Building expertise: A system of professions approach to low-carbon refurbishment in the UK and France

Nösperger Stanislas
EDF R&D,
Site des Renardières, bâtiment W49/51, Ecuelles
F-77818 Moret sur Loing Cedex
stanislas.nosperger@edf.fr

Gavin Killip & Kathryn Janda, Ph.D
Environmental Change Institute, Oxford University
South Parks Road
OX1 3QY Oxford, United Kingdom
gavin.killip@eci.ox.ac.uk
Katy.Janda@ouce.ox.ac.uk

Keywords

actors, education, system analysis, broader social context, building refurbishment, professions

Abstract

Much of the recent social science work in the energy field has been focused on changing the behaviour of individuals at home through values, attitudes, and information about climate change. This paper takes a modified "system of professions" approach, which incorporates the role of intermediaries (e.g., architects, engineers, builders, 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 World Business Council for Sustainable Development suggests that a new "system integrator" profession is needed to develop the workforce capacity to save energy. The United Kingdom supports a network of energy advice centres and is focusing on the introduction of a new 'Green Deal' programme in 2012 to make capital available with a 25-year payback. France has a system of tradable energy efficiency certificates ('white certificates'), which has led to collaborative projects between energy suppliers and small and medium-sized enterprises (SMEs) in the construction industry. Both countries have systems for building energy performance labels under the EU energy Performance of buildings Directive (EPBD). 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 in UK and France.

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 both France and Britain, the residential sector is the largest single consumer of energy and the largest single emitter of CO_2. Although energy policy in both countries has emphasised energy efficiency in housing (DTI 2003; FFB 2005; de Boissieu 2006; DEFRA 2007), both countries now recognise that more radical and transformative changes are needed, particularly for existing homes (DECC 2009a; Carassus 2007; Nösperger 2005). The transposition of the Energy Performance of Buildings Directive to national contexts has required the development of new systems for providing energy ratings of buildings, which has created the demand for a new service to provide the ratings and a new 'intermediary' role in the whole socio-technical system. Other intermediaries – both new and pre-existing – may also have important roles to play. In France, housing refurbishment is highlighted as the top priority in achieving European and Kyoto Directives in both the Environment Roundtable (Grenelle de l'Environnement) and the inter-departmental building energy research programme (Programme Interministériel de Recherche et d'Expérimentation sur l'énergie dans le

Bâtiment, PREBAT) 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 an 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, as this paper discusses, 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 and 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 reports on the early stages of a three-year cooperative, comparative study on this topic in Britain and France. Because we are interested in whether a new profession might arise, our 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 paper provides a general backdrop of work practices and policy contexts in both countries, against which our later work will be set.

We begin with a brief review of 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). Next, we provide two reviews. The first review discusses the construction industry in France, describing first the policy context in which it operates, and then the state of the construction industry itself, focusing mainly on the practitioners involved in refurbishment of housing. The second review does the same for the UK. The paper concludes with a comparison of the state of the system of professions in both countries, leading to an initial assessment of how each is organised from the multiple perspectives of each group's legitimacy, access to decision-makers on refurbishment projects, interest in the jurisdiction, technical competency, and their opportunity to integrate the varius elements needed to achieve a successful outcome.

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 challenge the synaptic path that leads policymakers to think that technology is separate from people, and that people's only interaction with houses is as householders. We need to think of people and technology as two sides of the same coin, which develop in a process of co-evolution, with technology shaping behaviour and vice versa; and the home needs to be recognised as a place of work for those who make their living in the multi-billion euro market for repair, maintenance and improvement in the residential sector.

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, and Pinch 1987; Wiebe E. Bijker and 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 and 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 and 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. Parag and Janda (2010) conceptualize 'the middle' in energy systems as an important level between the atomised level of individual citizens/firms/projects, on the one hand, and national-level institutions on the other. In their paper, they discuss in greater detail the characteristics of bottom-up and top-down approaches to energy transitions and show the importance of the 'middle-out' approach in shaping and delivering systemic change. They argue that the middle is more than 'filler'; rather, it has many qualities and functions which are unique and essential to a systemic transition. They suggest that often the middle agents have both the agency and the capacity to make and support the changes, and conclude that it would be useful to add a middle-out strategy to the top-down and the bottom-up ones.

A "system of professions" (Abbott 1988) approach helps us to describe an important set of middle agents embodied in the building industry. This approach fits within the general sociology of professions (Tripier and 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. (Whether or not these groups fulfil their roles adequately is not our focus here). 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 and 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 we focus on. 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.

So what does the current system of professions for housing refurbishment look like in France and Britain, and how might it change (or need to be changed) to mainstream low-carbon housing refurbishment? In a previous paper, we suggest that there is a gap in expertise that may need to be filled (Janda and Killip 2010).

Figure 1 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 profession and/or competency. Existing professions (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 profession 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.

We understand "competency" as someone's ability to tackle a given problem or task or situation through the mobilization of three separate elements: technical know-how ('savoir-faire'), the personal skills and habits needed for an individual to take responsibility for their own actions and communicate effectively ('savoir-être') and the resources available (Le Boterf 1995, 1997; Carré 1999). A given job is made of several tasks which can be performed if the performers of those tasks have the relevant competencies. Competency turns out to be a kind of capital and to follow the "law of supply and demand": the more a given competency is scarce and sought-after, the more it is source of wealth. Professionals have several competencies which they can use simultaneously or singly to accomplish the tasks considered to be within their jurisdiction (see above). As a source of wealth, competency is also a source of power : claiming a role as professional in a given domain means that there is an expectation of authority over those who are not professional. Competency also entails a claim for legitimacy and peer-to-peer recognition, which gives a collective power to the population of a given profession. This collective power (or authority) can accept or reject some competencies in as much as they are considered as related to this profession or not. Competency is therefore the basis of professional identity and the source of differentiation in a world of interconnected professions. Every actor uses his professional identity and its related competencies for legitimising and justifying his business role. Besides, professional and personal identities are related. The professional identity shapes someone's vision of a given industry or society. All professional identities are bound to work together by abiding by formal or informal rules. Each time one of these rules is not respected a conflict can occur, which threatens collaborative working.

The low-energy buildings agenda can have a double impact on the existing system of professions :

- The use of new technologies may require changes to the existing distribution of competencies – some existing ones that may need to be adopted by different professions, and

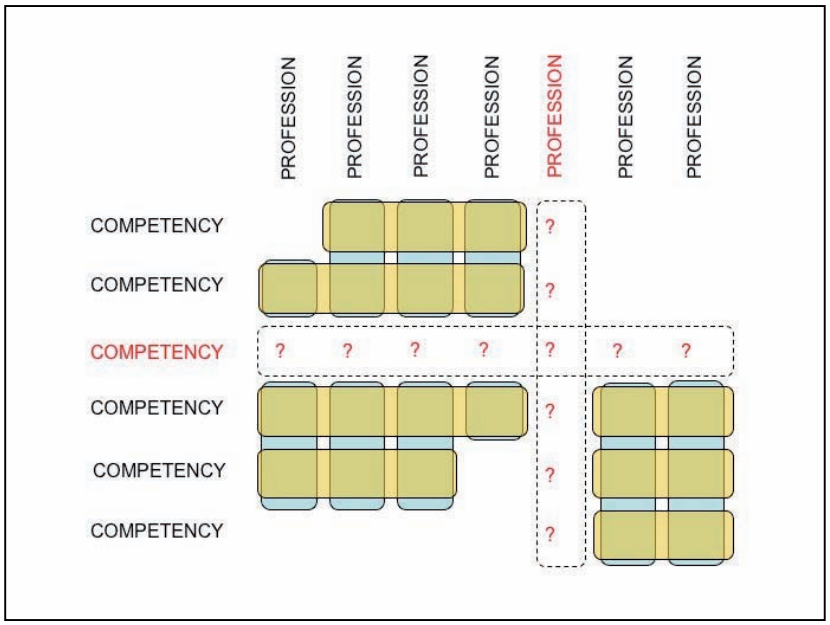

Figure 1. Roles and competencies for the integration of low carbon refurbishment into a system of professions.

also some that are entirely new. The existing distribution of competencies and the system of professions will both need to adapt.

- An efficient building-focused retrofit differs from traditional refurbishment operations such as boiler replacement because it is performance-oriented and it requires an integrated view of the building and its energy systems. This systemic leap suggests the need for a new actor system with new cooperative ways of working (see Zélem et al 2010, Du Tertre 2008). This raises the question of new competencies which could be helpful at the interfaces between actors.

Review 1: France

FRENCH POLICY CONTEXT

A nationwide process called "Grenelle de l'Environnement" (Environmental Round Table) sets very ambitious targets for energy efficiency in France, notably a decrease in energy consumption in the housing stock by 38 % in 2020 and 75 % in 2050.

In addition, the entire stock of public buildings and all private buildings that are in construction, for sale, or for rent must be assessed for their energy performance. The Energy Performance Certificate gives a mark (A-F for the residential stock and A-I for commercial and public buildings) for their conventional assessed Energy Consumption (kWh /m²/year) and CO_2 emissions (kg CO_2/m²/year). This certificate also includes advice on relevant retrofit operations for an improved performance. Despite all the drawbacks of the existing EPC process (especially assessment reliability), it associates a building and its performance and it therefore helps housing owners consider a retrofit from an energy performance point of view.

Several government initiatives have been developed to reach the energy reduction targets for existing homes.

Loans and tax credits for home improvements

Any housing occupant, whatever his status (owner or tenant) can benefit from tax credit if he invests in energy-efficiency operations in his home (insulation, condensing boiler, heat pump fitting, heating control device fitting, duct insulation...). He can also benefit from a 10-year soft loan (contracted with any bank) provided it is below €30,000. Regional policies can strengthen national support in housing retrofit through specific incentives, for instance additional soft-loan, subsidies

The French white certificate scheme: housing retrofit actors as key partners

Since 2006, some companies and organisations (energy suppliers) are involved in the new "Energy Efficiency Certificates" or white certificates (French Acronym: CEE) scheme. Energy suppliers have to achieve energy savings (approved and valued with these CEE) according to their specific target. The energy suppliers' specific targets depend on a nation-wide target to reach within a three-year period (2006–2009 and 2011–2013), and on the market share of each supplier on the Residential and Tertiary markets (from a value and energy volume point of view). These actors can be called "obliged parties ". Other actors are allowed to achieve energy efficiency measures and to get CEE that they will be able to sell to the "required actors" (especially "public" retrofit agencies and local authorities).

At the moment, there is no CEE extra value for coupled retrofit operations (both on envelope and systems), which does not help an overall vision of a energy-targeted building refurbishment. White certificates can be sold to any obliged actor in the frame of a structured market or through bilateral agreement.

The energy suppliers are especially involved in this scheme, as they already have strong positions in the energy efficiency market (energy surveys, consulting services, retrofit incentive, and partnerships with the building refurbishment industry). As the housing stock stands for the greatest share of the CEE market, the building retrofit industry and its very small com-

panies (craftsmen) play a key role in this system. They are the key contacts for residents willing to retrofit their housing and they are therefore "key partners" for the obliged actors, who need established networks of endorsed craftsmen. We can notice that financial institutions have to play a role too as the existing housing stock retrofit would stand for a 600 bn Euro investment.

THE FRENCH BUILDING INDUSTRY STRUCTURE AND ORGANISATION

Overview

The construction market in France is a 142 billion Euro industry (in 2008). Economically, the revenue is about evenly balanced between new buildings and refurbishment. Politically and structurally, however, these subsectors are not equivalent. The new building market is composed predominantly of large firms, has a clear organisational structure, and has a sectoral 'identity' in strategic debates. In contrast, the refurbishment sector is made up of small companies operating in a highly diffuse way, with no organised 'identity' (Nösperger 2005).

Beside the "pure" construction companies, a number of other players can be identified: e.g., distributors (traders, wholesalers, building-oriented home improvement centres), financial institutions, and real estate agencies.

There are about 318,000 companies in the building construction sector in France. Almost all of these companies (97 %) are "craft" companies with less than 20 employees (Marco 2009). Altogether, they earn a turnover of 86 billion Euros, which is about 60 % of the construction market's total. These companies can be split into two broad categories: (1) general builders carrying out structural works (28 billion Euros), and (2) specialist contractors (58 billion Euros). The specialist trades include: plumbers, heating engineers, electrical device installation, joiners, decorators, and so forth. Table 1 provides a brief overview of the sector, with a focus on small "craft" companies.

Very small-sized companies (with an average staff of less than 5 employees) operate principally in the residential market. However we can describe their activity with more accuracy:

- About 57 % of the small building companies mainly work on the home renovation market, most of the time on their own. They generally have a high influence over specification of works. They work with 4 or 5 suppliers whatever their kind (mass market distributors, specialized material traders, etc.);
- 15 % of these companies work mainly on the dwelling construction market and as a subcontractor of the house builder or for the final customer (individual person). Their influence over specification can change with the kind of their customer, and they are supplied by traders and wholesalers

Table 1. Schematic analysis of the building craft sector (Nösperger 2005, Marco 2009).

	Home renovation	Non-residential sectors	Dwelling construction
Number of companies	174000	82000	<50000
% SMEs involved in sector	56,5%	26,5%	16%
Turnover Bn€	32	26	28
% of the overall craft companies turnover	38%	30%	32%
Activity	Renovation (90%)	Renovation (>50%)	New buildings (>50%)
Share of the residential market	>80%	<50%	>50%
Work as sub-contractor	No (80%)	Quite frequently (40%) for a large general building company	Frequent (>50%) For house building companies
Customers	Housing occupants	Public and private org.	Housing owner
Size (employees)	0-2	6-19	*3-5*
Average age of firm	>5 years for thermal system fitters; <5 years for envelope-related craftsmen	>10 years	<5 years
Trades/activities	Electricians, Plumbers, joiners, painters	Electricians, heating engineers, metal shaping, joinery, window installers	general builders, carpenters, insulation and gypsum plate professionals
Education level	Secondary (A levels)	University degree	None
Professional skills	None	Certification	changing
Main activity	Multi-activity	Installation and end-works	Construction work
Prescription influence	Very strong	Quite weak	Quite strong
Potential advisor	Dwellings	Building owners, building project managing companies	House building companies
Supply network	Several suppliers	Specialised suppliers	Professional suppliers

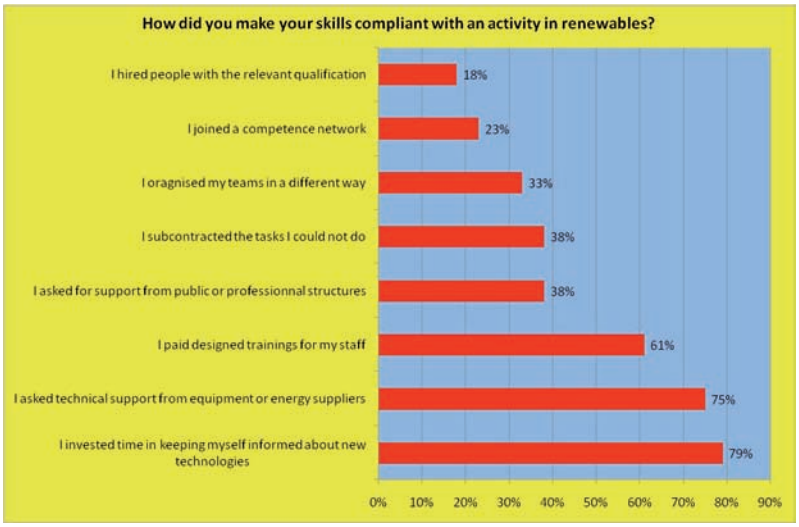

Figure 2. Strategies for acquiring skills among French building small companies (GMV).

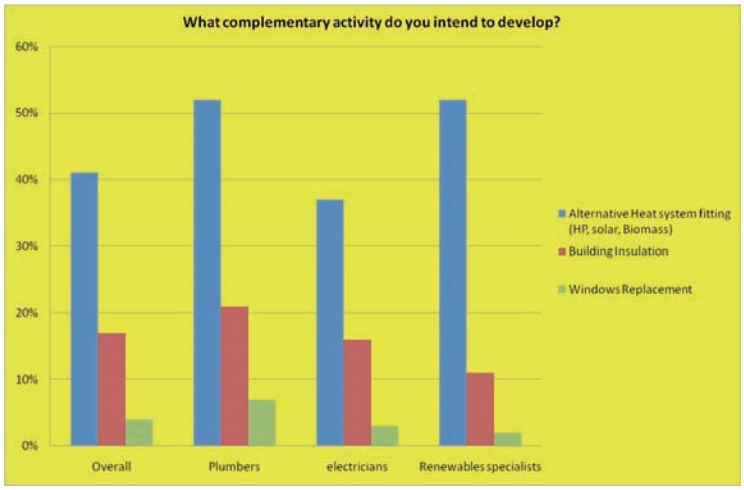

Figure 3. Intended development of complementary business among French tradespeople.

Is the French construction industry preparing for low-carbon?

A survey of contractors in 2009 (GMV) sought to elicit their views on the challenge and opportunity of the 38 % energy reduction target for the housing stock. Installers clearly identified insulation work and renewable energy systems (thermal solar, PV, heat pump and biomass) as the most promising business opportunities, and the most relevant answer to the current climate challenge.

The installers acknowledge missing training and they intend to focus on the information search, and also limited partnerships with skilled companies and staff specific education to deal with the change in their activity (Figure 2).

The heat pump market development in France illustrates the impact of a new technology on the established system of professions. The jurisdiction of home heating and cooling used to be divided among electricians (dealing with electric convectors), plumbers (boiler fitting) and air-conditioning professionals. However, proper sizing of heat pumps requires a more accurate prediction of heating and cooling loads than in the case of a standard boiler. Therefore, fitting a heat pump requires joint competencies in electricity, centralised water-based heating systems (e.g boilers), and thermodynamic properties of the house and its use. None of these trades used to have all these competencies. From a technical point of view, AC specialists would be the most suitable trade but they usually prefer to deal with large installations. As a consequence, the residential heat pump fitting market is imperfectly split between these three trades.

Nevertheless they seem to perceive this change rather as incremental and they do not really consider the global energy performance of the building in their approach. Only a few (10-15 %) intend to set up or join a formal "skill-network" made of cooperation and subcontracts in order to help renovate the housing stock. However, a quite significant share of plumbers (21 %) intends to integrate envelope-refurbishment works in their offer. The poor reflection on a new work organization or skilled people hiring reinforce the feeling that they have not made out the building stock refurbishment challenge yet.

Their lack in involvement in a performing building delivery is also highlighted with their disappointing commitment in maintenance. Although most boiler fitters offer a maintenance service, only 50 %-60 % of the other tradesmen do so. However, considering the energy performance of the building asks to encompass installation and exploitation/maintenance. That

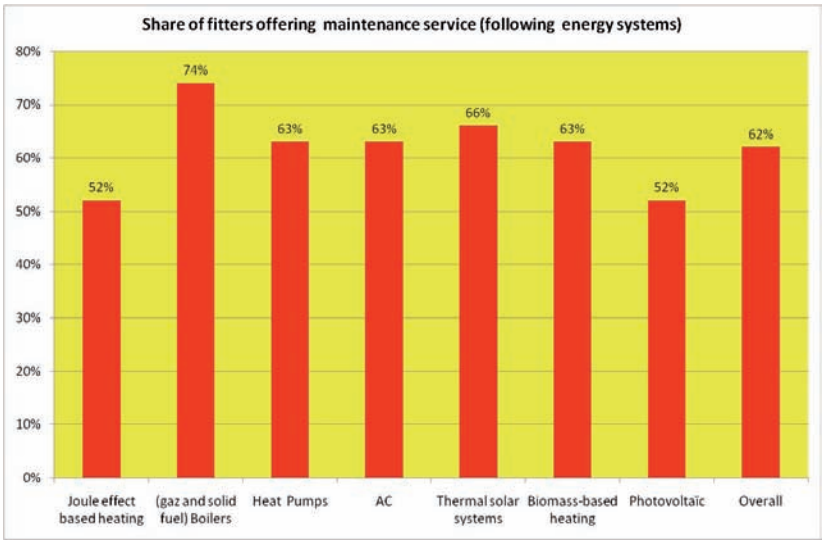

Figure 4. Share of tradespeople offering both fitting and maintenance service.

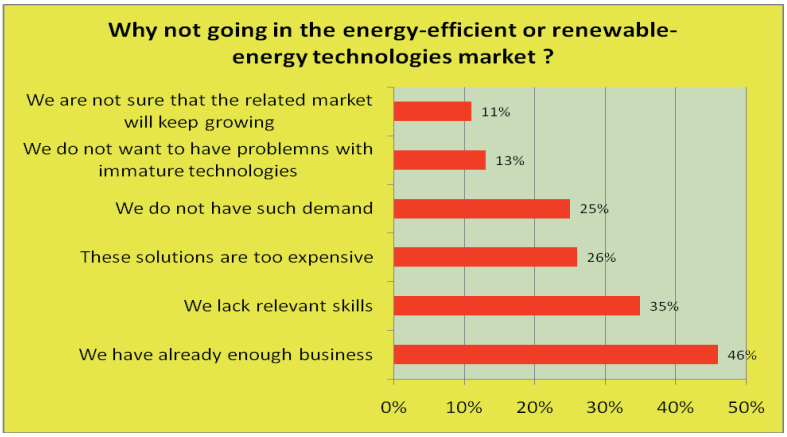

Figure 5. Trades' reluctance factors for an entry on the renewable market.

means that only roughly 60 % of the existing tradespeople are likely to deal with the performing building challenge, even if they focus only on their speciality.

Why do they change not so easily? According to the installers themselves, 35 % quoted poor competence in the new technologies and 46 % said that vigorous demand for existing services prevent them from changing in their professional offerings. Moreover, the demand for highly energy-efficient solutions seems still too small for them to change. 25 % of those surveyed said they had not been asked to provide energy efficiency services, and 11 % did not think the market for these services would grow.

Emerging dynamics in the system of professions in France

According to the installers, a customer's decision to renovate housing is mainly based on a rational economic (cost and benefits) calculation, taking economy savings into account. That is why any national or institutional financial help (subsidies, zero-rate loans) is useful! However, installers ignore other official conclusions which state that comfort improvement is another lever for energy-related housing refurbishment.

Tradespeople see product manufacturers (e.g., boilers, heat pumps, etc.) as relevant to support craftsmen in their efforts to change whereas energy suppliers should just bring commercial help (which already exists). On the opposite, official energy efficiency institutions (Ademe or local energy efficiency institutions) are obviously ignored.

Installing renewable energy systems is a new and promising business from the fitters point of view, but it is considered in a continuous way and with no concern for the global housing energy performance. They obviously lack ambition in their adaptation capabilities and abilities to change their business practice in a way so that they could be able to deal with today's trend in energy efficiency challenge. Unfortunately, they do not request the help of actors with a more comprehensive sight (energy agencies, energy suppliers …). The existing demand for full energy-efficiency targeted retrofit offers does not seem to encourage craftsmen to change.

Review 2: the UK

UK POLICY CONTEXT

The UK's Climate Change Act of 2008 requires government to produce mitigation strategies and regular reviews, of which the Low Carbon Transition Plan is the first, committing to a

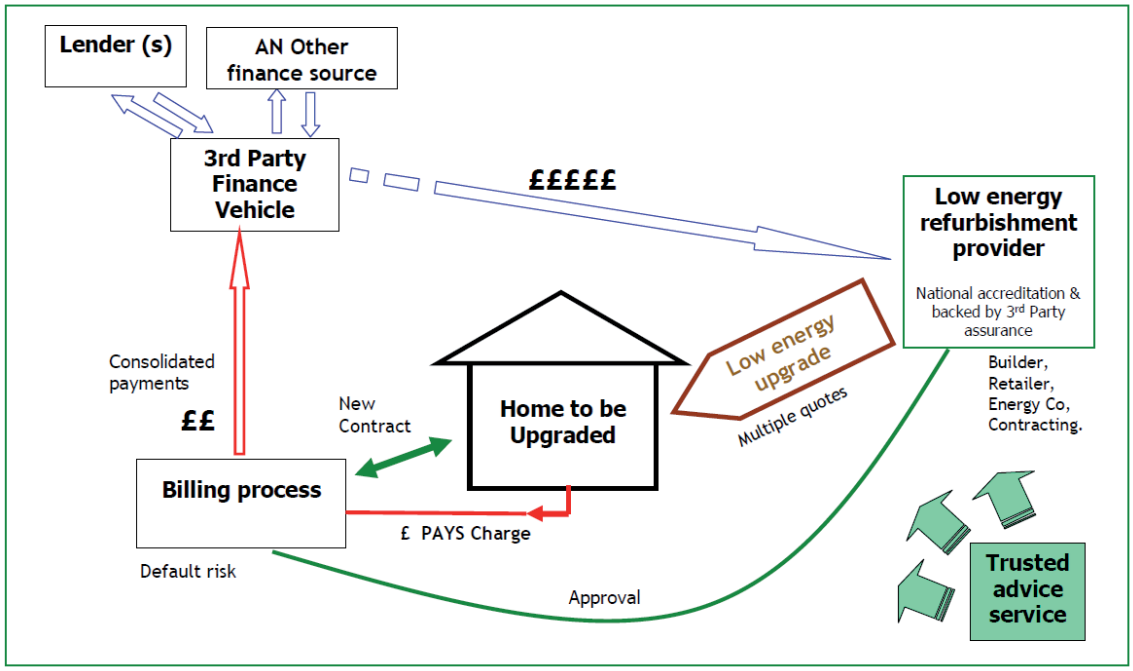

Figure 6. Overview of PAYS finance mechanism (UK Green Building Council 2009).

34 % reduction in greenhouse gas emissions over 1990 levels by 2020, and an 80 % reduction by 2050 (DECC 2009a). In the shorter-term for the residential sector, this equates to a drop from 77 $MtCO_2e$ in 2010 to 56 $MtCO_2e$ in 2020 – a reduction of 27 % (DECC 2009b, table 1.2).

The policy and delivery infrastructure that has developed over several decades to support investment in energy efficiency in UK homes has reached a strategic crossroads. The future potential of measures supported through the supplier obligation (Carbon Emissions Reduction Target, CERT) is limited by the fact that the measures it supports will each reach saturation point (full take-up), estimated to be around 2015 for cavity wall and loft insulation (needs a ref). Policy-makers and industry groups are looking beyond CERT, in terms of the funding mechanism, technical specifications and policy framework that might be required in future. These debates have been a recurring theme in government consultation documents and strategy documents in recent months and years. The most significant of those are reviewed in the following sections.

The 'Green Deal' is a proposal for a finance mechanism for low-carbon refurbishments, based on a legal charge on property deeds, which would effectively make the repayment of the capital binding on the property, rather than any particular person. If the property were sold before the capital was repaid, the duty to pay would pass to the new owner. The advantage of such a scheme is that it could provide up-front capital costs, with repayment spread over a longer period than a normal (personal) loan, with a 25-year payback period being discussed, in line with current proposals for 'cost optimality' under the recast EPBD. In theory, the savings from energy efficiency would be greater than the charge on the property, making the finance available at no net loss to any resident.

An intensive round of expert workshops was paid for by the government and coordinated by the UK Green Building Council in 2008 to develop the idea in detail, resulting in a summary report (UK Green Building Council 2009).

However, the administration costs of such a scheme could be quite high, including: administration of the financing; approvals system between refurbishment service provider and billing service provider; new contract to negotiate between PAYS subscriber and billing energy service provider; and legal costs of the new charge on the property (Figure 6). The costs of these administrative overheads would all need to be recouped from the savings made if the logic of the current proposal were to work.

The UK introduced a feed-in tariff in April 2010, but no precondition for energy efficiency, so this is likely to stimulate the renewable energy industry, rather than integrated efforts to do energy efficiency and deploy building-integrated renewables on a bigger scale.

THE UK BUILDING INDUSTRY STRUCTURE AND ORGANISATION

In 2008, construction in the UK accounted for £123.6 bn (142.1bn Euros) of output, of which some £48.2 bn (55.4bn Euros) was spent on housing (39 % of the total) (Office for National Statistics 2009). The breakdown for where this money was spent shows that most money was spent in the private sector (new-build and repair & maintenance), while the total expenditure on housing repair & maintenance (in both public and private sectors) was 58 % of the total – exceeding the total amount of money spent on new housing (Figure 7).

The UK construction industry is made up of over 200,000 firms: a large number of small businesses, particularly micro-businesses, and a small number of large firms. Firms with 1-3 employees make up 70 % of the total number of firms in the industry (Figure 8).

Construction is a sector which responds rapidly to changing fortunes in the wider economy, and the current recession is reflected in the employment figures. As recently as 2006 the Construction Skills Network estimated that the industry needed to recruit and train 88,000 entrants per year for five years (CITB-ConstructionSkills 2006), but by 2009 firms were

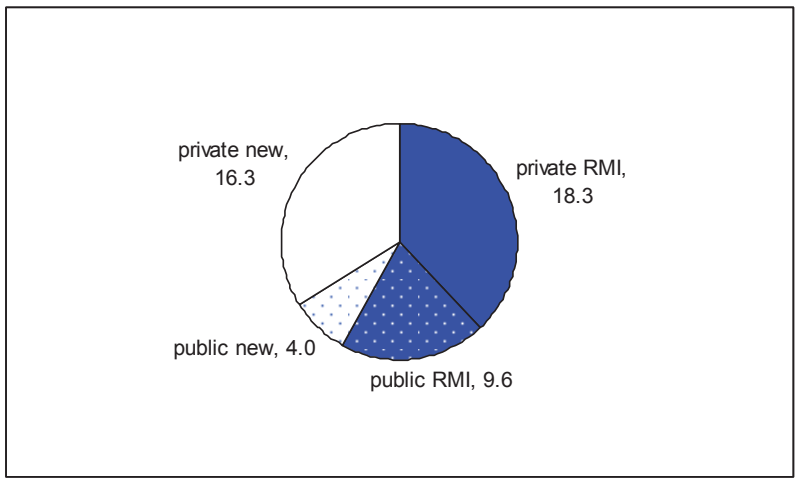

Figure 7. Public and private investment in housing, £bn, GB 2008 (Office for National Statistics 2009, table 2.1).

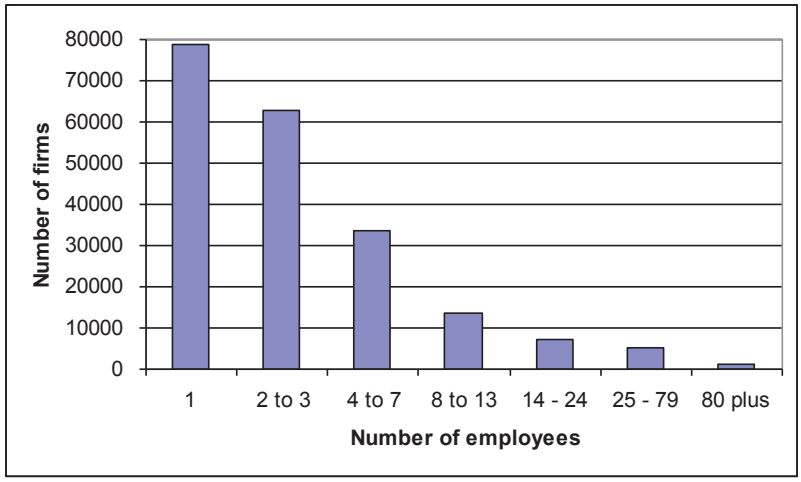

Figure 8. Number of firms in construction by number of employees, GB 2008 (Office for National Statistics 2009).

laying off staff and the overall estimated labour shortage was down to 37,000, of which 13,000 were in manual trades (CITB-ConstructionSkills 2009). The housing RMI market has experienced a decline over the same period, as 'consumers cut back on non-essential work on their properties, particularly as disposable incomes have come under pressure and employment uncertainties increase' (CITB-ConstructionSkills 2009), p. 4). Nonetheless, the industry is forecast to grow in the period 2010 – 2014, in line with forecasts for general economic recovery (CITB-ConstructionSkills 2009).

Is the UK construction industry preparing for low-carbon?

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 and Tantram 2008). On this evidence, few clients make sustainability a primary object 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.

Emerging dynamics in the system of professions in the UK

The UK government estimates that its 'Warm Homes, Greener Homes' strategy will generate 65,000 'core' jobs and potentially many times more throughout the various supply chains involved in delivering this work. A new 'retrofit consortium' is proposed to bring products to market, drive down costs and encourage employers to invest in training, but the non-governmental members of this proposed grouping are large-scale property owners and private sector organisations 'such as British Gas and the Mark Group.' (Department for Energy and Climate Change 2010b, p. 47).

SME tradespeople are mentioned in this strategy document as one source of advice on refurbishment decisions to householders, but the main thrust of the document is still dominated by an approach based on individual measures, a strong focus on the need for cost reduction and the role of government at national and local levels. The estimate for job creation is an interesting allusion to the economic potential, but the emphasis placed by HEMS on existing markets in mainstream construction is extremely muted when compared with the construction industry's own view of the potential of the LCTP. In its interim report to the Secretary of State for Business, Innovation and Skills, the Low Carbon Construction Innovation Growth Team observes that '[o]ver the next 40 years, the Low Carbon Transi-

tion Plan is virtually a business plan for construction' although they also identify numerous barriers and market failures, essentially linked to the almost complete lack of client demand for the necessary work (Department for Business, Innovation and Skills 2010).

In summary, the UK government's focus is on delivering the 'standard' insulation measures by 2015 and developing a finance mechanism for more expensive works to be launched in 2012. The construction industry has begun to show its awareness of the enormous economic potential of low-carbon refurbishment, but is also aware that market demand is currently tiny. The surveyors also draw attention to the lack of demand for low-carbon properties, and have so far seen it as a kind of professional duty to remain detached from current policy debates: the surveyors present themselves as somehow neutral observers of market trends, rather than as part of a policy-led push to create demand. To them it would be unprofessional to assign 'value' where they feel it does not really exist.

Comparative analysis and conclusion

Building on these two country reviews, we can now begin to analyse and compare where the professional gaps are, based on an assessment of what each country's policy targets require and what the building industries in both countries are prepared to provide. In order to do this analysis, we propose six criteria by which each professional group can be assessed:

- Policy-based legitimacy : to what extent a considered actor is legitimated either by the national (or regional) energy efficiency policy (e.g. white certificate scheme gives the energy suppliers a very important role) in the context of advanced low-carbon refurbishment
- Professional-based legitimacy : to what extent a considered actor is legitimated by the existing system of profession in the context of advanced low-carbon refurbishment
- Access to decision-makers: to what extent does an actor group have the ability to influence decisions and specifications in a housing refurbishment project?;
- Expressed business interest: Consistence with general business purpose of the profession: does an involvement in performance-oriented building retrofit make sense to a given actor from an activity or profitability point of view?
- Technical competency: from a first and overall point of view, to what extent does a given actor group have the relevant thermal and technical competencies to achieve or lead an integrated building retrofit. This question of "relevant competencies" shall be deepened during the research project.
- Integration opportunity: How well-placed is the actor group to interact with all the other groups of actors in order to achieve an integrated building retrofit?

The variety of relevant actors may vary from one country to another but some actors are sure to be common to both : building envelope-related professionals, thermal system fitters, equipment and material manufacturers and suppliers, energy suppliers, energy advice agencies, financial institutions. An initial analysis is shown in Table 2, using a qualitative measure (high, medium or low) based on expert judgement for the current situation in each country. This initial analysis will be developed and improved during the life of the project, but this initial analysis allows us to begin to draw useful lessons from the similarities and differences between the two countries. According to this review, we can propose a first synthetic analysis of today's actor system and relevance regarding the challenge of the building performance-oriented energy retrofit.

The analysis in Table 2 is based on very early findings, and is not intended to be definitive. However, it does show that a comparative mapping of the system of professions in the two countries can be instructive. Why are the two countries similar in certain aspects but different in others?

The broad pattern in Table 2 shows a mis-match in both countries between the high-level policy goals – which are fairly firmly in place with the support of specialist firms and organisations – and the engagement with mainstream industry, which is much less well developed.

The small building firms, who are currently closest to the end-user in actually doing the refurbishment work, report an almost non-existent demand for these services. In both countries, there is also a widespread lack of knowledge, skills and experience of the work involved. The attention paid to heat pumps in France and solid wall insulation in the UK suggest that policy and industry find it easier to conceive of change in terms of individual technologies or stand-alone tasks, whereas house as a system retrofit efforts with mainstream industry is only weakly observed. The analysis presented in Table 2 suggests that 'integration opportunity' is concentrated in the hands of only a small number of strategically placed actors – builders, architects and actors in product supply chains. At the same time, these actors seem rather remote from policy-based legitimacy in particular. This analytical approach allows us to begin to describe in some detail how the system of professions is currently configured, and how much (and in what direction) it needs to change if lowcarbon housing refurbishment is to become mainstream. From this initial presentation of evidence, it seems reasonable to conclude that there is not yet a socially-accepted 'jurisdiction' for low-carbon refurbishment of housing. Some of the pieces of the jigsaw are at least partly in place, but the overall picture is patchy and fragmented. However, these observations are perhaps symptomatic of the wider culture of policy in both countries, which focuses primarily on cost-benefit analysis and takes a deterministic approach to individual technologies. There are a handful of "house as a system" refurbishment programs in both the UK and France, but these are very niche efforts that affect hundreds of buildings rather than thousands. Part of our forthcoming research on this project will be to explore in more detail the motivations, workings and dynamics among the innovators, and to trace the evolving pattern of relationships that they have with each other and with others in the actor-network.

References

Abbott, A. 1988. *The System of Professions*. Chicago: University of Chicago Press.

Banks, N. 2008. Implementation of Energy Performance Certificates in the Domestic Sector. UKERC/WP/DR/2008/001. Working Paper. UKERC: Oxford.

Table 2: A first comparative analysis of the system of professions in the existing building retrofit industries in France and the UK.

	Policy-based legitimacy		Pro-fessional legitimacy		Access to decision-makers		Expressed Business interest		Technical competency		Integration opportunity	
	F	UK	F	UK	F	UK	F	UK	F	UK	F	UK
Insulation installers	High	High	High	High	High	Part	Med	High	Part	Part	Low	Low
Energy systems installers	High	High	Med	High	High	Part	Low	High	Part	Part	Low	Low
Energy suppliers	High	High	Part	Part	High	Part	High	Med	Part	Part	Med	Low
Energy-efficiency bodies	High	High	Low	Low	Low	Low	High	High	High	Part	Low	Low
Local authorities	High	Med	Low	Low	Med	Med	Med	Med	Med	Low	Low	Low
Product manufacturers	Low	Low	High	High	Low	Med	High	High	High	High	Med	Low
Distributors/ wholesalers	Low	Low	Med	Med	Med	Med	High	Med	Med	Med	High	Low
Financial institutions	Med	Med	Low	Low	High	Part	Med	Med	Low	Low	Low	Low
Architects	Low	Low	Low	Med	Low	Med	Low	Med	Low	Med	High	Med
Builders	Low	Low	Med	Low	Low	High	Low	Low	High	Low	High	High

Bell, M., and R. Lowe. 2000. "Building Regulation and Sustainable Housing. Part 2: Technical Issues." *Structural Survey* 18 (2):77-88.

Berry, S. 2009. Overview of the Green Loans Programme: Presentation at Oxford University.August 31, 2009

Bijker, W. E., T. P. Hughes, and T. Pinch, eds. 1987. *The Social Construction of Technological Systems*. Cambridge, MA: MIT Press.

Bijker, W. E., and J. Law, eds. 1992. *Shaping Technology/Building Society*. Cambridge, MA: MIT Press.

Boardman, B., S. Darby, G. Killip, et al. 2005. 40% House. Environmental Change Institute: Oxford.

Brannigan, J., and J. Tantram. 2008. Building Future Skills. ConstructionSkills: Scotland.

Bureau, S., and J.-B. Suquet. 2009. "A Professionalization Framework to Understand the Structuring of Work." *European Management Journal* 27 (6):467-475.

Carassus, J. 2007. "Trois Modèles De Maîtrise De L'énergie Dans Les Bâtiments : Une Comparaison Internationale." *Les Annales de la Recherche Urbaine* 103 (Juillet).

Carré P., Caspar P., Bélier S., 1999, Traité des sciences et techniques de la formation, Dunod, 1999

CITB-ConstructionSkills 2006, *CITB-ConstructionSkills annual report and accounts 2005* [Homepage of CITB-ConstructionSkills], [Online]. Available: http://www.citb-constructionskills.co.uk/aboutus/corporatepublications/2005-annual-report.asp [2006, November, 23].

CITB-ConstructionSkills 2009, *Annual report and accounts 2008*.

de Boissieu, C. 2006. Division Par 4 Des Émissions De Gaz À Effet De Serre De La France À L'horizon 2050. Ministère de l'Industrie, Ministère de l'Ecologie et du Développement durable: Paris.

DECC. 2009. Heat and Energy Saving Strategy Consultation Document. Department for Energy and Climate Change: London.

DEFRA. 2007. Uk Energy Efficiency Action Plan. Department for the Environment, Food and Rural Affairs: London.

Department for Business, Innovation and Skills 2010, *Low Carbon construction Innovation & Growth Team: Emerging Findings*, H M Government.

Department for Energy and Climate Change 2009a, *UK Low Carbon Transition Plan,* The Stationery Office, London.

Department for Energy and Climate Change 2009b, *UK Low Carbon Transition Plan emissions projections*, The Stationery Office, London.

Department for Energy and Climate Change 2010a, *Community Energy Saving Programme* [Homepage of DECC], [Online]. Available: http://www.decc.gov.uk/en/content/cms/what_we_do/consumers/saving_energy/cesp/cesp.aspx [2010, August 6]

Department for Energy and Climate Change 2010b, *Warm Homes, Greener Homes: a strategy for household energy management*, HM Government, London.

Développement & Construction, "Marco 2009, tableau de bord des marchés du bâtiment"

DTI. 2003. Our Energy Future – Creating a Low-Carbon Economy. Department of Trade and Industry: London.

Du Tertre et al., 2008, l'economie de la fonctionnalite, une voie pour articuler dynamique economique et developpement; durable, enjeux et debats. www.atemis-lir.cEvetts, J. 2006. "Short Note: The Sociology of Professional Groups: New Directions." *Current Sociology* 54 (1):133-143.

FFB. 2005. Etude Prospective Sur La Filière Du Bâtiment, Rapport De Recherche Non Publié. Fédération Française du Bâtiment: Paris.

GMV 2010, "La Mutation des installateurs thermiques", private multiclient study.

Grenelle de l'environnement, French Environmental Roundtable, *http://www.legrenelle-environnement.fr/*

Guy, S., and E. Shove. 2000. *A Sociology of Energy, Buildings, and the Environment*. London: Routledge.

Hermelink, A. 2006. "A Retrofit for Sustainability: Meeting Occupants' Needs within Environmental Limits." In Proceedings of *ACEEE Summer Study on Energy Efficiency in Buildings*, (Asilomar, CA). American Council for an Energy-Efficient Economy.

Hughes, T. P. 1983. *Networks of Power: Electrification in Western Society, 1880-1930*. Baltimore: John Hopkins University Press.

Janda, K. B., and G. Killip. 2010. "Building Expertise: Renovation as Professional Innovation." In Proceedings of *Constructing Green: Sustainability and the Places We Inhabit*, May 20-22, 2010 (Ann Arbor MI). University of Michigan.

Le Boterf. 1995, De la compétence, essai sur un attracteur étrange, Paris, Editions d'organisations.

Le Boterf., 1997, compétence et navigation professionnelle, Paris, Editions d'organisations

Marchand, C., M. H. Laurent, R. Rezakhanlou, et al. 2008. "Le Bâtiment Sans Énergie Fossile? Les Bâtiments Pourront-Ils Se Passer Des Énergies Fossiles En France À L'horizon 2050." *Futuribles* 343:79-100.

Nösperger, S. 2005. Etude Prospective De La Filière Française De La Construction Rénovation. HE-11/05/036/A. Note interne Electricite de France – Research & Development:

Nösperger, S. 2010. "Synthèse de l'étude GMV sur la mutation des installateurs thermiques". H-E12-2010-00710-FR. Note interne Electricite de France – Research & Development

Office for National Statistics 2009, Construction Statistics Annual, Office of Public Sector Information

Office of gas and electricity markets 2010, 3/6/2010-last update, Community Energy Saving Programme. Available: http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/cesp/Pages/cesp.aspx [2010, August 6]

Roudil, N. 2007. Artisans Et Énergies Renouvelables : Une Chaîne D'acteurs Au Cœur D'une Situation D'innovation. 103. Ministère de l'Ecologie, du Développement et de l'Aménagement Durables (MEDAD): Paris.

Royal Institution of Chartered Surveyors & Department for Communities and Local Government 2010, Energy efficiency and value project, RICS, London

Sørensen, K. H., and N. Levold. 1992. "Tacit Networks, Heterogeneous Engineers, and Embodied Technology." *Science, Technology, and Human Values* 17 (1):13-35.

Tripier, P., and C. Dubar. 2005. *Sociologie Des Professions*. Second ed. Paris: Armand-Colin.

UK Green Building Council 2009*, Pay As You Save (PAYS) Task Group – final report.*

WBCSD. 2009. Energy Efficiency in Buildings — Transforming the Market. ISBN: 978-3-940388-44-5. World Business Council for Sustainable Development: www.wbcsd.org/web/eeb.htm

Wilson, C., and H. Dowlatabadi. 2007. "Models of Decision Making and Residential Energy Use." *Annual Review of Environment and Resources* 32:169-203.

Zélem et al., 2010. Vers des bâtiments économes. L'intégration des économies d'énergie par les professionnels du bâtiment : contraintes au changement, dynamisation des réseaux et besoins en formation. Comparaison: Midi-Pyrénées, Languedoc-Roussillon et Rhône-Alpes

Acknowledgements

This work is jointly supported by EdF and the Research Councils' UK Energy Programme under the "People, Energy, and Buildings" Programme. The UK Energy Programme is led by the Engineering and Physical Sciences Research Council (EPSRC). It brings together the work of the Biotechnology and Biological Sciences Research Council (BBSRC), the Economic and Social Research Council (ESRC), the Natural Environment Research Council(NERC), and the Science and Technology Facilities Council (STFC). www.rcuk.ac.uk/energy