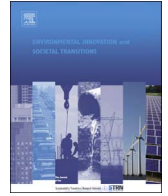




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Original Research Paper

Creating innovative zero carbon homes in the United Kingdom — Intermediaries and champions in building projects

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ABSTRACT

A transition to zero carbon buildings is needed for mitigating climate change. Yet, it is far from gaining sufficient momentum in many countries, particularly the United Kingdom. This article focuses on actors and platforms facilitating change towards zero carbon residential buildings by integrating the concepts of innovation intermediaries and champions. Drawing on interview data and building on the literatures of innovation intermediaries, champions and Strategic Niche Management, the article analyses actor configurations in three new build housing projects. The findings show that actors and platforms acting as innovation intermediaries advance zero carbon buildings at different stages of project development, with varying intensity, influence and longevity. Some intermediaries take also championing roles, while also other actors champion projects when intermediation is absent. At a time of limited policy support for zero carbon housing innovations, intermediation and championing activities become especially important in the transition towards zero carbon buildings.

1. Introduction

Actions driving zero carbon buildings are pertinent in the broader transition towards more sustainable energy systems. Such transitions provide an opportunity for the built environment to contribute to emissions reduction (e.g. Nykamp, 2017). It has been argued that to improve the energy performance of buildings, the building sector needs system innovation (Mlecnik, 2013). This means the integration of several independent innovations (e.g. technical products, applications, services) to work together to perform new functions or improve performance as a whole (Cainarca et al., 1989). The large scale adoption of system innovations, such as zero carbon buildings, suffers from complexities of the concept (Jain et al., in press) and the slow renewal rate of the building stock in general (Meeus et al., 2012). However, the myriad of actors involved in transitions (e.g. Wittmayer et al., 2017) such as intermediaries, could potentially be performing crucial activities that support the uptake of system innovations.

In the context of building new zero carbon homes, system innovation implies novel configurations of solutions relating to building fabric, insulation, ventilation, heat recovery, on-site renewable energy generation, and demand response. While many of the components already exist globally, a specific configuration may be a completely new kind of combination (i.e. system innovation) at least in the context of the United Kingdom (UK), where the building sector is locked into incremental innovation (Lees and Sexton, 2014), and low impact building solutions remain limited (Heffernan et al., 2015).

This article focuses on three case studies falling into the category of system innovation in zero carbon buildings, that have

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received less focus on innovation and transition studies than modular solutions, such as heat pumps (Caird et al., 2012; Hyysalo et al., 2013) and solar PV (Heiskanen et al., 2014; Smith et al., 2014). While system innovation may face more generic innovation barriers, due to its path breaking nature, system innovation may also require more support than modular innovation from intermediating agents to connect different innovations and actors, particularly in the diffusion (Van Hal, 2000) phase.

In this article, we draw on Strategic Niche Management (SNM), and the processes of niche protection (Schot and Geels, 2008; Smith and Raven, 2012) to analyse three innovation cases of zero carbon new build in the UK, paying particular attention to how intermediation and championing (defined in Section 2) have supported and facilitated the building processes. Different phases of niche development have been illustrated in the SNM literature: starting with the development of concrete local projects, where actors work together to connect, network, share experience and replicate, eventually forming a ‘cosmopolitan’ or global niche (Geels and Deuten, 2006; Geels and Raven, 2006; Seyfang et al., 2014). This niche is described as an abstract or imagined wider community within a field that consolidates, through intermediation, the experiences and learning from multiple local projects (Geels and Deuten, 2006; Geels and Raven, 2006; Seyfang et al., 2014).

We extend the emerging literature on intermediation in SNM by analysing intermediation from the perspective of specific niche projects, rather than from the perspective of specific intermediary actors; which much of previous research has focused on (e.g. Hargreaves et al., 2013; Seyfang et al., 2014; Kivimaa, 2014; Fischer and Newig, 2016; Bush et al., 2017). In doing so, we add a new layer to intermediation in SNM by focusing attention on who – besides those that operate on the ‘cosmopolitan’ niche level or as ‘global carriers’ of best practice (Seyfang and Longhurst, 2013; Seyfang et al., 2014) – are important in facilitating transition in specific projects. Thus, we complement studies on broader niche development (Hargreaves et al., 2013; Seyfang et al., 2014), paying attention to local projects, and their connections with the wider niche through intermediating actors or platforms. Championing tends to focus on supporting specific innovation projects (Klerkx and Aarts, 2013), and can, therefore, complement niche intermediation, which we analyse by focusing on the overlaps between intermediation and championing.

Previous literature lacks attention to the potential of intermediation and championing in local projects in a phase, when a cosmopolitan niche has already developed, and in particular in the domain of zero carbon buildings. We address this gap by examining case studies of specific building projects, shaped by the cosmopolitan niche. Although our main focus is on the building projects, we make a connection to the cosmopolitan niche by showing how intermediation and championing in this broader context influence the set-up of new projects and the transfer of learning from these projects to the niche. Our case study context is the zero carbon building niche that reached a take-off phase in the UK in early 2000 s but has not yet accelerated.¹ The niche has been significantly hindered by policy changes since 2010 (cf. Kivimaa and Martiskainen, 2017), particularly the removal of the ‘Zero Carbon Homes Target’ in 2015 (see Rosenow and Eyre, 2016; Ares, 2016). The niche incorporates system innovation as described above and shares a drive to develop, diffuse and mainstream zero carbon construction to address the old and inefficient building stock that contributes approximately 25% of the UK’s greenhouse gas (GHG) emissions (Palmer and Cooper, 2013).

Focusing on the specific building projects located in the City of Brighton and Hove, UK, we answer the research question: *How do innovation intermediation and/or championing manifest and evolve in the development of zero carbon building projects?* The research examines specifically:

- 1.) What kinds of actors take on intermediation and championing in the studied cases?
- 2.) What activities are associated with intermediation and championing in different phases of the building projects, and how are these connected with each other and to SNM?
- 3.) What is the relevance of intermediation and championing in the studied cases?

The article is arranged as follows. Section 2 discusses the conceptual framework used in the article, drawing on literature on SNM, innovation intermediaries and innovation champions. Section 3 explains the research method. Section 4 presents findings from the three case studies of innovative building projects. Section 5 discusses the findings, while Section 6 concludes.

2. Conceptual framework: strategic niche management, intermediaries and champions

2.1. Strategic niche management (SNM)

The literature on sustainability transitions claims that new technological and social innovations are needed to deal with the mounting challenges such as resource scarcity and climate change (e.g. Hoogma et al., 2002; Geels et al., 2008). While incremental innovation is typically supported by established socio-technical regimes, more disruptive innovations develop in niches; spaces in which they can seek momentum to emerge and diffuse (Schot and Geels, 2008). SNM was developed to better understand technological change in connection with economic and social changes, simultaneously, aiming to build more constructive relationships to progress the adoption of new technology to social contexts (Hoogma et al., 2002). Niches can be seen as protective spaces for innovations otherwise likely to be unsuccessful in the selection environments of dominant regimes (Smith and Raven, 2012). In this protective space, three intertwined processes nurture innovations (Hoogma et al., 2002; Schot and Geels, 2008):

¹ The key database for low energy housing in the UK, the Low Energy Building Database, lists less than 90 completed new built projects that were designed to be nearly zero carbon: <http://www.lowenergybuildings.org.uk/projectbrowser.php?fs=Private%20Residential&fes=PassivHaus> [Accessed 09.06.2017]

- (1) Articulation of expectations and visions shared by many actors and demonstrated by multiple projects: strong visions can attract external support for the niche.
- (2) Creation of networks enabling niche actors to interact, form partnerships and pool collective resources; and
- (3) Learning in multiple dimensions, including aggregating best practice and lessons from projects and initiatives, and sharing knowledge towards local experiments.

Connecting intermediation and SNM, Hargreaves et al. (2013) and Seyfang et al. (2014) examined the development of the UK community energy niche. They view niches as comprising multiple on-the-ground local projects (such as, in this article, zero carbon building projects) that are linked together by intermediary organisations and the shared institutional infrastructure they generate (Hargreaves et al., 2013 and Seyfang et al., 2014). They, thus, depict that intermediaries consolidate learning from multiple local projects and reformulate it into ‘global’ transferrable standards, best practice and other mobile forms helping new projects (see also Geels and Deuten, 2006, Wihlborg and Söderholm, 2013). They see intermediaries operating largely in this ‘global’ sphere, also used in describing country-scale developments (Hargreaves et al., 2013, Seyfang et al., 2014). Seyfang and Longhurst (2016) continue this logic in their analysis of community currencies, arguing that national intermediaries performing cosmopolitan niche functions are crucial for the extensive replication of projects. Hatzl et al. (2016) conclude that the shortage of intermediary organisations producing institutional knowledge or coordinating between projects impaired the formation of a solar PV niche in Austria.

Kivimaa (2014) argues that government-affiliated intermediaries contribute to niche building by initiating and managing new policy, or market processes, and by acting as impartial agents for new networks of niche actors. Such intermediaries may also act in projects, for example, by finding funding sources, brokering between parties (networking), engaging in prototyping and piloting, or disseminating information from projects (learning) (Kivimaa, 2014). Intermediation, thus, occurs in support for both local projects and the cosmopolitan niche. Later, Bush et al. (2017) studied intermediaries in relation to new, fictional UK district heating projects, and found that local and national intermediaries could perform differing, yet complementary, support for the niche.

The term champion has had limited explicit use in SNM. Caniels and Romijn (2008) make connections between champions (with visionary qualities) and change agents: “According to all the major SNM studies, a further crucial factor... is the presence of a change agent who champions the innovation” (p.252). Kemp et al. (1998) view of entrepreneurs building new technological systems with persistence meets the definition of a technology champion by Klerkx et al. (2013). Caniels and Romijn (2008, p.253) see a specific role for innovation champions in the implementation phase of experiments – for setting goals, building actor networks and facilitating learning process.

We analyse how intermediation and championing became part of and shaped building projects, and created links to the cosmopolitan niche. In doing so, we make a stronger link to champions in the SNM literature, albeit on the project level. Due to the importance of project-based collaboration aiding system innovation in the building sector (Mlecnik, 2013), we are interested in both intermediation and championing in specific zero carbon building projects and whether there are overlaps and/or differences between them, further elaborated in Section 2.5. Given the emerging nature of the literature on intermediaries within sustainability transitions (Kivimaa et al., 2017), we draw on innovation studies’ concepts of ‘innovation intermediaries’ and ‘innovation champions’ to better understand how these activities manifest in building projects.

2.2. Innovation intermediaries

Innovation intermediaries are central actors in innovation processes (Howells, 2006). While the term ‘intermediary’ has been used and defined in different ways in different research approaches (Kivimaa et al., 2017), we understand intermediaries as actors “who create spaces and opportunities” for others (Stewart and Hyysalo, pp.296-297) and “mediate, ... work in-between, make connections, enable a relationship between different persons or things” (Hodson et al., 2013, p.1408). Intermediaries – be it individuals, organisations or platforms – are more than knowledge brokers (Geels and Deuten, 2006) or networkers (Hamann and April, 2013). They can facilitate innovation processes by educating, gathering and distributing financial and human resources, evaluating new technologies/practices, creating partnerships, and influencing regulations and rules (Stewart and Hyysalo, 2008; Kivimaa, 2014). They may also shape (e.g. configure) the way in which the innovation occurs when it reaches the user, and connect and negotiate on behalf of other actors (e.g. broker) (Stewart and Hyysalo, 2008).

While intermediaries can at first glance be seen as ‘neutral’ or ‘unbiased’ mediators (e.g. Kivimaa, 2014), they have also been shown to be more engaged, and less neutral, by for example actively managing innovation processes (Agogue et al., 2013). The length of intermediation too can vary, from short-term projects to medium and longer-term programmes (Hodson et al., 2013, Poncet et al., 2010), with intermediaries taking on new functions in line with the changing environment (Moss, 2009). Much of the literature has focused on the roles of intermediaries (e.g. Howells, 2006, Kivimaa, 2014), with much less knowledge on how intermediation changes over time in innovation processes (cf. Hakkarainen and Hyysalo, 2016), for example, from initial project initiation to going beyond completion of a specific project. Furthermore, while previous literature on innovation intermediaries has studied them, for example, in the context of adoption of innovations (e.g. Aggarwal, 1997) and of specific projects or programmes (e.g. Poncet et al., 2010), there has been less research on how project specific intermediation connects to niche development in the sustainability transitions literature.

2.3. Innovation champions

Innovation champions have been defined as individuals who “actively and enthusiastically promote innovations through the crucial

Table 1
Different types of innovation champions (based on Klerkx et al., 2013, p.186).

Innovation champion type	Activities	Barrier type	Power base
Technology champion (or an 'expert champion')	(1) Inventor of technology (never regarded as an intermediary) or (2) an expert who wishes to advance a technology and advocates it.	Technological barriers	Knowledge speciality, technological expertise
Power champion (or the 'godfather' of innovation)	Sponsor and supporter of the innovation by exerting social and political effort to mobilise support. The godfather is a very high-level person with limited involvement, but who is very powerful (such as a CEO). May sometimes be an intermediary.	Institutional barriers: ignorance, opposition, lack of resources	Hierarchical potential, control of resources
Process champion	Fulfils a key role in creating a receptive environment (in the firm) by linking the technology champion and the power champion through translating 'technology language' into 'business language', turning an idea into a plan of action. Many similarities to an intermediary.	Institutional barriers: administrative, bureaucratic	Procedural know-how, communication skills
Network champion (or 'relationship champion')	Fulfils a bridging and brokerage role between already connected and previously disconnected organisations. Many similarities to an intermediary.	Organisational barriers: cooperation, dependency	Networking and communication competence

organisational stages, [and] are necessary to overcome the social and political pressures imposed by an organisation and convert them to its advantage" (Howell et al., 2005, p.642). While much of the earlier literature has identified them as intra-organisational actors (see e.g., Shane et al., 1995; Howell et al., 2005; Markham and Aiman-Smith, 2001; Kelley and Lee, 2010), more recently Klerkx et al. (2013) have argued that, given the increase in collaborative innovation processes, many actors external to specific organisations can also be innovation champions in system innovation, including consultants, facilitators and policy makers. Even though they often emerge informally (Klerkx and Aarts, 2013), innovation champions can also be appointed formally (Klerkx et al., 2013).

Innovation champions aim to address barriers such as "lack of resources, missing linkages and deficient coordination between actors, and opposition of incumbent actors" (Klerkx and Aarts, 2013, p.195), especially when there might be resistance to an innovation (Shane et al., 1995). They generally express enthusiasm and confidence about the success of an innovation, persist under adversity, use their influence and get the right people involved (Howell et al., 2005, Kelley and Lee, 2010). Promotion of an innovation (see also Fichter, 2009, Hauschildt and Kirchmann, 2001), securing resources and motivating others are key actions (Howell et al., 2005, p.646). However, innovation champions face challenges too, such as resistance to the innovation, and lack of information and resources (Kelley and Lee, 2010).

In this article, we adopt the categorisation of innovation champions by Klerkx and colleagues (Klerkx and Aarts, 2013; Klerkx et al., 2013, see also Fichter, 2009; Gupta et al., 2006; Hauschildt and Kirchmann, 2001; Kelley and Lee, 2010; Markham and Aiman-Smith, 2001; Smith, 2007) under four types: technology champion, power champion, process champion, and network champion (see Table 1). A specific actor can adopt multiple championing roles: i.e. a technology/power champion can also act as a process/network champion (Klerkx and Aarts, 2013).

2.4. Previous research on innovation intermediaries and champions in the context of zero carbon buildings

Research on intermediation and championing in zero carbon building transitions is an emerging empirical line of enquiry. Previous research has focused on intermediaries in different aspects of building processes. For example, Fischer and Guy (2009) argued that architects may become increasingly important interpretive intermediaries with the move towards tightened building regulations in the UK. In this new regulatory space, architects can intermediate between "the regulatory requirements and regulators on the one hand, and the design process and its actors on the other hand" (Fischer and Guy 2009, p.2579). Building sector organisations, such as the US Green Building Council, have been identified as potential intermediaries improving information between builders and house buyers, and stimulating demand for low energy housing via a green design certification scheme (Arora et al., 2014). Municipalities in Denmark have facilitated, lobbied and disseminated for low energy housing concepts, and influenced policy (Holm et al., 2011). In Finland, a government-affiliated intermediary was active in voicing expectations, finding funding, investing in new businesses, and creating opportunities for learning-by-doing (Kivimaa, 2014). In Belgium, a passive house platform had a key role in facilitating an innovation journey for highly energy efficient buildings (Mlecnik, 2013). Post-construction, Grandclément et al. (2015), examining a low energy residential care home in France, concluded that the onsite building manager acted as an influential intermediary between residents, building designers and building maintenance. S/he facilitated learning processes between the residents and new technology, and brokered between the residents and contractors when problems arose (Grandclément et al., 2015).

Innovative small builders in the United States have been identified as technology champions in building energy efficiency (Koebel, 2008). Also specific individuals in housing cooperatives have been described as influential champions promoting the implementation of energy efficiency measures in Sweden (Palm, 2012). Previous studies have not, however, typically approached both energy efficiency and transition perspectives, had a temporal perspective on intermediation, or used the concepts of champions and intermediaries jointly. Furthermore, apart from Fischer and Guy (2009) there are limited studies that would have focused on intermediation, and/or championing, in local projects in the UK low energy building sector, a gap this research addresses.

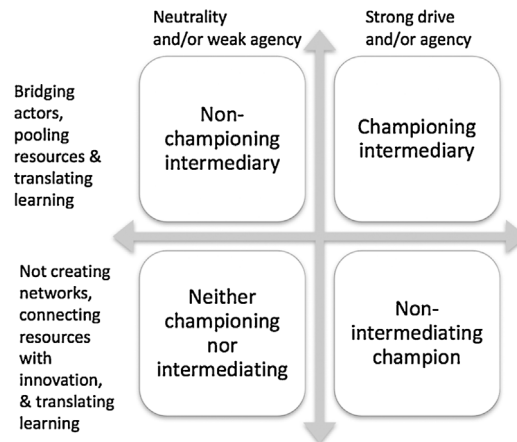


Fig. 1. Intermediation and championing.

2.5. Analytical framework combining intermediating and championing in local projects and cosmopolitan niche

The concepts of ‘innovation champion’ and ‘innovation intermediary’ both complement each other and overlap. We approach intermediation and championing as sets of activities that different actors (or platforms) can undertake temporarily or more permanently. In previous literature, intermediation has been associated with differing degrees of change agency (Kivimaa, 2014; Parag and Janda, 2014), motivation to promote sustainability transitions (e.g. Hodson and Marvin, 2009; Moss 2009) and normative positioning ranging from neutral to strongly advocating a certain position (e.g. Elzen et al., 2012; Orstavik, 2014). It is likely that actors both with or without strong agency can adopt intermediary roles in SNM. We make this distinction clearer by drawing on the concept of champion(ing). Championing is typically associated with strong agency, dedication and drive focused around a specific innovation (e.g. Howell et al., 2005; Klerkx et al., 2013). Actors undertaking championing may or may not also intermedate. We, therefore, show in Fig. 1 how intermediation and championing overlap, and in Table 2 illustrate the different types we focus our analysis on: non-championing intermediary, championing intermediary, and non-intermediating champion. We distinguish those from neither championing nor intermediating entities as a fourth category.

A *non-championing intermediary* is regarded as neutral, being less passionate in advocating or visioning activities, and more focused on linking other parties in a project or between projects through learning or networking. This reflects Parag and Janda (2014) view of an intermediary actor. A *championing intermediary* is similar to a process or network champion. Such actor has a strong motivation for particular sustainable solutions or advancing policy change in the field, and creates links between parties including customers, developers and builders. Champion-intermediaries link to Kivimaa (2014) view of systemic intermediaries. A *non-intermediating champion* is similar to Klerkx et al. (2013) view of a technology or power champion. This can be an inventor, builder, developer or other supporter, with a strong personal interest and drive for advancing new concepts and creating visions for them. There is less focus on network creation, connecting resources or translating learning. *Neither championing nor intermediating* entities (typically actors) are involved in the innovation process but do not have strong agency; nor do they undertake networking, learning and visioning activities.

Network and process champions “*focus more on the micro level [or]... are concerned with day-to-day orchestration*”, while power champions could potentially use their influence and ‘sell’ their innovations to ‘the right’ intermediaries (Klerkx and Aarts, 2013, p.206). Both champion and non-champion intermediaries can help those non-intermediating champions who “*struggle with limited access to resources and a lack of support*” (Kelley and Lee, 2010, p.1010). Both intermediation and championing concepts link also closely to other actors driving innovations identified within the sustainability transitions literature, such as frontrunners (Brown et al., 2013), hybrid actors (Elzen et al., 2012) and community leaders (Martiskainen, 2017; Uhl-Bien et al., 2007).

In Table 2, we outline non-championing intermediaries, championing intermediaries, non-intermediating champions, and neither championing nor intermediating entities, listing example activities for each in project and niche phases. This categorisation of activities pertaining to local projects and the niche was used to examine the case studies of zero carbon building projects.

In our analytical framework, we draw on the conceptualisations of intermediation and championing and merge them with how regime and niche has been depicted in SNM, adding to that local projects (Fig. 2).

4.1. Research method: In-depth case study research

The empirical research design uses an in-depth case study approach (cf. Flyvbjerg, 2011; Yin, 2009), based on qualitative analysis of three zero carbon building projects in the UK. At first, seven scoping interviews were conducted with stakeholders (Appendix A) to map out developments and issues in the field, and to derive case selection criteria and recommendations for innovative cases. A decision was made to locate all cases in the City of Brighton and Hove (from now on referred to as ‘Brighton’) to enable comparison of intermediation and championing in different building projects within the same geographical and administrative context. Brighton

Table 2

Defining non-championing intermediaries, championing intermediaries, non-intermediating champions and those who are neither championing nor intermediating for zero carbon building.

Type of actor	Description in the context of zero carbon building	Key activities in zero carbon building
Non-championing intermediary	A neutral actor linking other parties in a project or between projects either through knowledge dissemination or networking. More dependent on external funding than championing intermediaries. Reflects Parag and Janda (2014) view of an intermediary actor.	<p>May have an interest in zero carbon housing but is not its passionate advocate; more of a neutrally regarded actor. Particular focus on networking and (disseminating) learning. No active visioning but may disseminate visions of others. Facilitating learning through:</p> <ul style="list-style-type: none"> ● Providing education, advice, and/or information locally/nationally/globally on zero carbon building ● Aggregating and sharing knowledge of local experiments ● Creating spaces for new idea generation and learning ● Connecting project external learning with project development ● Advising others in a project ● Adapting learning from a project as it goes along <p>Networking</p> <ul style="list-style-type: none"> ● Instrumentally maintaining the network, i.e. organising meetings etc. ● Pooling resources for the project ● Acting as a nodal point between project actors, and towards actors external to the project
Championing intermediary (typically process or network champion)	An actor linking other parties in the project or niche including customers, developers and builders. Strongly motivated to drive particular sustainable technologies or advancing policy change in the field. Links to Kivimaa (2014) view of systemic intermediaries.	<p>Holds a strong interest in advancing the zero carbon/sustainability goal in building projects more generally. Visioning and creating expectations always in addition to networking and/or facilitating learning. Articulation of visions and expectations through:</p> <ul style="list-style-type: none"> ● Piloting zero carbon building concepts ● Lobbying for policy and industry change locally/nationally/globally towards zero carbon ● Facilitating the creation of new national/global standards for zero carbon building ● Creating and/or implementing a vision and expectations regarding a specific project ● Turning an idea into action (process champion) <p>Facilitating learning through:</p> <ul style="list-style-type: none"> ● Providing education, advice, and/or information locally/nationally/globally on zero carbon building ● Aggregating and sharing knowledge of local experiments ● Creating spaces for new idea generation and learning ● Connecting project external learning with project development ● Advising others in the project ● Adapting learning from the project as it goes along <p>Networking</p> <ul style="list-style-type: none"> ● Raising support locally/nationally/globally for zero carbon building in general or for a specific project (network champion) ● Connecting actors to form a project in the first place ● Pooling resources for the project ● Acting as a nodal point between project actors, and towards actors external to the project
Non-intermediating champion (typically technology or power champion)	An inventor, builder, developer or other supporter. Strong drive and advancement for zero carbon building or creating new housing concepts. Similar to Klerkx et al. (2013) view of a technology or power champion. No active creation of networks, connecting resources or translating learning	<p>Often personal interest in advancing the project. May take on visioning and (technological) learning, less focus on networking and translating learning to others. Articulation of visions and expectations through:</p> <ul style="list-style-type: none"> ● Inventing and piloting zero carbon building concepts locally/nationally/globally, e.g. an inventor, a technology advocate (technology champion) ● Lobbying for policy and industry change towards zero carbon, e.g. a sponsor, a 'godfather' (power champion) or a technology advocate (technology champion) ● Creating a vision/design or expectations for a specific project, e.g. an inventor, an owner-builder or an architect
Neither championing nor	An actor (or entity) involved in the innovation process	Involved in low energy housing projects e.g. in building and <i>(continued on next page)</i>

Table 2 (continued)

Type of actor	Description in the context of zero carbon building	Key activities in zero carbon building
intermediating	through their position in the building sector: for example an architect, builder or a project manager. Does not have strong drive for zero carbon building, and is not linking parties or advancing the field.	supervising such projects. Has knowledge but does not necessarily share this knowledge beyond her/himself. May remain neutral non-advocate through e.g. increased difficulty of construction or limited resources for wider engagement. <ul style="list-style-type: none"> ● Limited involvement in articulation of visions and expectations, networking and wider learning processes

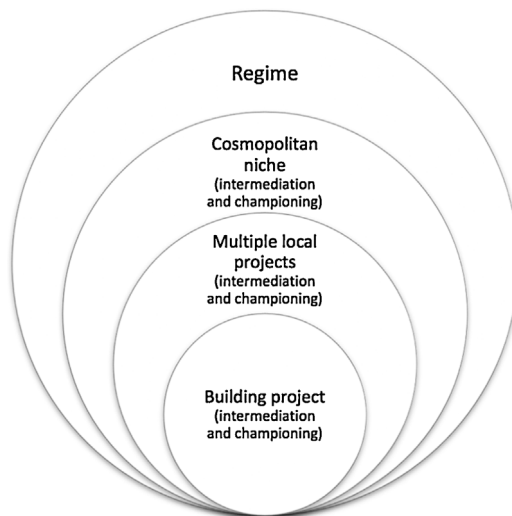


Fig. 2. Layering of intermediation and championing from local building projects to the cosmopolitan niche.

provides an interesting setting, because it has a high proportion of emissions linked to housing. It is one of the ‘hotspots’ for environmentally sustainable buildings in the UK, alongside Bristol and London (see Section 4.1). In addition to scoping interviews, Brighton’s ‘Eco Open Houses’ brochures were used as a source for identifying cases. Three cases involving different building types (e.g. apartment building, terraced house, detached house) and building processes (e.g. large commercial developer, private householder, self-builder) were chosen for the in-depth study (see Table 3).

Principal data collection for case studies was conducted using semi-structured interviews, either face-to-face, over the phone or, in one instance, over email. The number of interviews ranged from 1 to 6 per case depending on the number of people involved in the building project. The interviews paid particular attention to key stages of project development, with questions focusing on: idea development and planning (e.g. project start and initiation, knowledge gathering, acquiring planning permission), building process (e.g. creating teams and partnerships, constructing the project) and dissemination of experience (e.g. project dissemination, acting as an example to others, contribution to learning). Interviewees were also asked about their expectations for the project, whether those were met and what key learning emerged. Key actors were also identified. The interviews were digitally recorded, noted and transcribed, following the University of Sussex ethical review guidelines. In addition, background documents, site visits and in one case (One Brighton), an attendance of an on-site learning tour organised by the UK Green Building Council (UKGBC), were used as additional materials.

Following data collection, a detailed case history – tracing planning, construction, post-construction and embedding stages of each zero carbon building project – was written by the research team, including a detailed timeline for each project (following innovation histories by Douthwaite and Ashby, 2005). The case histories were sent to all interviewees to check for accuracy. Once finalised, the case histories were coded by two researchers who identified which actors or platforms carried out intermediation or championing (following Table 2) in each stage of the building process. From this analysis, a typology of intermediation and championing was developed.

5. Results: intermediaries and champions in low energy housing

5.1. Context of case studies: the United Kingdom and city of Brighton & Hove

The UK has around 27 million residential buildings. There is a need for new homes to meet housing demand, though the rate of new build remains low. The construction sector suffered from the 2008 global financial crash and subsequent recession, recovering slowly since 2014 (Rhodes, 2015). In total, the sector contributed £103 billion in economic output in 2014, around 6.5% of the UK total (Rhodes, 2015).

Table 3

Cases selected for in-depth analysis.

Case	Description	System components	Methods & data sources
Grantham Road	Private new built house (built to meet level 5 of UK Code for Sustainable Homes)	<ul style="list-style-type: none"> - Airtight construction with high level of insulation - Air Source Heat Pump - Double glazing - Low energy lighting and appliances - Natural materials - Solar PV and solar thermal - Rainwater harvesting - Underfloor heating - Ventilation system with heat recovery - Woodburning stove with back boiler 	3 face-to-face interviews (owner, architect, builder); background documents
Hartington Road	Self-build new house (no specific zero carbon criteria used)	<ul style="list-style-type: none"> - Airtight construction with high level of insulation - High performance double glazing - LED lighting and low energy appliances - Mechanical ventilation with heat recovery (MVHR) - Passive solar gain - Rainwater harvesting - Solar thermal - Sustainable and low embodied energy materials - Timber frame and part cladding - Underfloor insulation - Water saving fittings - Woodburning stove 	1 face-to-face interview (owner-builder); background documents, including brochure and media articles
One Brighton	Two apartment blocks (172 flats; designed to EcoHomes Excellent standard with an aspiration to zero carbon definition)	<ul style="list-style-type: none"> - Airtight construction with high level of insulation - Biomass heating and hot water - Breathable clay block walls - Car-free - Energy efficient light fittings - High performance glazing - Highly efficient building fabric - Photovoltaic panels - Rain-water harvesting - Roof top allotments - Sustainably sourced timber - Ventilation system with heat recovery - Water efficient taps, fittings and appliances 	6 face-to-face interviews (developer, construction company, local council, sustainability consultant, architect, commercial tenant); 1 email (resident) response; attendance of an on-site learning event; background documents

The UK's 2008 Climate Change Act (UK Government, 2008) requires an 80% reduction in greenhouse gas (GHG) emissions by 2050. Despite this target, many building energy efficiency policies were removed in 2015 (see for example Rosenow and Eyre, 2016). Thus, other forms of support are necessary for a transition towards zero carbon buildings, as the UK is unlikely to meet its emissions reduction targets without contribution from the building sector. Coordination of zero carbon building is also needed as the building sector consists of thousands of small, and often uncoordinated companies (Killip, 2013), that may not have the competence or resources to innovate independently (Mlecnik, 2013). Skills shortages (Dowson et al., 2012) and developers not valuing energy efficiency (Fischer and Guy, 2009) constitute further barriers.

Brighton, comprising 250,000 residents, is located on the south coast of England. The quality and impact of housing is of particular importance to the city as housing counts for the largest percentage of its carbon emissions – 42% compared to 31% nationally (Brighton and Hove City Council, 2015a). While the city does not have heavy industry, there is a high proportion of older buildings built before 1919 (39.8% compared to the national average of 24.9%) that tend to have higher carbon footprints (Brighton and Hove City Council, 2015a). The City Council has been active in promoting zero carbon buildings through, for example, organising the Eco

Open Houses event together with Low Carbon Trust and Brighton Permaculture Trust. The event was held annually from 2008 to 2015 (Eco Open Houses, 2015) (due to resume in 2017). During the event, new and retrofitted homes were opened to the general public to see a variety of sustainable buildings. In 2015, over two weekends, 1400 people visited 13 homes across the city (Green Building, 2015). The City Council has also explored a ‘One Planet Living’ concept in planning sustainable development (Brighton and Hove City Council, 2015b, 2015b). The concept was developed by Bioregional in 2003, covering sustainability in ten different areas including energy, materials, waste, transport, food, land use & wildlife, culture & community, equity & economy, and health & happiness (see also Section 4.4). These activities by the City Council have provided a protective space and a ‘window of opportunity’, whereby the Council has been able to influence the zero carbon building agenda (Fudge et al., 2016).

5.2. Grantham Road

Grantham Road is a detached, three-bedroom house, incorporating a mix of sustainability and low energy measures with a strong focus on design and aesthetics. The owners, a semi-retired couple, both graphic designers, wanted to build a sustainable house that is high-tech, striking and comfortable but also low-cost in their retirement years. Their initial motivation goes back to the 1970s when the couple visited the Centre for Alternative Technology (CAT) in Wales. CAT is a pioneer in low energy housing and renewable energy technologies (Lovell, 2007), providing educational courses, a visitor centre with on-site applications of low energy solutions, and research reports such as Zero Carbon Britain (CAT, 2017). During their visit to CAT, the couple saw first-hand low energy housing ideas and technologies creating expectations of what was possible. This inspired them to plan building their own, sustainable, home. CAT created expectations regarding this project, but also through its broader activities in transferring learning and influencing policy and industry, it has acted as a *championing intermediary* for the niche in the UK.

When the couple finally started to fulfil their lifelong dream of building a sustainable home in 2009, during the following six-year planning stage, they sought knowledge from house building TV programmes, magazines and visits to Eco Open Houses (see Section 4.1). The latter provided an opportunity to see sustainable homes, find out who had designed and built them, and what technical solutions they contained. Eco Open Houses provided a space for learning and networking, effectively acting as a *non-championing intermediary* for local projects.

The couple hired an architect who could also project manage the build – a practice others who had built their own homes highly recommended. The architect was appointed in 2009. Whilst being interested in low energy housing, he had not previously worked on the high level of sustainability and energy performance required for the Grantham Road house. His key task was to translate the owners’ vision into a design, giving a range of configurations for the owners on how to do this. He also dealt with the local authority to apply for required planning permissions and adjusted designs as required, negotiating the design process between the couple and the planning authority. While the architect started as a *non-championing intermediary* for the project, later visioning and engagement activities made him a *championing intermediary*. The architect helped the couple to select a builder – which had built one of the Eco Open Houses that they had visited and were impressed by. The building company had won the Federation of Master Builders (FMB) Energy Efficiency Award in 2011, indicating they may be a *non-intermediating (technology) champion* recognised for technological advocacy by local and national actors.

The house was built on land that had been part of a large garden in the couple’s previous house. Building on a garden site meant that the house had to meet strict sustainability criteria (Code Level 5 of the Code for Sustainable Homes²) – a requirement following a policy change during the project in 2014–2015, which changed garden sites from brownfield sites to greenfield sites.³ This change in policy meant that Grantham Road had to incorporate further sustainability measures – a process managed by the architect through configuring the house design and engaging in individual learning on how to do this. In addition to solutions such as air tightness, highly efficient double glazing, an air source heat pump, solar thermal and PV, wood burning stove and rainwater harvesting, the designs included bat and bird boxes, a bike shelter and outside washing lines for example. All building materials were carefully chosen to meet sustainability criteria, including recycling of waste materials. Over the course of the project, the architect became increasingly enthusiastic about zero carbon housing and went beyond his duty, investing personal time in learning about renewable energy technology and sustainable building materials. He developed into a *championing intermediary (a process champion)*, turning the initial idea into a plan of action and configuring the project design. After five years of planning and a year of construction, Grantham Road was completed in 2015, at a cost of £450,000. The couple and the architect took part in the Eco Open Houses event, showcasing Grantham Road to others, thus contributing to wider learning for the low energy building niche in Brighton.

5.3. Hartington Road

Hartington Road is a terraced, two-bedroom house designed and built by its former owner, a mechanical engineer and a product designer, who had several years of experience in sustainable design, especially using wood-based materials. The 80 m² house, built on

² The Code for Sustainable Homes was launched in 2007 as an environmental assessment method for rating new homes in terms of energy and environmental impact. Code Level 6 was the highest, and most efficient, level of the Code. The Code also allowed councils to adopt their own sustainability levels as a planning requirement for new residential development. However, the Code was removed by government in March 2015.

³ Greenfield sites are land not previously built on, whereas brownfield land is usually previously developed, derelict or disused land. Following the reclassification of garden sites as greenfield sites, from July 2010 onwards Brighton and Hove City Council required all new developments on garden sites to meet Level 5 of the Code for Sustainable Homes.

an old paint shop site, cost a total of £170,000. The owner-builder had searched for a suitable plot in Brighton for several years as rising house prices meant that a family house was financially possible only through a self-build.⁴ The owner-builder was fortunate in securing a self-build mortgage just before the 2008 financial crash hit the UK housing market, even though in practice the staged-payments design of the mortgage delayed the project at times.

The owner-builder started the 2.5-year building process in 2010. The house has several sustainability features, including a timber frame, high levels of insulation, double glazing, mechanical ventilation with heat recovery (MVHR), solar thermal and a wood burning stove. The house is not connected to gas network. During the building process, the owner-builder used an independent building inspector, rather than the City Council's building inspectors. The independent building inspector was more expensive but the owner-builder decided to spend the extra given the inspector's specialisation in timber building and a recommendation by the timber-frame company. The independent inspector offered a whole package of builder manufacturer's warranty, a service provided by them, and they also undertook all the required checks such as compliance with building regulations, Energy Performance Certificate and air tightness. The local planning team and its sustainability officer were supportive of the project, encouraging the sustainability aspects that the owner-builder wanted to achieve. The owner-builder, for example, sent examples of materials he proposed to use to the sustainability officer, who agreed with his choices. The sustainability officer acted as a *non-intermediating (power) champion* for local projects, trusting the owner-builder in his material and technological choices. The sustainability officer had been active in encouraging also others by, for example, organising the Eco Open Houses events and developing planning guidance on sustainable home renovations.

The owner-builder had a mix of skills required for sustainable building techniques, including design and engineering. He was extremely efficient and inventive in building practices, developing novel solutions, and recycling and reusing material off-cuts where possible. He utilised his networking and negotiating skills by seeking advice from trusted friends, and using opportunities like appearing in a national TV programme, which he used to his advantage in negotiating discounts from suppliers. The house was featured in a BBC TV documentary, a building magazine, as well as the Eco Open Houses event (*non-championing intermediary* for local projects, see Section 4.1). The owner-builder wanted to show his home to others, sharing his learning and decision-making during the building process. As the project developed, the owner-builder became more of a *non-intermediating (technology) champion*, advancing zero carbon building technology in the local area through Eco Open Houses, as well as nationwide through TV and magazine appearances.

5.4. One Brighton

One Brighton is a multipurpose building complex developed with an objective of creating a space that enables sustainable, healthy and happy lifestyles. A brainchild of an environmental charity Bioregional, which invents, delivers and promotes sustainable living solutions, One Brighton was based on their learning from BedZED, a pioneering low energy housing development completed in 2002 (Lovell, 2007). It was built during 2007–2010 and has two apartment buildings containing 172 flats. Of these 54 are affordable: they either have shared equity (i.e. people buy an apartment via an equity loan, whereby they own a certain percentage of the property) or are provided as social housing. Part of One Brighton is dedicated for renting by community groups (i.e. groups or organisations working for the public benefit), and there is an organic café on site. The development has a range of sustainability features, including highly energy efficient building fabric and windows, solar panels, rooftop allotments and waste recycling facilities. It is a car-free development, except for disabled parking and a car club, and includes one of a few large-scale residential biomass boilers in the UK. Residents also purchase certified renewable energy through an Energy Services Company (ESCo) for the remaining energy consumption.

One Brighton is part of a wider regeneration of 'New England Quarter', an old railway site derelict in central Brighton since 1968. Initial plans for the site were made in the mid-1990s which included a new supermarket and a large car park. At the time, a local community group Brighton Urban Development and Design (BUDD) was set up to challenge the master plan of New England Quarter, to ensure that the local community's views and expectations were taken on board in the development. Brighton Urban Development and Design (BUDD) sought Bioregional's help in 1999 to propose sustainable alternatives to the master plan. This resulted in the owner of the site to submit a new, improved master plan. The new master plan was approved in 2003, and as required by the City Council's planning department, included key sustainability principles of high density, proximity to public transport, low or car free parking and energy saving measures. Lobbying for local policy change and raising support for a changed vision for the site made BUDD a *championing intermediary (process champion)* for the One Brighton case.

Initial plans for the actual One Brighton development started to form in 2005, when a Brighton-based sustainability consultant became involved by a chance encounter in aiding the City Council's sustainability objectives for the New England Quarter site. The sustainability consultant brought together key actors, by brokering relationships between the later chosen developer Bioregional and the City Council's planning department. He also facilitated a two-year, extensive, community engagement activity for the proposed development by organising public meetings, and meetings for specific community groups. He became a *championing intermediary (network champion)* for the project, enabling the local community to air their views on the vision of One Brighton. Bioregional, taking a role of a *championing intermediary* within the project, brought on board financial and operational backing from a large national housing developer. The CEO of the developer had personal commitment and interest in One Brighton as an opportunity for his company to learn more about zero carbon building. This backing, the influential position of the CEO and his company made the CEO a *non-intermediating (power) champion* for the project.

⁴ The average price for a terraced house in Brighton in June 2007 was £ 307,427 (Home.co.uk, 2007).

Following several years of planning and consultation with the local community, planning for One Brighton was approved in 2007. Support by the City Council's Head of Planning was key for the project, especially for having a car-free development in the city centre, which Conservative party members of the planning committee had opposed but Green party members supported. The Head of Planning effectively acted as a *non-intermediating (power) champion*, given his position and firm support for the project. During construction Bioregional hired a sustainability integrator whose key objective was to ensure that sustainability criteria were met at all stages of the construction process, and by all involved parties. The sustainability integrator promoted and facilitated the creation of a culture of sustainability – following Bioregional's guidance – during the construction process. He helped to educate project participants on key sustainability principles, acting as a *non-championing intermediary* for the project, translating and implementing sustainability learning within the project. The sustainability consultant, meanwhile, continued supporting the development during construction by, for example, promoting the project's sustainability approach to the construction industry, finding tenants for the community space, seeking external funding for the biomass boiler and aiding the establishment of the energy service company. He continued as a *championing intermediary* for the project, also sharing the project's experience to the wider niche.

Following the completion of One Brighton in 2010, Bioregional created a network of One Planet Living Communities. Several building projects across the world have followed the sustainability principles of One Planet Living. These include also city districts such as Hanover & Elm Grove, in Brighton, which aims to become the city's first One Planet Living Community (Hanover Action, 2016). Bioregional has been extensively involved in One Brighton post-construction stage, collecting detailed energy consumption and building performance data, and sharing learning through reports, case studies and learning tours, including the Eco Open Houses event. The City Council's planning team has used One Brighton as an exemplar of what can be achieved with a large-scale, zero carbon building project, encouraging other developers to achieve the same. The sustainability consultant has also been involved in One Brighton post-construction, as a property manager. The national house builder too took on board learning from the project, especially in relation to the sustainability of the company's supply chain and the concept of lifestyles in low energy housing.

5.5. Intermediaries and champions relating to SNM in different phases of project development

The case studies portray rather different characteristics of zero carbon building development, not only due to the varying size between One Brighton and the other two cases, but also in terms of idea generation and construction. Each case comprised 3–6 actors/platforms undertaking intermediation and/or championing, the influence of which changed throughout the duration of the projects (illustrated in Table 4). In all cases intermediation and championing went 'beyond' the projects, especially through showcasing solutions and communicating learning to others. In a sense, we observed an 'ecology of intermediaries and champions' (Steward and Hyysalo, 2008) that interacted within local projects in Brighton and also more broadly with the UK zero carbon building niche. The analysis shows that some actors who were not initially intermediating or championing, took on such activities over the course of the project.

Besides Bioregional, cosmopolitan niche intermediaries/champions were not internal actors in the building projects but rather externally consolidated and transferred learning between projects, similarly as described by Seyfang et al. (2014).

In early project idea generation stage, championing intermediaries external to projects, such as CAT, were important for stimulating the ideas to build zero carbon houses (*articulation of expectations and visions*). Whilst projects moved on to the planning stage, local non-intermediating (power) champions supported novel zero carbon buildings (shown in One Brighton and Hartington Road cases), as final visions needed to meet planning requirements and views of the local community. These championing actors were crucial in this phase of project development to ensure that specific projects took off. In the One Brighton case, the sustainability consultant, a local championing intermediary, facilitated community engagement, collecting the local community's views and feeding those back for further configuration of the project details. Furthermore, the sustainability consultant progressed from a championing intermediary for multiple local projects to an internal championing intermediary for One Brighton, who also shared experience with the cosmopolitan niche as the project advanced. A non-championing intermediary, Eco Open Houses, meanwhile, provided a space for showcasing examples and providing an outlet at the end of completed projects to further diffuse experiences (*aggregating learning*).

The importance of (championing and non-championing) intermediaries within building projects seems to increase with the size of the project due to the need to connect and broker between a larger range of different actors (*networking*) and maintaining that the end result meets the original project vision, often going beyond their initial duties. Champions pushing forward new concepts and 'getting things through', showed in all three cases; most typically a non-intermediating technology or power champion. In the smaller projects, championing intermediaries or non-intermediating champions were particularly important for *visioning, creating expectations and facilitating learning*, while, in the larger project, *networking* became a crucial issue in terms of finding financial resources and competence, gaining planning permission, engaging with the community and key stakeholders, and creating a business case to execute the project.

6. Discussion

Our analysis in this article shows that different types of actors can perform intermediation or championing in zero carbon building projects. We added to previous literature on intermediation and SNM, mainly focused on the 'cosmopolitan niche' (Hargreaves et al., 2013, Seyfang et al., 2014), by showing how intermediation and championing manifest specifically (1) in inspiring, advancing and linking local zero carbon building projects; and (2) connecting local projects to the wider 'cosmopolitan' niche (see Fig. 2). These are discussed in more detail below.

Table 4
Project-internal and external intermediaries and champions in different stages of project development and their key activities in relation to each case.

Case and Project Internal/External actors	Idea generation	Planning	Construction	Post-construction
Grantham Road Internal actors		<p>Architect A non-championing intermediary for the project (<i>visioning initial idea into a plan of action, networking with the local council and other actors</i>)</p>	<p>Architect Championing intermediary for the project (<i>strong drive for sustainable technology, networking with local actors, active learning</i>)</p> <p>Builder Non-intermediating (technology) champion for the cosmopolitan niche (<i>developing and advocating technological solutions, award winner</i>)</p>	<p>Architect Championing intermediary for local projects (<i>showcasing solutions, disseminating learning</i>)</p>
External actors	<p>CAT Championing intermediary for the niche (<i>strong drive for sustainable technology, visioning, creating expectations, active learning processes</i>)</p>	<p>EOH Non-championing intermediary for local projects (<i>providing a space for learning and networking</i>)</p>		<p>EOH Non-championing intermediary for local projects (<i>providing a space for showcasing and disseminating learning</i>)</p>
Hartington Road Internal actors		<p>Owner-builder Non-intermediating (technology) champion for the project (<i>visioning, advancing technological solutions</i>)</p>	<p>Owner-builder Non-intermediating (technology) champion for the project (<i>advancing technological solutions, active learning</i>)</p>	<p>Owner-builder Non-intermediating (technology) champion for the niche (<i>showcasing and disseminating learning</i>)</p>
External actors		<p>EOH Non-championing intermediary for local projects (<i>providing a space for learning and networking</i>)</p> <p>BHCC Sustainability Officer Non-intermediating (power) champion for local projects (<i>supporting, organising EOH</i>)</p>	<p>BHCC Sustainability Officer Non-intermediating (power) champion for local projects (<i>supporting, organising EOH</i>)</p>	<p>EOH Non-championing intermediary for local projects (<i>providing a space for showcasing and disseminating learning</i>)</p>
One Brighton Internal actors	<p>Sustainability consultant Championing (network) intermediary for the project (<i>networking and linking local actors together</i>)</p>	<p>Sustainability consultant Championing (network and process) intermediary for the project (<i>networking, organising and leading stakeholder engagement in planning process</i>)</p> <p>Bioregional Championing (technology, network & process) intermediary for the project and the niche (<i>visioning, creating expectations, linking local actors together, strong drive for sustainable technology, advancing technological solutions</i>)</p>	<p>Sustainability consultant Championing (network and process) intermediary for the project and the niche (<i>networking, promoting project to others, seeking resources</i>)</p> <p>Bioregional Championing (technology, network & process) intermediary for the project and the niche (<i>networking, facilitating learning within project</i>)</p>	<p>Bioregional Championing (technology, network & process) intermediary for the niche (<i>visioning, creating expectations, promoting advocating, networking, disseminating learning</i>)</p>

(continued on next page)

Table 4 (continued)

Case and Project Internal/External actors	Idea generation	Planning	Construction	Post-construction
	<p>CEO of housing developer Non-intermediating (power) champion for the project (<i>visioning, providing support and resources</i>)</p>	<p>CEO of housing developer Non-intermediating (power) champion for the project and the niche (<i>providing resources, active learning</i>)</p> <p>Sustainability integrator Non-championing intermediary for the project (<i>facilitating learning within project</i>)</p>	<p>CEO of housing developer Non-intermediating (power) champion for the project and the niche (<i>providing resources, active learning</i>)</p> <p>Sustainability integrator Non-championing intermediary for the project (<i>facilitating learning within project</i>)</p>	
External actors	<p>BUDD Championing intermediary for local projects (<i>visioning, connecting actors</i>)</p> <p>Bioregional Championing (<i>technology and process</i>) intermediary for the niche (<i>visioning, networking, active learning</i>)</p>	<p>BHCC head of planning Non-intermediating (power) champion local projects (<i>visioning, creating space for change</i>)</p>		<p>BHCC planning team Non-intermediating (power champion) for local projects (<i>visioning, creating expectations, disseminating learning</i>)</p>

Key to acronyms: Brighton Urban Development and Design (BUDD), Brighton & Hove City Council (BHCC), Centre for Alternative Technology (CAT), Chief Executive Officer (CEO), Eco Open Houses (EOH).

6.1. Inspiring, advancing and linking local zero carbon building projects

Individual building projects are connected to a community and sequence of local projects through championing and non-championing intermediaries that range from architects and sustainability consultants to community activists. Such intermediation can be coupled with championing, either internally within a project, or externally, for instance by local planning officials.

An initial vision for the project can be created by a non-intermediating champion or championing intermediary, while local non-championing intermediaries, such as Eco Open Houses, can provide space for initial visioning by sharing experience from completed projects. In turn, managing the implementation of that vision can be an important intermediation activity undertaken by an architect or a developer, for instance. In smaller self-build projects, one non-intermediating champion can be in charge of both creating the vision and its implementation. Local non-championing intermediaries, in this case Eco Open Houses events, can provide niche protection by aiding the process of creating visions of how the local niche might develop, transferring and aggregating learning via activities such as showcasing specific projects and providing a space for local networking. While showcasing projects and the achievements of system innovation in low energy housing, Eco Open Houses provided a neutral space, rather than advocating certain technological solutions.

Initial visions and learning can be further implemented by stronger advocates in specific projects. The One Brighton case shows that non-intermediating champions' support for system innovation can be crucially important in key stages such as acquiring planning permission, while the support of the non-intermediating champion of the City Council's sustainability officer was needed in the Hartington Road case in relation to the choice of materials.

As much as supportive intermediation and championing can inspire and advance local building projects, those projects themselves also provide opportunities for intermediaries and champions to come together, in effect, partly validating those actors and creating further opportunities for them (Jepsen et al., 2014). Pioneering projects can "lead to exposure in the community and to potential new partners. They legitimise involved interpreters, allowing them to enter new elite circles and to become key nodes in their networks" (Jepsen et al., 2014, p.9). This could be observed more broadly in Brighton in how a network of championing (see also Fichter 2009) and intermediating individuals knew each other and worked together, effectively creating an ecology of local intermediation (Stewart and Hyysalo, 2008).

6.2. Connecting local projects to the wider 'cosmopolitan' niche

Regarding the cosmopolitan niche, our analysis found that in local contexts cosmopolitan niche intermediation and championing also played a part in motivating project initiation. This is a contrary finding to previous research by Seyfang et al. (2014) who found in a study of 12 UK community energy projects that, despite the existence and activity of intermediaries, "none of the projects were originally inspired or instigated by intermediary-level organisations" (p.36). In two cases, championing niche intermediaries (Centre for Alternative Technology and Bioregional) had an important influence in instigating the innovative building projects in the idea generation and planning stages, creating expectations of the future and visioning of what can be done. Only in the larger building project (One Brighton), a championing cosmopolitan niche intermediary was also actively involved throughout the building process from project initiation to development and beyond construction.

System innovations in buildings so far have rarely been replicated as identical designs but, rather, they have diffused through (1) learning transferred to others from such projects by intermediaries and (2) further reconfigurations to create context-specific solutions in the building projects that follow. Therefore, while it is not certain how and if local projects can support the scaling up and production of zero carbon homes for the mainstream housing market, non-championing intermediaries such as Eco Open Houses can create a neutral space for learning and networking. Furthermore, strong advocates, i.e. championing intermediaries and non-intermediating champions, such as an architect or a developer, can disseminate learning from their completed projects to the cosmopolitan niche. This shows how intermediation can go beyond aggregating of learning and distribution of knowledge from local projects (Geels and Deuten, 2006, Hargreaves et al., 2013), to stronger agency for driving the development of the cosmopolitan niche. Therefore, while it is not certain how and if local projects can support the scaling up and production of zero carbon homes for the mainstream housing market, intermediaries such as Eco Open Houses can create the space for learning.

7. Conclusions

This article set out to analyse innovation intermediation and championing in the empirical setting of zero carbon housing projects in Brighton, UK. Using three in-depth empirical case studies and supporting literature as evidence, the research answered the following question: *How do innovation intermediation and/or championing manifest and evolve in the development of zero carbon building projects?* The following three sub questions were addressed: 1) What kinds of actors take on intermediation and championing in the studied cases?; 2) What activities are associated with intermediation and championing in different phases of the building projects, and how are these connected with each other and to SNM?; and 3) What is the relevance of intermediation and championing in the studied cases?

We showed that intermediation and championing are closely linked, creating a typology illustrating their overlaps and complementarities in the context of sustainability transitions and Strategic Niche Management: A *non-championing intermediary* may have an interest in the sustainable innovation and is supporting networking and learning, but is not the most passionate advocate of the innovation or a project. A *championing intermediary* has strong motives to promote the innovation, contributing also to visioning, networking and learning. A *non-intermediating champion* usually has a strong personal interest in advancing the innovation, but is less

involved in niche visioning. Lastly, *neither championing nor intermediating* entities are involved in the innovation process but do not necessarily share knowledge or link with others beyond their usual professional roles.

The analysis of three in-depth zero carbon building projects shows that a range of actors can be, or become, intermediaries and champions, in the course of project development. Examples in the studied cases included architects, eco open house platforms, consultants, builders, council sustainability officers, housing developers, architects, and charities. Some of these actors might not be obvious from the outset of specific projects and the duration of intermediary and champion activities can also vary.

Local and cosmopolitan intermediation and championing comprise activities, such as inspiring project initiation by creating expectations through visioning exercises, showcasing projects, and communicating learning from them. Many actors take on new intermediation activities in the planning and construction stages of the building project, such as organising community engagement and facilitating local networks to enable feedback on project plans. The influence of intermediation and championing also goes beyond those projects. Non-championing intermediaries such as Eco Open Houses can undertake showcasing activities again once projects have been completed, providing a neutral space for local learning. Intermediating champions meanwhile may act as ‘spokespersons’ or pioneers in the media. All these activities also support niche development. We argue for the importance of observing and analysing what intermediation and championing activities are carried out, instead of merely focusing on which types of particular organisations or actors are present in building projects. The key issue is not *who* performs intermediation and championing, but that they *are* performed.

We added to previous, newly emerging, literature on intermediation and championing in Strategic Niche Management (SNM) by demonstrating that intermediation and championing are not stable attributes throughout even rather brief building projects, indicating even less stability for such activities in the context of niche development. We illustrated a micro-layer of project specific intermediation and championing that manifests alongside intermediation and championing in multiple local projects and in the cosmopolitan niche, jointly forming an ecology of intermediaries influencing niche development.

We suggest further research is needed to test the concepts of non-championing intermediary, championing intermediary, and non-intermediating champion, especially in relation to how they connect and potentially advance (or do not advance) local projects and wider cosmopolitan niche development.

Empirically, the article showed that system innovation in zero carbon building is still in such an early niche development phase in the UK that building projects are dependent on intermediation and championing to pull through. At the time of increasingly urgent climate change mitigation pressure and nationally diminishing policy support for low energy housing in the UK, championing intermediaries such as Bioregional could have a vital role in inspiring and connecting projects, while non-championing intermediaries such as Eco Open Houses provide opportunities for shared learning, both types of actors providing protection for the low energy housing niche.

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Appendix A

Scoping interviews

Details of organisation, location and date of interview.

- UK government office, location details withheld to ensure anonymity, 07.10.2015
- Peabody Trust, London, 28.10.2015
- Centre for Sustainable Energy, Bristol, 30.10.2015
- Building Research Establishment, Watford, 23.11.2015
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- Greater London Authority, London, 07.01.2016
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