

Emerging actors in sustainable renovations of single-family houses

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Abstract

An extensive energy renovation of the existing building stock requires the involvement of a plurality of social and market actors. Therefore, it is important to understand in detail the role each actors play in relation to energy renovations, and through what products and services it is possible to further promote energy renovations. This paper uses an intermediation perspective to investigate and conceptualize how market actors relate to the issue of energy renovation by introducing new products and practices. Through the case study of a bank offering a dedicated loan for energy renovation, this paper emphasizes the importance of understanding intermediation and intermediaries in the context of energy renovations.

Keywords

Single-family houses, low-carbon renovations, energy efficiency, financing, banks, intermediation, intermediaries

Introduction

The energy efficient renovation of the building stock is a central aspect of climate change mitigation strategies. Climate and energy policy plans in developed countries rely substantially on cutting energy consumption from new and existing buildings in order to reduce CO₂ emissions (European Commission, 2011; HM Government, 2011; Regeringen, 2011).

Energy renovations have however proven to be elusive. Barriers hindering the adoption of energy efficient technology in buildings are traditionally classified into financial, economic, market and behavioural (Carbon Trust, 2005; Levine *et al.*, 2007). At a market level, the fragmentation of roles and of a lack of coordination in the value chain of energy renovations are significant issues for the initiation and implementation of renovation projects. It is held that, in order to facilitate access to energy saving solutions, market players may begin offering single points of access to renovation projects, or function as “system integrators” during projects (World Business Council on Sustainable Development (WBCSD), 2009; Tommerup *et al.*, 2010; Vanhoutteghem *et al.*, 2011).

However, while investigations about institutional and economic factors, determinants of decision making, as well as evaluations of regulatory and economic policy instruments are relatively common (see, e.g. Beerepoot and Beerepoot, 2007; International Energy Agency, 2008; Ryghaug and Sørensen, 2009; Nicol, 2011; Weiss *et al.*, 2012), there has been less research regarding how actors’ initiatives and creativity may contribute to policy goals as well as the extent to which they are able to intermediate and communicate with other actors involved in renovation projects. Previous studies on the role, capacity and potential of intermediary actors are limited the study of energy advisers (Heiskanen *et al.*, 2009; Mahapatra *et al.*, 2011), of building professionals (Janda and Parag, 2011; Killip, 2011) of energy service companies (Vine, 2005) and of potential business models for “one-stop-shops” (Tommerup *et al.*, 2010; Vanhoutteghem *et al.*, 2011).

Although the process of conceptualizing the role of actors in energy renovations is under way (see, e.g., Janda and Parag, 2011), there is a general lack of knowledge on the intermediation and networking aspects these roles imply: most literature in fact focuses on institutional or market barriers while ignoring the qualities, drivers and motivations of the different actors. It is for example seldom investigated why house owners *do* renovate and, with regard to other actors, *who* and *how* can catalyse renovation projects.

Focusing on aspects mainly related to single-family houses, in this paper I contribute to bridge such gap and to conceptualize of the role of actors involved in renovation projects. The research question of this paper is:

How do market and social actors create new services and products to address barriers concerning the energy renovations of single-family houses?

The paper is structured as follows. In the next section, the analytical framework of the study is described. The framework draws from literature on the role of intermediary actors in re-arranging, facilitating and configuring relations and knowledge between other actors. Later, a case study is presented. The case study describes how a bank in the Danish context exploits its position as an intermediary to streamline decision making related to the adoption and implementation of energy renovations, while creating new business and better client relationships for itself. In the analysis that follows I put forward some reflections about the intermediating role of actors, and their drivers, interests and motivations with regard to the promotion of energy renovations. In the final section, the paper presents some considerations about the relevance of the findings for the climate policy goals and lessons learnt from the study of best practices.

Analytical framework: Intermediary actors in the energy renovation process

In this paper, energy renovation projects are loosely defined as improvements to the energy performance of a building (in this case, single-family houses). Assuming that the simplest improvements (e.g. the introduction of efficient lighting or the replacement of energy using appliances with more efficient ones) can be implemented in a do-it-yourself fashion and with limited investments, I focus on renovation projects requiring the participation of built environment or energy professionals in order to be executed.

Although in this study I avoid the discussion regarding the skills and competences of built environment and energy professionals, it should be noted that, due to increasingly stringent quality and energy standards and to the increasing complexity of buildings, renovation projects are often long and costly endeavours, requiring more and more sophisticated expertise from the actors involved (Bro, 2011; Killip, 2011).

It has long been known that fragmentation of the value chain behind renovation projects is a barrier to energy efficiency in buildings. Accidentally, most of the actors operating in the fragmented home improvement and refurbishment markets (electricians, plumbers, craftsmen) are also those actors working the closest to home owners. The close contact with house owners implies that these actors are in the position to guide decisions during the adoption and execution of energy renovations, as pointed out in Gram-Hanssen (2011) and Mahapatra *et al.* (2011). This is likely to happen notwithstanding what skills and knowledge such actors have. Study describing the determinants of decision making also highlight how home owners do not necessarily adopt economically rational decisions (in the most classical meaning of the term) but tend to interpret and re-elaborate information with regard e.g. to the source of the information (Gram-Hanssen *et al.*, 2007; Heiskanen *et al.*, 2009). For an overview over the potential actors involved in renovation projects see Haavik *et al.* (2011).

So there is a considerable number of intermediate actors not only taking part in renovation projects but also providing information and advice to house owners. Although there is not much literature on the topic, it is reasonable to assume that these actors influence decision making not only with regard to the nature and extent of the technological solutions to be adopted, but also with regard to how the renovation process is arranged, what other contractors should be hired and so on.

At this regards, the notion of “intermediaries” is useful to describe these actors and their intermediation function between various actors as well as between actors, things and knowledge (see e.g.; Latour, 2005; van Lente *et al.*, 2003; Howells, 2006; Medd and Marvin, 2008; Stewart and Hyysalo, 2008; Beveridge and Guy, 2009; Heiskanen *et al.*, 2009; Backhaus, 2010).

Intermediaries have been defined in various ways. The meaning the term conveys is imprinted, and debated at length, under the conceptual framework of actor-network theory. Latour (2005) distinguishes between intermediaries and mediators, holding that the formers “transport meaning or force without transformation”, so sampling replicating their input. Mediators on the other side, “transform, translate, distort and modify the meaning or their elements they are supposed to carry”. Notwithstanding this distinction, in the academic literature the term “intermediaries” seem to have been used in a looser way, often just in a descriptive way to indicate those actors who are not posing as users-consumers, producers-providers or regulators (Moss *et al.*, 2009). Beveridge and Guy (2009) adopt an interpretation of intermediaries as an “entity” serving “to translate between the actors in such a way that their interaction can be more effectively co-ordinated, controlled, or otherwise articulated”. According to Stewart and Hyysalo (2008) intermediaries are actors that “attempt to configure the users, the context, the technology and the “content”, *but they do not, and cannot define and control use or the technology*” (quotation marks and italic in the original).

Research dealing with sociological approaches to the diffusion of innovations (and the translation of policies) offers further material for the conceptualization of the role of intermediary actors (Bessant and Rush, 1995; van Lente *et al.*, 2003; Howells, 2006; Stewart and Hyysalo, 2008). A common point of these approaches is the refusal to limit the analysis to institutional and economic factors to instead extend it to the capacity and agency of actors and to the role they play.

At this regard, Howells (2006) lists ten functions of intermediaries in the innovation process. These functions space from diagnostic to evaluation including brokering as well as scanning and information processing. Bessant and Rush (1995), in their studies of consultants in technology transfer define six key activities including the creation of business cases, communication and development. In van Lente *et al.* (2003) the role of “systemic” intermediaries in connecting, translating and facilitating flows of knowledge at a network and system level, is highlighted as opposed to “more traditional” intermediaries who only operate bilaterally. Stewart and Hyysalo (2008) introduce, in the context of social learning, the categories of *facilitating*, *configuring* and *brokering*.

<Insert Table 1 here>

In the context of energy efficiency in buildings, the term “intermediary” has been used to describe actors who, either with the goal of implementing policy programmes (Heiskanen et al., 2009; Backhuas, 2010; Mahapatra et al., 2011) or as businesses pursuing their own financial interests (Janda and Parag, 2011; Nair, 2012) operate in the spaces between policy makers, energy suppliers and energy users in relation to the adoption of energy conservation measures in buildings.

Like in the studies on the diffusion of innovations, in the context of energy renovations a focus on the roles of intermediaries allows to challenge (or develop) the traditional approach on the barriers to the adoption of energy renovations to focus on the role of actors both with regards to adoption and the implementation stage.

With reference to energy renovations the categories introduced by Stewart and Hyysalo (2008) can be presented as per Table 2:

<Insert table 2 here>

While configuring, facilitating and brokering, convey a generally positive meaning especially in the context of learning and adoption of innovations (and although often these actors’ agenda includes the promotion of energy efficient renovations) it should not be forgotten that other times intermediary actors can also be or create barriers to adoption and implementation due to vested interests, conflict, negative attitude towards innovations, diverging views about optimal solutions, lack of knowledge and scarce coordination (Ferlie *et al.*, 2005).

Under these considerations, the research question can be revisited as follows:

How do actors facilitate, configure and broker information and knowledge to promote energy efficient renovations?

Context, Methods and Materials

The case study presented in this paper takes place in Denmark. Five contextual factors need to be pointed out to better understand the setting of the case study. Firstly, up to 50% of the population in Denmark live in detached houses (Statistics Denmark, 2011a). Secondly, peripheral and rural areas in Denmark are characterized by high energy (especially heat) prices, mainly due to issues related to the design of the (decentralized) heating district systems in many of these areas (Möller and Lund, 2010). Because of these factors, many households incur in substantial expenses to heat up their dwellings. A third factor is the regulatory and policy measures to promote energy efficiency in buildings, especially the schemes mandating energy utilities to realise energy savings (Togeby *et al.*, 2009; Gram-Hanssen and Christensen, 2011). Fourthly, after the outbreak of the 2008 financial crisis, and at least until the time of writing, (May 2012), interest rates are (historically speaking) exceptionally low, thus taking down investments costs. It is thus possible to cheaply finance the costs of energy renovations through the house mortgage by tapping into the building’s equity (for a technical and economic assessment of such approach, see Kragh and Rose, 2011). This possibility is however compromised by another financial factor, the negative development of house prices in Denmark (at a national level, roughly a decrease of almost 25 per cent from the outbreak of the crisis to the time of writing (Statistics Denmark, 2011b)). The negative trend in house prices brings up the importance of financing renovation projects and of financing actors, such as banks.

The selection of the case was aimed at investigating how intermediary actors can use their position and skills to enable house owners to undertake energy renovations. Criteria for the selection included the capacity of such actor(s) to involve, communicate and work with other actors, a focus on detached house owners, the active promotion of opportunities deriving from energy efficiency renovations, and the innovativeness of the products and services offered.

At this regard, a case concerning a Danish bank (Spar Nord) offering dedicated loans to promote energy efficient renovation was selected. Beside appearing rather unique based on anecdotal experience, the value of dedicated energy loans as a case study was reinforced by the importance of access to

capital in the context of energy renovation (which is often mentioned as a barrier) as well as by the interplay of actors in the product design and implementation.

An exploratory investigation of banks in Denmark revealed that only four banks in Denmark offered similar products. The investigation was conducted by accessing the webpages of banks (all the 123 banks affiliated to the national bankers' associations were considered) and observing general information regarding sustainability practices in banks and, specifically, about dedicated loans for energy efficiency renovations. In order to gain context regarding the activity of the banks, it was also observed whether banks had a corporate sustainability policy and whether they offered sustainable investment products (e.g. sustainable or "ethic" funds). While banks may be providing house owners with loans to implement energy renovations without explicitly advertising them, the explicit advertising of such products was considered as a hint regarding the active promotion of renovations and the design of (new) products to promote the implementation of renovations. Following these criteria, it was possible to establish the uniqueness of the identified case.

<Insert table 3 here>

Following the identification of the case, data was collected through documents analysis and qualitative interviews. It was possible to collect information at an organizational level by accessing through internal documents drafted during the preparation and launch of the product, promotional material and other project management documents such as the final internal reporting of the initiative. This documentation was used partly to understand the background for the internal decision making in the bank, and in part to triangulate information from the interviewees.

Semi-structured, qualitative interviews were carried out between November 2011 and April 2012. All interviews were conducted by the author, except for one interview which was conducted by two research assistants. The first interviews were conducted with a freelance consultant who contributed to the product idea, design and implementation and with the bank's Head of Real Estate Finance, who played a major role during the development and launch of the product; these interviews were conducted with the goal of knowing more about the energy efficiency loans offered while also investigating drivers and barriers to their implementation in banks as organizations. The relevance and extent of cooperation with other partners was also investigated.

After this first stage, further interviews were conducted. The freelance consultant was interviewed again as well as the bank's partner responsible to manage the technical aspects of renovation projects (a local energy utility). The latter interview had the goal of identifying coordination and intermediation aspects of these actors. Two research assistants interviewed the CSR manager in the same bank, in order to better define the topic of energy efficiency loans under the light of the bank-customer relationship and the bank's corporate social responsibility in general.

Furthermore, in order to contextualize the drivers, motivations and barriers of banks to actively be involved in energy renovations, three bank managers in three different banks were interviewed. Two of the banks did not have any dedicated product to promote energy renovations, while one of them did.

Case study

The case study deals with a loan for energy efficiency renovations offered as a product by the bank Spar Nord. Spar Nord is Denmark's fifth largest bank. It operates with 71 offices at a national level although it is historically a regional bank from the Northern Jutland region, where its headquarters are located. It is owned for 30 per cent by a fund, while the remaining shares are divided into some 90.000 small investors. The bank is active in all the traditional retailing and commercial banking channels offering investment opportunities and loans to both private and corporate clients.

One of its products, *Energirigtige Boligrådgivning* (loosely translated as "Energy efficient housing advice") is offered to private customers with the intention of reducing their housing-related energy costs and hence of improving their economy or disposable income. The product offers the bank's clients the possibility of obtaining technical, financial and economic information regarding the renovations of their

houses in a structured way. Four versions of the products are available. The most basic version provides the elaboration of the house's energy and building envelope data in a software program which delivers an energy report containing suggestions increasing the energy efficiency of the building and is offered for free to the bank's clients. The most advanced version of the product includes, beside the basic energy report, a thorough energy audit with more detailed intervention points, cost and savings analysis and indications on how to proceed to the energy renovations. Such products are offered in collaboration with three other partners: an energy utility which is involved in energy saving activities, an energy consultancy and a financial partner which supports with knowledge and calculations regarding the real estate market.

The product is actively advertised by the bank with brochures, emails, and other communication channels, also in circumstances not directly related to energy efficiency or real estate market, and employees at the bank (especially loan officers and financial counsellors) are instructed to present the product to clients in conjunction with yearly meetings, and requests for non-energy efficiency loans. According to one of the bank's managers, the product has been received with interest by clients, also due to the personalized approach which usually takes into consideration the living and financial situation of the household, as opposed to a standard solution. For example, bank officers only propose investments that make sense according financial situation of their clients.

Once the client decides to use this product, she is put in contact with the bank's partners who have to execute the more "technical" part of the project, i.e. elaborating a report indicating which measures are most profitable with relation to the building envelope and energy supply system of the household. To be able to access the loan (which is offered at somewhat favourable rates) the client has to follow the suggestions of the energy report, although he is free to hire the craftsmen he prefers to execute the renovation. Although both the bank's and the energy utility managers agreed that this last step may be the weak link of the project, they had not taken this consideration as far as creating a list of craftsmen or professionals for the implementation of renovations. Barriers to attaching specific craftsmen to the project were, reportedly, the difficulty in the objective assessment of skills and expertise at that level, as well as in possible problems with market players regarding the disturbance of competition (also considering the prominent role of the energy utility at a local level).

Three main drivers can be found behind the realization of this product: the first was the aim of improving the clients' economy with relation to energy and running housing costs. The second driver resulted from the interaction with a consultant (originally a client of the bank) who knew personally one of the bank's managers and persuaded him to realize the product. A third driver was the advantage in terms of reputation and image for the bank.

Although the expertise found in the bank was sufficient to assess households' economic situation and credit worthiness, knowledge concerning energy efficiency in houses was, expectedly, limited. Such lack of knowledge created difficulties with regards to both the creation of the products and with its implementation. For these reasons, loan officers had to be trained to be able to understand and subsequently promote energy efficiency loans. Another consequence of the lack of knowledge about energy efficiency was the impossibility to implement the product in the market. Even though bank personnel had been trained with basic notions regarding energy efficiency, they could not acquire the skills needed to assess and guide a renovation project. For this reason a partner was selected to carry on the technical tasks related to renovations, especially performing energy audits and advising house owners about the priority intervention points.

Ensuring collaboration with partners was necessary not only to guide the clients through the various phases of the renovation project, but also to ensure the investment actually attended a renovation project. In this way the bank is able to access technical knowledge that could not otherwise be found in the organization, so establishing criteria to assess the nature of the loan. Assessment criteria are needed with regards to the efficiency and effectiveness of the loan as well as to ensure the money lent is actually invested in energy efficiency improvements. The technical partners have also the task of following up projects to verify whether the efficiency goals were achieved.

Through this structured process of cooperation with actors, and with the aid of a series of technical and process documents (e.g. calculations, checklists, the bank aimed at providing a guide to the house owner who is interested (or has been persuaded) in energy renovations.

Analysis

By describing the creation of a rather unique and new type of products, the case offers an insight on how certain intermediaries are able to re-organize markets and networks. The emergence of banks, not a usual actor in the energy renovation or home improvement markets, as new actor can be seen as an example of the “emergence of certain intermediaries as part of socio-technical innovations” (Stewart and Hyysalo, 2008), but also an example of “the qualities of the middle as an enabler” (Janda and Parag, 2011).

The action of banks as an intermediary is relevant under both aspects of adoption and execution of projects. When it comes to the adoption of energy renovation projects, *Energirigtige Boligrådgivning*, offers an innovative and relatively easy point of access to information and expertise on energy renovations. The advantages of renovation projects are *brokered* downstream (to house owners) by involving and coordinating different actors, as well as by disseminating knowledge and creating the awareness about possible costs savings achievable through efficiency, thus addressing important barriers to energy renovations.

When it comes to implementation, it is important to point out that the design of the product entails much more than just the financing of renovation projects, being it a mean to *configure* and *facilitate* ways to adopt energy efficiency technology. This places the bank outside its ordinary (or expected) range of action, showing that (as pointed out in the literature) intermediaries are flexible and their role can change over time.

When it comes to the promotion of technology, the product does not configure any particular technology. On the opposite, the choice of technology is decided by other actors in accordance to the physical characteristics of the house and the preferences of house owners. Promoting the adoption of technology to the only extent of energy savings (and not with focus on a particular technology) requires a certain degree of flexibility which is clearly due to the fact that, differently from craftsmen (and to a certain extent also from the energy utility functioning as a partner), banks do not have the interest to sell any particular technology.

In this sense, the important contribution represented by this product is not to create new knowledge, new products or innovative technological solutions, but rather to be able to act as a broker to bring together different actors in a context where there is not dominant actor as well as to re-organize and facilitate the decision making process of house owners.

House owners have in fact traditionally relied on the family’s trusted craftsmen or on acquaintances to decide about energy renovations, an approach which has often resulted in the adoption of out-dated technologies, non-optimal investments or badly executed projects. Time and energy spent in looking for contractors also added to the (perceived) costs implied by renovations. The bank’s product puts in place an organized process with guidance through the various steps of renovations as well as access to qualified expertise. This also implies that some of the “hassles” renovations entail are taken away from the house owners, while increasing the quality of the projects. Practically speaking, projects are streamlined by providing an easy point of access to knowledge and competent actors.

It is clear from this case study that it is be aware of the potentiality of intermediaries to change and re-configure market dynamics and not just to the existing ones, as also pointed out in Stewart and Hyysalo (2008).

One of the boundaries (limitations) of this study is the lack of house owners’ perspective, which was not possible to gain due to privacy-related concerns. It is reckoned that interviews with house owners who used the banks’ product would have offered insights on how information regarding renovations is perceived in this particular context and when originating from banks, as opposed to e.g. energy advisers or built environment and energy professionals. Because of this, it was obtained by the bank’s technical partner to gain access to the software developed in order to prioritize the energy renovations’ intervention points. This allowed having an overview of the procedures of the service offered to the bank’s customers.

Conclusions

With regards to the debate around new professional figures and products or services to facilitate the adoption and execution of renovations, I have identified in banks an actor with the potential to provide

an easy point of access to the energy renovation of single family houses. Although banks are not in the strict sense players in the markets of energy renovations and home improvement and refurbishment, this case study shows how, thanks to their proximity with house owners they are able to provide innovative solutions and rationalize certain aspects of the interaction in markets. This is important especially in the context of the highly fragmented energy renovations markets. In contrast to the potentiality for market niche for a “system integrator” offering full service renovation projects, this study rather points towards the direction of leveraging on existing intermediaries to assume a more effective role, for example as coordinator or broker.

Such direction presents, however, various challenges: what is the actual reach of such intermediaries, both upstream and downstream? How to fully understand (and exploit) the flexibility and potential of intermediaries? What are the implications for policy –making?

While the case illustrated in this paper provides an example of the power of intermediaries, the conceptual categories provided by the literature have a far greater potential to be unpacked and explored than what could be done here. In the context of energy renovations, it is in particular important to understand the drivers and barriers to the action of intermediaries, the extent to which their action is dependent on contingent contextual factors, as well as the motivations, interests, power games and conflicts at that level.

References

- Backhaus, J. 2010. Intermediaries as Innovating Actors in the Transition to a Sustainable Energy System. *Central European Journal of Public Policy*, 4, 86-109.
- Bartiaux, F., Gram-Hanssen, K., Fonseca, P., Ozoliņa, L. and Haunstrup Christensen, T. 2011. A practice-theory based analysis of energy renovations in four European countries. Conference Proceedings of the 2011 ECEEE Summer Study proceedings, European Council for an Energy Efficient Economy (ECEEE), Brussels.
- Beerepoot, M. and Beerepoot, N. 2007. Government regulation as an impetus for innovation: Evidence from energy performance regulation in the Dutch residential building sector. *Energy Policy* 35(10), 4812-4825.
- Bessant, J. and Rush, H. 1995. Building bridges for innovation: the role of consultants in technology transfer, *Research Policy*, 24, 97-114.
- Beveridge, R. and Guy, S. 2009. Governing through translations: intermediaries and the mediation of the EU's Urban Waste Water Directive, *Journal of Environmental Policy and Planning*, 11(2), 69-85.
- Bro, R.Z. 2011. Crafting Competencies – The future of skilled worker in Denmark. *6th Nordic Conference on Construction Economics and Organisation*.
- Building Regulations, 2010. Building Regulations of Denmark, Retrieved from http://www.ebst.dk/file/155699/BR10_ENGLISH.pdf, on September 30, 2011.
- Carbon Trust. 2005. *The UK Climate Change Programme: Potential evolution for business and the public sector*. London: The Carbon Trust.
- EnEV 2009 - Energieeinsparverordnung für Gebäude, Verordnung über energiesparenden Wärmeschutz und energiesparende Anlagentechnik bei Gebäuden, [Energy savings regulation for buildings, Regulation on energy-saving thermal insulation and energy-saving systems engineering for buildings]. Retrieved from http://www.enev-online.org/enev_2009_volltext/index.htm, on September 30, 2011.
- European Commission, 2011. *Energy efficiency plan, 2011*. Brussels: European Commission.
- Ferlie, E., Fitzgerald, L., Wood, M. and Hawkins, C. (2005) The nonspread of innovations: the mediating role of professionals, *The Academy of Management Journal*, 48(1), 117-134.
- Gram-Hanssen, K., Bartiaux, F., Jensen, O.M. and Cantaert, M. 2007. Do homeowners use energy labels? A comparison between Denmark and Belgium. *Energy Policy*, 35, 2879-2888.
- Gram-Hanssen, K. 2011. Existing buildings – users, renovations and policy. Conference proceedings of the World Renewable Energy Congress 2011. Linköping, Sweden.
- Haavik, T., Aabrekk, S., Tommerup, H., Svendsen, S., Mahapatra, K., Gustavsson, L., Paiho, S., Ala-Juusela, M. 2011. *Report on stakeholder interests*. Part of Success Families project WP 2.

Heiskanen, E., Hodson, M., Kallaste, T., Maier, P., Marvin, S., Mourik, R., Rinne, S., Saastamoinen, M. and Vadovics, E. 2009. A rose by any other name...? New contexts and players in European energy efficiency programmes. Conference proceedings of the 2005 ECEEE Summer Study proceedings, European Council for an Energy Efficient Economy (ECEEE), Brussels.

HM Government, 2011. *Carbon Plan*. Retrieved from <http://www.decc.gov.uk/Media/viewfile.ashx?FilePath=What%20we%20do/A%20low%20carbon%20UK/1358-the-carbon-plan.pdf&filetype=4&minwidth=true> on September 30, 2011.

Howells, J. 2006. Intermediation and the role of intermediaries in innovation. *Research policy*, 35(5), 715-728.

International Energy Agency (IEA). 2008. *Promoting Energy Efficiency Investments: Case Studies in the Residential Sector*. OECD/IEA and AFD: Paris.

Janda, K.B. and Parag, J. 2011. A middle-out approach for improving energy efficiency in existing buildings. Conference Proceedings of the 2011 ECEEE Summer Study proceedings, European Council for an Energy Efficient Economy (ECEEE), Brussels.

Killip, G. 2011. Can market transformation approaches apply to service markets? An investigation of innovation, learning, risk and reward in the case of low-carbon housing refurbishment in the UK. Conference Proceedings of the 2011 ECEEE Summer Study proceedings, European Council for an Energy Efficient Economy (ECEEE), Brussels.

Kragh, J. & Rose, J. 2011. Energy renovation of single-family houses in Denmark utilising long-term financing based on equity. *Applied Energy*, 88, 2245–2253.

Latour, B. 2005. *Reassembling the social: An introduction to actor-network-theory*, Oxford University Press, USA.

Levine, M., Ürge-Vorsatz, D., Blok, K., Geng, L., Harvey, D., Lang, S., Levermore, G., Mehlwana, A.M., Miragedis, S. and Novikova, A. 2007. Residential and Commercial Buildings. Climate Change 2007; Mitigation, in Metz, B., Davidson, O.R., Bosch, P.R., Dave, R., Meyer, L.A. (eds), *IPCC Fourth Assessment Report: Climate Change 2007*, Cambridge University Press, Cambridge, United Kingdom and New York, NY. Lützkendorf, T. and Lorenz, D. 2011. [Capturing sustainability-related information for property valuation](#). *Building Research & Information*, 39(3), 256–273.

Mahapatra, K., Nair, G. and Gustavsson, L. 2011. Energy advice service as perceived by Swedish homeowners, *International Journal of Consumer Studies*, 35, 104-111.

Medd, W., and Marvin, S. 2007. Strategic intermediation: Between regional strategy and local practice, *Sustainable Development*, 15, 318-327.

Moss, T., Medd, W., Guy, S. and Marvin, S. 2009. Organising water: The hidden role of intermediary work, *Water Alternatives*, 2(1), 16–33.

Möller, B. and Lund, H. 2010. Conversion of individual natural gas to district heating: Geographical studies of supply costs and consequences for the Danish energy system, *Applied Energy*, 87(6), 1846-1857.

Nicol, L.A. 2011. The role of institutional regimes in motivating change for sustainable housing, *Building Research and Information*, 39(5), 459-472.

Regeringen, 2011. *Energistrategi 2050, fra kul, olie og gas til grøn energi [Energy strategy 2050, from coal, oil and gas to green energy]*. Copenhagen: Klima- og energiministeriet.

Ryghaug M. and Sørensen, K.H. 2009. How energy efficiency fails in the building industry, *Energy Policy*, 37, 984-991.

Statistics Denmark, 2011a. BOL101: Boliger efter område, beboertype, anvendelse, udlejningsforhold, ejerforhold, opførelsesår og ejerforhold [Dwellings by region, type of resident, type of dwelling, tenure, ownership, year of construction and ownership]. Retrieved from <http://www.statistikbanken.dk/statbank5a/default.asp?w=1280>, on April 15, 2012.

Statistics Denmark, 2011b. EJEN14: Prisindeks for ejendomssalg (2006=100) efter ejendomskategori [EJEN14: Price index for property sales (2006=100) by property category]. Retrieved from <http://www.statistikbanken.dk/statbank5a/default.asp?w=1280>, on April 15, 2012.

Stewart, J. and Hyysalo, S. 2008. Intermediaries, users and social learning in technological innovation, *International Journal of Innovation Management*, 12(3), 295-325.

Togebj, M., Dyhr-Mikkelsen, K., Larsen, A., Juel Hansen, M. and Bach, P. 2009. Danish energy efficiency policy: revisited and future improvements. Conference Proceedings of the 2011 ECEEE Summer Study proceedings, European Council for an Energy Efficient Economy (ECEEE), Brussels.

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Tommerup, Henrik M., Vanhoutteghem, L., Svendsen, S., Mahapatra, K., Gustavsson, L., Haavik, T., Aabrekk, S., Paiho, S., Ala-Juusela, 2010. *Existing sustainable renovation concepts*. Copenhagen: Successful Sustainable Renovation Business for Single-Family Houses, SuccessFamilies, 2010.

Van Lente, H., Hekkert, M., Smits, R., and van Wavern, B., 2003. Roles of systemic intermediaries in transition processes. *International Journal of Innovation Management*, 7, 1–33.

Vanhoutteghem, L., Tommerup, H.M., Svendsen, S., Mahapatra, K., Gustavsson, L., Haavik, T., Aabrekk, S., Paiho, S., Ala-Juusela, M. 2011. *Sustainable renovation concepts for single-family houses*. Copenhagen: Nordic Call on Sustainable Renovation, Norden, Nordic Innovation Centre.

Vine, W. 2005. An international survey of the energy service company (ESCO) industry. *Energy Policy*, 33, 691–704.

Weiss, J., Dunkelberg, E. and Vogepohl, T. 2012. Improving policy instruments to better tap into homeowner refurbishment potential: Lessons learned from a case study in Germany. *Energy Policy*, 44, 406-415.

World Business Council for Sustainable Development (WBCSD), 2009. *Energy Efficiency in Buildings – Transforming the Market*, World Business Council for Sustainable Development, Geneva.

Tables

Activities (Bessant and Rush, 1995)	Functions (Howells, 2006)	Roles (van Lente <i>et al.</i>, 2003)	Roles (Stewart and Hyysalo, 2008)
1. Articulation of needs, selection of options	1. Foresight and diagnostics	1. Connect	1. Facilitate
2. Identification of needs, selection training	2. Scanning and information processing	2. Translate	2. Configure
3. Creation of business cases	3. Knowledge processing and (re)combination	3. Facilitate	3. Broker
4. Communications, development	4. Gatekeeping and brokering		
5. Education, links to external info	5. Testing and validation		
6. Project management, managing external resources, organisational development	6. Accreditation		
	7. Validation and regulation		
	8. Protecting the results		
	9. Commercialisation		
	10. Evaluation of outcomes		

Table 1 Functions, activities and roles of intermediaries (adapted from Stewart and Hyysalo, 2008).

	Definition in Stewart and Hyysalo (2008)	Relevance in energy renovations
Facilitating	Providing opportunities to others, by educating, gathering and distributing resources, influencing regulations and setting local rules.	Promotion of renovation through information dissemination, awareness-raising, etc., e.g. about the cost-effectiveness of energy renovations. Setting criteria and procedures for implementation with regards to adopted technologies, financing, etc. (e.g. establishing priority intervention points).
Configuring	The creation of the space that facilitates appropriation by others and influencing the perceptions and goals of sponsors and users; [C]onfiguring technology, [...]; creating and configuring content; setting rules and regulations on use and usage, prioritising uses, the goals and form of projects, and the goals and expectations of other members of a network. Configuration is not only technical but also symbolic.	The creation of streamlined process and pathways to simplify the process of adoption and implementation of energy efficiency technologies. Configuring energy efficient technology, setting goals and expectations on prices, costs, pay-back. Setting rules, goals and expectations for other actors (e.g. contractors) involved in renovations project. Empowering house owners
Brokering	[R]aise support for the appropriation process from sponsors and suppliers.	Access relevant source of private and public financing. Involve new actors.

Table 2 Facilitating, configuring and brokering in the context of energy renovations.

Type of bank	Type of products	Investment and financing guidelines	Sustainable investment options for clients	Loans for “sustainable consumption”	Loans for energy efficient renovations
Major banks		Medium	High	Low	Very low (no bank)
Saving banks		Low	Medium	Medium	Very low (four banks)

Table 3 Evidence of sustainable practices in major and saving banks in Denmark.