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Green Building and Sustainability: Diffusing Green Building Approaches in the UK and Germany

Kirstie O'Neill and David Gibbs

Background

Concerns over the need to reduce energy consumption, greenhouse gas emissions, and resource use are increasingly encouraging a focus upon the building sector, given that buildings represent a major share of emissions and energy use while also potentially representing one of the most cost-effective and significant opportunities to achieve such reductions. Moreover, a shift toward a "green" building sector is also seen as a means to deliver new jobs, growth, and improved business competitiveness (Aldersgate Group 2011). In this chapter, we examine the development of the green building sector in the UK and Germany and explore how the contingent political, economic, and social contexts of both countries have influenced green building policies. We outline the main legislative drivers in both countries for green building, before highlighting the effects of these in facilitating or constraining the green building sector. We draw on qualitative research with 55 green building entrepreneurs and policy makers in the UK and 24 interviews in Germany (Gibbs and O'Neill

K. O'Neill (✉)
Department of Geography and Environment, London School of Economics and Political Science, London, UK

D. Gibbs
Department of Geography, School of Environmental Sciences, University of Hull, Hull, UK

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2014; O'Neill and Gibbs 2014). This provided the opportunity to compare experiences and practices, as well as assess the potential of these to offer lessons for future policy development.

The Policy Context for Green Building

The European Commission and United Nations have identified construction and housing as priority areas for action on carbon emissions (UNEP 2016; Vickers and Vaze 2009; CBI 2007; European Commission 2011). The building sector is a significant contributor to greenhouse gas emissions (GHGs)—at the European level, the building sector accounts for 42 percent of the final energy consumption and about 35 percent of all GHGs (Deutsche Bank 2010). In the UK, the Royal Institute of Chartered Surveyors estimates that the built environment accounts for 25–40 percent of energy use globally, 30 percent of raw material use, 30–40 percent of greenhouse gas emissions, and 30–40 percent of solid waste generation (Hartenberger 2011). Housing accounts for around 30 percent of energy consumption and 27 percent of national carbon dioxide emissions (cf. Mason 2013; DECC 2011). Globally, these figures are set to increase as a result of population growth and increasing demand for buildings in developing countries (UNEP 2016). UK housing is some of the poorest performing within Europe in terms of energy efficiency, offering potential for significant savings in energy use and thus carbon (and other pollutant) emission reductions. Despite the advances made in green building in Germany, German housing has similar levels of CO_2 emissions per capita to the UK and a parallel policy trajectory for emission reductions of 40 percent by 2020 and 80 percent by 2050 (McLeod et al. 2012). In developed countries, where rates of new build are low compared to the stock of existing buildings, retrofitting buildings is a major component of achieving carbon reduction targets (Owen et al. 2014; Hodson et al. 2016). In the UK, it is estimated that around 75–80 percent of the UK's 2050 building stock already exists (SDC 2006); any low carbon transition will therefore have to encompass both green new build and retrofitting.

Many of today's ideas and approaches for green building stem from the 1970s appropriate technology (AT) movements. In Germany, as well as the UK, these social movements took radical approaches to the development of technology, with housing forming a particular focus for action (Smith 2006). At the outset, these AT activists and their approaches were viewed as quirky; however, their innovations are now becoming associated with mainstream thinking on green building and gaining increasing attention from policy

makers. Both Germany and the UK have had similar directions of green building development, linked to the emergence of AT and concerns over the environmental impacts of conventional development. However, in Germany there may be other underlying reasons for the adoption of some ATs and practices, beyond concerns about environmental change and energy security (Mössner and Freytag 2013). For example, the 1970s Organization of the Petroleum Exporting Countries (OPEC) oil embargo stimulated the growth of renewable energy, including the emergence of a solar electricity industry, stimulating government and business interest (Hinrichs 2014). By contrast, the discovery of abundant oil and gas in the North Sea tied the UK more firmly into a carbon-based energy system. Mössner and Freytag (2013) also argue that traditional concerns over economic development in Germany overlapped with concerns about the development of nuclear energy, thus resulting in a dual-focused coalition against the nuclear sector. Therefore, while many attribute developments in the 1970s to radical social change and movements concerned about resource *consumption*, in Germany there was also a parallel discourse of resource *scarcity* that prompted the requirement for alternatives. More recently, in both countries, climate change is providing a stimulus for changing practices and consumption.

Case Studies: Green Building in the UK and Germany

Green Building in the UK

In the UK, the built environment has become a key focus of regulatory intervention aimed at cutting carbon emissions (Fischer and Guy 2009). The UK Government announced the need for a rapid transition to zero-carbon new building in December 2006 as a key step in reducing GHGs from the domestic and non-domestic sectors (DCLG 2006a; Weaver 2006; McLeod et al. 2012). The original definition of zero-carbon homes (ZCH) was established in the UK in December 2006 when the Code for Sustainable Homes (CSH) was introduced as a voluntary six-tiered sustainability rating system leading to Code Level 6 or a zero-carbon home (DCLG 2006b; Gibbs and O'Neill 2015). Through these measures, the UK Government proposed meeting the European Commission's Nearly Zero-Energy Building (NZEB) requirement under the Energy Performance of Buildings Directive (EPBD 2010/31/EU), which requires all new buildings constructed in the European Union from

2021 to be nearly zero-energy buildings.[1] In 2015 the CSH was withdrawn, albeit that the UK remains committed to the EU target (Greenwood et al. 2016), although this is just one policy area that may be affected by the UK's recent decision to leave the European Union. The CSH concentrated purely on new build housing—no equivalents exist for retrofitting, nor are there currently UK energy performance standards that make detailed reference to the embodied energy or carbon emissions from a building (McLeod et al. 2012). Despite the policy focus on new builds, Galvin (2010, 836) argues that due to the materials required for new buildings "even if a new building uses hardly any energy over its lifetime, it still takes 25–50 years before it starts to pay its way in comparison to an old building modestly renovated so as to reduce its emissions by 1 or 2 tonnes of CO_2 per year." In terms of retrofitting existing properties, arguably a greater challenge, the UK Government created three financial frameworks to encourage investment in low-carbon technologies and refurbishment of buildings—Feed-In Tariffs (FITs), the Green Deal, and the Renewable Heat Incentive[2] (RHI) (Tweed 2013); the FITs have since been abolished and were thus rather short-lived, and the parameters of the Renewable Heat Incentive have changed following a government consultation in 2016. Like the Green Investment Bank, the Green Deal has recently been sold off to a private company, changing from a public policy to a private finance institution. The Green Deal aimed to facilitate mass thermal renovation through financing renovation projects in rental and owner-occupied homes (Galvin and Sunikka-Blank 2013) and was a voluntary financial incentive, supported by private sector annual investments of £7 billion. Householders could apply for a property-attached loan to install energy efficiency measures—a key pillar of this policy was its so-called golden rule, in which monthly fuel consumption savings would cover the loan repayments.

Carbon emissions in UK buildings are also dealt with by Building Regulations, where Part L relates to energy efficiency and consumption (Fischer and Guy 2009). Part L sets the minimum level required in order to meet building regulations and deals with specific building elements. By contrast, the CSH encouraged the consideration of issues beyond energy consumption and a holistic, whole-building approach (Gibbs and O'Neill 2015). Under Part L, developers are required to achieve energy performance targets set through a National Calculation Methodology and to demonstrate that their buildings will meet those targets (McManus et al. 2010). The targets are expressed in terms of a Target Emissions Rate (TER) in kilograms of carbon dioxide per square meter per year ($kgCO_2/m^2$ yr) and an energy demand target in kilowatt-hours per square meter per year (kWh/m^2 yr). Part L covers performance levels for the overall building and allows designers to offset weak

performance in one element of the building with better performance elsewhere (Raman and Shove 2000). Frequent revisions (most recently in 2016) of the Building Regulations have been confusing and time-consuming for all involved in building processes (Fischer and Guy 2009). Part L of the Building Regulations is now the only statutory means for reducing the environmental impact of housing in the UK and does not go as far as the CSH previously did. This means that, in reality, going beyond the requirements of UK building regulations is purely voluntary—whereas Level 6 of the CSH was to become mandatory from 2016, the revised Building Regulations now work to Code Level 4.

During the time in which the UK's CSH was operational, the government changed the definition of ZCH (McLeod et al. 2012). The original definition stated that net CO_2 emissions from all energy used in the dwelling as well as net CO_2 emissions from use of appliances in the homes should be zero or better (averaged over a year) (DCLG 2006b). At the time, the Renewable Advisory Board (2007, since disbanded) advised that the ZCH policy should "minimize the use of remote offsite energy generation in meeting zero carbon standards e.g. by setting a tight cap on its use and a high 'buy-out' cost for any offsite generation fund" (BERR 2007, 24). Despite this, the zero-carbon definition was revised (HM Treasury 2011), and so-called Allowable Solutions (Fig. 29.1) were introduced in law in 2014 (since scrapped in 2015), which effectively contradicted the Board's original advice. McLeod et al. (2012) argue that changing definitions have effectively watered down the key energy efficiency parameters required to achieve a zero-carbon dwelling, compared to the original definition. They also argue that even if the ZCH recommendations had been implemented, many of the UK's future so-called zero-carbon dwellings may have performed little better than buildings that simply comply with the legal minimum standards. This is unlikely to improve given the political changes consequent upon the election of a Conservative government in 2015.

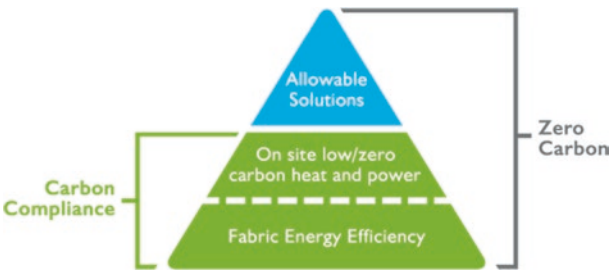

Fig. 29.1 Allowable Solutions for meeting ZCH requirements (Source: Zero Carbon Hub website. Accessed 15 August 2014)

They question why very low-energy building designs (such as the Passivhaus standard or PlusEnergy Homes[3]) are not being encouraged through UK housing policies. However, this assumes energy is the most pressing concern and ignores the wider issues that many green builders are concerned about such as resource sustainability, occupant health, and low use of hazardous materials.

Under the Allowable Solutions, developers had the option to invest in offsite renewable energy generation, rather than providing onsite generation, effectively a form of carbon offsetting. At the time, critics questioned how the Allowable Solutions would have worked, including the length of time such Allowable Solutions would operate in relation to the emissions they were supposedly offsetting. For the UK building sector, the introduction of Allowable Solutions effectively introduced a buyout clause. As with most forms of carbon offsetting, the system would have been inherently complex to implement and monitor (Kill et al. 2010), and there is a growing body of evidence suggesting that carbon trading and offsetting does not lead to emission reductions (McLeod et al. 2012). Despite this, Stephen Williams[4] announced that the UK Government had decided that developer choice should be paramount—"developers will be free to decide how they use the Allowable Solutions scheme."[5] The rationale for this, according to the Department for Communities and Local Government (DCLG), was that: "if the definition of zero carbon is too rigid (such as requiring all renewable energy to be onsite) or too costly, it could potentially prejudice smaller urban brownfield developments in favor of larger greenfield sites [as they] offer greater economies of scale in energy supply technologies" (DCLG 2008). Such comments illustrate a lack of ambition in UK policy and the role it could potentially play in engendering a low carbon transition. Examples of buildings, such as Passivhaus and PlusEnergy Homes, which produce their own power and require very little power to heat them already exist, yet have been neglected in UK policies. Evidence that such challenges can be coherently addressed on a large scale is documented in the European Energy Cities project, where case studies of successfully implemented large-scale zero-carbon developments include Kronsberg (Hanover) with 6000 Passivhaus dwellings proposed for 15,000 people relying mainly on solar and wind energy, and the Vauban district of Freiburg, located on a former French barrack site with all buildings meeting the Passivhaus standard (Mössner 2015; Energy cities[6]). Thus, while the then labor government initially sought to achieve carbon emission reductions through a set of comprehensive policies for the building sector, this lacked consistency and been subject to frequent amendments and abolition by subsequent administrations in favor of the dominant building regime (Lafferty and Hovden 2010), as well as a preference for economic growth.

Green Building in Germany

Like the UK, Germany has a policy of reducing GHGs by 80 percent by 2050 compared with 1990 levels (BMU 2007). As elsewhere in the EU, there is increasing interest in thermally renovating existing housing stock so as to save heating energy and reduce GHGs (Tuominen et al. 2012, in Galvin and Sunikka-Blank 2013). Building is one of the biggest and most important sectors in Germany, and its economic and ecological potential is considerable, according to the Building for the Future (ZukunftBau) initiative (BVBS 2010). This initiative involves the Federal Government investing in new and innovative building approaches and materials and thus using its own construction projects to set examples of green or sustainable building methods. The Government therefore sees itself as integral to promoting exemplary, modern, and innovative buildings. For the Federal Government, sustainable building is defined as:

> *…reducing land use, minimising energy consumption in construction and operation of the building, meeting the requirements of future generations by ensuring the longest possible service life and relying on regenerative raw materials for building purposes*. (BVBS 2010, 15)

The German Government introduced a certification scheme for its own buildings in advance of the creation of the Deutsches Gesellschaft für Nachhaltiges Bauen (DGNB—German Green Building Council) certification scheme in 2009. In addition, at the local level, Passivhaus standards have been incorporated in some German cities for public buildings (e.g., Frankfurt). In Germany, there are additional measures that promote varying degrees of green building. The Kreditanstalt für Wiederaufbau (KfW Bank), a government-owned green bank, finances green buildings, particularly through funding support for "Die Energieeinsparverordnung" (EnEV, or The Energy Conservation Law) (2009, revised 2016). Loans of up to €50,000 are provided toward the cost of a new low-energy dwelling (known as an Effizienzhaus[7]) and up to €75,000 toward the cost of refurbishment. The interest rate of the loan is significantly less than a standard high street loan, and in addition, a grant is available depending on the energy efficiency level that the dwelling achieves (Cutland 2012). In addition to the support available from the KfW, grants are also available at the local, regional, and state level for Passivhaus buildings (Cutland 2012). This contrasts with the UK, where no similar support is available and where the Green Investment Bank (which the UK Government recently sold to the Macquarie Group and is now a private

institution) predominantly funded large-scale infrastructure projects.[8] German thermal renovation standards are set out in the Energy Conservation Law (EnEV). In 2002, compulsory thermal standards for retrofits were introduced under the EnEV—whenever 20 percent or more of a house (e.g., wall or roof) was being repaired or renewed, that entire feature had to be thermally renovated to the same standard as a new build. Despite this, Galvin (2010) notes that crucially the EnEV targets primarily new builds, not renovations. The EnEV standards are driven by the government's commitment to reduce energy consumption in buildings, but are also negotiated with the construction industry to take account of its current and future capabilities, so that optimally energy-efficient new buildings are also economically viable (Galvin 2010). Furthermore, there are Federal Government guidelines for green roofs, as well as various taxes, grants, and incentives at a range of geographical scales. These laws have provided an inspiration for other countries' legislation on, for example, Feed-in-Tariffs and energy-saving standards. The European Energy Performance of Buildings Directive (2010/31/EU) also applies in Germany, although Galvin and Sunikka-Blank (2013) indicate that specifications for the "nearly zero-energy" standard still have to be defined at national level.

At first sight then, it would appear that Germany has experienced a more consistent and comprehensive policy approach to green buildings. However, despite these regulations and laws applicable to green or sustainable building, how well do policy makers and businesses feel that this is enabling good practice to diffuse or translate to other contexts regionally, nationally, and internationally? In the following sections, we explore our empirical material by concentrating on the diffusion of building practices in the national contexts of the UK and Germany and the ways that key actors in the green building sector are central (or not) to such diffusion.

Lessons Learned

In our research, we have drawn upon a body of work within social studies of technology concerned with the transformation of socio-technological regimes, which emphasizes the role of innovative (technological) niches in effecting transitions toward sustainability (Smith 2003; Geels 2005; Grin et al. 2010). In this work, such niches, in this case the green building sector, 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 new technologies and ways of working in the building and construction industry. Breakthroughs

and tipping points may be reached as a result of niche innovations creating momentum for change, as well as bottlenecks in the mainstream regime (i.e., the building and construction sector) or pressures at the wider societal level (e.g., rising fuel bills and climate change). If the policy and political contexts are supportive, opportunities may open up for niche innovations to become mainstreamed (Schot and Geels 2008). Key actors within the niche may facilitate such breakthroughs by acting as change agents.

Learning and sharing experiences are core elements of the processes of upscaling, diffusing, and translating niche innovations, as is networking. The actions that niche actors take to disseminate niche practices are related to the success (or not) of niche innovation expansion. Learning activities can involve learning by doing, learning by interacting, and learning by using (Geels 2002) and are most effective when contributing not only to everyday knowledge and expertise but also through second-order learning where people question the assumptions and constraints of existing ways of operating in sectors such as building and construction (Kemp et al. 1998). As Darby (2006) suggests, learning can be viewed as an experiential cumulative acquisition of tacit knowledge—for example, residential green buildings may be an important vehicle for higher-order learning about energy conservation at a societal scale (see also Marres 2013; Preller et al. 2017). In our UK research, a number of respondents providing buildings for green holidays suggested that their buildings offered such an opportunity for visitors to learn about green buildings and green living, as an experiential space as a precursor to perhaps implementing green building methods in their own lives.

In Germany, the 1975–6 civil campaign against the planned nuclear power station in Wyhl, near Freiburg, triggered a new approach to building, energy use, and social living practices (Doyle 2005; Mössner 2015; Fastenrath and Braun 2016), leading to Freiburg becoming a hotbed of such innovations. Key examples of green building in the area, such as the Sun Ship and Solar Settlement[9] (designed and built by the Freiburg-based architect Rolf Disch), were flagship examples of what could be achieved and led to both experimentation and learning. In this manner, learning may be seen as a mechanism for policy change (Nilsson and Persson 2003).

Networking is an allied process of sharing information—by embracing different stakeholders and partners, niches can benefit from resources and support from a wide range of organizations. Such activities can help niche learning dissemination and reinforce the lessons learned from local projects (Geels and Raven 2006). Several examples of learning and networking mechanisms were evident in Germany, for example, the Ministry of Transport, Building, and Urban Development developed a PlusEnergy House in Berlin where a family

of four live (the house also powers electric vehicles) and all the technologies are being monitored—the building is a home, a research object, and show location. In addition, networks such as Öko-bau Rheinland (Eco-Building Rhineland) are established to bring together like-minded businesses that build, supply, and use eco- or natural building materials. Network members offer training sessions to other members, as well as the wider business sector, to disseminate knowledge about both their businesses and natural building materials and to attempt to change practices.

These mechanisms of best practice sharing and policy mobility were not always straightforward or successful. For example, a Freiburg architect described some of the problems associated with transferring learning from one regional context to another:

> *…every once in a while I get a phone call, normally from some [Middle Eastern] country, someone saying 'oh I want this'. And of course it doesn't work. This is for our climate. It does not make sense at all to have this kind of structure somewhere in the Saudi Arabian desert. And they get disappointed…* (Interview with Architect)

This is particularly interesting, as Freiburg has positioned itself as a center of excellence for green building, low-energy design, and a major destination for people wanting to learn about such methods. However, in practice such translation is not necessarily straightforward and frequently requires adaptation—"ecologically oriented building is not a fixed concept that can be applied to any construction project in the same way."[10] Nevertheless, practices *have* to be diffused, given that climate change is a problem that does not just apply to one city or region but requires approaches that take a more global vision:

> *…if you could change the world by only doing things in Freiberg [our firm] probably would do that. But of course, you can't do it. And as for the CO_2 it doesn't matter if you save it here or if you save it in China…* (Interview with Architect)

While definitions of zero-carbon and low-carbon building in the UK have been contested and subject to legislative changes, in Germany, despite their advanced sustainable building sector, there was a feeling that concepts such as low-energy consumption buildings are also lacking and this is creating tension for builders. One architect suggested that Passivhaus standards should form part of the definition:

> *From 2020, at least that's what [the EC] say. Every new building in Europe should be very, very, very low energy in consumption, whatever that means. It has not really*

been defined [there are] 20 pages saying nothing…it should actually be something like Passivhaus standard. (Interview with Architect)

Defining such concepts is part of a process necessary to ensure learning and experimentation can continue toward agreed goals. While Smith (2006) argues that form follows environment, this approach suggests that form may be better following energy (cf. Disch, undated). Beyond what Smith (2006) describes as voluntarily over-complying with the regulations in search of sustainable development, some of the innovators involved in our research have been setting the benchmark, and regulations and legislation have subsequently followed their innovatory work. Even though Germany has been building and experimenting with buildings like Passivhaus and PlusEnergy Houses for over 25 years, it was the view of one architect that many other European countries were lagging behind and that German experience had not been widely diffused, which would make it difficult to meet the European legislation on nearly zero-energy buildings by 2020:

…this is what we've been doing for 25 years now and now we have this [EU legislation]. I doubt that we would actually see that happening in 2020 because there are many countries in Europe where you don't have a single Passivhaus as yet. (Interview with Architect)

For this architect, there is now a need to move beyond pilot projects since "the technical problems, all the planning problems, have been solved"; what is needed now "is if the little town or a village has a new housing estate project you do that in PlusEnergy. You have to do the big things now." Such big things are not so easily adopted by existing regulatory regimes, which are set up to deal with accepted designs and processes and which adopt new ideas slowly. This is particularly relevant in the UK where the planning system represents one of the biggest hurdles for those wanting to build green buildings (Seyfang 2010). While McLeod et al. (2012) and Tofield (2012) argue that the Passivhaus standard is the only energy efficiency standard capable of delivering long-term reductions in space heating, cooling, and hot water energy consumption, such ambitious standards appear to be contentious in some contexts. It is not only in the UK where Passivhaus has not substantially penetrated building practices—one architect in the Cologne region described how "even over 5–6 years [there has not been a] material increase in the number of architects doing Passivhaus." As a means of learning about Passivhaus and creating demand, he sends new clients to existing Passivhaus projects to show them what is possible "the owners of the houses are proud and want to

show off…so are happy to receive visitors." Certification schemes are also part of the process of defining and agreeing on problems and solutions for transitioning toward sustainability, although they have been critiqued for encouraging a tick-box mentality rather than holistic design principles (see Boschmann and Gabriel 2013, for instance). In contrast to the general view of Germany as a leading country, in developing a certification scheme for sustainable buildings, Germany developed relatively late. As the director of one such scheme described:

> *In 2005 there were investors coming from UK and US and they brought their own certification systems…the German architects and designers they felt that those systems don't really fit the needs of the German buildings and the technologies and the design philosophy and that is why we decided to do our own certification system…* (Interview with Certification Organization)

As the interviewee indicates, translating schemes from other countries is not necessarily easy or helpful. However, having rules and regulations was criticized by some German respondents as stifling creativity and innovation, politically, technologically, and socially. One German policy maker described how "in Germany [we have] enough codes and standards already, that is why we never had a certification scheme before because people thought we had so many regulations in Germany and then you do a certification scheme on top, [it] is too much." Despite this, investors were reported as demanding a scheme that would give them a quality seal.

By comparison, the UK's post-2015 approach to green building relies on minimal standards being met rather than pushing the boundaries to reach higher levels of sustainable building. Reliance on Building Regulations and in particular Part L to encourage more sustainable, low-carbon buildings appears to have encouraged the building industry only to work to the minimum required. As one green builder involved in our research commented:

> *sometimes you'd struggle to say "well, is this sustainable", because it's clearly not; it's a compromise; I think that's what we've always said. We'll try to do it slightly better than it's been done before, we're doing it often in excess of what's expected of us, say, in terms of Building Regulations or whatever. And again, that's always been our kind of ethos, we work beyond that, you know…the building industry works to the minimum not the maximum – Building Regs are minimum, as soon as they hear that, they stop. Our ethos was to…ignore that and see how much we can get into a building and still make it viable.* (Interview, Green building company)

In contrast to Germany, in the UK, some green builders lamented the time taken for product testing and certification of new materials and innovations. For a UK green materials supplier, "the products that we've got now are all tested and certificated, they've got technical approval in Germany," but this is not necessarily transferable to the UK context, for example, in terms of insurance as "people like Premier and NHBC[11] who are again very big insurers in terms of construction, Premier will accept our products; NHBC won't because it's not certificated by a particular organization here…." Another green builder talked similarly about triple glazed, well-insulated windows which have been available in countries like Sweden and Germany for "the last thirty years or so," but in the UK, "it's taken almost 'til the last couple of years for window manufacturers to say right, well we've got to – not imitate it – but come up with something similar,[12] similar ways of building because that is, that's what people want, and also it makes sense." However, in niches such as straw bale building methods, builders in both the UK and Germany recognized the UK's leading role—a German green builder had been to the UK to learn about straw bale building, while a UK straw bale builder reflected that while Germany is a leader in many green building approaches, "they're certainly not in straw bale building, and they're very limited because…they're really quite over the top with their details…which you know is a positive and a negative. So, it's positive in that you get high quality houses built and it's negative in that it's very, very hard to do anything that's new or different…they can't do load-bearing…they could be pushing the boundaries but they like to stay within the rules." Similarly, natural building promoters in the Cologne region stated that Germany has a very conservative attitude toward adopting new building methods and designs. As Smith and Stirling (2007) argue in relation to the diffusion of clean tech, overarching structures of design criteria and routines, markets, final consumer demand, institutional and regulatory systems, and inadequate infrastructures for change can limit diffusion or indeed encourage it—much the same can be said with respect to green building. Crucially, sustainability will not be reached by technology alone; learning by policy makers, individuals, professional societies, and other institutions is central to this process of transition (Brown and Vergragt 2008), as well as a shift in practices (cf. Shove 2003). There is therefore a need for "learning between actors in the policy network leading to changes in sector policy-making processes and outputs as a result of new mandates of environmental concerns and knowledge about environmental consequences" (Nilsson and Persson 2003, 340).

Challenges and Barriers

There are a range of measures, from funding schemes to policy frameworks, that promote green buildings in Germany, at a variety of geographical scales, many of which stemmed from early experiments and pilot projects. As discussed above, while the UK initially introduced a raft of policy measures aimed at both encouraging a green building sector and linking this with wider policies for a low-carbon economy, these were subsequently watered down or abandoned altogether. Indeed, UK zero-carbon housing policy has been plagued by disagreement and inconsistency,[13] and this has been criticized by both niche and mainstream actors in the building industry for creating policy uncertainty and additional costs (Greenwood et al. 2016). The need for consistency of policies is a key lesson to be learned from the UK evidence. However, despite the views of our UK respondents that Germany is an easier place for green building developments, our research suggests that green building in (parts of) Germany is still largely a niche sector, albeit with the potential to be mainstreamed (Deutsche Bank 2010). Many German interview respondents lamented that politically the country is quite conservative, which has inhibited the implementation of measures, which could have significant potential for improving sustainable building. Indeed, German respondents reported challenges, such as consumer concerns, cost differentials between green and conventional building, prejudices, and lack of support from policy makers and politicians as inhibiting further advances.

While green building companies in the UK look to learn lessons from Germany as an example of green building success, in Germany many businesses reported that there were still hurdles to be overcome. Despite this, there was certainly a sense of normalization (or progression from being a niche to the mainstream) for some green architects in Germany by comparison with the UK where green building remains very much a niche activity. They suggest that now there is more awareness and comprehension—as green or sustainable building methods and materials become more visible, more people are interested and understand what is involved. In this chapter, we have highlighted the unevenness of learning from, and experimentation with, green building, as well as the limitations to translation. We have shown how a number of key actors are leading the way in terms of innovation and experimentation, and that policy measures can support or hinder such developments. Policy measures and associated programs of support and incentives in both the UK and Germany need to encourage the diffusion of

green building as a core means of tackling anthropogenic GHG emissions; this is an urgent action, and one that our respondents do not see happening quickly enough.

Notes

1. The EPBD is the main legislative instrument, at the European level, for improving the energy efficiency of buildings. A key element of the EPBD is its requirement for Nearly Zero-Energy Buildings (NZEB). According to the EU, a nearly zero-energy building means a building that has a very high-energy performance. The nearly zero or very low amount of energy required should be covered to a significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby. http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCHomes_Nearly_Zero_Energy_Buildings.pdf (accessed 2 October 2014).
2. The Feed-in-Tariff and the Renewable Heat Incentive provided financial support to those installing renewable energies domestically for the generation of electricity and heat (e.g., solar PV or ground heat source pumps). The Green Deal provided loans for households installing a range of energy efficiency measures. The first round of changes to the Renewable Heat Incentive is due to come into force on 20 September 2017 and affect the incentives for different types of renewable technologies.
3. Although Passivhaus and PlusEnergy Homes are propriety design concepts rather than toolkits or guidelines for low-carbon low-energy building.
4. Parliamentary Under Secretary of State for Communities and Local Government.
5. https://www.gov.uk/government/speeches/speech-to-the-zero-carbon-hub.
6. http://www.energy-cities.eu/ (accessed 12 September 2014).
7. An Effizienzhaus is one that requires less energy than new builds which meet building regulations, at specified percentage savings—so, an Effizienzhaus-70 required 30 percent less than a new build which requires 100 percent.
8. See http://greeninvestmentgroup.com.
9. The Sonnenschiff and Solarsiedlung in Freiburg are PlusEnergy buildings with residential and commercial spaces.
10. http://www.sueddeutsche.de/geld/oekologisch-bauen-babylonische-bauverwirrung-1.286335 (accessed 21 August 2014).
11. National House Builders' Council.
12. However, many products developed often emphasize energy consumption, rather than the sustainability of the materials used. For instance, in relation to windows, many UK windows still use uPVC (a harmful material) despite being more energy efficient.
13. http://www.theguardian.com/environment/2014/feb/13/storms-floods-climate-change-upon-us-lord-stern, Accessed 13.03.14.

Further Reading

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