structures and forms are in place (Gibbs, 2002). Many of those working in the socio-technical transitions field are agreed that intervention in the pursuit of sustainability "is possible and potentially effective" (Walker and Shove, 2007: 219). The degree of change that entrepreneurs bring about depends on the value ascribed to entrepreneurship in that particular society (Hannafey, 2003), and the networks and relationships which green entrepreneurs and other actors develop in order to translate innovations from the niche to the wider regime and changes in the landscape which may present 'windows of opportunity'. The state plays an additional role in promoting the green economy through its enabling and supporting role encouraging innovation and the development of new sectors (Barry and Doran, 2006). What is less clear is exactly what form such intervention should take, beyond a recognition that it will involve multiple tools, methods, actors and knowledges. While governments, policy makers and academics are increasingly interested in green economies as a new growth paradigm, empirical evidence from entrepreneurs running green businesses has been lacking – here we present a step to redress this imbalance and suggest that we need to recognise that both entrepreneurship and policy processes involve contestation and 'messiness' rather than linear development.

To conclude, at the national scale, while encouraging the development of a green economy appears to be strongly embedded within the UK policy framework, there is some degree of uncertainty within this which affects green businesses. The research has coincided with the Conservative-Liberal Democrat government's decision to reduce the funding through the Feed-in Tariff, and this is a particular issue which concerned our respondents, even for those not directly involved in solar installations. For our respondents, such changes are indicative of a lack of strategic direction and incoherence through lack of policy leadership and U-turns leaving some feeling that the policy framework is transient. Rodgers (2010) suggests that, with respect to policies, green issues themselves are becoming niche, relegated to specific departments within corporate business, and this is perhaps not surprising as it mimics the UK Government's own vision of 'the green economy', as a bolt-on or freestanding part of the wider economy rather than a more holistic greening of all economic activity regardless of sector. Uncertainty and lack of clarity

is therefore a key issue for the future development of green entrepreneurial activity, despite claims that 'the green economy' is where future economic growth will occur.

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