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Business models for nZEB renovation of small wooden buildings

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Abstract. To achieve a sustainable building stock, it is necessary to focus on existing as well as new buildings. New houses built according to the Norwegian building code are close to nZEB (near Zero-Energy Building) level, but existing buildings contribute a significant share of the energy consumption, and the difference between new and older houses is increasing. As the renovation rate is low, it is important to include ambitious energy upgrading once a renovation project is undertaken. So far, however, there is almost no market for nZEB renovation of small wooden buildings. These buildings are challenging to renovate, and even more challenging to do so with ambitious climate targets. In effect, only half of the renovations in Norway include energy renovation. The demand for ambitious renovation depends on a value proposition that is understood by the customer. Novel and well-designed business models can be central tools for achieving this. In this paper, existing and potential business models for renovation of wooden housing are identified and analysed.

This paper is based on the “Energy upgrading of wooden dwellings to nearly zero energy level” (OPPTRE) project. One of the activities for researchers, industry and public partners in OPPTRE is to identify, analyse and assess current business models, and develop novel approaches through collaborative workshops and interviews. The results are documented and elaborated upon by the research team before the next step, which is to test the most promising models.

Previous research indicates that only a small share of Norwegian enterprises have changed their business model over time. Two of the reasons for this are lack of critical reflection on existing business models and fear of changing the status quo. A third reason is lack of knowledge of how to manage the transformation process. In the process of identifying existing and developing novel business models, the partners in OPPTRE explore new opportunities to promote ambitious energy upgrading. Their commercial performance is likely to increase through the focus on business model design. New business models may also help increase the uptake of innovative energy solutions in the renovation market for small wooden buildings.

1. Introduction

In order to mitigate climate change, it is necessary to create business opportunities in new and more sustainable ways. Business model (BM) innovation is seen as a prerequisite to achieving a sustainable transition to a low-carbon society. In addition to the need for new and more sustainable BMs to combat



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climate change, research has shown that BM innovation is economically rewarding [1]. Despite this, BM innovation is rare in practice. This is related to limited awareness in enterprises, both about their present BMs and about how challenging it can be to change the status quo [1].

In this paper, we discuss current BMs and prospects for sustainable BM innovation in the market for renovation of small wooden dwellings in Norway to nearly Zero-Energy Building (nZEB) level. The discussion is based on ongoing research which started in spring 2018 and will continue over the next two to three years. The findings must therefore be considered preliminary.

1.1 Renovation of small wooden buildings

Buildings are accountable for approximately 40% of energy consumption and 36% of CO₂ emissions in the EU. Furthermore, 35% of buildings in the EU are over 50 years old and nearly 75% of the building stock is energy inefficient [2]. Energy efficiency renovations present a tremendous opportunity to decrease energy use [3]. Energy use in Norwegian dwellings was 48 TWh in 2016. This is more than half of the total energy used in the whole building stock. Klinski et al. estimated the potential energy savings for residential buildings to be 4.5 TWh by 2020 [4]. Norwegian residential buildings are largely wooden houses. A quarter (25%) of these are privately owned detached houses built between 1960 and 1990 and will soon need repair and renovation. A study from 2015 shows that only half of the renovations in Norwegian dwellings include upgrading of the energy standard [5]. A large amount of money is, however, spent on kitchens, bathrooms and other interior upgrading.

In the EU, the delivery of energy renovations is hindered by financial, technical, process, regulatory and awareness barriers [6] [7]. Much of the previous research on nZEB renovation is on how such barriers work and how they may be reduced or eliminated [7]. The need to develop skills and capacity on the supply side has received less research attention to date [8].

1.2 The OPPTRE research project

This paper is based on the “Energy upgrading of wooden dwellings to nearly zero energy level” (OPPTRE) research project, which aims to create knowledge for cost-efficient energy renovation of wooden dwellings for homeowners and builders, and knowledge for public and private decision-makers on BMs, regulations and incentives that can lead to a significant market uptake of nZEB renovation towards 2030. The project runs from 2018 to 2021 and includes nine partners. The level of energy efficiency for nZEB renovations is not necessarily as ambitious as for new buildings for all parts of the building. In this paper, nZEB renovation is used as a term for renovation towards nZEB level and may comprise several steps of upgrading.

2. Earlier findings and relevant research projects

2.1 Previous research on business model innovation

The capability to develop new BMs is increasingly seen as key to improving sustainability performance and building sustainable competitive advantage [9]. Private business is a pivotal stakeholder in sustainability transitions, commanding most resources and capabilities. Technological advances tend to be incremental, and innovation at BM level is required to align incentives and revenue mechanisms and facilitate uptake of sustainable solutions. While there has been a lack of consensus concerning what a BM actually is [10], Geissdoerfer et al. propose a definition that is much in line with Osterwalder and Pigneur [11], seeing BMs as “*simplified representations of the value proposition, value creation and delivery, and value capture elements and the interaction between these elements within an organizational unit*” [9]. The BM canvas, a template for developing new or recording existing BMs, designed by Osterwalder and Pigneur [11] can be seen as a representation of the economic side of a BM. By adding two more layers – the environmental and the social layers – the depth of the model corresponds to the triple bottom line of the sustainability concept [12]. This model is referred to as the triple layered BM canvas [13].

BM research in the building and construction disciplines is still at an emerging stage [14]. The home renovation market is highly fragmented, and it is argued that better coordination of the supply-side actors is necessary to increase the scope for sustainable innovation. One such way of coordinating the market is through a One Stop Shop (OSS). The idea of an OSS in the context of renovating private homes is to form teams of architects, energy consultants, builders and other craftspeople that together can supply the homeowner with all the services needed for an energy renovation. Only a few researchers have adopted BM research for analysing energy renovations in detached houses, e.g. [6] [15] [16] [17].

2.2 Previous relevant research projects

Most of the researchers referred to in the previous paragraph collaborated in the EU project COHERENO, which explored collaborative BMs (e.g. OSS) as a market device for realizing single-family home energy renovations [8] [18]. The COHERENO team basically worked as change agents to facilitate collaboration between enterprises in 24 consortia across Europe. A key finding was that innovative business modelling was useful for vision formation, networking and increasing customer orientation, but did not readily lead to implementation of collaborative business approaches. Effort to support small and medium-sized enterprise (SME) collaboration and continued action-based research was therefore recommended [8]. A general observation was that SMEs in construction are not used to target-group-oriented thinking, and although participation is more mixed in other countries, architects and consultants are less involved in energy renovation of private homes in Norway [8].

In the IEE EU NeZeR project, among other projects also drawing upon COHERENO, many countries identified the OSS model as relevant for nZEB renovation of private buildings [19]. While advantages of this model are holistic solutions and provide easy access to the service, it also requires high levels of trust, and customers may be more inclined towards stepwise actions for overall energy performance and costs [19].

The Norwegian research project SEOPP (Systematic energy upgrading of small wooden dwellings built between 1960 and 1990) was carried out from 2013 to 2016. The scope was to show examples of ambitious energy renovation combined with up-to-date architectural expression and living qualities. Two detached houses were fully upgraded [20].



Picture 1: Example from SEOPP, before (1) and after (2 and 3) upgrading. Photo: Jyri Havran.

For the participating partners, these best practice projects were used to promote their experiences of energy renovation. This has up to now only resulted in a few new projects, demonstrating that a best practice project alone is not enough to induce major market change. Most of the OPPTRE partners are therefore continuing to collaborate in OPPTRE, where the focus is on affordable upgrading for a larger market share.

3. Method

The paper is based on findings developed from two workshops in OPPTRE, as well as a limited study of literature and websites. One objective has been to investigate how actors in general and the user partners in OPPTRE in particular relate to BM innovation. What do they think of it, and how does this thinking materialize? Another objective has been to develop new ideas for BM innovation for nZEB renovation. This was discussed using the BM canvas as developed by Osterwalder and Pigneur [11].

3.1 Workshops

BM innovation was discussed as part of a general workshop (partner seminar) at the project start-up, where all partners were present. Furthermore, all partners were invited to a half-day workshop on BMs in March 2019. Seven of nine partners accepted the invitation and six participated.

In the first workshop, new business ideas were discussed with a focus on the following questions: 1) How can the building industry earn money from nZEB upgrading of wooden detached houses? and 2) How can the building owners gain from upgrading of their home? The second workshop investigated the following topics: 1) How the partners relate to their present BMs, and 2) New ideas to develop innovative BMs for nZEB upgrading.

3.2 Business modelling

The partners have individual motivations for participating in OPPTRE. However, all agreed on the aims to contribute to sustainability transitions, by developing BMs, methods, products and solutions for sustainable renovation of detached, wooden houses. By focusing on innovative BMs, we would like to illuminate the possibility of changing one or more steps in a current BM. An innovative BM may only have changed, for example, the customer segment. If this change makes the BM new to the industry or market, it is simultaneously an innovation. The main questions related to the BM canvas are as follows: 1) **What** are we selling/which needs do we fulfil? 2) **Who** are we offering this to? 3) **How** do we go about bringing our offer from the “production line” to the customer? 4) **Why** do we do this?

In order to deliver nZEB renovation, it is necessary to be able to supply products and services that not only deliver economic value, but also social value as well as environmental qualities such as in the triple layered BM. Supplementary questions raised by applying this model are related to environmental and social impacts and benefits.

4. Results

In this section, preliminary findings from the workshops and the literature will be presented while answering the questions of **What, Who, How** and **Why** explained in sub-section 3.2. Furthermore, aspects of the respective BMs of partners in OPPTRE are investigated along the three layers of the sustainable BM canvas.

4.1 Current business models and market situation

In the following, the industry partners in OPPTRE are referred to by category, followed by number of partners in brackets (). Furthermore, the producers of building materials will be referred to as the producer of wood fibre insulation, the producer of roof windows, the supplier of tightening products (to aid air and water tightness) and membranes, and the producer of ventilation systems.

The partners in OPPTRE relate to business development towards nZEB renovation in different ways. The architect (1) primarily has large public projects in its portfolio, but is also working to establish a stable income from smaller private projects. They have found that a way to reach the private renovation market is to register as energy advisors in the Enova system¹. For energy renovation, they see the largest potential among young, economically secure people who buy old houses. Architects are generally renowned for having less focus on profit, and more focus on high-quality solutions. The experience so

¹ Enova SF is a state owned enterprise which aims to reduce greenhouse gas (GHG) emissions, develop energy and climate technology, and strengthen security of supply.

far is that marketing and sale of energy renovation has not led to significant growth in demand, even with the “best practice projects” from SEOPP to refer to.

The producers of building materials (4) primarily sell to wholesalers in the Norwegian market, some of which are expanding in the value chain by vertical integration (organic growth and acquisitions). Partially because of discounts and bonus agreements, it is difficult to get an overview of prices of products and services. Craftspeople have deals with the wholesalers which give them privileges in terms of better prices compared to what private homeowners can achieve. Lack of overview hinders the end customer (the homeowner) from comparing prices and to some degree makes this “the wholesalers’ market”. Value creation in the existing BMs must take this into consideration.

Many producers of building materials create invisible materials inside the construction, like insulation and tightening products. This means that they compete on other aspects aside from the visible ones such as quality/durability, price and environmental performance. The producer of wood fibre insulation has sustainability as part of its vision and also has elements of the circular economy in its BM. This is mainly linked to the environmental quality of wood, as well as use of residuals (sawdust) in its production. The supplier of tightening products and membranes competes on price, quality (durability) and risk reduction. They work to bring the end users closer, for example by inviting building contractors to attend courses. Both see a small but growing focus on environmental aspects among their customers.

The producer of roof windows is selling “fresh air and daylight” and appeals to emotions when they market their products to the end user. They primarily sell to house builders and also work in close cooperation with architects. About 50% of the firm’s turnover is from renovation projects. In the Netherlands, where the headquarter is situated, their products are all based on traceable, reused wood, and they also promote holistic thinking of sustainability on their international website. The producer of ventilation systems is the market leader for domestic ventilation in Norway. They also offer indoor climate control with integrated ventilation and domestic hot water, which reduces the overall energy bill by around 50%. It has been expanding by servicification: after selling a ventilation system, they can also offer regular filter changes. This market is expected to grow.

The house builders associations (2) support their member craftspeople with design and building documentation of catalogue houses, advice and competence-building activities. They also have a role as wholesalers and sell discounted building materials to their members. Both housing associations informs readers about retrofitting and energy renovation on their website. The market for new houses has been booming over recent years and the profit from new buildings is probably at the expense of prioritizing renovation projects. Renovation projects are often small and seen as infill jobs between larger projects concerning new buildings.

4.2 Business model innovation

Some aspects of the current BMs were highlighted in sub-section 4.1. In Table 1, some key characteristics of the BMs in OPPTRE are mapped according to the three aspects of the triple layered BM canvas. The table describes aspects of the current situation and focuses less on the aspirations. Unless stated otherwise, the location is set in Norway.

Table 1. Key aspects in a triple layered business model canvas related to the OPPTRE partners.

	Economic aspects	Environmental aspects	Social aspects
The architect	Customer is the end user. Provides plan and design, as well as holistic cost control. Often in cooperation with builders. Sees renovation projects as a small but stable source of income.	Provides functionality and aesthetic solutions. Promotes environmental and energy-friendly solutions on website. Eco-Lighthouse Certified.	Develops solutions in line with the client's budget.
The producer of wood fibre insulation	Sales through wholesalers and house builders. Provides wood fibre insulation and related building materials. Competition based on durability, sustainability and price.	Wood implies low GHG emissions. Continuously searching for ways to reduce energy use in the production. EPD (Environmental Product Declaration) owner.	Builds alliance with primary distributor, promoting products with low emissions. Uses waste/residual materials (sawdust) in their production.
The supplier of tightening products and membranes	Customer is primarily wholesalers and house builders. Provides tightening products and membranes for the building envelope. Competition based on durability and price.	Some information about energy efficiency on website. EPD owner.	Aims to be ahead of stricter building regulations. Reduces moisture problems which leads to a more healthy indoor climate.
The producer of roof windows	Customer is primarily house builders. Half of the market is renovation. Marketing addresses end users and appeals to emotions.	International website has extensive information on impact and benefits of roof windows.	More daylight improves well-being.
The ventilation system producer	Customers are primarily house builders and HVAC contractors. About 20% of market is in renovation of dwellings.	Reducing energy consumption and CO ₂ emissions through energy efficient products for ventilation system with heat recovery, hot water production and heating solutions.	Is selling indoor comfort through fresh air. Technology to improve indoor climate using a lower power load.
Association of house builders, 1	Customer is house builders (members). Provides professional advice and competence-building activities.	Has information about renovation /refurbishments on website, with advice about energy efficiency.	
Association of house builders, 2	Customer is house builders (members). Provides professional advice and competence-building activities.	Promotes healthy indoor climate and energy efficiency by referring to its partners. Informs about renovation/refurbishments on website.	

Economic impacts and benefits are mainly dependent upon customers, the character of the product (such as visibility) and the sales channels. For some, the renovation market is a large part of their activity, although the share of *energy* renovations is low or not possible to gather information on. Environmental impacts and benefits are mainly linked to energy efficiency, and some of the partners own environmental product declarations. Social impacts and benefits are linked to what relations are built with stakeholders as well as attention to qualities such as aesthetic, fresh air and daylight. It can also be argued that all participants in OPPTRE pay attention to social responsibility by attending research projects such as OPPTRE. It shows determination to contribute to a sustainable transition.

5. Discussion and conclusion

It seems challenging to create profit from energy renovation projects. This is due to factors such as high activity (and profit) in new buildings, as well as a high level of uncertainty for the craftspeople: what will they find when they open the construction? This perceived risk is reflected in the pricing of renovation projects. The building materials market is dominated by very few and powerful actors which also affects the pricing of products. At the same time, building owners struggle to find coherent and credible advice that takes their budget into account. Where do we go from here?

The triple layered BM canvas builds on and expands the template created by Osterwalder and Pigneur [11, 13]. Economic aspects include value proposition, value creation and capture. When environmental values are added, environmental impact and benefits must be included, which could be explored by, for example, life cycle assessment including materials and energy used in the process of renovation and afterwards. In OPPTRE, the focus is on cost-effective solutions, which consequently also has social implications. In addition, the BMs and actions of each organization have consequences, not only for the customer, but also for other actors in society. These are part of the social layer in the triple layered BM canvas. Other research has shown that sustainable behaviour has ripple effects on other areas in life as well. In OPPTRE, more knowledge will contribute to risk reduction when pricing renovation projects. An architect competition (part of the OPPTRE project) will provide several examples that can be used for promotion and to increase engagement.

These preliminary findings are in line with earlier research; partners in OPPTRE are likely to have unreleased potential if they become more conscious of how to use their BM in order to trigger more activity in the renovation market. In this respect, the focus on BMs in OPPTRE is likely to give ideas for BM innovation, and already has.

5.1 Ideas for business model innovation and further research

There are several ideas for BM innovation that need to be further explored. The application of the appraised OSS model has so far not led to any boom in the renovation market. Preliminary findings indicate that it has failed, so far, in terms of affecting market growth. However, the model addresses several barriers towards growth in energy renovation and will be further explored in OPPTRE.

Could there be potential if a neighbourhood, not a separate building, was the core of attention and analysis? This has been discussed in OPPTRE and needs to be further elaborated upon. It is potentially cost-effective to expand from one to several buildings if these are from the same time period and somewhat similar, but the potential also depends on the owners of these buildings.

Expanding by new ways of approaching the market should also be further explored. Could potential customers be presented with a net-based calculation and visualization tool to explore renovation of their homes? Could the regular line of production be expanded by adding a service, like the producer of ventilation systems has, as well as the architect? New developments provide new possibilities, such as smart technology, big data, artificial intelligence and more. In connection with the aforementioned architect competition, we will investigate motivations for renovation on the demand side.

The lack of transparency in pricing of building materials/products is likely to slow the transition down. Is the “wholesalers’ market” a barrier to cost-efficient nZEB renovation, and could new ways of collaboration be found to give energy renovation the necessary push? The builders have key roles in the

sustainable transition of domestic buildings, but the wholesalers could also be more directly engaged in holistic renovation projects.

The primary objective of OPPTRE is to enable the development of cost-effective solutions for nZEB renovation of detached wooden houses. The role of sustainable BMs in order to reach this objective has been explored in this paper. We will continue our research by exploring and developing current as well as new ideas for BM development together with the partners in OPPTRE.

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