A triple-layered one-stop-shop business model canvas for sustainable house renovations

Georgios Pardalis¹, Krushna Mahapatra¹ and Brijesh Mainali¹

¹Faculty of Technology / Department of Built Environment & Energy Technology, Linnaeus University, Växjö, Sweden
E-mail: georgios.pardalis@lnu.se (Georgios Pardalis) E-mail: krushna.mahapatra@lnu.se (Krushna Mahapatra) E-mail: brijesh.mainali@lnu.se (Brijesh Mainali)

Abstract. Triple Layer Business Model Canvas (TLBMC) is a tool helping us to explore sustainability-oriented business model innovation. It extends the business dimension of the canvas with the addition of an environmental dimension based on life cycle perspective and a social dimension based on stakeholder perspective. A combined consideration of the three dimensions of the business model allows us to understand how an organization generates economic, environmental and social values. This paper presents the TLBMC of One-Stop-Shop (OSS) business model for energy renovation of detached houses. This three-layer canvas allows us to understand how OSS creates different types of values related to energy renovation, by using elements of life-cycle analysis and stakeholder management. It also contributes to the identification of gaps in research on energy renovation of detached houses, which need to be filled in order to better quantify the benefits of energy efficient renovation in those dwellings and develop such an OSS that will serve better the growing needs of the urban environments of the future.

Keywords: one-stop-shop, triple layered business model canvas, sustainable business model, environmental layer, social layer

1. Introduction
The current rates of renovation of the residential building stock in European Union (EU) member countries ranges between 0.5% and 2.5% per year and Sweden has a renovation rate of 0.8% per year [1]. These rates must increase to about 2.5-3% per year if EU would achieve the policy goals for energy efficiency in buildings. However, the market for energy-efficient renovation of single-family houses (hereafter “detached houses”) is fragmented in many EU countries, including Sweden, by local-based construction and building industry related actors offer single services in their area of expertise, e.g. tiling, facade and window replacement, heat pumps, etc. [2]. New business models that involve collaboration among such actors, which currently dominate the detached house segment, may accelerate the rate of house renovations. Such a business model is the one-stop-shop (OSS) business model, in which a single actor coordinates or collaborates with other actors to offer comprehensive renovation packages on energy-efficient renovation [3-6]. The
benefit of this model is that it offers the house owners a unique contact point for all the services for energy renovation, and the participating actors join together, redefine their activities, and increase their resource efficiency [2]. The European Commission has advocated the development of OSS in Europe [7] through the ‘Smart financing for smart buildings’ initiative and through the new Energy Performance of Buildings Directive [8].

There have been emerging examples of OSS business models for energy related renovation of detached houses in Nordic countries [4] and across Europe [7]. There have also been many theoretical studies examining the development of such a concept [2-4, 9]. These studies have “energy efficiency” as starting point, but the operationalization of the model is done from business perspective to achieve the goal of energy renovation.

In general, studies on business models have examined realization of economic value [10], delivery of customer value [11], interlocking elements that create and deliver value [12], and support of the value proposition for the customer [13] among other things. Osterwalder and Pigneur’s [14] business model canvas embodied all those elements and became a broadly used tool allowing the greater understanding and communication of an organization’s business model, and creatively supported business innovation [15]. However, economics is not the only dimension in a business model, but also includes environmental and social dimensions from a sustainability perspective [16]. Hence, the value created from a business model should consider the integration of economic, social and environmental goals to provide a more holistic picture from sustainability perspective [17].

In this paper we make such an integrated analysis of the OSS business concept for energy related renovations of detached houses by examining the economic, environmental and social dimension of the model. We operationalize this with the use of the Triple Layered Business Model Canvas (TLBMC) by Joyce and Paquin [18], which is relevant to explore sustainability-oriented business model innovations such as the OSS model. We make use of the TLBMC to explain how one-stop-shop business model expands going beyond the financial aspects to create, deliver and capture societal and environmental values. We are going to use elements of life-cycle analysis and stakeholder management to create, apart from the economic canvas, an environmental and a social canvas to conceptualize and connect multiple types of value creation within our proposed business model. It should be noted that this work refers to the theoretical OSS model that is currently developed in Sweden. Findings though are relevant for similar concepts being developed in other countries.

Energy efficiency in buildings has been found to be essential not only for climate change mitigation, but also for several other sustainable development goals (SDG) of Agenda 2030. Energy efficient residential buildings offer benefits like improved lighting, better air quality, improved heat comfort, which have been proven to positively impact health and well-being [19] (Goal 3). Furthermore, energy savings from efficient residential buildings create opportunities for lower expenses for energy use. Moreover, if energy efficiency coupled with renewable sources of energy (e.g. PV systems), that leads to improvement of energy security [20] (Goal 7). Almost 60 per cent of the world’s population will live in urban areas by 2030 [21], and so ensuring they are sustainable is of paramount importance. Residential buildings are the foundations of cities (detached houses count for almost 45% of the residential building stock in Europe), and energy efficiency in them is therefore the key for their long-term sustainability. The built environment contributes to the make-up of communities, which must be sustainable to ensure a high quality of life for all [22]. Cities are called to develop and implement policies that promote energy efficiency in building practices (Goal 11). Moreover, promoting energy efficiency and resource efficiency should become an important aspect in the building industry. Actors within the industry are called to prevent waste through reduction, recycle and reuse and develop ‘circular economy’ principles where resources are not wasted (Goal 12). Additionally, and more specifically for the case of Sweden, the residential sector is responsible for 22% of the total energy use [23], and therefore
a major contributor to greenhouse emissions and climate change. Through energy efficiency, residential buildings have a huge potential to combat climate change, by adopting measures that are cost effective.

The holistic examination of the economic, social and environmental parameters related to a concept such as one-stop-shop has potential to lead to great benefits from the perspective of SDGs.

2. Methods
Analyzing sustainability-oriented innovation requires new tools [24]. Lüdeke-Freund et al. [25] have identified 45 patterns to support sustainability-oriented business model innovation, and pointed out the need for the creation of assessment tools for sustainability-oriented business models that capture not only the economic performance of a business model, but also ecological and social performance of them. That is in agreement with the findings of Lundgren et al. [26], suggesting that businesses in their effort towards sustainable development should take into account environmental and social factors. Towards that direction, Joyce and Paquin [18] developed the Triple Layer Business Model Canvas (TLBMC).

TLBMC supports the creative exploration of sustainable business models and sustainability-oriented innovation more broadly. The TLBMC complements and extends the economically-oriented business model canvas by adding new canvas layers exploring environmental and social value creation. These two additional layers, on one hand parallel the original business model canvas by displaying the interconnections which support environmental and social impacts separately, and on the other hand take it one step further by illustrating connections across the three layers to support an integrated triple bottom line perspective of horizontal impact [27]. That essentially means that the TLBMC provides "horizontal" consistency within each canvas layer for exploring economic, environmental and social values individually, and "vertical" consistency integrating value creation across the three layers (Fig. 1). That way one can develop a deeper understanding of an organization’s value creation [28]. Related to horizontal consistency, each layer allows a certain level of depth in making clear different types of value creation, which have a potential to facilitate broader systems thinking towards a more holistic view of the entire business model. Regarding vertical consistency, the alignment of each layer component across the canvas layers supports the alignment of actions and possible interconnections across the different types of value. Those actions and potential interconnections show how environmental and social concerns, through the lens of TLBMC, can motivate organizations to become more active towards sustainability-oriented innovations.

To build the environmental layer of the TLBMC this study utilizes the findings of previous studies on detached and semi-detached houses renovations, to gain perspective on the environmental impact that activities within the OSS organization will have. Doing so it allows us to better understand where the OSS should focus in order to deliver greater positive environmental outcomes. The environmental outcomes are tracked with multiple indicators (e.g. reduction of energy demand, carbon footprint, ecotoxicity etc.), following a life-cycle approach on each of the components of the environmental layer. Similarly, for the social layer of the TLBMC findings from previous studies are utilized to show the social value created from OSS towards creating a path of sustainable growth.

TLBMC offers a great overview of OSS and allows us to understand what OSS aims to achieve and gives space for further exploration of innovation opportunities deriving from this concept (like for example waste management opportunities, circular economies etc.) Additionally, TLBMC highlights the need for further investigation of the single house renovation market regarding LCA and LCC to quantify in a more unjustifiable way the environmental benefits from energy-related renovation in the detached houses stock.
Figure 1. Horizontal and vertical consistency of the TLBMC (adapted from [18])

3. Elements of the TLBMC layers through OSS business model

3.1. Building the economic layer of the TLBMC

The economic aspects of OSS business concept in Sweden are illustrated in Fig. 2, and they have been analyzed in previous works [3-5, 29]. The OSS business concept aims to provide house owners with a single contact point for all the renovation process, from design to post-renovation follow up, and offer them a cost and energy efficient renovated dwelling. Costs are associated with all the parameters of traditional renovation (labor, material, pre-renovation inspection etc.), marketing for the service (advertisement, meetings with house owners and their associations, hiring new employees) and post-renovation commissioning and information material. OSS aims to house owners with houses built before or during 1970–1980, which have electrical heating as main heating system. All houses that are in need of renovation are of interest too from the perspective of mass market. House owners become aware of the service through meetings organized in the area they live, or through their interaction with local energy auditors and heating systems retailers/installers. In the following section, the ensuing environmental and social canvas layers are presented, and they are exemplified by expanding on OSS business model.

3.2. Building the environmental layer of the TLBMC

The environmental layer of the TLBMC allows us to understand how the organization generates more environmental benefits than environmental impacts. This stems from research on Life Cycle Assessments (LCA), which is a formal approach for measuring environmental impacts of a product or service across all stages of its life [30]. At the center of that canvas is the functional value, which describes what a product or service offers in terms of physical quantities. The left side of the canvas evaluates the environmental impacts or benefits that the material sourcing, production as well as supplies and outsourcing generates [31].

On the right side of the canvas, the distribution, use phase and end-of-life elements describe
| Value proposition | Customer segments |
|-------------------|-------------------|
| 1. Offer all types of home renovation services, especially energy efficiency measures, to homeowners. | 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) |
| 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 | |

| Key resources | Key activities |
|---------------|----------------|
| 1. Physical: vehicles and machines usually available with renovation firms, energy audit equipments with energy auditors | 1. Marketing to attract customers |
| 2. Human: skill and experience to attract customers, conduct proper energy audit, and to do quality renovation | 2. Building examination and energy audit |
| 3. Intellectual: softwares to conduct energy analysis, company reputation and database of condition of houses sold to attract customers | 3. Prepare renovation packages and show their cost-benefits |
| 4. Financial: to start and run a business | 4. Renovation of the building including purchase of building products |

| Customer relationship | Channels |
|-----------------------|----------|
| 1. Dedicated personal assistance (house visit, email, phone calls) | 1. Advertisement in newspapers and magazines, home delivered flyers |
| 2. Communities: Provide an online platform for customers to discuss with each other | 2. Local area meetings |

| Cost structure | Revenue stream |
|----------------|---------------|
| 1. Costs involved in traditional renovation (labour, material, free of cost building examination etc.) | 1. Payment from customers for renovation work |
| 2. Marketing costs (advertisement, local meetings, hiring new employees etc) | 2. Commission from suppliers of building products and heating systems |
| 3. Cost for post-renovation commissioning and information material | |
| 4. Companies can increase the use of their existing resources (benefits of economies of scale) | |

Figure 2. An analysis of OSS, which forms the economic layer of the TLBMC [29]
the environmental impacts or benefits of the offered product or service from the point of delivery until the end of its life cycle. At the bottom of the canvas is the value capture for the environment and our landscapes in the form of environmental benefits and environmental impacts. Practically this refers to how our business model negatively affect the environment and how it is positively increase benefits, or reduce existing negative impacts. Environmental benefits and impacts constitute the most important component of the canvas and it can be used without the other building blocks, when no detailed information can be presented in the rest of the building blocks. Coupling LCA with business innovation can support competitive product, service and business model innovations with enhanced environmental characteristics vis-à-vis traditional business innovations [32] and support ongoing impact measurement and improvement of sustainability-oriented innovations over time [33]. While the TLBMC does not integrate a formal LCA into the canvas, it does ensure a life cycle perspective when considering a business model and its environmental impacts.

### 3.2.1. Functional value

The functional value describes the points of focus of a service output delivered by the business. It is analogous to the functional unit in a life cycle assessment, which is a quantitative description of either the service performance or the needs fulfilled in the investigated product system [34]. The difference between a LCA’s functional unit and the functional value can be seen as one of usage. For example, the functional unit of the OSS’s LCA is the improvement in energy performance of one renovated house (in square meters), while the

---

**Figure 3.** The environmental layer of the TLBMC in OSS for detached house renovation

| Supplies & Outsourcing | Production | Functional Value | End-of-Life | Use Phase (adopted from [31]) |
|------------------------|------------|------------------|-------------|-----------------------------|
| • energy for renovation processes | A generalized measurement of carbon footprint cannot be given. Each renovated house should be measures individually | Improvement of energy performance per square meter of floor area multiplied per renovated square meters over a period of time | • wastemanagement of materials in newly built and renovated multi-family buildings (no study on single-family houses) | • global warming potential (around 54%) |
| • production of materials and automations | | | • Potential for development of circular economies to treat renovation waste | • cumulative energy demand (around 80%) |
| Materials | | | | • Ecotoxicity (around 56%) |
| FTX-ventilation systems, insulation materials, timber and wood fiber boards have high environmental benefits but considerable embodied energy | Distribution favoring trucks (no studies measuring the carbon footprint of distribution phase in the case of renovation of a single-family house) | | | • human non-carcinogenic toxicity (around 77%) |
| Environmental Impacts | Environmental Benefits | | | • total human toxicity (around 75%) |
| Negative impacts from the use phase | reduction of energy demand from 65% up to 80% [49-51] | | | | reduction of space heating between 80-90% [51] |
| | Gas savings for heating between 58%-76% [49] | | | | Reduction of CO2 emissions between 53%-75% [52] |
functional value is the total amount of energy efficient renovated houses (in square meters) in a given time-frame. The point of defining the functional value is first to define what is being examined in the environmental layer; and second, to serve as a baseline for exploring the impacts of alternative potential business models.

3.2.2. Materials
In the OSS concept a large amount of physical materials is purchased and transformed. Materials used in different energy efficient renovation scenarios, like for example FTX-ventilation system, some of the insulation materials, timber and wood fiber boards etc., have been found to have the higher values of environmental benefit and the highest embodied energy [35]. The OSS organization is expected to set certain environmental standards to the choice of materials used for renovation, to ensure not only energy efficiency, but also the lowest possible environmental impacts from those materials.

3.2.3. Production
The production component is the extension of the key activities component from the economic business model canvas to the environmental layer and depicts the actions that the organization engages in to create value. For OSS, production involves not only the IT infrastructure, transportation of people and materials and the actual renovation which transforms existing materials into higher value outputs. The focus will be on those activities which have high environmental impact. There has been a variety of LCA studies on renovation of single-family houses [40-44]. Since we are talking about single projects a generalized measure of the carbon footprint from the production phase cannot be given. It can be though calculated in each individual renovation project.

3.2.4. Supplies and outsourcing
Supplies and outsourcing depict all other various material and productive activities that are necessary for operational value but are not considered 'essential' to the organization [45]. Within the environmental layer, examples of such supplies are water or energy, which in the case of house renovations comes from in-house sources [46]. In terms of carbon footprint those activities have an insignificant value.

3.2.5. Distribution
As with the economic layer of the business model canvas, distribution involves the transportation of goods. In the case of a service provider or a product manufacturer, distribution represents the physical means by which an organization provides access to its functional value [18]. Thus, within the environmental layer, it is the combination of transportation modes, distances traveled and the weights of what is shipped which is to be considered. For OSS, distribution involves the shipment of materials and automation on site. The most favorable distribution practice is certainly small tracks, since we are talking about distribution of goods within narrow geographical areas and not in high volumes. When we refer to multi-family residential buildings there are studies with detailed calculations of the carbon footprint during the distribution phase [47-48]. Unfortunately though, there is no study measuring in detail the carbon footprint of distribution phase in the case of renovation of a single-family house, while a case study for a detached house by Tonooka et al. [49] claims that "due to the short distance of transportation of goods for such a house the total emissions are not so high", without quantifying them.

3.2.6. Use phase
The use phase focuses on the impact of the client’s share in the organization’s functional value, or core service and/or product. This would include maintenance and repair of products when relevant; and should include some consideration of the client’s material resource and energy requirements through use. Regarding house renovations, a study in an energy efficient renovated semi-detached house in Sweden [35] showed that the use phase has the use phase has
the highest values for global warming potentials (around 54%), cumulative energy demand (around 80%), ecotoxicity (around 56%), human non-carcinogenic toxicity (around 77%) and total human toxicity (around 75%).

3.2.7. End-of-life
End-of-life is when the client chooses to end the consumption of the functional value and often involves issues of material reuse such as remanufacturing, repurposing, recycling, disassembly, incineration or disposal of a product. Increasingly governments are forcing organizations to address this through various substance restrictions [46] and recycling requirements [47]. This can also be an opportunity for organizations to explore new innovative business models such as product service systems [48] and industrial symbiosis. For house renovations, end-of-life means addressing the impacts of the replaced materials, heating systems etc. A study by [49] has addressed the subject of waste management of materials in newly build and renovated multi-family buildings, but a similar analysis does not exist for single-family houses. Additionally, OSS is a form of a product service system, and it would be useful to examine if there are opportunities for more actors to be involved in OSS’s supply chain, as well as, exploring opportunities for development of circular economies in the field of house renovations, as part of a broader initiative for the transformation of urban environments [50].

3.2.8. Environmental impacts
The environmental impacts component addresses the ecological costs of the organization’s actions. Based on LCA research [51], these performance indicators may be related to biophysical measures such as CO2e emissions, human health, ecosystem impact, reduction of natural resources and water consumption. Some environmental indicators can take the form of traditional business metrics still related to LCA [52] such as energy consumption, water use and emissions. For renovated houses the biggest environmental impact can point to its largest contributor, the use stage as it has been analyzed in the relevant section. Moreover, further representative environmental indicators could be considered in the LCA analysis, including other midpoint indicators, such as ozone depletion potential and acidification potential, or also potential endpoint indicators, such as damage to human health, ecosystem and resource availability.

3.2.9. Environmental benefits
Similar to the relationship between environmental impacts and costs, environmental benefits enhances the concept of value creation beyond purely financial value. It circumscribes the ecological value the organization creates through environmental impact reductions and the value created through the development a positive ecological culture. From a sustainability perspective, this component provides space for an organization to explicitly explore those products, service, and even business model innovations which may reduce negative and/or increase positive environmental through its actions. Different studies related to the energy-efficient measures that OSS business concept aims to offer, have quantified the reduction of energy demand between 65%-80% [53-55], and calculate gas savings for heating purposes between 58%-76% [53] and total reduction of space heating needs between 80%-90% [51]. Moreover, Gupta and Gregg [56] in their study they have found that the adoption of extended energy-efficient measures during renovation, can lead to the reduction of CO2 emissions by 75% for older houses (more than 40 years) and 53% for younger houses.

3.3. Building the social layer of the TLBMC
The social layer of the TLBMC builds on a stakeholder management approach to explore an organization’s social impact [57]. That way it manages to depict the mutual influences between stakeholders and the organization. Moreover, this layer tries to depict the major social impacts of the organization that derive from those relationships. Doing so provides a better understanding
of where are an organization’s primary social impacts and provides insight for exploring ways to innovate the organization’s actions and business model to improve its social value creation potential. The social layer of the TLBMC consists of nine components, which are as following:

3.3.1. Social value
Social value refers to the aspect of an organization’s mission which focuses on creating benefit for its stakeholders and society more broadly. The intended social value of OSS can be interpreted through the need for long term collaboration between involved stakeholders, with an aim to exchange knowledge and find mutually beneficial support in missing competencies [58]. On a broader level, OSS aims to improve the quality of everyday life of its “customers” (the house owners), by offering them a living environment of higher quality. Towards this direction, OSS should consider aspects related to the aesthetics of the renovated house, as this has been found to be an important home quality indicator [59-60]. Moreover, indoor comfort should be in the core of the OSS value proposition as it has been found to be a major social indicator [61]. Additionally, by involving house owners in planning and design of renovation adds on their environmental awareness and understanding on the benefits of energy efficiency [62].

3.3.2. Employee
The employees’ component provides a space to consider the role of employees as a fundamental organizational stakeholder. A number of elements may be included here such as amounts and types of employees, important demographics such as variations pay, gender, ethnicity, and education (to name a few) within the organization. Moreover, it provides a space for examining potentials for professional development programs that will ensure the organization’s long term viability and success. In the case of OSS, locally based construction related actors, which are expected to offer such a service, have pointed out the importance of employees for their organizations, and additionally they have referred to the need for training programs for that personnel, as well as, the employment of additional personnel to be able to respond to the needs of their current operations and their potential renovation projects [58]. In a country like Sweden, which absorbs a significant number of refugees and immigrants that creates opportunities for them to receive training that will allow them to cover the needs of a growing market, contributing that way in their smooth integration into society and the further development of their skills.

3.3.3. Governance
The governance component depicts the organizational structure and decision-making policies of an organization. In many ways, governance defines which stakeholders an organization is likely to identify and engage with and how the organization is likely to do so [63]. In OSS concept we discuss a cluster of construction and building industry related actors, where one of them has the role of coordination of the other to offer to house owners a single contract and a single reference point. The MSE that has the coordinators’ role is the one bearing the risk of the project, and the one having managerial competence in house. To ensure a price for the “customer” the OSS provider signs individual sub-contracts with the other actors that he/she coordinates to ensure that they will be paid fairly for the services they are going to provide. Transparency within the OSS organization is ensured as the customer becomes aware of those professionals who are going to deliver the renovation work, he gets consultation regarding the measures required to be adopted for his dwelling and participates in the decision-making process regarding the measures of his preference.

3.3.4. Communities
While economic relationships are developed with business partners, there are social relationships developed with suppliers and local communities. These two stakeholders come together as communities when aligning the three layers of the TBLMC. When collaborating with communities, an organization’s success can be greatly influenced through developing and
maintaining mutually beneficial relationships. Though individual suppliers may have more or less influence over an organization [64], as a group, suppliers are also of great importance as they provide the organization with those resources necessary to support its success. In OSS concept, the involved actors forming the cluster offering the renovation service are locally based construction and building related enterprises. Additionally, the suppliers of building materials, heating systems etc. are a core part of the OSS cluster, and they are also locally based. Municipalities, that are expected to act as information mediators for OSS can partner with OSS providers to develop seminars and workshops that will allow house owners to become aware of the importance of energy efficiency and the adoption of energy efficient measures. Municipalities could also act as consultancy centers that could inform house owners regarding OSS services in their area, while developing activities towards stimulation of adoption of energy efficient measures by house owners [65].

3.3.5. Societal culture
The societal culture component refers to the potential impact of an organization on society as a whole. Considering the fact that business cannot succeed when society fails, this component influences the concept of sustainable value [66] to acknowledge an organization potential impact on society and how, though its actions, it can positively influence society [67]. Renovating an individual house cannot be considered as a point of reference to a societal culture. Promoting though energy efficiency in houses can be interpreted as a culture of environmental accountability and active effort towards the reduction of energy use and emissions.

3.3.6. Scale of outreach
Scale of the outreach describes how deep and extended are the relationships an organization builds with its stakeholders through its action over time. In the case of OSS, the goal is to build long-lasting relationships between the collaborating actors, but also between the OSS organization and the house owners and local communities. Its successful delivery can create impact not only in the local communities (through the improvement of energy performance of existing houses and the overall improvement of living environments) but also on a broader European level, as OSS concept in Sweden is part of a broader initiative in the European Union for the development of such collaborative business concepts [7]. Additionally, OSS’s outreach can gain more depth and essence through the training of professionals in the house renovation market that will lead to the development of more OSS services in both regional and national level.

3.3.7. End-users
As an end-user, we define the person who "consumes" the value proposition. The value proposition should be able to address the needs of the end-user, contributing to the improvement of his/her quality of life. Users with similar needs typically are segmented based on relevant demographics- e.g. age, income, level of education etc. It should also be noted that the end-user is not necessarily the customer defined in the economic layer of the business model canvas. For OSS though, the end-user is the same with the customer as defined in the economic layer, namely the house owner who seeks for a cost-effective comprehensive renovation for its dwelling, offered by a single actor, as described in the economic canvas. In the social canvas, OSS seeks to provide value by meeting the user's needs in terms of thermal comfort, improved energy efficiency and overall improvement of the living environment.

3.3.8. Social impacts
The social impacts component addresses the social costs of an organization. It counterparts and extends the financial costs of the economic layer and the bio-physical impacts of the environmental layer. Although there is a growing body of work on social impact measures [68], there is not yet a consensus on which social impacts to consider, nor how to quantify them. Benoît-Norris et al. [69] provide a set of common indicators like working hours,
health and safety, community engagement and so on, but it is the nature of an organization that creates the need for creation of individual indicators in different cases of organizations. For OSS, negative social impacts could derive from the collaboration of only a segment of professionals in the renovation market, which may affect the amount of work for other professionals in the market. Moreover, a social impact related to OSS is the potential exclusion of low income households, which have no access to favorable funding for a comprehensive renovation.

3.3.9. Social benefits
Social benefits are the positive social value creating aspects of the organization’s action. This component is for explicitly considering the social benefits which come from an organization’s actions. Similar to social costs, social benefits can be measured using a broad range of indicators. For OSS, social benefits derive directly from the European Commission strategy regarding building renovations [1]. A renovated dwelling offers to its owner health benefits related to the reduced energy demand, which reduces energy production and associated air pollution from burning fossil fuels. Moreover, a renovated dwelling has improved air conditions, decreasing that way respiratory diseases. Renovation is also a key issue in the reduction of the level of severe housing deprivation in Europe. Eurostat defines severe housing deprivation as “the percentage of the population which is considered overcrowded”, while also exhibiting at least one of the housing deprivation measures (leaking roof, no bath/shower/ no indoor toilet, high level of darkness in dwelling) [70]. Additionally, renovated dwellings can reduce energy poverty by cutting energy bills. Furthermore, renovation of dwellings with energy efficiency measures can lead to an increased property value [71].

4. Discussion
TLBMC provides a comprehensive visual representation of an organization’s business model. As mentioned previously, each layer of the TLBMC supports a horizontal coherence, as it explores economic, environmental and social impacts, by focusing in key actions and relationships within the components of each layer. If we combine the three layers we get vertical consistencies through connecting the components of each layer to their analogs in the other layers, further explaining in detail key actions and connections and their impact across layers. That allows to potential customers to have a holistic view of the organization and become more aware of how an organization is able to create value.

4.1. Horizontal consistency
One-stop-shop business model offers to its customers all types of renovation, especially energy-efficient renovations, in a way that its name describes, meaning a single contact point responsible from planning, design, implementation and post-renovation service. To each of those stages of the renovation process the customer receives services from specialists, and additionally the OSS provider can offer facilitation to financing schemes and guarantees on the final delivered product (renovated house). At the environmental level OSS concept aims to the overall improvement of energy performance per square meter of floor area of an amount detached houses in a given time-frame considering several dimensions such as production, use, end-of-life etc. At the social level OSS has as goal to offer house owners healthier living environments which are going to be energy efficient and have aesthetic value. Other dimensions of social value are awareness creation of homeowners, local communities, governance, employee satisfaction, etc. Using the TLBMC, one may identify issues, like e.g. further discussions with house owners on matters related to their home environment needs, that will allow OSS providers to develop solutions that will satisfy the actual needs of customers and delivering greater value.
Figure 4. The social layer of the TLBMC in OSS for detached house renovation

4.2. Vertical consistency
The alignment of each layer component across the canvas layers provides a vertical consistency. These supports exploring the alignment of actions and interconnections across the different types of value. Key activities of OSS seem to lack consistency with end/of/life actions and societal culture. Key activities are related to the relationships developed between OSS provider and customers, which have their bases in the activities related to the renovation of each dwelling, and OSS provider and collaborators, which have their basis in the promotion and utilization of products and services that are environmentally friendly and assure a greener way of delivering business. Each renovation is an individual project and is hard to say that it creates an extended social culture towards energy efficiency in houses. A number of energy-efficient renovated houses though, with the support of municipalities can create an environment of broader awareness on the benefits of energy efficiency in the detached house stock, and at the same time act as advocates of the OSS business model. Moreover, end-of-life activities apply for concepts that are not yet developed in Sweden. There are though opportunities for the creation of waste management activities and development of circular economies that could create greater impacts and deliver greater value on both environmental and society level. Potentially those actions can lead to further innovations in the field of detached house renovations.
4.3. Limitations and potential for future research

The main limitation of TLBMC is that, despite the fact it provides a holistic approach towards the proposed model, it fails to explore in depth and assess the actual innovation of OSS. It offers a great overview of OSS, but also fails to get deeper in the details that are required to scale the concept beyond Sweden and are related to the need to tailor parts of the business concept based on specific regulatory and financial schemes in each country. On the positive side, TLBMC allows us to understand what OSS aims to achieve and gives space for further exploration of innovation opportunities deriving from this concept (like for example waste management opportunities, circular economies etc.) Additionally, TLBMC highlights the need for further investigation of the single house renovation market regarding LCA and LCC to quantify in a more unjustifiable way the environmental benefits from energy-related renovation in the detached houses stock.

5. Conclusion

This paper contributes in the most holistic investigation of OSS business concept for energy related renovations of detached houses in Sweden, through the examination of the environmental and social dimensions of it. With the use of Triple Layer Business Model Canvas (TLBMC) we gain perspective on the economic, environmental and social impact of this concept, and examine the sustainability orientation of it. That way, we become aware of the interrelations of value delivered across all the three layers and identify the gaps that need to be addressed in order our concept to become more robust and deliver what promised in the best possible way.

References

[1] Artola, I., Rademaekers, K., Williams, R., & Yearwood, J. (2016). Boosting Building Renovation: What Potential and Value for Europe?: Study. European Parliament.
[2] Mlecnik, E., Straub, A., & Haavik, T. (2019). Collaborative business model development for home energy renovations. Energy Efficiency, 12(1), 123-138.
[3] Haavik, T., Aabrekk, S. E., Mlecnik, E., Cre, J., Kondratenko, I., Paiho, S., ... & van der Have, J. A. (2012). Guidelines: How to develop a business model for One Stop Shop house renovation: ERA-NET Eracobuild project report.
[4] Mahapatra, K., Gustavsson, L., Haavik, T., Aabrekk, S., Svendsen, S., Vanhoutteghem, L., ... & Ala-Juusela, M. (2013). Business models for full service energy renovation of single-family houses in Nordic countries. Applied energy, 112, 1558-1565.
[5] Mlecnik, E., Kondratenko, I., Cré, J., Vrijders, J., Degraeve, P., van der Have, J. A., ... & Svendsen, S. (2012). Collaboration opportunities in advanced housing renovation. Energy Procedia, 30, 1380-1389.
[6] Bjørneboe, M. G., Svendsen, S., & Heller, A. (2017). Using a One-Stop-Shop Concept to Guide Decisions When Single-Family Houses Are Renovated. Journal of Architectural Engineering, 23(2), 05017001.
[7] Boza-Kiss, B., & Bertoldi P. (2018). One-stop-shops for energy renovations of buildings. Ispra: European Commission, JRC113301.
[8] European Parliament. (2018). Directive 2018/844/EU of the European Parliament and of the council of 19 June 2018 on the energy performance of buildings (recast). Official Journal of the European Communities, 61(156), 75-91.
[9] Vanhoutteghem, L., Tommerup, H. M., Svendsen, S., Paiho, S., Ala-Juusela, M., Mahapatra, K., ... & Aabrekk, S. E. (2011). Full-service concept for energy efficient renovation of single-family houses. In SB11 Helsinki World Sustainable Building Conference.
[10] Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. Industrial and corporate change, 11(3), 529-555.
[11] Magretta, J. (2002). Why business models matter. Harvard Business Review, 80, 86-92.
[12] Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing your business model. Harvard business review, 86(12), 57-68.
[13] Teece, D. J. (2010). Business models, business strategy and innovation. Long range planning, 43(2-3), 172-194.
[14] Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons.
[15] Abraham, S. (2013). Will business model innovation replace strategic analysis? Strategy Leadersh. 41 (2), 31-38.
[16] Ueda, K., Takenaka, T., Vánca, J., & Monostori, L. (2009). Value creation and decision-making in sustainable society. CIRP annals, 58(2), 681-700.
[17] Schaltegger, S., Lièdeke-Freund, F., & Hansen, E. G. (2012). Business cases for sustainability: the role of business model innovation for corporate sustainability. International journal of innovation and sustainable development, 6(2), 95-119.
[18] Joyce, A., & Paquin, R. L. (2016). The triple layered business model canvas: A tool to design more sustainable business models. Journal of cleaner production, 135, 1474-1486.
[19] Arif, M., Katayfgyiotou, M., Mazroei, A., Kaushik, A., & Elsarrag, E. (2016). Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature. International Journal of Sustainable Built Environment, 5(1), 1-11.
[20] Ellabban, O., Abu-Rub, H., & Blaabjerg, F. (2014). Renewable energy resources: Current status, future prospects and their enabling technology. Renewable and Sustainable Energy Reviews, 39, 748-764.
[21] Ritchie, H., & Roser, M. (2018). Urbanization. Our World in Data. Retrieved from https://ourworldindata.org/urbanization.
[22] Van der Heijden, J. (2014). Governance for urban sustainability and resilience: Responding to climate change and the relevance of the built environment. Edward Elgar Publishing.
[23] Swedish Energy Agency (2017). Energy in Sweden: Facts and Figures. Retrieved from http://www.energimyndigheten.se/en/facts-and-figures/publications/
[24] Lozano, R. (2014). Creativity and organizational learning as means to foster sustainability. Sustainable development, 22(3), 205-216.
[25] Lièdeke-Freund, F., Carroux, S., Joyce, A., Massa, L., & Breuer, H. (2018). The sustainable business model pattern taxonomy—45 patterns to support sustainability-oriented business model innovation. Sustainable Production and Consumption, 15, 145-162.
[26] Lundgren, T., Dam, L., & Scholtens, B. (2019). Sustainable Business Practices—An Environmental Economics Perspective. In Challenges in Managing Sustainable Business (pp. 205-229). Palgrave Macmillan, Cham.
[27] Sherman, W. R. (2012). The triple bottom line: the reporting of doing well & doing good. Journal of Applied Business Research (JABR), 28(4), 673-682.
[28] Lozano, R. (2008). Envisioning sustainability three-dimensionally. Journal of cleaner production, 16(17), 1838-1846.
[29] Mahapatra, K., & Gustavsson, L. (2011). Full service energy efficient renovation business for Swedish single-family houses. In World Sustainable Building Conference, 18-21 October, Helsinki, Finland.
[30] Svoboda, S. (1995). Note on Life Cycle Analysis in Pollution Prevention in: Corporate Strategy. National Pollution Prevention Center for Higher Education, Univ. of Michigan, Report: LCA Note.
[31] Guinée, J. B., & Lindiejér, E. (Eds.). (2002). Handbook on life cycle assessment: operational guide to the ISO standards (Vol. 7). Springer Science & Business Media
[32] FORA (2010). Green Business Models in the Nordic Region a Key to Promote Sustainable Growth. Commissioned by the Nordic Council of Ministers.
[33] Chun, Y. Y., & Lee, K. M. (2013). Life cycle-based generic business strategies for sustainable business models. Journal of sustainable development, 6(8), 1.
[34] Rebitzer, G., Ekvall, T., Frischknacht, R., Hunkeler, D., Norris, G., Rydberg, T., ... & Pennington, D. W. (2004). Life cycle assessment: Part 1: Framework, goal and scope definition, inventory analysis, and applications. Environment international, 30(5), 701-720.
[35] Svensson, M. (2013). Life cycle assessment of the semidetached passive house" Röda lyktan" in northern Sweden: A comparison between the construction phase and the use phase.
[36] Peuportier, B.L.P., 2001. Life cycle assessment applied to the comparative evaluation of single family houses in the French context. Energy and buildings, 33(5), pp.443-450.
[37] Cabeza, L. F., Rincón, L., Vilariño, V., Pérez, G., & Castell, A. (2014). Life cycle assessment
(LCA) and life cycle energy analysis (LCEA) of buildings and the building sector: A review. Renewable and sustainable energy reviews, 29, 394-416.

[38] Mithraratne, N., & Vale, B. (2004). Life cycle analysis model for New Zealand houses. Building and Environment, 39(4), 483-492.

[39] Wiberg, A. H., Georges, L., Dokka, T. H., Haase, M., Time, B., Lien, A. G., ... & Maltha, M. (2014). A net zero emission assessment of a single-family house. Energy and buildings, 74, 101-110.

[40] Rauf, A., & Crawford, R. H. (2015). Building service life and its effect on the life cycle embodied energy of buildings. Energy, 79, 140-148.

[41] Christopher, M. (2016). Logistics & supply chain management. Pearson UK.

[42] Christopher, M. (2016). Logistics & supply chain management. Pearson UK.

[43] Cuéllar-Franca, R. M., & Azapagic, A. (2012). Environmental impacts of the UK residential sector: Life cycle assessment of houses. Building and Environment, 54, 86-99.

[44] Stephan, A., & Crawford, R. H. (2014). A multi-scale life-cycle energy and greenhouse-gas emissions analysis model for residential buildings. Architectural Science Review, 57(1), 39-48.

[45] Tonooka, Y., Takaguchi, H., Yasui, K., & Maeda, T. (2014). Life cycle assessment of a domestic natural materials wood house. Energy Procedia, 61, 1634-1637.

[46] European Commission (2012). REACH. Retrieved from http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

[47] Environment Agency (2012). Waste Electrical and Electronic Equipment (WEEE). Retrieved from http://www.environment-agency.gov.uk/business/topics/waste/32084.aspx

[48] Tukker, A., & Mont, O. (2006). Product-Service Systems: reviewing achievements and refining the research agenda. Journal of Cleaner Production, 14(17), 1451-1454.

[49] Eskilsson, P. 2015. Renovate or rebuild? - a comparison of the climate impact from renovation compared to demolition and new construction for a multi-dwelling building built in the era of the “Million Programme” using lifecycle assessment

[50] Caputo, P., Ferrari, S., & Zagarella, F. (2020). Urban Renovation: An Opportunity for Economic Development, Environmental Improvement, and Social Redemption. In Regeneration of the Built Environment from a Circular Economy Perspective (pp. 125-135). Springer, Cham.

[51] Jolliet, O., Margni, M., Charles, R., Humbert, S., Payet, J., Rebitzer, G., & Rosenbaum, R. (2003). IMPACT 2002+: a new life cycle impact assessment methodology. The international journal of life cycle assessment, 8(6), 324.

[52] De Benedetto, L., & Klemš, J. J. (2015). The Environmental Performance Strategy Map: an integrated life cycle assessment approach to support the strategic decision-making process. In Assessing and Measuring Environmental Impact and Sustainability (pp. 367-408). Butterworth-Heinemann.

[53] Heuts, E., & Versele, A. (2016). RenoseeC: renovating with a social, ecological and economic benefit through a collective approach. Energy Procedia, 96, 540-550

[54] Bin, G., & Parker, P. (2012). Measuring buildings for sustainability: Comparing the initial and retrofit ecological footprint of a century home--The REEP House. Applied Energy, 93, 24-32.

[55] Ekström, T., & Blomsterberg, Å. (2016). Renovation of Swedish single-family houses to passive house standard--Analyses of energy savings potential. Energy Procedia, 96, 134-145.

[56] Gupta, R., & Gregg, M. (2016). Do deep low carbon domestic retrofits actually work?. Energy and Buildings, 129, 330-343.

[57] Freeman, R. E. (1984). Stakeholder management: a strategic approach. New York: Pitman.

[58] Pardalis, G., Mahapatra, K., & Mainali, B. (2020). Swedish construction MSEs: simply renovators or renovation service innovators?. Building Research & Information, 48(1), 67-83.

[59] Risholt, B., Time, B., & Hestnes, A. G. (2013). Sustainability assessment of nearly zero energy renovation of dwellings based on energy, economy and home quality indicators. Energy and Buildings, 60, 217-224.

[60] Støa, E. (1996). Boliger og kultur: norske boligfelt på åtti-tallet sett i lys av beboernes boligideal (Dwellings and culture: Norwegian dwelling areas in the 1980s and the dwellers ideals).

[61] Støa, E. (1996). Boliger og kultur: norske boligfelt på åtti-tallet sett i lys av beboernes boligideal (Dwellings and culture: Norwegian dwelling areas in the 1980s and the dwellers ideals).
[62] Tommerup, H., Vanhoutteghem, L., Svendsen, S., Paiho, S., Ala-Juusela, M., Mahapatra, K., ... & Aabrekk, S. E. (2010). Existing sustainable renovation concepts for single-family houses. In SB10 Finland Conference Proceedings. Finnish Association of Civil Engineers RIL and VTT Technical Research Centre of Finland.

[63] Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. Academy of management review, 22(4), 853-886.

[64] Pfeffer, J., & Salancik, G. R. (2003). The external control of organizations: A resource dependence perspective. Stanford University Press.

[65] Meijer, F., Straub, A., & Mlecnik, E. (2018). Consultancy centres and pop-ups as local authority policy instruments to stimulate adoption of energy efficiency by homeowners. Sustainability, 10(8), 2734.

[66] Laszlo, C., & Cescau, P. (2017). Sustainable value: How the world’s leading companies are doing well by doing good. Routledge.

[67] Steurer, R., Langer, M. E., Konrad, A., & Martinuzzi, A. (2005). Corporations, stakeholders and sustainable development I: a theoretical exploration of business–society relations. Journal of business ethics, 61(3), 263-281.

[68] UNEP, S. (2009). Guidelines for social life cycle assessment of products. United Nations Environment Programme (UNEP) and Society of Environmental Toxicology and Chemistry (SETAC), Belgium

[69] Benoît, C., Norris, G. A., Valdivia, S., Ciroth, A., Moberg, A., Bos, U., ... & Beck, T. (2010). The guidelines for social life cycle assessment of products: just in time!. The international journal of life cycle assessment, 15(2), 156-163.

[70] Eurostat (2018a): EU Statistics on Income and Living Conditions (EU-SILC). Methodology: https://ec.europa.eu/eurostat/statistics explained/index.php/EU_statistics_on_income_and_living_conditions_(EU-SILC)_methodology_-_introduction (accessed November 2019).

[71] Wilkinson, S., & Sayce, S. (2019). Energy efficiency and residential values: a changing European landscape.

Acknowledgments
The authors would also like to acknowledge the financial support from the Kamprad Family Foundation for Entrepreneurship, Research & Charity, Smarthousing Småland, and European Union Horizon 2020 project ‘INNOVATE’.