

Full service energy efficient renovation business for Swedish single-family houses



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Summary

More than 80% of the Swedish single-family houses were built prior to 1977 when energy efficiency was introduced in the national building code. These houses are more than 30-40 years old and need renovation. This provides a unique opportunity for large-scale implementation of energy efficiency measures. However, there is a lack of business model to introduce full service energy efficiency renovation packages that include consulting, contract work, follow-up and financing. Under the Nordic project "Successful Sustainable Renovation Business for Single-Family Houses – SuccessFamilies", we have conceptualized a new business model to offer such a full service package to the Swedish homeowners. The new business could be offered by existing construction/renovation companies in collaboration with energy auditors/building consultants and heating system retailers/installers. The business could be targeted to houses built during 1971-80 as the primary energy efficiency potential is significant in this segment. Especially houses that are on sale could be targeted because people usually do indoor renovation when they buy a house and therefore, they may be interested in energy efficient renovations. Banks may consider post renovation value of the newly-bought house based on planned renovation package from an entrepreneur to provide increased mortgage finance for renovation. Other options to improve energy efficient renovation of single family houses include tax subsidies, preferential loans and guarantee on energy or energy cost savings.

Keywords: Energy efficient renovation, Target group, single-family house, Sweden

1. Introduction

In Sweden, 60% of the 145 TWh energy used in the residential and service sector in 2008 was for space heating and hot water purposes [1]. Of this 60%, about 42% was used by the 1.7 million single-family houses (actually "one- and two-family houses" according to Statistics Sweden). There is considerable potential to improve the energy efficiency of these existing houses, a large share of which was constructed in the 1960s and 1970s before energy efficiency was emphasized in the building codes in 1977. A public investigation reported that the final energy demand for heating and electricity in single-family house segment could be reduced by about 14 TWh under the period 2005-2020 [2]. However, the actual realization of this techno-economic potential depends on adoption of the energy efficiency measures by the end-users.

More than 80% of Swedish single-family houses are more than 30 years old and majority of them need some renovation. Technical solutions exist for residential energy efficiency improvement and they can be cost effective if implemented during major renovation works [3, 4, 5, 6]. However, there is a substantial lack of business concepts for energy efficient renovation of single-family houses in Sweden and other Nordic countries. The renovation market is dominated by a craftsman based

approach with individual solutions, traditional warehouses "do-it-yourself-shops" and actors marketing single products. A package of measures are given less priority may be due to a lack of information, knowledge or awareness about the energy and non-energy benefits of such measures, or due to a lack of access to the capital cost involved. When several measures are sourced from different actors or 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 whose fault it is.

To address these disadvantages of traditional individual solution renovation approach and to speed up the implementation of energy efficient renovation of single-family houses there is a great need for 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. Recently, few such concepts have emerged in the Nordic countries. See Tommerup et al. [7] to know more about those concepts e.g. ENRA in Finland, JADARHUS Rehab in Norway, Energieffektiva Hus AB in Sweden, and Dong Energy Cleantech in Denmark.

There seems to be a significant business potential for full service or one-stop-shop renovation concept. For example, in Sweden there are about 2 million single-family houses. If annually 1% of these houses i.e. about 20,000 houses would be renovated with an average investment cost of about 100 KSEK the total market potential would be 2000 million SEK. This is an extremely conservative estimate as the yearly market for renovation and extension of single family houses in Norway is approximately 38 Billion NOK [8].

In this paper we use a business model canvass [9] to analyze and develop a one-stop-shop business model to offer full-service renovation packages in Sweden. This will be an important source of information for companies planning to develop a one-stop-shop concept.

2. The one-stop-shop business model

Every business explicitly or implicitly uses a business model which describes the rationale of how to create, deliver and capture value. In other words business model is a blueprint for a strategy to be implemented through organizational structures, processes and systems to deliver value to customers, entices customers to pay for value, and convert those payments to profit [9]. However, there are risks that a business model may not be successful due to inadequate planning and implementation, changing market conditions and policy framework, and lack of customer interest in the value proposition.

A business model essentially has nine building blocks; Value proposition, customer segment, key activities, key partners, key resources, customer relationship, channels (communication, distribution and sales), Cost structure, and revenue stream. These building blocks can be analyzed using a "business model canvas" [9]. Such a canvas applied to the full service or one-stop-shop concept for energy efficient renovation of single-family houses in Sweden is depicted in Table 1.

2.1 Value proposition

This building block explains the value offer of the business by answering which customer problems or needs the business seeks to solve or satisfy. An important aspect of the one-stop-shop business model is that a single actor is responsible to offer all relevant steps necessary for the energy efficient renovation of a building - from planning, over actual renovation to cleaning and maintenance of the installations as per contractual agreements. The value of such a model over traditional individual craftsman based renovations is that the homeowners get a professionally renovated house that reduces operating energy and maintenance costs, while they will avoid the trouble of coordinating a number of actors and the risks and responsibilities of construction and workplace regulations. A single entrepreneur means homeowners are more secure about where to turn when there is any problem during or after renovations. Furthermore, homeowners' lack of knowledge, awareness, or access to energy efficiency measures will be lesser problem for them to

implement such measures.

Table 1. A business model canvas applied to full service or one-stop-shop concept for energy efficient renovation of single-family houses in Sweden (Based on [9])

Value proposition <ol style="list-style-type: none"> 1. Offer all types of home renovation services, especially energy efficiency measures, to homeowners. 2. Single-point contact responsible for planning, design, implementation and post-renovation service 3. Free-of-cost preliminary building examination/energy audit report 4. Detailed energy analysis by independent agency for a fee; Refunded or discounted if homeowners use the company service to renovate their house 5. Free of cost price estimation for the renovation work 6. Help to apply for subsidies and obtain construction permissions 7. Coordinate with banks to facilitate mortgage financing 8. Fixed price for the total work as agreed in the contract 9. Guarantee on the renovation work for two years 10. Free of cost information on energy efficient use of the building 	Customer segments <ol style="list-style-type: none"> 1. Target group: houses built before during 1970-80 and heated with resistance heaters, but all houses in the need of renovation are of interest (mass market) Key partners <ol style="list-style-type: none"> 1. Renovation company (service provider) 2. Energy auditor (partner) 3. Retailer of heating systems (partner)
Key resources <ol style="list-style-type: none"> 1. Physical: vehicles and machines usually available with renovation firms, energy audit equipments with energy auditors 2. Human: skill and experience to attract customers, conduct proper energy audit, and to do quality renovation 3. Intellectual; softwares to conduct energy analysis, company reputation and database of condition of houses sold to attract customers) 4. Financial: to start and run a business 	Key activities <ol style="list-style-type: none"> 1. Marketing to attract customers 2. Building examination and energy audit 3. Prepare renovation packages and show their cost-benefits 4. Renovation of the building including purchase of building products 5. Apply for subsidies and building regulations 6. Customer service 7. Post renovation commissioning 8. Information provision to the customers
Customer relationship <ol style="list-style-type: none"> 1. Dedicated personal assistance (house visit, email, phone calls) 2. Communities: Provide an online platform for customers to discuss with each other 	Channels <ol style="list-style-type: none"> 1. Advertisement in newspapers and magazines, home delivered fliers 2. Local area meetings 3. Interaction with energy auditors when house is sold 4. Interaction with heating system retailers/installers
Cost structure <ol style="list-style-type: none"> 1. Costs involved in traditional renovation (labour, material, free of cost building examination etc.) 2. Marketing costs (advertisement, local meetings, hiring new employees etc) 3. Cost for post-renovation commissioning and information material 4. Companies can increase the use of their existing resources (benefits of economies of scale) 	Revenue stream <ol style="list-style-type: none"> 1. Payment from customers for renovation work 2. Commission from suppliers of building products and heating systems

2.2 Customer segment

The “customer segment” building block identifies the groups of people or organizations an enterprise aims to reach and serve; Mass market, niche market, and segmented, etc. The full service energy efficiency renovation concept could be available for all homeowners who need to renovate their houses. But, from the service provider point of view, it is important to target potential

customers who might be more interested in the value proposition. Once a critical mass of such potential adopters is reached the diffusion process would be self-sustainable [10]. One such target group is the owners of houses that have large potential for energy efficiency improvements, which would make it easier for the service providers to show the cost effectiveness of the investments and thereby attract the potential customers. Hence, we analyze the energy efficiency potential of existing single-family houses of different construction year.

The average final energy use for space heating and hot water purposes decreases with decreasing age of the Swedish single-family houses (Table 2). This suggests there is a significant potential to reduce final energy use of older buildings by renovating them to the energy standards of newer

Table 2: Number of one- and two-dwelling houses (including agricultural property) from different construction periods and average final energy use for heating and hot water (kWh/m²) in those houses, 2008 [11].

Construction year	Number houses (1000s)	Final energy use (kWh/m ²)
-1940	525	172
1941-1960	265	165
1961-1970	258	141
1971-1980	398	130
1981-1990	166	132
1991-2000	73	128
2000-	58	111

houses. The largest potential might be in the houses built before 1960 as these houses have the highest per floor area final energy use and they constitute about 50% of the single-family houses. However, the final energy use reported in Table 2 is based on energy content of the fuel input for biomass or oil-based heating systems, while for electric or district heating system the estimation is based on actual use of electricity or district heat excluding conversion and distribution losses

energy use in an electric heated house from the 1970s could be reduced by about 70-80% with the implementation of energy efficiency measures in the building envelop and changes in the heating system. Maximum gain was from replacing the resistance heaters with a bedrock heat pump or connection to a district heating system. Hence, the primary energy efficiency potential of houses built after 1970, predominantly with electric heating systems, might be higher than that of the pre-1970 houses heated mostly with biomass or oil-based heating systems. The largest potential for primary energy efficiency could be with the houses from 1971-80 because the absolute number of houses with electric heating systems is highest from this period; 145000 houses have electric systems only and another 114000 houses have electricity and biomass system [11].

Joelsson [12] and Tommerup et al. [7] have concluded that the primary

2.2.1 Two types of customers among the owners of houses from 1971-80

From primary energy efficiency point of view, houses with electricity heating systems and built during 1971-80 could be targeted for introducing the full service energy efficiency renovation concept. However, there are two categories of homeowners among these types of houses: houses

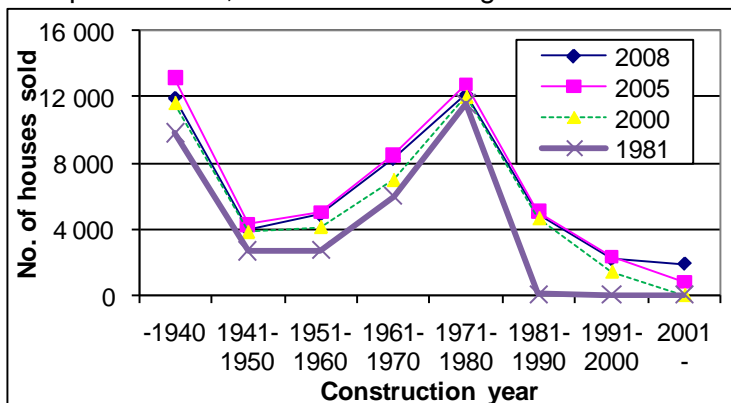


Fig. 1. Number of houses from different construction periods sold in Sweden in 1981, 2000, 2005 and 2008 [13]

that are on sale or recently sold/bought and houses where the owner has lived for many years. Two major differences are related to locating the potential houses to be renovated and financing for renovation.

Statistics on houses sold in previous years show that majority of the houses being sold are built prior to 1941 or during 1971-80 (Fig. 1). For entrepreneurs of full service renovation, it might be easier to find such a house that needs to be renovated, if they collaborate with energy auditors/building consultants or

real estate agents. These actors have first-hand information about the condition of the house on sale. Certified energy auditors issue energy declaration which is mandatory for houses sold in Sweden and real estate agents entrust building consultants to prepare building condition reports to attract potential house buyers. These energy auditors/building consultants have a unique opportunity to motivate the prospective buyers to go for energy efficient renovation as they are usually consulted by the prospective buyers to learn about the condition of the house. In contrast, it might be difficult to identify owners interested in renovation of house that are not on sale. One possibility is to use various forms of advertisement to inform the potential customers about the availability of the full service renovation packages and interested customers will contact the service provider.

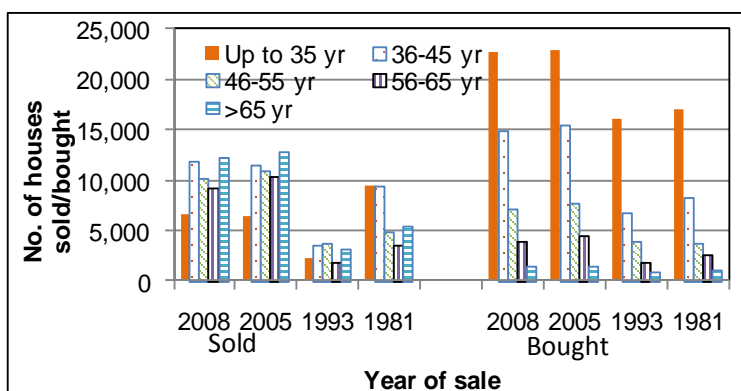


Fig. 2. Number of houses sold/bought by different age groups in 1981, 2000, 2005 and 2008 [13]

People sell their house for various reasons, but a common reason is when homeowners reach the age of retirement and children have moved out. They may sell the house and move to apartments. This trend is reflected from Fig. 2, where homeowners more than 65 years old are most likely to sell a house. People of this age are less likely to have made energy efficiency investment if they had income constraints post-retirement and/or they did not expect to recoup the investment during their occupancy of the house [14, 15].

Buyers of single-family houses usually are young people who move from an apartment to start a family. This is reflected in Fig. 2, which shows that majority of the home buyers are below 36 years old. Studies have shown that homeowners of this age group were least likely to invest in new energy efficiency heating system or retrofit building envelope components [14, 15]. One reason could be that these young owners have less information and finance to make energy-related investment decisions, but the situation improves over time with increased awareness and income [16]. However, house buyers usually do indoor renovations, and therefore may be interested in energy efficient renovations.

The most cost-effective way of financing energy efficient renovation is financing from banks by using the house as mortgage. The interest rate is one of the lowest among various borrowing options and homeowners can borrow up to 85% of the purchased/appraised value of the house. People who have recently bought a house are most likely to have borrowed up to this ceiling and therefore, may find it very difficult to avail mortgage finance to renovate their house. On the other hand, homeowners who have lived in a house for several years, it is likely that value of the house has increased and they may have paid back a portion of their mortgage. Hence, it may not be difficult for them to avail mortgage financing to renovate their houses.

2.3 Key partners

In Sweden, the traditional small to medium size construction/renovation companies can and in some cases do carry out all types of renovations themselves or with help from other companies, but they usually do not do energy auditing or offer financing. These companies can offer the full service renovation packages in collaboration with energy auditors/building consultant and heating systems supplier. Energy auditors/building consultants are responsible to inspect the condition of the building, conduct energy analysis, and suggest packages of energy efficiency measures. They usually also have first hand information about the condition of the houses on sold. Certified energy auditors/building consultants cannot offer energy efficient renovation service as they are mandated to be independent of marketing building products and services. Heating system retailers or installers (vvs-företag/installatör in Swedish) can also be key partners as renovation of a typical house from the 1970s involves replacing electric heating system with other heating systems such

heat pumps, pellet boilers or district heating system and may include a hydronic system for distribution of heat with the house. Homeowners interested to install a new heating system usually contact the heating system retailers/installers and this provides an opportunity for the heating system retailers/installers to discuss with the homeowners about the full service renovation possibilities.

2.4 Key activities

The key activities in the one-stop-shop business model include marketing to attract customers, coordinating activities of number of actors involved in the renovation process, energy audit/building examination, energy analysis, apply for subsidies and building permits, renovation of the building, post-renovation commissioning, consult banks to convince them about the benefits of financing the energy efficient renovation, and customer service.

2.5 Key resources

A business requires several key resource or assets to do the activities needed to deliver the value proposition. Those resources can be physical, intellectual, human capital, or financial. For the full service renovation of single-family houses, the key physical resources include all that is required for conventional renovation, e.g. machines and equipment to carryout the renovation, and vehicles to transport goods and workers, telephone to reach customers etc. Additional physical resources required from the partner companies include supply of heating systems and equipment to conduct energy audit. The human resources include skilled and experienced workers to do proper energy audit and analysis, quality renovation, and offer good customer service. Intellectual resources include company reputation to attract customers (brand), softwares to conduct energy analysis and cost-benefit calculations (from energy auditors) and database of condition of houses sold (from energy auditors). Overall, the service provider needs financial resources to conduct the business, especially when homeowners make payments for the renovation work after the renovation is done.

2.6 Customer relationship

Customer relationship is important to entice new customers and retain existing customers. Especially for renovation business it is important to attract new customers as people who have already renovated their house are very less likely to renovate the house again. Potential customers are likely to be influenced not only by the approach of the service provider, but also by the feedback of the people who have already renovated their house. If owners of houses that are renovated are not happy with customer service, they may pass on their negative experience to potential customer.

Several categories of customer relationship (e.g. personal assistance, dedicated personal assistance, self-service, automated service etc.) may co-exist in a company's relationship with its customers. Dedicated personal assistance represents the deepest and most intimate type of relationship. Such a relationship is common in conventional renovation business and is important for full service renovation concept also as homeowners may feel it easy and comfortable to contact one person among several people and companies involved in the renovation process, starting from home visit to understand homeowner needs to post-renovation commissioning for few years. Moreover, the service provider may provide an online platform for their customers to share experience and take help from each other. Such user communities are useful to expand customer base.

2.7 Channels

There are several channels to communicate with the customer and deliver the value proposition. Homeowners in general could be informed about the full service renovation offer through advertisement in newspapers, magazines, and home delivered fliers. Especially, it could be effective to arrange local area meetings to interact directly with the homeowners as was done by the ENRA group in Finland and the energy company Jämtkraft in Sweden [17]. Presumptive owners' of houses on sale or owners of recently bought houses could be reached through energy

auditor as they are usually consulted by such homeowners before purchasing the house. Similarly, owners of houses interested to install a new heating system could be reached through the heating system retailers/installers.

2.8 Cost structure

The full service renovation packages are intended to be offered by a consortium of existing companies. Since, such companies already possess the required resources to renovate a house there may not be any significant additional cost to offer full service renovation. In fact, there are benefits of economy of scale with increased use of the existing resources. However, for the service provider there will be a marketing cost to inform and attract customers, for example, costs for advertisements, local area meetings, and hiring new employees. There is a cost involved in the free-of-cost preliminary building examination and cost estimations for a package offer. These costs could be a significant burden if enough people do not use the company service to renovate their houses. Also, there are costs for dedicated customer service, post-renovation commissioning, and information material to educate the homeowners about operation and maintenance of the building.

2.9 Revenue stream

The revenue stream building block represents the sources of cash a company generates from the business. The main source of income in the full service renovation model is the payment from the homeowners for the renovation work. The service provider may also earn commissions from the energy auditor/building consultants, heating system retailer/installers, and building product suppliers who can earn money from increased sale of their product of service.

3. Renovation process in the one-stop-shop model

The renovation process of house according to the one-stop-shop model could differ between houses on sale and houses when people have lived for a long time.

3.1 Houses on sale

1. Homeowner contact real estate agent.
2. Real estate agent contact energy auditor (energy declaration mandatory in Sweden) and building consultant.
3. Energy audit report and building examination report is prepared and handed over to real estate agent.
4. Energy audit report and building examination report is made available to interested buyers.
5. Prior to actual sale of the house, building consultant discusses with the potential buyer about the energy audit report and building examination report. The consultant must have access to energy declaration, if the same is issued by a different company or expert.
6. The building consultant indicates the opportunities for a package offer to implement energy renovation and suggest several companies. If the potential buyer is positive to the offer, the consultant asks if it is OK that a company offering full service energy renovation of houses contact the buyer.
7. House is sold.
8. Service provider (construction/renovation company) contact the buyer and discusses the possibility of full service energy renovation of the house based on the energy declaration and building examination report.
9. Service provider, on its own cost, prepare a preliminary package offer according to the customer requirement. The offer should include the following.
 - a. Based on energy analysis of the current situation of the building and household, energy saving and cost effectiveness of individual measures is estimated.

- b. Financier/real estate agent estimates the post-renovation value of the house, if the estimated measures will be implemented.
 - c. Service provider will indicate the investment cost of the planned measures.
 - d. Financing (based on the owner's existing banking relationships).
 - e. Cost-benefit analysis of the measures.
10. With positive response from the homeowner, the offer is refined and a detail workplan is prepared.
11. Contract signed with the homeowners; time-line, costs, guarantee, independent agency agreed by both parties to look into the renovation work, etc.
12. Service provider is responsible to implement the package offer according to the contract.
13. Final inspection of the renovation work by the independent agency.
14. Service provider provide information to homeowner about operation and maintenance of the building.
15. Homeowner pays to the Service provider.
16. Service provider makes regular visit to the house as part of post-renovation commissioning

3.2 Homeowners lived for long time in the house

1. Service provider advertises in mass/local media about their service, dispatch home-delivered brochures highlighting benefits of energy efficient renovation, may arrange information meetings in specific areas
2. Homeowners interested in energy renovation contact service provider and discuss about the possibility of a package offer

Or service provider get contact details of potential customers from the energy auditor/building consultant or heating system retailer/installer and contact the homeowners to discuss about the possibility of a package offer
3. Service provider make a free of cost home visit for a preliminary building examination
4. If homeowners are willing to pay, a detailed energy audit/building examination by an independent agency is conducted. This fee may be returned to the homeowner if renovation service is taken from the service provider.

The rest of the steps are same as the steps 9 onwards for houses on sale

4. Conclusions

Significant final energy efficiency potential exists in houses built before 1977, when a new building code with higher energy performance requirement of buildings was implemented. Primary energy efficiency potential mostly lies in the houses built during 1970-80, about 33% of which have electric heating systems only. These houses are more than 30 years old and needs to be renovated. This provides an opportunity for implementation of energy efficiency measures. To tap this opportunity there is a need for 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.

We have proposed a business model where existing small to medium sized construction/renovation companies can collaborate with energy auditors/building consultants and heating system retailer/installers to offer full service energy efficiency renovation of single-family houses. There is significant business potential as the renovation market for single-family houses could be in the order of billions of Swedish Crowns per year. Homeowners will get an improved

quality renovated house with little risk or responsibility which usually is the case with traditional renovations with individual solution, the energy cost will be reduced, market value of the house is likely to increase, mortgage banks will have a safer asset and there is societal benefits in terms of reduced energy use and greenhouse gas emission.

However, the one-stop-shop business model for energy renovation of single-family houses is yet to establish. One major uncertainty with such a model is to find enough interested customers. Following suggestions may improve the situation.

1. **Financing:** The best option to finance energy efficiency renovation of single-family houses in Sweden mortgage refinancing. However, the need to self-finance the amount not covered in the mortgage loan and a higher cost for the top loan (amount above 75-85% of the appraised value of a house) may not homeowners to go for energy efficiency renovation. This could be addressed if government provides soft loans or subsidies to cover the investment cost beyond the mortgage (base) loan. In some countries, e.g. Germany and Norway, there are preferential loans for energy efficient renovation of single-family houses.

Attention should be given to the limitation of mortgage financing for energy efficient renovation of recently bought houses. Banks should consider an energy efficient renovation plan prepared by an entrepreneur and pre-evaluate the post-renovation value of the house in collaboration with real estate agents. This valuation could form the basis for the bank to confirm the homeowner and the entrepreneur that certain amount of investment cost would be covered by mortgage refinancing. The rest may be covered by the government sponsored soft loan or investment subsidies.

2. **Tax deduction linked to energy efficiency measures:** From July 01, 2009 private persons in Sweden can get tax deduction (ROT program) amounting to 50% of the labour cost for specific repair, maintenance, renovation, or extension works in a single-family house or tenant-owned apartment. The maximum claim allowed is SEK 50000/person/year. This deduction can be combined with subsidies to replace resistance heaters or to decontaminate radon in single family houses. However, often this tax deduction is used for non-energy related measures such as improving kitchen, painting, a new or improved balcony, or house cleaning. An amendment to the tax deduction programs to incorporate specific requirements regarding energy efficiency of implemented measures may increase homeowners' interest in energy efficient renovation.
3. **Guarantee on energy savings:** Annual energy cost is the most important factor in the homeowners' decision to implement energy efficiency measures [14, 15]. Hence, a guarantee on energy or energy cost saving may encourage energy efficient renovation of houses. But, at present it is less likely that such guarantee will be given as the full service energy renovation concept is yet to be tested and not enough experience exists regarding energy savings potential in the context of varying household energy behaviour. However, such concepts exist for industrial and public buildings (the ESCO concept) and are emerging for residential buildings. It is possible that service providers may consider offering a guarantee on energy savings based on theoretical calculations.

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