Building Expertise:
A System of Professions Approach to Low-Carbon Practice

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ABSTRACT

Much of the recent social science work in the energy field has been focused on saving energy by changing the behaviour of individuals at home through values, attitudes, and information about climate change. This paper takes a modified "system of professions" (Abbott 1988) approach, which incorporates the role of intermediaries (e.g., architects, engineers, builders, building operators, "commissioning" agents. etc.) and their work. From this perspective, a profession is linked (neither permanently nor absolutely) to a set of socially-accepted tasks considered to be its jurisdiction. Professional groups compete and develop interdependently, based in part upon their ability to perform (and defend) the tasks within their jurisdiction. Growth in knowledge—in this case, the causes and impacts of climate change— can create a "new" legitimate set of problems and therefore an opportunity for new professional group(s). Some such potential new professions have already been identified. The WBCSD (2009) suggests that a new "system integrator" profession is needed to develop the workforce capacity to save energy. The UK supports a network of energy advice centres and is training domestic energy assessors to draw up Energy Performance Certificates (Banks 2008), while the Australian government is vigorously supporting the development of a new profession of in-home energy advisors (Berry 2009). These activities and other skills-related efforts raise a number of questions. Who can best deliver low-carbon improvements over the coming decades? How will they be educated? Will the tasks be taken up by members of existing groups, or by new entrants to the market? This paper considers these questions with evidence drawn from developments in the residential sector, mainly in the UK.

Introduction

The built environment must undergo dramatic changes to meet climate change targets. The World Business Council for Sustainable Development (2009) calls for a worldwide building sector energy reduction of 77% below projected 2050 levels. In Britain, the residential sector is the largest consumer of energy and the main emitter of CO_2. Although energy policy in the UK has emphasised energy efficiency in housing (e.g., DTI 2003; DEFRA 2007), the country now recognises that more radical and transformative changes are needed, particularly for existing homes (DECC 2009). Killip (2008) estimates that transforming the entire UK housing stock by 2050 will require 500,000 refurbishments of older, inefficient properties every year. The sheer scale of these transformations requires radical changes in both technology and work practices.

The large technical potential for improvement in the housing sector has been demonstrated, requiring a integrated combination of ambitious demand reduction strategies (eg insulation, improved airtightness, more efficient appliances, behaviour modifications) and low- and zero-carbon technologies (LZC) such as solar technologies and heat pumps (e.g., Boardman et al. 2005; Marchand et al. 2008). Research shows that to reach higher levels of carbon savings in refurbishment (e.g. 50% or more) it is not just one technology that needs to be implemented,

but a suite of coordinated strategies that treats the dwelling, services it provides, and its occupants as an integrated system (Hermelink 2006; Roudil 2007). We call this the "house as a system" approach.

Although optimising the suite of available technical and social strategies for each existing dwelling will yield the best results in reducing carbon emissions, it is a tremendous challenge to assign this task to a fragmented construction industry. In both the UK and France, housing refurbishment is the preserve of small and medium-sized enterprises which include general builders, specialist builders (eg roofing contractors), plumbers, heating engineers, electricians, architects, design engineers, project managers, and building control inspectors. These groups are often considered to be "intermediaries" in the technology adoption process, and as such are expected to provide low carbon refurbishment if their clients demand it. Yet we know that expertise matters, and it is not equally distributed. Quality design and highly skilled installation are essential to the success of low-carbon refurbishment projects, particularly in the areas of insulation, thermal bridging and air-tightness (Bell & Lowe 2000). If some intermediaries are more equal than others, then the supply of low carbon refurbishment is *not* perfectly responsive to the demand. Instead, intermediary groups have their own habits, practices, ways of thinking about problems, and ways of working that affect their ability to provide (and interest in promoting) low carbon refurbishment. How might the need for low carbon refurbishment change the roles of professions, and their interactions? How are existing professions developing to meet the challenge? Which professions will gain control over the new activities involved in low carbon refurbishment?

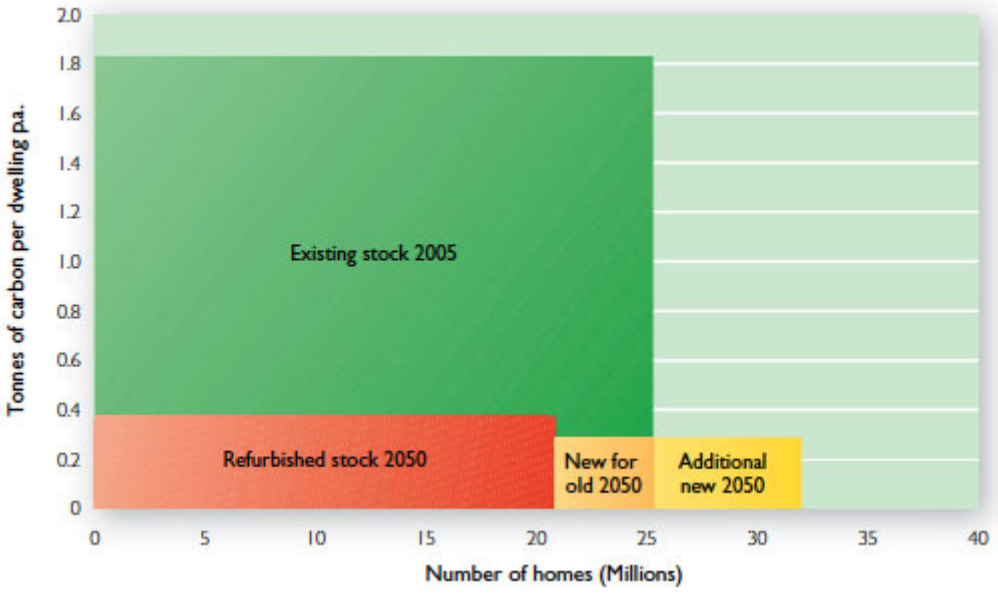
To address these critical questions, we take up the challenge of discerning which institutions can successfully intervene in the total socio-technical system of the built environment to steer it toward sustainable performance. In doing so, we move from discussions of *what* needs to be done to reduce carbon emissions in the existing housing stock, and draw attention to *who* will do it and *how*. Specifically, we focus on the role of so-called "intermediaries", their expertise, and their ability to enhance (or inhibit) the implementation of sustainable strategies in existing residential buildings. This paper begins with a review of some recent literature on innovation in the residential sector. Noting that literature on innovation in residential refurbishments is comparatively scarce, we argue that the understanding of this topic needs improvement, particularly with respect to the need for building expertise. To move towards filling this gap, this paper suggests a "system of professions" approach, which addresses the role of experts and expertise in refurbishment. This discussion draws upon the intersection of two theoretical approaches: innovation in socio-technical systems (STS) and the system of professions (Abbott 1988). The paper concludes with a snapshot of the UK residential refurbishment industry that emphasizes increasing buildability, integrated training, and a recommendation to foster regional innovation networks.

Background: Innovation in Housing

Recent work on innovation in construction suggests that influences on multiple levels affect the shape and nature of innovation. Koebel (2008) suggests that there are individual, firm, and industry characteristics of particular importance, including risks associated with innovation, the role of technology champions, and the degree of centralization in decision making between small custom builders and large production builders. With respect to green building, Hoffman & Henn (2008) agree that both individual and organizational factors inhibit innovation, and they

add a third level — institutional barriers— which is broader and more pervasive than the structure of the industry itself. In Hoffman & Henn's framing, institutional barriers to green building include regulative, normative, and cognitive aspects of the larger social system in which building occurs. In particular, they assert that social and psychological barriers are in need of greater attention, for they believe that understanding and overcoming these barriers will lead to changes in social structures, rewards and incentives. Focusing particularly on passive housing designs, Gentry (2009) argues that it is the building process itself that needs to be changed . Whereas the process employed by large production builders leads to greater fragmentation in the construction of each house and a reduction in labor force skills, Gentry asserts that a design-build approach coupled with integrative design should be the way forward. One important aspect of Gentry's proposal is reconnecting the homeowner with the builder, so that the homeowner (or occupant) becomes more actively engaged with the design and eventual operation of the home. Taylor & Levitt (2005) also believe that the organizational process of building is important. They delineate the concepts of incremental and systemic innovations in the building industry, treating it within a project-based industry context. They argue that incremental innovations happen in the building industry about as readily as they do in manufacturing industries. On the other hand, when it comes to systemic innovations, which require multiple companies to change in a coordinated fashion (e.g., supply chain management), the homebuilding industry is a laggard adopter. Taylor & Levitt hypothesize that systemic innovations will increase when the homebuilders reduce the number of specialists they use on multiple projects and when the level of interdependence between specialist tasks is decreased. Taylor & Levitt are particularly interested in improving the overall economic efficiency of the industry; they do not mention energy efficiency as a goal of their work.

Figure 1. CO2 Emissions from UK Refurbished and New-Build Housing: 75% Reduction Scenario



Source: Royal Commission on Environmental Pollution (RCEP 2006)

It is important to note that the above studies are all about new housing. For many years, research and policy arenas have ignored renovation and retrofits. The implicit assumption is that because existing housing has already been built, the interesting organizational changes (e.g., integrated vs. sequential design) or radical technical approaches (e.g., passive solar strategies) are not applicable. This orientation, however, is changing in large part due to the carbon reduction agenda. Figure 1 shows the projected CO2 emissions from the UK domestic sector to 2050 in a 75% reduction scenario. The largest block of emissions to be abated is from the existing stock. Even if all new homes were zero carbon by 2016 in keeping with UK government targets, carbon emissions from an untouched existing stock would swamp the new build improvements.

The refurbishment industry has grown substantially in recent years and is poised to grow even faster, in large part because of the emphasis on sustainable development and due to economic conditions. In central Europe, Kohler & Hassler (2002, p. 226) claim that these trends have been operating for close to 30 years and believe that they will "oblige the building professions to shift their focus from new construction to maintenance and refurbishment of existing buildings." In the UK, a report commissioned by the Federation of Master Builders presents the poor performance of residences as a business opportunity (Killip 2008). The report claims that building firms, product manufacturers and suppliers could tap into a new market worth between £3.5 and £6.5 billion per year if the UK develops policies, skills programmes, and financial incentives to upgrade the existing housing stock to make it greener and more energy efficient. In addition a refurbished housing stock would help reduce escalating household energy bills as well as making a real difference to climate change.

Although the authors above recognize the need for changes to the structure of professional practice, this recognition may be a minority view. Michael J. Kelly, Chief Scientific Advisor to the UK Department for Communities and Local Government, recently wrote a commentary in the journal *Building Research & Information* on the importance of retrofitting the existing UK building stock. In this article, he states there are four ways in which carbon emissions from existing buildings could be tackled (Kelly 2009, 198-9):

- Re-engineering the fabric of buildings
- Improving the efficiency of appliances
- Decarbonizing the sources of energy
- Changes in personal behaviour

Kelly states that the first three approaches are "engineering related," and the last one "is a matter of psychology and sociology." In our view, Kelly's construction of the solution set is fairly common and has important implications. First, most of the problem can be solved by technology rather than people; second, that social science is mostly relevant for changing homeowner behaviours. We challenge these implications below.

A Socio-Technical System of Professions Approach

In this section, we introduce a way of thinking about innovation in the refurbishment industry that is informed by theories of socio-technical systems together with the sociology of

professions. Our aim is to reconnect the synaptic path that leads policymakers to think that technology is separate from people, and that people only live in houses rather than making their livelihood in them.

The science and technology studies (STS) literature provides an over-arching framework in which the 'seamless web' of social and technological effects of change can be understood. This perspective tells us that technological change does not come about independently of behavioural change and the development of social norms; rather, the technical and the social co-evolve and depend on each other in a complex socio-technical system (Hughes 1983; Wibke E. Bijker, Hughes, & Pinch 1987; Wiebe E. Bijker & Law 1992). With regard to energy use in buildings, this means 'relating the form, design and specification of more and less energy-efficient buildings to the social processes that underpin their development.' (Guy & Shove 2000, p. 67). The social processes that have been studied in this field often focus on the behaviour, habits and motivations of the individuals who occupy homes (eg, Wilson & Dowlatabadi 2007). In contrast, we highlight the common experiences, work practices and shared understandings among experts who renovate homes.

Sørensen and Levold (1992) call attention to the fact that macro studies of government technology policies and micro analysis of individual scientists and technologists miss the "meso" level of analysis. They argue for more attention to be paid to "intermediate" institutions and in institutional arrangements, particularly networks. These authors are more concerned with understanding the general process of technological innovation. However, we agree that a systems approach is essential to understanding the intermediating role of building professionals and expertise.

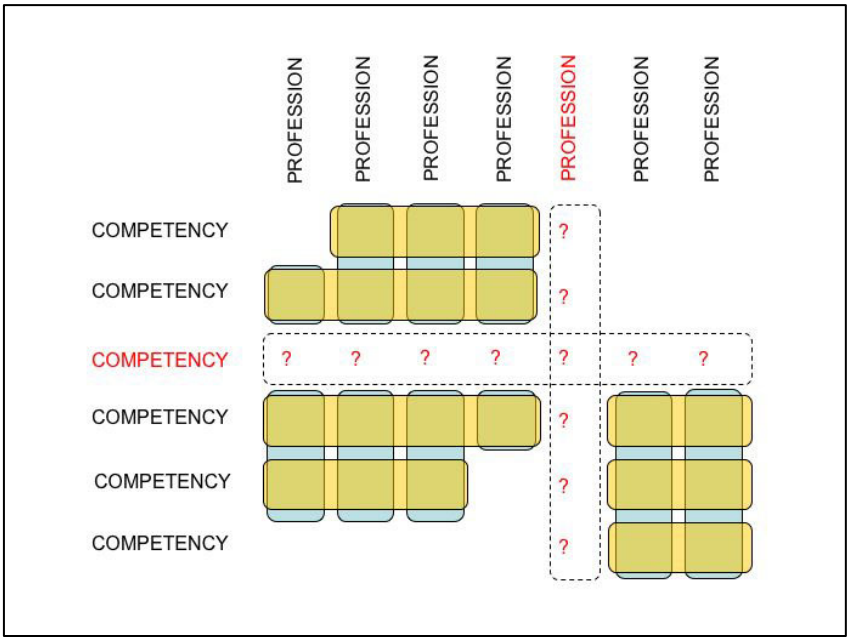
A "system of professions" (Abbott 1988) approach fits within the general sociology of professions (Tripier & Dubar 2005). It is concerned with the ways in which different professional or occupational groups define their work and compete for authority, which is linked to their use and appropriation of knowledge. From a system of professions perspective, each work group is linked (neither permanently nor absolutely) to a set of socially-accepted tasks considered to be its jurisdiction. Architects, for instance, may see themselves (and be seen by others) as the profession with responsibility for creating quality of place and aesthetic values in the built environment; while engineers may be more concerned with the technical practicalities of making structures that are safe, healthy, and thermally comfortable. Professional groups compete and develop interdependently, based in part upon their ability to perform (and defend) the tasks within their jurisdiction. Jurisdictions and professions change over time and are shaped by a number of social, economic, historical, and institutional factors (Abbott 1988; Bureau & Suquet 2009; Evetts 2006). Abbott focuses mainly on the meso or systems level, investigating relationships between professions, but he also looks at the levels below and above. At the micro level, he considers differentiation *within* professions related to work context, and at the macro level, he discusses the larger social forces which create the "system environment" in which the professions exist.

Abbott admits that his framework explains the shape of existing professional groups better than the development of new groups. However, he posits that growth in general knowledge can create a "new" socially legitimate set of problems and therefore an opportunity for new professional group(s). It is this underexplored element in Abbott's work that most intrigues us. Is growth in knowledge about climate change—its impacts, causes, and opportunities for mitigation—sufficient to challenge the current system of professions operating in the built environment today? Some industry and government organizations believe so. The

WBCSD (2009) argues that a new "system integrator" profession is needed to develop the workforce capacity to save energy. The UK is training domestic energy assessors to draw up Energy Performance Certificates (Banks 2008), while the Australian government is vigorously supporting the development of a new profession of in-home energy advisors (Berry 2009). Each of these entities asserts that a new profession will help solve the "problem", but each proposed professional solution is different.

So what does the current system of professions for housing refurbishment look like in Britain, and how might it change (or need to be changed) to mainstream low-carbon housing refurbishment? Figure 2 shows a general conceptual map of the fragmented construction industry, with professional roles arrayed along the horizontal dimension, and skills or competencies stacked along the vertical dimension. In this two-dimensional representation of the 'problem space' of our research topic, gaps appear at the intersections of the roles and competencies, indicating imperfections in the current system. To this system, we add low carbon refurbishment as a possible new role and/or competency. Existing roles (eg architect, structural engineer, general builder, roofer) may expand to encompass new competencies (eg energy assessment, installation of roof-mounted renewable energy systems, whole-home system integration). Competencies which are well established within one professional role may need to be expanded to become the preserve of other roles, for which they have not traditionally been a concern; also, new roles and new competencies may be needed.

Figure 2: Roles and Competencies for the Integration of Low Carbon Refurbishment into a System of Professions



Toward a UK Low-Carbon Refurbishment Industry

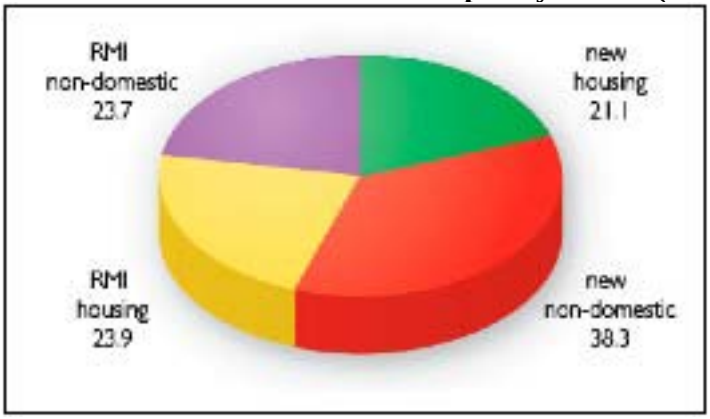
The usual policy approach to retrofits is to give rebates or assistance for individual qualifying measures, such as cavity wall insulation. The remaining potential for uptake of these measures is still significant - for example, roughly 10 million cavity walled homes do not have their cavity walls insulated (CIGA 2008). At the same time, an acknowledgement is needed that

this policy approach is both time-limited and insufficient to meet CO2 reduction targets. In the short-term this means carrying on with existing measures, while simultaneously preparing for a shift of emphasis in the next few years. Going beyond the existing programme requires a new approach, which makes low-carbon refurbishment a mainstream 'normal' decision for people. Key to managing this transition is to engage more fully with the construction industry, specifically the firms—usually small & medium enterprises (SMEs)—who are already involved in housing repair, maintenance and improvement works. If the opportunities for low-carbon refurbishment are to be exploited fully, this kind of renovation needs to be on offer every time a building tradesperson is asked to quote for work.

The State of the Shelf

Construction is a major employer in the UK economy, providing roughly 1.2 million jobs and generating over £107 billion of economic activity in 2005 (DBERR 2007). Construction is multi-faceted, ranging from major infrastructure projects, such as the 2012 Olympics, right through to decorating and handyman services in people's homes. The industry as a whole is made up of a small number of very large firms (perhaps 100 with 80+ employees) and a very large number of small firms (close to 14,000 with 1-3 employees).

Figure 3. 2005 Great Britain Construction Output by Sector (£ billions)



Source: Department for Business Enterprise and Regulatory Reform, (DBERR 2007)

New construction is a different market from repair, maintenance and improvement (RMI), just as construction work in housing is a different market from non-domestic work. This creates a broad four-way split, with housing RMI accounting for some £23.9 billion of the total in Great Britain in 2005 (Figure 3). Many individuals working within the industry move across these boundaries as their careers progress and as the availability of work and sub-contractual arrangements shift in response to wider economic forces. Some firms specialise in one particular type of work, while others are generalists; some concentrate on domestic work, some stick to commercial projects, and some do both. SMEs are predominantly involved in RMI work, although some are developers of new housing, mainly on a small scale. The Federation of Master Builders is the main industry group for small builders. Of their 13,000 members, approximately 75% concentrate on RMI work and 25% build new homes.

The importance and prominence of sustainability issues in construction is much lower on the ground than among policymakers and strategists. Two of the top ten skills issues for Construction Industry Training Board/Construction Skills are 'making sustainability a reality in

construction' and 'improving the skills base and competence through client-led demand, enhancing industry's responsiveness to technical change and productivity improvement' (CITB-ConstructionSkills 2008). In the SME sector working on housing refurbishment, there is a long way to go before these aims are met. In a survey of 152 members of three trade federations in Scotland, on average only 10% had received any form of training on sustainable development whilst 6% reported ever having lost business for environmental or social reasons (Brannigan & Tantram 2008). On this evidence, few clients make sustainability a primary objective of the work that they commission. At the same time, 50% of all respondents to the Scottish survey believed that the pressure to be more environmentally responsible would grow over the next 1-2 years, and over 80% thought this pressure would definitely increase within five years. The pressure is largely perceived as being policy-driven, rather than driven by demand in the market for refurbishment work. At the same time, the opportunity for new business is significant and some of the more innovative, forward-looking firms are actively searching for information that can help them make the most of those opportunities. In many cases, information does exist (for example, publications from the Energy Saving Trust, including good practice guides) but the perception (especially among those who do not use the internet) is that information is not easily available. This suggests that some useful and relevant information is not being disseminated through the channels of communication that most SMEs use and trust. It could be a role for trade associations – which are seen as trusted sources of information – to help disseminate existing information that is available from other bodies. For SME building tradespeople to deliver low-carbon refurbishments on a large scale, the sector's capacity to do this kind of work needs to be developed – almost from scratch. In the following sections, we concentrate on three aspects essential to this development: increasing the buildability of innovations, increasing integrated practice and multi-skilling, and developing regional innovation networks.

Increasing Buildability

The work to build capacity in the sector needs to take account of established custom and practice – or the endeavour will result in rejection by most practitioners. This insight is captured in the idea of 'buildability' – a term intended to capture the reality of how builders operate and the fact that, whenever refurbishment is carried out, the contractors have to be confident of their ability to do the work and achieve satisfactory results, both for themselves and for their clients. If a low-carbon refurbishment strategy can be devised in such a way that it takes account of the need for 'buildability', then the strategy has the greatest chance of acceptance by the SME construction sector. Without it, it is likely to be ignored or subverted on the ground. Key elements of the 'buildability' idea are that building work needs to be made up of products and methods that must be all of the following: practical, replicable, affordable, reliable, sellable, available, guarantee-able, and profitable (Killip 2008, 23-4).

Where new products are needed to help meet the low-carbon refurbishment agenda, the key stakeholders (in addition to the SME building tradespeople) are the manufacturers and suppliers. Where new supply chains need to be developed, the key to success is a strong long-term policy commitment from government. This will stimulate investment and strategic business developments, both among existing players in the market and among potential new market entrants.

Increasing Integration

The skill-sets of traditionally-defined tradespeople (for example, plasterers, electricians, etc) will need to be expanded so that they understand enough of the low-carbon refurbishment agenda to play their part effectively. This is likely to include a better understanding of how the interaction of different trades on-site can lead to loss of overall building performance (for example, airtightness can be compromised if wet plaster is stopped at the height of skirting boards instead of reaching floor level; the performance of vapour barriers and insulation materials can be compromised by inaccurate installation and subsequent drilling of holes for pipes, ducts, wires and recessed light fittings). In relation to the installation of low and zero carbon technologies (LZCs), the relevant sector skills council has identified these new technologies as key to the future of mechanical and electrical building services (National Energy Foundation 2007). This council hasß begun a process of setting national occupational standards for training on the installation of LZCs, starting with a review of the short courses and other forms of training that have emerged during the early period of market development. This work confirms a widely-held observation that innovation in skills training does not start with vocational qualifications, but with short courses. Developing short courses into vocational qualifications is an important part of mainstreaming the capacity to deliver new services.

The traditional focus of training has been on traditionally defined trades (plumbing, plastering etc), but the challenge of the new LZC technologies is to move towards training requiring elements of several traditional trades, as well as new competences – the so-called multi-skilling agenda. For a whole-home refurbishment that incorporates building works (for example, wall insulation, re-plastering) as well as energy systems design, the multi-skilling challenge is greater and includes aspects of project management (for example, optimal ordering of works on-site) as well as integrating demand reduction measures with energy supply technologies (for example, working out how much heating a well-insulated property will require and sourcing heating system technology to match). This represents an additional shift of emphasis away from trades and specific technologies to an integrated ‘whole home’ refurbishment focus, including some technical understanding of energy systems and building physics. Some of the more technical aspects of this work may be best addressed through the development of one or more packages for refurbishment (ie an all-inclusive design and specification, which can be applied without understanding all of the reasons behind it). Having said that, there is a risk that packages may not work well in practice (or in certain situations), as the assumption that ‘one size fits all’ is almost certain to be misplaced, given the variety and size of the housing stock. The low-carbon refurbishment agenda therefore presents a series of challenges for training and skills, with the strong possibility that existing national occupational standards may have to be amended (leading to changes in related vocational qualifications) and, fairly probably, that one or more new sets of occupational standards and vocational qualifications will be needed. Without a perceived need from the industry leaders who guide the development of new skills, none of this work on mainstreaming skills for low-carbon refurbishment will come about.

Developing Regional Innovation Networks

There are several reasons for thinking that a regional focus is needed to foster some of the innovation implicit in the low-carbon refurbishment agenda, as summarised below.

- **Housing stock variations.** Locally and regionally, UK housing has quite different characteristics - from Scottish tenements to back-to-back terraces in northern English cities; from rural houses made of traditional materials (for example, Devon cob) to inner-city high-rise flats. While some dwelling types are common and ubiquitous, there is also geographical diversity. Tackling these issues at the level of a devolved administration or an English region would allow for more detailed work on the predominant types in that particular part of the country.
- **Climate and climate change impacts.** Heating demand is typically higher in colder Scottish winters than in Cornwall, while the changing climate may lead to a significant increase in demand for summer cooling in London and the south east, but not elsewhere.
- **Devolved administrations.** Both Wales and Scotland have taken different paths to England in terms of the zero-carbon new-build agenda, while Scotland's Building Regulations are also significantly divergent. As refurbishment moves up the political agenda, it seems reasonable to assume that the devolved governments will want to define their own strategies for the existing housing stock as well**.**
- **Business networks.** Most SME construction firms work at a local level, but federations and business-to-business networks typically operate at the slightly larger scale of English regions, nations (Scotland and Wales) and the province of Northern Ireland.
- **Regional/devolved development agencies.** There is considerable potential for new jobs and new economic development, much of which could benefit from financial assistance and other development services that are available at a regional level.
- **Training centres.** ConstructionSkills and the further education college network can usefully be integrated into a regional structure. In light of the far-reaching implications that low-carbon refurbishment has for skills, the involvement of these institutions is key. Developing the low-carbon refurbishment agenda will require co-ordination of information, opportunities for networking and knowledge transfer activities. All of these can usefully take place at a regional level and, in many instances, there are existing partnerships or stakeholder networks in which the low-carbon refurbishment agenda could be accommodated, making good use of existing structures.

Conclusions and Next Steps

This paper has set out some of the issues around low-carbon refurbishment and proposed some ideas and recommendations for government and other stakeholders to consider. Much more work is clearly needed to bring about the transformation of the UK housing stock to meet low-carbon standards. This amounts to a completely new service provided by the SME construction industry, potentially adding between £3.5 billion and £6.5 billion to the existing market for housing repair, maintenance, and improvement (£23.9 billion). A new kind of service is needed, combining new and traditional skilled trades in ways which result in low-carbon refurbishment. Many vocational qualifications will need to be amended so that awareness of energy and carbon issues among the SME construction industry is significantly improved and practices changed to meet these new requirements. To increase the chance of success, refurbishment initiatives need to take into account the ways in which building tradespeople operate, making the objectives of policy practically deliverable.

To make these changes, we emphasize the importance of rethinking the ways in which practitioners, policymakers and academics think, learn, and teach about the built environment.

Making significant change in the built environment is not a matter of re-engineering a technical system on paper, it is about reshaping a socio-technical system by redefining established skills, work practices, and professions on the ground.

Although low carbon refurbishment is not currently the norm, we are interested in exploring the ways in which built environment professionals see gaps, opportunities, and challenges for integrating low carbon refurbishment in their work. In September 2010, we will start a three-year cooperative, comparative study on this topic in Britain and France, together with researchers from ECLEER. ECLEER is a European energy efficiency research centre created by Electricité de France (EdF) in partnership with academic institutions in Paris and Lausanne. This work is jointly supported by EdF and the UK Engineering and Physical Sciences Research Council. Because we are interested in whether a new profession might arise, the forthcoming work will focus particularly on the work practices of innovators as providing a key to understanding the social construction of new competencies and/or roles that may alter the current system of professions. This focus on innovation will be set against a backdrop of more general work practices and policy context.

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