Successful Sustainable Renovation Business for Single-Family Houses - SuccessFamilies

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1 EXECUTIVE SUMMARY

In Nordic countries significant primary energy efficiency potential exists in houses built before 1980. These houses are more than 30 years old and need to be renovated, which provides an opportunity for implementation of energy efficiency measures. However, there are several economic and market barriers and the renovation markets are dominated by handicraft-based individual solutions. In this project we analyze the opportunities for implementation of one-stop-shop business models where a single actor offers full-service holistic renovation packages including consulting, independent energy audit, renovation work, follow-up (independent quality control and commissioning) and financing.

The project participants are VTT, Finland (project co-ordinator), Technical University of Denmark, Mid Sweden University, and Segel AS, Norway. The reports (or deliverables) from the project are based on literature review, workshops, input from industry representatives and project participants' experience and judgment. This summary report (D3.3) contains synthesized information from other reports from the project which cover a review of existing sustainable renovation concepts (D1.1), identification of target groups and energy efficiency potential of packages of measures (D1.2), proposals on improved sustainable renovation concepts (D1.3), analysis of stakeholder interests (D2.1) and market strategies (D2.2), analysis of financing schemes (D3.1) and business models (D3.2).

There is a significant business potential for a one-stop-shop business model as the renovation market for single-family houses could be in the order of hundreds of million Euros per year in each Nordic country. Homeowners will get a quality renovated house with little risk and responsibility which usually is the case with traditional handicraft renovations. The energy cost will be reduced, market value of the house may increase, mortgage banks will have a safer asset and there are societal benefits in terms of reduced energy use and greenhouse gas emission. However, there is uncertainty over who will be responsible for guarantee of the renovation work if the service provider goes bankrupt.

Recently, some companies have started to offer full service renovation of detached houses in the Nordic countries e.g. Bolig-Enøk in Norway, K-Rauta & Rautia and ENRA in Finland, and Dong Energy Cleantech and ProjektLavenergi (not targeted to single-family houses at present) in Denmark. In Sweden, the only identified company to offer such a service is Energieffektiva Hus AB, which renovated one house in Öckerö. A comparative assessment of the business models shows that different type of actors may play the key role in a one-stop-shop for energy efficient renovation of single-family houses. In some models the service provider collaborates with financing institutions to provide renovation financing. There are differences on how customers are contacted, while the similarities are more on how the service is provided. A main challenge is how to secure independent advising.

Even though there is a strong business potential for one-stop-shop energy renovation concept, still it has been difficult to start or run such a business, e.g. Dong Energy Cleantech and ENRA concepts have ceased to operate. One of the main reasons is the uncertainty about the customer base. There is a lack of awareness about the possible energy efficiency measures and their benefits. The uncertainty regarding the level of energy savings, partly due to a varying household energy behaviour and lack of standardised measurements and verifications protocol may not encourage, both the customers and financiers, to go for energy efficiency investments.

High investment cost is an obstacle for energy efficiency renovations. In Nordic countries mortgage financing seems to be the most cost efficient option to finance such investments for single-family houses. 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. This suggests that people who have lived in a house for long time and paid back most part of their mortgage have the financial capacity to invest in energy efficiency renovation.

However, people who availed mortgage financing to buy a house recently may find it difficult to avail additional mortgage financing to invest in energy efficiency renovation, even though they are much likely to be interested in such renovations. One option to address this issue is that banks may 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 evaluation 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 financing.

National governments may provide soft loans (low interest and long-term) and subsidies for energy efficiency renovations, especially for energy audit of houses and to cover the investment cost beyond the mortgage loan. Also, tax deduction programs for labour cost for home renovation and other household work (as in Denmark, Sweden and Finland) could be amended to incorporate specific requirements regarding energy efficiency of the measures implemented. This would strengthen the market for energy efficiency renovation.

There could be a national goal for the energy efficiency improvement in existing buildings and a list of actions needed to achieve that goal. The incentives can then be tailored so that they consistently support this plan. In this case, better support could be given to those actions that strive to whole-building solution instead of single solutions. For a single-family house owner, the goal could be set by energy-certificate, and then one-stop-shop service would provide the plan and actions needed to get there.

A guarantee on energy saving may encourage energy efficient renovation of houses as energy cost saving is one of the most important factors in the homeowners' decision to implement energy efficiency measures. At present it is less likely that a guarantee will be given due to uncertainties regarding energy savings potential and also in the context of varying household energy behaviour. However, such concepts exist for industrial and public buildings (the ESCO concept) and may emerge for residential buildings.

Information campaigns highlighting the benefits of energy efficiency improvements and availability of economic incentives may create customer interest in energy efficient renovations. Emphasizing the loss incurred by residents due to non-adoption of energy efficiency measures may be more effective than the one projecting the gains made by adoption of such measures as people act more to avoid a loss than to achieve a gain. Public funded energy advisers as in Sweden and Finland may encourage homeowners to adopt energy efficiency measures as the energy advisers are mandated to provide independent advice which improves their trustworthiness. Also, the installers/sellers, who have a strong influence on homeowners' choice of energy efficiency measures, may be trained to provide comprehensive information on holistic energy efficiency renovation.

One way to develop the concepts and the market potential may be to provide public funding for few demonstration projects to test different business models, e.g. those identified in this project. Such projects will bring together actors interested in one-stop-shop concept and they will gain important experience. Advertisement of results of successful demonstration projects may attract more customers and entrepreneurs.

2 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 and 36% of greenhouse gas emissions in the EU (European Parliament, 2010). Many countries have introduced building codes with energy efficiency aspects for new buildings. However, the addition of new buildings to the existing stock happens slowly especially in developed countries. Hence, it is important to target also the existing buildings for energy efficiency improvements, especially the single-family houses as they (excluding row houses) account for an average of 40% of the number of dwelling stock in the Nordic countries, varying from 30% in Sweden to 52% in Norway (Tommerup et al., 2011a).

In Nordic countries majority of existing houses are built before 1980 and are in the need of renovation. This provides an opportunity for implementation of energy efficiency measures, but there is a lack of need among the homeowners for energy efficiency renovation and there are several economic and market obstacles to overcome. Based on this background, the aim of this Nordic SuccessFamilies (Successful Sustainable Renovation Business for Single-Family Houses) project has been to analyze the scope of implementing full-service packages including consulting, independent energy audit, renovation work, follow-up (independent quality control and commissioning) and financing for energy efficient renovation of single-family houses.

The project participants are VTT, Finland (project co-ordinator), Technical University of Denmark, Mid Sweden University, and Segel AS, Norway. The project has five work packages (WPs).

WP1. Sustainable renovation concepts (Leader: Technical University of Denmark)
WP2. Marketing strategies for sustainable renovation (Leader: Segel)
WP3. Successful service models (Leader: Mid Sweden University)
WP4. Dissemination (Leader: VTT)
WP5. Coordination (Leader: VTT)

The reports (or deliverables) from the project are based on literature review, workshops, input from industry representatives and project participants' experience and judgment. This summary report (D3.3) contains synthesized information from the previous reports which cover review of existing sustainable renovation concepts (D1.1), identification of target groups and energy efficiency potential of packages of measures (D1.2), proposals on improved sustainable renovation concepts (D1.3), analysis of stakeholder interests (D2.1) and market strategies (D2.2), analysis of financing schemes (D3.1) and business models (D3.2).

3 STATISTICS ON EXISTING DETACHED HOUSE STOCK

A summary statistics of energy related information in detached houses of Nordic countries is presented in Table 1. The share of such houses in the total number of dwellings in each country varies from 30% in Sweden (excluding farmhouses and row houses) to 52% in Norway. Final energy use for heating and hot water purposes is higher in older houses. The average yearly final energy use for space heating and hot water ranges from 200 kWh/m^2 in Norway to 135 kWh/m^2 in Denmark. In comparison, the requirements for heating demand are much more stringent for new houses, for example, a maximum of approximately 60 kWh/m^2 for a typical house in Denmark (Danish building code BR10). This indicates that there is significant potential to improve energy efficiency of existing buildings.

Table 1. Summary statistics of energy related information for detached single-family houses of Nordic countries (Tommerup et al., 2011).

	Denmark	Sweden	Norway	Finland
Number (1000s) of detached houses	1,141	1,360[1]	1,200	1,083
Share of detached houses in the total number of dwelling stock (excluding row houses)	46%	30%	52%	39%
Average heated floor area per house	149m^2	123 m^2	125 m^2	139 m^2
Average yearly final energy use for heating and hot water (kWh/m^2)	135 (in 2008)	148 (in 2008)	200 (in 2005)	180 (in 2005)
Existing heating system	Mostly oil/gas boilers + district heating	Direct electric heaters + wood + heat pumps	Mostly electric heating (70%)	Direct electric heaters + wood + oil boilers
Existing 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

[1]Not including detached farmhouses. Included for the other countries.

4 ENERGY EFFICIENCY POTENTIAL OF TYPICAL HOUSES

In the Nordic countries typical single-family houses with large primary energy saving potential are those from the 1960´s and 1970´s, since they were built in large numbers and built just before the tightening of the insulation standards in the late 1970's, and because electric heating is prevalent (except for Denmark). Although a part of the single-family houses built before 1945 has been renovated, energy renovation of those houses would still account for large specific energy savings.

Tommerup et al. (2011a) have used the calculation tool WinDesign to analyze primary energy efficiency potential of typical single-family houses in the Nordic countries. The calculations are made assuming a room temperature of 20°C, internal heat gain (people and household electricity) of 5 W per m^2 gross heated floor area and air change rate per hour of 0.5 h^{-1} for both natural and mechanical ventilation. A primary energy factor of 2.5 for electricity use and 1 for use of oil, natural gas and district heating are applied for Denmark. For Sweden, Norway and Finland the primary energy factors used for electricity are 2.65, 2.5 and 3.0, respectively, and oil, natural gas and district heating systems are not analyzed.

The energy analysis results for typical houses built during 1970s showed that renovation measures together with the use of a 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. Typical Danish houses can be renovated to a level of energy performance which is comparable to the requirement for new houses today. The primary energy savings 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 with cogeneration of district heat and electricity then maximum primary energy savings can be gained by replacing resistance heaters with such a system (Joelsson, 2008). The potential of mechanical ventilation system with heat recovery (VHR) depends on the air tightness of the house, electricity used to operate the system, the heat recovery efficiency of system, energy losses due to defrosting and the energy supply system. If an efficient heating system exists, supplied e.g. by district heating or heat pump, then primary energy savings gained by the installation of a VHR may be small and require good air tightness of building envelop and low electricity use to operate the VHR system.

The excessive solar radiation in summer may result in overheating, especially when applying extensive energy renovation measures that reduce heat losses. In order to reduce such problems, external solar shading - whether or not combined with a higher venting rate bypassing the heat recovery system if used - is the most efficient. The external shading should optimally be moveable but it is usually costly to install and may be sensitive to hard winds.

Table 2: Energy use for space heating, hot water and ventilation purposes for different renovation scenarios of typical houses from 1970s in different Nordic countries (Tommerup et al., 2011a)

Finland (Helsinki), 100m^2 floor area	Scenarios				
	1	2	3	4	5
U-value walls	0.28	0.24	0.24	0.24	0.17
U-value roof	0.30	0.15	0.15	0.15	0.09
U-value floor	0.22	0.19	0.19	0.19	0.16
U-value window	2.10	1.40	1.40	1.40	0.80
Total UA-value	85	61	61	61	44
Ventilation	Natural	Natural	Natural	VHR 85%	VHR 85%
Heating system	RH	RH	HP (COP 3)	HP (COP 3)	HP (COP 3)
Heat demand (kWh/m^2/year)	171	138	138	93	71
Final energy use (kWh/m^2/year)	175	142	47	35	27
Primary energy use (kWh/m^2/year)*	526	426	140	104	82

Norway (Oslo) , 137 m^2 floor area					
U-value walls	0.38	0.22	0.22	0.22	0.18
U-value roof	0.20	0.15	0.15	0.15	0.15
U-value floor	0.36	0.20	0.20	0.20	0.20
U-value window	2.20	1.60	1.60	1.60	1.00
Total UA-value	121	75	75	75	71
Ventilation system	Natural	Natural	Natural	VHR 85%	VHR 85%
Heating system	RH	RH	HP (COP 3)	HP (COP 3)	HP (COP 3)
Heat demand (kWh/m^2/year)	125	95	95	59	50
Final energy use (kWh/m^2/year)	125	95	32	22	19
Primary energy use (kWh/m^2/year)*	312	238	79	53	48

Sweden (Stockholm), 236 m^2 floor area					
U-value walls	0.40	0.32	0.32	0.32	0.18
U-value roof	0.25	0.11	0.11	0.11	0.13
U-value floor	0.45	0.27	0.27	0.27	0.15
U-value window	2.70	0.80	0.80	0.80	0.80
Total UA-value	165	113	113	113	71
Ventilation system	Natural	Natural	Natural	VHR 85%	VHR 85%
Heating system	RH	RH	HP (COP 3.3)	HP (COP 3.3)	HP (COP 3.3)
Heat demand (kWh/m^2/year)	120	79	78	44	38
Final energy use (kWh/m^2/year)	124	81	24	16	12
Primary energy use (kWh/m^2/year)*	328	216	63	42	32

Denmark, 154.5 m^2 floor area					
U-value walls	0.53	0.19	0.19	0.19	0.13
U-value roof	0.27	0.10	0.10	0.10	0.10
U-value floor	0.36	0.36	0.36	0.36	0.15
U-value window	2.80	1.34	1.34	1.34	0.80
Total UA-value	181	106	106	106	70
Ventilation system	Natural	Natural	VHR 85%	VHR 85%	VHR 85%
Heating system	Gas boiler	Gas boiler	New gas boiler	Solar heating	Solar heating
Heat demand (kWh/m^2/year)	203	125	104	92	58
Final energy use (kWh/m^2/year)	241	150	99	96	62
Primary energy use (kWh/m^2/year)*	246	154	104	100	66

VHR = Mechanical ventilation with heat recovery; RH = Electric resistance heaters; HP= Heat pump; COP = Coefficient of performance.

5 DIFFUSION OF ENERGY EFFICIENCY MEASURES – THE ONE-STOP-SHOP BUSINESS MODEL

Technical solutions exist for residential energy efficiency improvement (Tommerup et al., 2011a) and their adoption is beneficial in the long-run. However, diffusion of energy efficiency measures is not successful and that has often been referred to as market barriers. Several studies have analysed these issues (Brown, 2001; DeCanio, 1993; Sorrell *et al.*, 2004; IEA, 2008) and we summarize them below.

Low priority is given to energy issues by the stakeholders, especially the end-users (IEA, 2008). There is a *lack of need* among the homeowners as they are satisfied with existing condition of their buildings (Nair et al., 2010). There is a lack of information, knowledge or awareness among the homeowners about the energy efficiency measures and their energy and non-energy benefits. Installers/sellers have a significant influence on homeowners' decision (Nair et al., 2010) and they promote products/services that are beneficial for them.

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 whose fault it is (Mahapatra et al, 2011a).

Investment cost is one of the important factors in homeowners' choice of energy efficiency measures (Nair et al., 2010). 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 don't 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 (Mahapatra et al, 2011b).

Use of *"payback time" as an investment decision* tool by financiers (BPIE, 2010; IEA, 2008; Golove and Eto, 1996; Hermelink, 2009) and homeowners (Kragh and Rose, 2011) do not consider benefits accrued after the payback time and that is particularly important in the building sector context since buildings' actual lifetime may vary from the assumption made in the calculations (IEA, 2008; Hermelink, 2009). Also, there is no agreement on the appropriate level of the discount rate which should be applied in the discounted payback calculations (Thompson, 1997; Hermelink, 2009). The monetary value of *non-energy benefits* gained with implementation of building energy efficiency measures, for example, health benefits due to improved indoor air quality and comfort level are difficult to evaluate (Jakob, 2006) and are often not considered in the investment decisions.

Energy efficiency projects are viewed as risky investments (BPIE, 2010; IEA, 2008), maybe because of their small size, difficulty to control energy use behaviour of the occupants and the difficulty to predict future energy prices. Commercial bankers typically pick investments which are safest and grant medium return on investments. They give inadequate attention to the fact that implementation of energy efficiency measures improves credit capacity of the customers (IEA, 2008).

There is a *lack of standardised measurements and verifications protocol* for energy efficiency investments (Ramesohl and Dudda, 2001; IEA, 2008) which creates uncertainty among the financers

and customers regarding the level of energy savings to be achieved. It is difficult to judge the cost effectiveness of an energy efficiency measure that would be implemented *anyway* if the existing installation was old or damaged and need to be replaced.

One way to overcome some of the above-mentioned issues is to introduce one-stop-shop business models where a single actor offers full-service *holistic renovation packages including* consulting, independent energy *audit, renovation work, follow-up (independ*ent quality control and commissioning) and, financing. Some companies, e.g. Bolig-Enøk in Norway and K-Rauta & Rautia in Finland have started to offer variants of one-stop-shop service for renovation of single-family houses.

In the Energy Performance Contracting (EPC) model an Energy Service Company (ESCO) enters into arrangements with property-owners to improve energy efficiency of their property by implementing various measures. ESCOs can also finance or arrange financing for the operation, and their remuneration is directly linked to demonstrated performance regarding the level of energy savings or energy service. But, ESCOs are almost non-existent in the Nordic residential sector mainly due to the difficulty to give guarantee on energy/cost savings and due to the fact that the small size of individual projects means that profits may not be significant (Mahapatra et al., 2011b) and with relatively high risk. The providers of one-stop-shop service for energy efficient renovation of single-family houses can be called ESCOs if they can arrange financing and give some kind of guarantee on energy and/or cost savings similar to the ESCO RENESCO Ltd (earlier Sun Energy Baltic Ltd) in Latvia (RENESCO, 2011).

6 AN IDEAL PROCESS OF IMPLEMENTING THE ONE-STOP-SHOP MODEL

Tommerup et al. (2011b) has presented an *ideal* process of implementing the one-stop-shop business model. The process consists of five phases: investigation of the house, extensive analyses, proposal for renovation, actual renovation and commissioning after renovation. We expand that process to six phases to include "marketing" to attract customers (Figure 1).

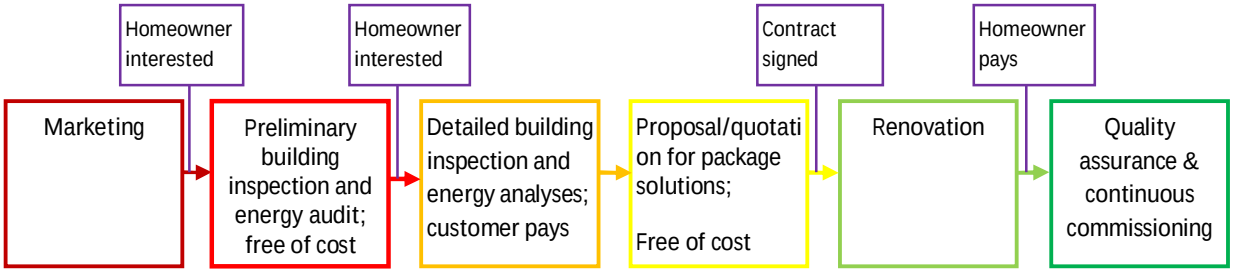

Figure 1. Implementation process of a general one-stop-shop model for energy efficient renovation (adapted from Tommerup et al., 2011b)

Marketing

The first step in implementation of a one-stop-shop model is that the company offering such a service must do some kind of marketing to inform the customers about the value proposition and create interest in the full service concept. Marketing may include advertisement in mass media, warehouse displays, interpersonal communication such as local area meetings, and information from real estate agents or energy auditors when a house is newly-bought, etc. Typically mass media advertisement is useful to *inform* the customers, while interpersonal communication is important to convince the customers to adopt a product or service.

Preliminary building inspection and energy audit

Homeowners interested in the full service concept will contact the one-stop-shop service provider. Similar to a traditional renovation process, the service provider should visit the house to be renovated, conduct a free of cost preliminary building inspection and energy audit and discuss with the homeowner about the renovation requirements and the availability of subsidies. This is an opportunity for the service provider to offer the possibility of a more comprehensive building inspection and a detailed energy analyses by an independent actor. A basis for the analysis is a possible existing energy label, house condition report, drawings, pictures and other relevant documents.

Detailed building inspection and energy analyses

Based on the outcome of the preliminary analysis some homeowners may opt for traditional renovation process and avoid a more detailed energy analysis. However, others may be inclined to know more about the condition of the building and the possibility to improve energy efficiency. If homeowners show such interests, the service provider could arrange an independent company (e.g. in Sweden there are accredited energy auditors and building inspection companies) to do a more detailed inspection of the building and a deeper energy analysis. This service should be carried out by the company in dialogue with the homeowner and paid for by the homeowner but refunded if a

renovation package solution is bought from the company. The extensive analyses will also provide the company with knowledge that allows for a safe foundation to convince the homeowner about the benefits of energy renovation packages and to offer fixed price quotations.

Proposal for package solutions

In this phase proposals for renovation package solutions are put together, including quotation for the work, financing and management of the contract work. The main point is that the typical homeowner needs help in the design and decision making process. The company should be able to carry out this phase within few hours provided that the right system for configuration of technical standard solutions is in place including simplified but accurate calculation models. It is possible to prepare packages of standard solutions for houses of similar architectural design, e.g. houses built during 1970s. The company should provide "fixed prices" for various packages including visualization/documentation of the effect on:

- Total and annualized investment cost versus savings in energy cost
- Household economy – short and long term including effect of increased value of the house etc.
- Indoor environment, e.g. indoor temperatures, draught, air quality and daylight
- Other durability and maintenance issue
- Alternative housing for the family if they needed to vacate the house during renovation.
- Time line for the renovation work
- Possibilities for installation of energy feedback instruments (e.g. energy clock, hot water use meters)

Coordinated execution of the renovation work

The homeowner evaluates the packages and if (s)he chooses to accept any of the proposals, any remaining economic and financing issues are clarified and a contract for renovation work is signed. A detailed work description including the time line is set in place, drawings if needed are prepared, and the contract work is carried out. The company obtains the necessary renovation permissions from the authorities and helps the homeowner to apply for possible loan and/or governmental subsidies. The quality of the renovation work should be checked continuously to make corrections making sure that defined requirements are fulfilled. At the end of this phase the renovated house is ready for use.

Quality assurance and continous commissioning

The renovated house is inspected by an independent agency to check for the quality of work. A certified energy consultant prepares an energy performance certificate. The heating and ventilation systems are commissioned for at least two years. One important issue is to check that energy performance is continuously reached. Energy performance of the building is regularly recorded and compared with estimated energy savings potential. The homeowner is presented with a user manual on how to operate the building and explained with information on the consequences for energy use and indoor environment if the house is not operated as prescribed.

7 EMERGING ONE-STOP-SHOP MODELS IN NORDIC COUNTRIES

7.1 Examples from DENMARK

The Dong-CleanTech concept developed by Dong Energy A/S, one of Northern Europe's leading energy groups, is a full service package solution offered in cooperation with partners for installation of heat pumps, insulation, windows, solar heating and building thermography. Dong Energy took care of advice, sale and coordination, e.g. handled the necessary paperwork and possible application for a national renovation subsidy and offered financing solutions. However, Dong-CleanTech ceased to operate from early 2012. An employee who earlier worked in Cleantech reasoned that Dong Energy has decided to focus on the core business of the company as oil and gas producer and accordingly stopped the activity of actively stimulating energy savings in buildings in Cleantech. The operation of Cleantech was too expensive with respect to the outcome. However, as part of its energy efficiency obligation target (Energiaftale, 2008) Dong Energy gives subsidies for some specific energy saving activities carried out by house owners if they apply for it (Svendsen, 2012).

The concept "ProjektLavenergi" is a holistic energy renovation concept offered by Adsbøll, which is a well known and trusted local contractor in southern Demark. Its activity originates from being a partner of Green Business Growth, a private-public partnership for energy efficient buildings in the region of southern Denmark with the aim of creating growth in green building and renovation. Adsbøll works together with a network of pre-selected partners that are well known and/or trusted in the market. The craftsmen used can be trained in relevant courses arranged by the mentioned partnership to become "energy-craftsmen" with special knowledge of energy efficient renovation. This concept was planned to be applied to single-family houses, but currently applied to multifamily houses only.

7.2 Examples from FINLAND

There are two Finnish examples of business models analyzed below. The ENRA concept was offered by a group of companies offering different individual energy renovation services or solutions in a holistic package. The technical solutions offered were energy-efficient windows and doors, heat pumps, internal extra insulation or new insulation, and demand-based ventilation with heat recovery. Since May 2011 the concept is on break and is not offered by anyone as the core company Rustholli (a renovation service provider) went bankrupt at the end of 2010. According to the representatives of the company, the reason for bankruptcy was not due to their launch of the one-stop-shop concept. Rather, the one-stop-shop concept formed only a marginal share of their revenue and the whole company had serious cash deficits. The concept is now owned by the company NordBuild.

The other Finnish example is offered from early 2012 by the two hardware store chains K-Rauta and Rautia of the Kesko group (www.kesko.fi). K-rauta is an international specialty store for builders, renovators and interior decorators. It operates in Finland, Sweden, Estonia, Latvia and Russia. Rautia is a nationwide hardware and builders' supplies store chain to serve builders and renovators at over 100 locations throughout Finland. The energy renovation service concepts in both chains are basically the same, where trusted local renovation companies complete the renovation work. The company

Raksystem Anticimex conducts building inspection and provides independent advice. Financing is also included in the package solution.

7.3 Example from NORWAY

The Norwegian company Bolig Enøk is a newly established daughter company of one of the two major insulation actors in Norway; Glava AS. Bolig Enøk offers a Project Manager service to owners who have a need for renovation of their single family houses. The Project Manager is responsible for the complete renovation process including technical analysis, recommendations, project management, contact with all involved actors such as main contractor, subcontractors, authorities, and assists the homeowner with application for relevant grants. Bolig Enøk planned to issue the invoice for the complete project and thereby take on the risk towards the customer. This would be easiest for the customer, but due to the Norweigian consumer law the guarantee period for the customer is longer than what Bolig Enøk can claim towards their suppliers (B2B law). Currently they therefore receive all the invoices, control them, and forward to the house owner who pays directly to the supliers. Bolig Enøk invoices the customer for their service as project management. Bolig Enøk will not interfere with the mother company Glavas' two main distribution channels; retail chains and carpenters. Each renovation project will therefore buy all products (including insulation) through local suppliers. The advantage of this model is that Bolig Enøk is more independent from suppliers than initially planned, which means more trustworthy in the eyes of the customer.

7.4 Example from SWEDEN

Presently there is no established company offering one-stop-shop energy efficient renovation of single-family houses in Sweden. We propose a model (*Enrenov*) where a traditional small to medium size construction/renovation company coordinates with an energy audit company and heating system installers/retailers to offer full service energy efficiency renovation packages. Energy auditors/building inspectors are responsible to inspect the condition of the building, conduct energy analysis, and suggest packages of energy efficiency measures. Energy audit is mandatory when a house is sold and the auditors have the opportunity to discuss with the potential buyers about energy efficiency renovation measures. Heating system retailers or installers can also be key partners as homeowners interested to install a new heating system usually contact the heating system retailers/installers.

7.5 Comparative assessment of the business models

Every business explicitly or implicitly uses a business model which describes the rationale of how to create, deliver and capture value. A business model essentially has nine building blocks; customer segment, value proposition, key activities, key partners, key resources, customer relationship, channels (communication, distribution and sales), cost structure, and revenue stream. These building blocks, which form the basis for a tool namely “business model canvas” (Osterwalder and Pigneur, 2010), are used to discuss the emerging one-stop-shop business models for energy efficient renovation of single-family detached houses in the Nordic countries (see Mahapatra et al, 2011a, deliverable D3.2 for detail). A comparison of the models is presented in Table 3.

The one-stop-shop concept means that a single service provider is responsible for holistic renovation of single-family houses as per the wishes of the house owners, including implementation of energy efficiency measures, or kitchens and bathrooms. *Ideally*, this means that the value proposition and key activities should more or less be same for different business models, but the service provider

could be different. And depending on the in-house capability of the service provider, the partnership and key resources could be different. Also, the channels and customer relationship to serve the customers could be different.

However, a comparative assessment of existing or proposed one-stop-shop models in the Nordic countries showed that the value proposition varies, which means there are possibilities for improvements to attract customers. Also, in some models e.g. ENRA, ProjektLavenergi, Bolig- Enøk, Enrenov (proposed) the service provider actively looks for customers through local meetings, while it is not the case in other models such as Dong-Cleantech. One major issue is how to offer independent but quality advice to the customers in order to improve trustworthiness of the business proposition. In some models financing is not available, and guarantee on energy savings is lacking in all models.

Table 3: Comparative assessment of emerging (proposed) one-stop-shop business models for energy efficient renovation of single-family detached houses in the Nordic countries (adapted from Mahapatra et al, 2011a)

	Denmark		Finland		Norway	Sweden
Building blocks of a business model	Dong-Cleantech[1]	ProjektLav-energi[1]	ENRA[1]	K-Rauta & Rautia	Bolig- Enøk	Enrenov[1] (proposed)
Key partnership						
Service provider	Energy utility	Contractor	Renovation company	Hardware store chain	Building product supplier	Renovation company
Key partners						
Contractors/installers	x			x	x	
Products/heating system suppliers	x	x	x	Manufacturers	Retailers	x
Energy utility/auditor		Utility	Auditor	Auditor	Auditor	Auditor
Financial institutions	x	x		x		
Customer segment						
Houses built	Before 1973	1970-80s	1940-90	Not specific	1960-80s	1960-80s
Value propositions						
Individual/holistic solutions	Individual	holistic	holistic	holistic	holistic	holistic
Holistic solution		x	x	x	x	x
Full service	x	x	x	x	x	x
Financing	x	x		x		
Channels						
Mass media and website	x	x	x	x	x	x
Personal contacts	x	x	x	x (Own stores)	x	x
Key partner contacts	x	x	x		x	x
Local meetings		x	x		x	x
Customer relationship						
Dedicated personal assistance	x	x	x	x	x	x
Key resources						
Product/project manager	x	x	x	x	x	x
Administration and marketing personnel	x	x	x	x	x	x
Renovation employees and logistics		x	x			x
Distribution network				x		

Building blocks of a business model	Denmark		Finland		Norway	Sweden
	Dong-Cleantech[1]	ProjektLav-energi[1]	ENRA[1]	K-Rauta & Rautia	Bolig- Enøk	Enrenov[1] (proposed)
Key activities						
Marketing	x	x	x	x	x	x
Building inspection and energy audit	x	x	x	x	x	x
Approvals from local authorities & apply for subsidies	x	x	x	x	x	x
Project management	x	x	x	x	x	x
Renovation work	x	x	x	x	x	x
Independent post-renovation inspection					x	x
Post renovation information provision to the customers			x		x	x
Service/after sales	x	x	x	x	x	x
Revenue streams						
Customer payment for Renovation	x	x	x	x	x	x
Detailed energy audit					x	x
Commission from suppliers				x		x
Cost structure						
Marketing	x	x	x	x	x	x
Salary of product /project manager	x	x	x	x	x	x
Administration and support	x	x	x	x	x	x
Travel	x	x	x	x	x	x
Subcontracting	x	x	x	x	x	x
Improvement possibilities[2]						
Holistic renovation	x					
Evaluation of potential guarantee on energy savings	x	x	x	x	x	x
Independent advise by third party	x	x	x			
Actively search for customers	x			x		
Follow up and information pack	x	x		x		
Financing			x		x	x

1 - Currently not in operation or directed to single-family houses; 2 - not part of the building blocks of business model

8 STRATEGIES TO IMPROVE MARKET FOR FULL SERVICE ENERGY EFFICIENCY RENOVATION OF SINGLE-FAMILY HOUSES

There is significant business potential for one-stop-business model for full service energy efficient renovation of single-family houses in Nordic counties (Haavik et al, 2011). Still it has been difficult to start or run such a business, e.g. Dong Energy Cleantech and ENRA concepts have ceased to operate. This shows that the diffusion of energy efficiency measures is troublesome even though their adoption is beneficial for involved actors. Following strategies may improve the market condition for one-stop-shop model for energy efficient renovation of single-family houses in the Nordic countries.

8.1 Marketing strategies

Independent of the business model the responsible company needs to make some strategic choices. In the section below we have listed the main strategic issues which each company may give different answers to. Each company has also to take into respect the current regime of regulations and incentives. This may therefore differ from country to country.

1. Definition of target group

As the one-stop-shop renovation market is at the very early market phase, it will be innovative and open minded persons who are most likely to go for a holistic renovation project. As such renovation is an expensive investment the potential buyers have to have capacity to finance the investments, for example by increasing their mortgage loan within what may be secured by the value of the house. Depending of the operational radius of the company the geographical location of the potential customers must be defined. Another relevant criterion is how long the potential customer has owned the house. Owners of newly bought houses may consider renovating their houses.

2. Definition of the service and differentiation factors

The core business of the one-stop-shop should be defined. If it is an existing company which wants to expand their business and offer a one-stop-shop for a holistic renovation with high ambitions on energy savings, this will be incorporated into a wider menu of services of that company. The next step of developing this strategy is to identify and highlight the factors the company can use for differentiating from (competing – which hardly exists) or substituting services in the market. Such factors must build on the strengths of the company or strengths achieved through alliances with other actors.

Independent of the business model chosen, it is a necessity for securing a holistic renovation that the first step of the service is to make an analysis of the house and present a plan with recommended energy efficiency measures. The plan is the basis for discussion with the house owner what should be done and in which order it should be implemented considering the house owner's budget.

3. Build credibility

The service is new and may be perceived as risky by house owners. It is therefore crucial that the one-stop-shop is credible and the credibility has to be maintained through quality assurance to

secure satisfied customers. To buy a complete package including quality control and certification from the same company needs a high degree of trust. Few companies have such a strong reputation/brand that a house owner would not ask for an independent control. One way of building trust is through cooperation with well reputed research organisations or public bodies.

The leading partner in the one-stop-shop is responsible for the quality of the service. However, quality assurance regarding all participating companies is essential. Extra training as well as one-stop-shop "school programs" might be launched as part of the different business models.

4. Partnerships

The company which is responsible for the service has to consider which parts of the service may be delivered by in-house resources of the company and which must be covered by other actors. Some of this may be supplied through ordinary sub-contracting, while other may be considered too critical for which a stronger partnership agreement may be needed. Key elements to be judged in this respect are own capabilities and capacity, need of control and risk management.

5. Communication strategy

There are four main elements (Mlecnik, 2011) which should be addressed to motivate the customer for the idea of high ambition energy renovation:

- Exemplify: demonstrate to the customer what this is about.
- Engage: let the house owner be engaged with his own ideas and wishes.
- Enable: show how he/she can do this within his budget. Inform about available public incentives.
- Encourage: Give the customer some sort of positive confirmation about his decision. Example: Work with public actors which promote energy efficient renovations. In this way the customer can see that it is not only the one-stop-shop company which wants to sell something.

For any type of one-stop-shop business for high ambition renovation, it is important also to use "non energy benefit" arguments in addition to the energy benefits for promoting the service. The pitfalls of selling only on payback time argument should be avoided. The best would be to find what is important for the homeowner and avoid he/she regretting in future of not doing holistic renovation. The one-stop-shop's core mission is to make sure that the measures taken are the best in a holistic and long run perspective.

6. Marketing mix

As a final check to evaluate if most important strategic issues have been considered, the four "P's" in the marketing mix (Kotler, 2003) and their interaction must be discussed and adjusted to achieve the optimal mix.

- Product - what is to be sold? Should already be covered above in point 2.
- Place - where is the service sold (where is the trade counter). This should already be defined in the description of the business model.

- Promotion – how is the service promoted? This should be covered above in point 5.
- Price – what is the pricing model for the service? Part of this question is covered in the business model description, but the principles for calculating the price must also be decided. How should the mark-up be for each of the elements of the service? Relevant strategy could be to subsidise the initial analysis of the house.

8.2 Policy instruments

1. Regulation

There are no building level energy efficiency standards for renovated buildings, while such standards exist for new buildings. Regulations might be changed to have energy efficiency standards of renovated buildings and minimum energy efficiency requirements for products to be installed (there are few requirements in Danish building code BR10). A step-wise long-term national plan for energy efficiency improvement of buildings will signal the stakeholders that action has to be taken. For example, in Denmark the policy that the buildings will be fossil fuel free by 2035, including electricity supply to be based on renewable resources, led the Danish Construction Association to recommend one-stop-shop service to its members to offer full service holistic energy efficiency renovation of single family houses (Dansk byggeri, 2012).

In all Nordic countries, except for Finland, energy audit report or energy performance certificate is mandatory (voluntary in Finland) when a house is sold. Such a document usually contains a list of recommended measures to improve the energy standard of the house. The idea behind the energy audits/certificates is that prospective buyers will factor the energy audit information in the house purchase decision and implement the recommended energy efficiency measures. In Sweden and Denmark the energy audit is done by certified energy auditors, while in Norway house owners can themselves use a web tool to generate the certificate. Furthermore, the energy audit report in all Nordic countries is not very detailed and comprehensive.

In each country it might be made mandatory to have detailed energy and building condition audit report for all houses of certain age (e.g. those built before the 1980s). A joint audit by the independent energy auditors and building consultants might provide a basis for a set of high quality recommendations of energy efficiency measures to be implemented, either at a time or in phases to improve the energy performance of the house. Energy efficiency subsidies linked to energy audit of the building may encourage the homeowners to go for energy efficiency renovations.

2. Economic incentives

Investment subsidies to reduce the cost burden may be useful to promote energy efficiency renovations as investment cost is one of the important factors influencing homeowners' choice of energy efficiency measures (Nair et al., 2010). On the other hand, grants given to energy efficient single products may result in sub-optimizing. A subsidy or tax deduction scheme might be introduced for preparation of a detailed building inspection and energy audit report, which will form the basis for energy efficiency renovation of houses. The report should be prepared by an independent actor to increase the trustworthiness of the suggested measures to be implemented. Grants for energy audit of multifamily houses exist in Norway.

In Denmark, Sweden and Finland there are tax deductions for labour cost for home renovation and

other household work. However, often this tax deduction is used for non-energy related measures such as improving kitchen, bathrooms, 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. The level of subsidy or tax deduction could increase with increased level of energy efficiency renovation.

3. Financing

The most cost efficient option to finance energy efficiency renovation of single-family houses in the Nordic countries is mortgage refinancing. However, the need to self-finance the amount not covered in the mortgage loan and a higher cost for the top loan (typically amount above 75% of the appraised value of a house) may hinder the 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 Norway as in Germany there are preferential loans for energy efficient renovation of single-family houses.

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

Norwegian authorities have a special incitement called "Young people's housing savings" (BSU) for persons less than 34 years old to save money for their first dwelling. You may save max 20.000 NOK a year and accumulate NOK 150.000 on a special account. This money is then later used as the own capital in combination with mortgage loan from their bank to buy a house. If the money is used for other purposes the reduced tax has to be paid (Skatteetaten, 2011). All banks offer their best terms for such accounts. A similar system could be introduced to households to save money for energy efficient renovation.

4. Guarantee on energy savings

Annual energy cost is one of the most important factors in the homeowners' decision to implement energy efficiency measures (Mahapatra and Gustavsson, 2008; Nair et al., 2010; Sitra, 2011). Hence, comprehensive evaluation of energy savings and a potential guarantee on energy savings may encourage energy efficient renovation of houses. At present it is less likely that a guarantee will be given due to uncertainties regarding energy savings potential and also in the context of varying household energy behaviour. However, such concepts exist for industrial and public buildings (the ESCO concept) and may emerge for residential buildings. It is possible that service providers may consider offering a guarantee on energy savings based on theoretical calculations. Also, it should be emphasised that the energy efficiency improvements bring along other benefits like improved thermal comfort or indoor air quality.

5. Information

Information campaigns can be initiated where authorities encourage people to think holistically when doing a renovation of their houses. Messages such as "don't miss the opportunity to …" may be promoted in order to create a "pull-effect" in the market. Highlighting the energy (e.g. cost reduction)

and non-energy benefits (improved thermal comfort or indoor air quality) of energy efficiency improvements and availability of economic incentives may create customer interests in energy efficient renovations. Campaigns stressing the loss incurred by residents due to non-adoption of energy efficiency measures may be more effective than the one projecting the gains made by adoption of such measures (Yates and Aronson, 1983). This is because people act more to avoid a loss than to achieve a gain (Kahneman and Tversky, 1979).

Public funded energy advisers as in Sweden and Finland may encourage homeowners to adopt energy efficiency measures as the energy advisers are mandated to provide independent advice which improves their trustworthiness. However, the availability of energy advice service needs to be better advertised and the quality improved to attract more homeowners to avail such a service (Mahapatra et al., 2011).

6. Training installers/sellers

Installers/sellers have a significant influence on homeowners' choice of energy efficiency measures (Nair et al., 2012). However, they seem to have a lack of knowledge and interest in holistic energy efficiency renovations. Also, they could have low trustworthiness among the homeowners as was found in Finland. The Finnish homeowners were concerned that equipment suppliers capitalise on homeowners' limited knowledge on energy and building renovation issues (Sitra, 2011). The installers/sellers should be trained to give comprehensive information about energy efficiency alternatives and holistic renovation. The service providers of one-stop-shop may collaborate with public authorities and research and education institutes or create their own training centers to impart such training. There are already public-private collaborative research projects (Build up skills projects) running in 21 European countries, including the Nordic countries, to identify and improve skills of construction professionals to construct new low energy buildings and renovate existing buildings to low energy standards. Bolig Enøk has developed a training program, the Enøk School, which is meant for craftsmen and hardware store employees. This program can also be used towards home owners to learn to think holistic when starting up a renovation process. Similarly, Rautakesko in Finland offers energy related short term and one year training to its personnel (in Rautia and K-Rauta chains) who are called as energy experts and energy masters, respectively.

7. Demonstration projects

One way to promote the one-stop-shop market is to provide public funding for a few demonstration projects to test different business models, e.g. those identified in this report. Such projects will bring together actors interested in one-stop-shop concept and they will gain important experience. In such demonstration projects the full-scale energy renovation actions could be realised in shorter timeframe than in traditional piecemeal renovations. Advertisement of results of successful demonstration projects may attract more customers and entrepreneurs.

9 CONCLUSIONS

One-stop-shop concepts for full service energy efficient renovation of single-family detached houses are emerging in the Nordic countries. There is significant business potential for such a concept, still it has been difficult to start or run such a business. From customer point of view the major limitations of such a concept are trustworthiness of the actors. It seems established companies with strong financial background (e.g. insulation company in Norway, hardware chain store in Finland) can start such a business. Still, policy instruments are needed to support market formation, at least in the initial phases.

A national goal for energy efficiency improvements in existing buildings, and listed actions needed to achieve that goal will help to establish a market for energy efficiency renovations. Incentives can then be tailored so that they consistently support the plan. Better support should be given to those actions that strive to whole-building solution instead of single solutions. For a single-family house owner, the goal could be set by energy-certificate, and then one-stop-shop service would provide the plan and actions needed to reach the goal.

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