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Business models for full service energy renovation of single-family houses in Nordic countries

Krushna Mahapatra [a,*], Leif Gustavsson [a], Trond Haavik [b], Synnøve Aabrekk [b], Svend Svendsen [c], Lies Vanhoutteghem [c], Satu Paiho [d], Mia Ala-Juusela [d]

[a] Linnaeus University, SE – 35195 Växjö, Sweden
[b] Segel As, P.O.Box 284, N-6771 Nordfjordeid, Norway
[c] Technical University of Denmark, Brovej Building 118, DK-2800 Kgs. Lyngby, Denmark
[d] VTT, P.O.Box 1000, FI-02044 Espoo, Finland

HIGHLIGHTS

- In the Nordic countries there is significant primary energy saving potential in single-family houses from 1970s.
- There are several behavioral, economical and market related hindrances to adoption of energy efficiency measures.
- One-stop-shop business models to offer full service energy renovation packages are slowly emerging.
- Marketing strategies and policy measures are required to promote full service energy renovation of single-family house.

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ABSTRACT

In Nordic countries significant primary energy saving potential exists in houses built before 1980. These old houses need to be renovated, which provides an opportunity for implementation of energy efficiency measures. However, there are several economic and market hindrances and the renovation markets are dominated by handicraft-based individual solutions. In this paper we have analyzed the opportunities for implementation of one-stop-shop business models where an overall contractor offers full-service renovation packages including consulting, independent energy audit, renovation work, follow-up (independent quality control and commissioning) and financing. A comparative assessment of emerging business models in the Nordic countries shows that different types of actors can provide such a service. Financing is included in some models. There are differences in how customers are contacted, while the similarities are on how the service is provided. Even though there is strong business potential for one-stop-shop energy renovation concept, still it has been somewhat difficult to start or run such a business. Various options to overcome the hindrances to promote energy efficient renovation of detached houses are discussed.

1. Introduction

In the context of climate change and energy supply security there is a great need for improved energy efficiency of European building sector which accounts for about 40% of the final energy in the European Union [1]. Many countries have introduced energy efficiency standards for new buildings, but it is important to target also the existing buildings as the addition of new buildings to the existing stock happens slowly. In Nordic countries (Denmark, Finland, Norway and Sweden) single-family houses, which constitute about 40% of the number of dwellings, offer significant potential for energy efficiency improvements [2]. For example, in Denmark the average yearly final energy use of existing houses for space heating and hot water purposes is 135 kW h/m^2 (Table 1), while the requirement for a typical new house is a maximum of 60 kW h/m^2.

In the Nordic countries typical single-family houses with large primary energy saving potential are those from the 1960s and 1970s, since they were built in large numbers just before the tightening of the insulation standards in the late 1970s, and because electric heating is prevalent in those houses (except for Denmark). Swedish Energy Agency reported that during 1998–2007 annually

* Corresponding author. Tel.: +46 (0) 470 767813.
E-mail addresses: Krushna.mahapatra@lnu.se (K. Mahapatra), leif.gustavsson@lnu.se (L. Gustavsson), trond@segel.no (T. Haavik), synnove@segel.no (S. Aabrekk), ss@byg.dtu.dk (S. Svendsen), lieva@byg.dtu.dk (L. Vanhoutteghem), Satu.Paiho@vtt.fi (S. Paiho), Mia.Ala-Juusela@vtt.fi (M. Ala-Juusela).

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Table 1
Summary statistics of energy related information for detached single-family houses of Nordic countries [2].

	Denmark	Sweden	Norway	Finland
Number (1000s) of detached houses (excluding row houses)	1141	1360[a]	1200	1083
Share of detached houses in the total number of *dwelling* stock	46%	30%	52%	39%
Average heated floor area per house[c]	149 m^2	123 m^2	125 m^2	139 m^2
Average yearly final energy use for heating and hot water (kW h/m^2)	135 (in 2008)	126 (in 2010)	142 (in 2009)[b]	199 (in 2009)
Heating system	Mostly oil/gas boilers + district heating	Resistance heating + wood boilers/stoves + heat pumps	Mostly electric heating (70%)	Resistance heating + wood boilers/stoves + oil boilers
Ventilation system	Natural ventilation	Natural ventilation before 1970s after that mechanical ventilation	Natural ventilation before 1970s after that mechanical ventilation	Natural ventilation before 1970s after that mechanical ventilation

[a] Not including detached *farmhouses*, which are included in statistics for the other countries.
[b] Average energy consumption of 182 kW h/m^2 (*Source*: Statistics Norway) minus 40 kW h/m^2 for household electricity use for lighting and appliances.
[c] There is no standard definition of heated floor area. Therefore, these numbers and the statistics for final energy use for heating and hot water may not be comparable and should be used cautiously.

about 1.3%, 1.1% and 2% of Swedish detached houses installed energy efficient windows, improved attic/wall insulation, and installed a new type of heating system, respectively [3]. Major share of such installations were done in the houses built during 1940s and very little in the houses from 1960s/1970s [3].

Tommerup et al. [2] have used the WinDesign calculation tool to analyze primary energy efficiency potential of typical single-family houses in the Nordic countries. It was found that renovation measures together with the use of a bedrock heat pump in typical Swedish, Norwegian and Finnish single-family houses can reduce the primary energy use by more than 80% for space and hot water heating. The primary energy savings of renovation measures depends mostly on energy supply system; higher when replacing resistance heaters with bedrock heat pump (analysis for Sweden, Norway, and Finland) than replacing a gas boiler with an efficient gas boiler as in the analysis for Denmark. However, when there is a possibility for a house to connect to district heating system, preferably biomass-based, with cogeneration of district heat and electricity then maximum primary energy savings can be gained by replacing resistance heaters with such a system [4].

However, there are economic and market hindrances to diffusion of energy efficiency renovation, and the renovation market is dominated by a craftsman based approach with individual solutions. Implementing one-stop-shop business models for energy renovation of single-family houses, where a single actor can offer full-service packages including consulting, independent energy audit, renovation, follow-up independent quality control and commissioning, and financing, may help overcome some of the hindrances. The idea is to strive for implementation of energy efficiency measures that are best in a holistic and long run perspective.

In this paper[1] we outline the hindrances to energy efficiency measures, discuss the emerging one-stop-shop models, and suggest marketing and policy measures to facilitate energy efficiency renovation of detached houses in the Nordic countries. The content of this paper is a comprehensive summary of eight detailed reports prepared for the three year (2009–2012) Nordic project "Success-Families" (Successful Sustainable Renovation Business for Single-Family Houses). Apart from literature review and own analysis, the reports were based mainly on discussion with industry representatives, public agencies and researchers, who participated in seminars/workshops in Denmark (1), Finland (2), Norway (2), and Sweden (1). Gathering opinion of stakeholders is an integral part of marketing and social science research.

2. Hindrances to adoption of energy efficiency measures

Technical solutions exist for residential energy efficiency improvement and their adoption could be beneficial in the long-run. However, diffusion of energy efficiency measures is rather slow due to several reasons as discussed in previous studies [6–9]. We discuss them below regarding single-family houses.

Low priority is given to energy issues by the stakeholders, especially the end-users [9]. Homeowners' have a perceived 'lack of need' for energy efficiency measures as they feel satisfied with the physical condition of the existing building [10], energy cost represents a small share of (3–4%) of household disposable income [11], they are interested in other investments such as renovating kitchens and bathrooms [12], and there is a lack of regulatory requirements regarding energy standard of a renovated building (in some countries, there are requirements for specific building components). They have insufficient information, knowledge or awareness about the energy efficiency measures and their energy and non-energy benefits. Installers/sellers have a significant influence on homeowners' decision [10] and they promote products/services that are beneficial for them. The market is dominated by a craftsman based approach with individual solutions. Even when several measures are sourced from different companies, a homeowner faces the difficulty of coordinating the activities of number of actors and he/she has to take the risk and responsibility of construction and workplace regulations. Moreover, if there is some problem during or after renovation, it might be difficult to ascertain which company's fault it is.

Investment cost is one of the important factors in homeowners' choice of energy efficiency measures [10]. Energy-efficient products often incur high investment cost and people who have low income or those who recently purchased a house using all their financial means typically do not have capacity to invest in energy renovation. Banks are willing to lend money to those homeowners whose existing house loan is significantly lower than the value of the house and the household income is sufficient to cover an increase of the loan.

Quite often "simple or discounted payback time" is used as an investment decision tool by financiers [9,13–15] and homeowners [16]. But, this tool does not consider benefits accrued after the payback time which is particularly important in the building sector

[1] A minor part of this paper has earlier been presented in a conference paper [5].

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