Accelerating the energy-efficiency renovation of single-family houses

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Abstract

The role of single-family houses in the transition to a sustainable energy system is often underestimated even though single-family houses account for a significant part of the housing stock in Sweden. The residential building stock in Sweden consists of two million single-family houses and two million apartments. Despite this, most of the focus thus far has been on energy-efficiency renovation of multi-family houses. Part of the reason lies in the fact that it requires considerably more work to mobilize single-family house owners than mobilizing professional property owners to renovate multiple houses. Another important factor is the lack of attractive business models for energy efficiency aimed towards single-family house owners. For entrepreneurs, working with individual homeowners also requires more deals and contracts than working with professional property owners with large housing stocks.

BeSmå is a network initiated by the Swedish Energy Agency. The network aims to create dialogue and advance the reduction of energy use in the single-family home sector in Sweden. A feasibility study carried out through BeSmå (2020) shows how the realization of energy efficiency within the single-family house stock can be accelerated through standardized packages of energy-efficiency measures. The feasibility study has analyzed:

- Business models for large-scale energy renovation of existing single-family houses
- Solutions to identify suitable homogenous areas of single-family houses
- Suitable standardized packages of energy efficiency renovation measures
- Recommendation for large-scale implementation

The study has drawn experience both from similar initiatives and projects and from actors who may participate in an implementation phase. The study has aimed to identify business models for energy renovation of single-family houses suitable for the Swedish market. The business models should make it easier for individual homeowners to implement relevant measures which contribute to a sustainable energy system. This paper describes the method and the results of the feasibility study, conducted through the network BeSmå in 2020 on behalf of the Swedish Energy Agency, as well as the recommendations for carrying out a large-scale project.

Introduction

BeSmå is a network aiming to improve the energy performance in both existing and new single-family houses in Sweden. The network is initiated by the Swedish Energy Agency, and it is co-financed between the Swedish Energy Agency and the network's member organizations. BeSmå aims to contribute to the transition to a sustainable energy system by accelerating the realization of energy efficiency measures in existing single-family houses and push energy performance in new single-family houses. The goal is to transform the market through innovative processes and tools. The network's activities include inter alia feasibility studies, analysis, procurement, exchange of experience, and demonstration projects.

The objectives within the network BeSmå are:

- Reducing heating and electricity demand in single-family houses, and thereby also reducing their greenhouse gas emissions.
- Developing methods and tools to remove barriers for a broad market introduction of energy-efficiency measures in the single-family house sector.
- Creating conditions for a faster market introduction of energy-efficient systems, products, and services through network activities.
- Creating the conditions for profitable energy-efficiency measures while maintaining or improving the indoor environment.

This paper is based on a feasibility study on the large-scale implementation of cost-effective energy efficiency packages for single-family houses (BeSmå, 2020a). The study has been carried out to create a business model which can increase the rate of energy-efficiency measures implemented in Swedish single-family houses. The feasibility study has aimed to identify possible business models for packages of energy-efficiency measures in single-family houses that can be used on the Swedish market. The business model aimed to include the identification of single-family houses where it is beneficial to implement packages of energy-efficiency measures. The aim has also been to make it easier for individual houseowners to implement relevant measures that contribute to reduced energy demand in the single-family house sector.

In 2019, a feasibility study was carried out on the energy efficiency potential of single-family houses within BeSmå (BeSmå, 2019). The feasibility study showed that there is a large share of profitable potential for energy efficiency in existing single-family homes and that the energy demand in the single-family house sector could be halved with profitable measures. Even though such a large energy-efficiency potential is profitable, several studies show that only a small part of the measures are realized. The results from the feasibility study also showed that it is easier to reduce heat demand than electricity demand.

In addition to the large potential, there are also several initiatives that aim to increase the pace of energy renovation. The EU Renovation Wave aims to double the pace of renovation over the next ten years and ensure renovation leading to higher energy- and resource efficiency (European Commission, 2020a). In July 2020, the EU regulation on a taxonomy for environmentally sustainable activities entered into force (European Commission, 2020b). The taxonomy creates a classification system for sustainable economic activities. One of the proposed recommendations for a technical screening criterion deals with reduced primary energy demand through renovation. In addition to these initiatives from the EU, there are also ongoing activities on the Swedish market. This includes, among other things, training initiatives on sustainability and energy efficiency for contractors and installers in the construction sector and research and businesses based on a one-stop-shop.

With this background, an initial study was conducted within BeSmå in the spring of 2020 (BeSmå, 2020b). The study aimed to identify areas for scaling up initiatives with packages of energy-efficiency measures. The initial study showed opportunities to identify areas and drafted packages of energy-efficiency measures that could be possible to roll out on a large scale. The initial study also analyzed obstacles preventing the profitable potential from being realized.

It is possible to overcome the obstacles identified in the initial study through package solutions for energy efficiency measures. The initial study showed there is a broad interest in moving from a business opportunity to a concrete business model, and the major importance to mobilize and involve several stakeholders for the action packages to be perceived as credible and gain a clear foothold. In addition to interest from the market, opportunities were also discussed to identify areas of single-family houses where many of the houses are similarly built and where there are great benefits in several single-family house owners joining forces and coordinating measures. The work from the initial study was therefore further developed in the feasibility study which this paper is based on (BeSmå, 2020a).

Methodology

The feasibility study which this paper is based on was carried out during the autumn of 2020. Most of the work was carried out as interview studies and dialogue meetings with stakeholders. A literature review has also been conducted to identify projects and business models used on other markets, and what distinguishes the driving forces for these markets from the driving forces under Swedish conditions. This study has been carried out in the following five steps:

1. **Identification and analysis of similar initiatives in other markets.** In the initial study, actors mentioned there are interesting projects which have been carried out both in Sweden and in other markets. Lessons have been learned from these and combined with drivers and incentives existing in a Swedish context.
2. **Identification of stakeholders and key players.** An important part of the feasibility study has been to identify key actors and stakeholders, and in collaboration with them identify the roles and needs of the various actors to facilitate and contribute to the implementation of packages of energy-efficiency measures.
3. **Development of packages with measures for energy renovation.** An approach to packages of energy-efficiency measures was made in the initial study. The proposals have been further developed into four concepts during the latest part of the work.
4. **Collaboration with ongoing projects and initiatives.** Collaboration with ongoing initiatives has been a part of the study, aiming at creating synergy effects and learn from other ongoing projects and initiatives.
5. **Recommendations for business models and continued work.** Based on the experiences from the initial study and the four initial parts of this feasibility study, recommendations were developed for business models which can take the packages of energy-efficiency measures into practical application. Recommendations have also been made for the continued work.

Results

AREAS WITH HOMOGENOUS SINGLE-FAMILY HOUSES

To implement measures to realize the energy-efficiency potential in the single-family house sector in Sweden, this study has focused on identifying areas with homogeneous single-family houses, where there is a need for renovation. The chosen approach is mainly based on national statistics on the Swedish stock of single-family houses.

The study has been limited to single-family houses built between 1961 and 1981. This delimitation has been chosen as numerous houses from this period are relatively uniformly built. From a national point of view, these single-family houses also account for more than a third of all Swedish single-family houses, and hence a large share of the energy demand of the single-family house stock (the Swedish Energy Agency, 2019). The houses have also reached an age where there is a need for renovation.

With the help of the Statistics Sweden's database "Masterfile" from 1990, areas with homogeneous single-family houses have been identified and the properties of the houses have been described (Statistics Sweden, 1990). Masterfile is a database, from Statistics Sweden, where the houses have been divided into their smallest homogeneous components. With the help of this database, it has been possible to locate homogeneous single-family house areas and characterize the houses in these areas. This has been done using the following variables:

- Number of detached houses, chain houses, and terraced house properties
- Most common type of single-family house in the area
- Total living space, m^2
- Average year of construction
- Geographical location: county, municipality, X and Y coordinates for the area
- Type of single-family house
- Living space, m^2
- Main heating method
- Building frame: stone or wood
- Insulation standard, new construction standard with and without insulating glass, etc.
- Additional insulation after 1973
- Ventilation
- Net heat demand for living space, MWh/year

Using the chosen criteria resulted in 5,655 areas with at least 25 homogenous single-family houses in each area. These areas together contain almost 300,000 single-family houses. If a larger number of houses in one area is sought after, there are 460 areas in Sweden with more than 100 homogenous single-family houses. The statistics is shown in Table 1.

Figure 1 shows where these areas are located in Sweden, the areas in one municipality, and in one single area respectively.

PACKAGES OF ENERGY-EFFICIENCY MEASURES

Implementation of multiple energy-efficiency measures in combination has been identified as a key to cost-efficient energy renovation. Three categories of single-family houses have been proposed for this application. The categories have been based on common attributes for the houses in the Masterfile. And they are:

- Single-storey house without a basement – dominant for the entire period 1961–1981

Table 1. Number and size of single-family house areas built between 1961–1981. Source: Masterfile 1990, Statistics Sweden.

	>25 houses/area	>50 houses/area	>75 houses/area	>100 houses/area
Number of areas	5,655	3,587	947	460
Detached houses	117,573	67,655	23,575	11,571
Chain/ town houses	182,306	55,750	84,851	55,026

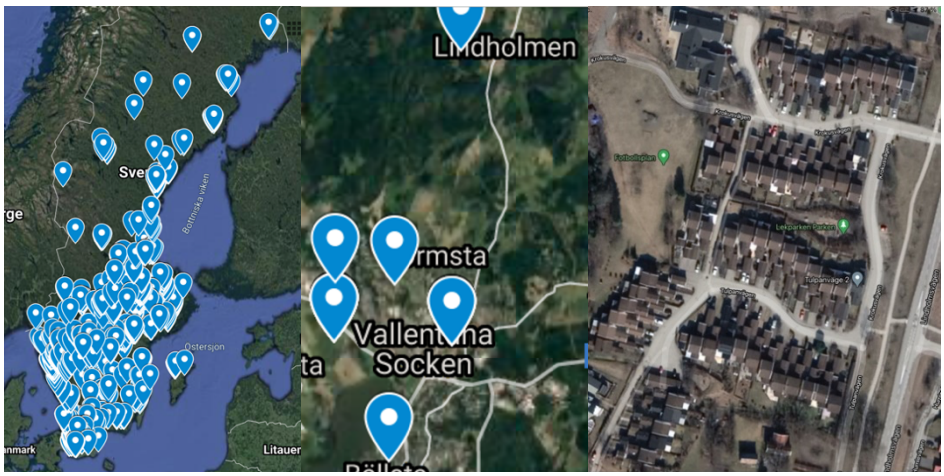

Figure 1. Mapping of homogenous single-family houses in Sweden (Google Maps and data from Masterfile).

- Single-storey house without a basement – occurs mostly during the first part of the 1960s
- Two-storey house without a basement – mainly terraced houses

It is common with electric heating, a concrete-based foundation on the ground, and double-glazed windows in all three categories. Natural ventilation was dominant in the single-family house sector until the mid-1970s. In total, these characteristics of single-family houses make up seventy percent of the houses in the identified areas of single-family houses.

The suggested packages of energy-efficiency measures have been named zero energy, near-zero, conversion to a liquid-borne heating distribution system, and indoor climate focus. The individual measures are taken from the study on the potential of increasing the energy efficiency in the single-family house sector in Sweden (Besmå, 2019). They are combined into these four packages to meet needs in the market. The package for zero energy responds to long-term climate ambitions. The package for near-zero answers to the criterion in the EU taxonomy on a 30 % reduction of the primary energy demand. Conversion to a liquid-borne heating distribution system has been developed due to the increasing demand for electricity to reduce the climate impact from other sectors. Conversion from electric heating can thereby enable sectors with a larger challenge in the transition to a sustainable energy system to use electricity. The combination of measures and the ambition of each package are:

- **Zero** energy, the goal of this package is to reach zero energy demand on a yearly basis. Includes:
  - Information
  - Additional insulation on the attic
  - Window replacement/renovation
  - Plumbing: water heater and fittings
  - Ventilation, supply and exhaust air with heat recovery
  - Heat pump, air-air
  - Energy-efficient appliances
  - Photo voltaics (to cover the remaining need)

  Some momentary power needs will remain also after the implementation of the measures, mostly from the household appliances during the winter and evenings and for heating and hot water during the winter.
- **Near zero**, should include at least a 30 % reduction of the primary energy demand following the EU's proposed criteria for renovation according to the taxonomy. Includes:
  - Information
  - Additional insulation on the attic
  - Heat pump, air-air

  This package is characterized by a low cost and a minimal intervention
- Conversion to district heating with a liquid-borne heating distribution system. Focus on reducing electricity demand. The packages with the largest electric power reduction.
- Indoor climate focus, where upgrading of the ventilation system ensures a good air exchange and window replacement prevents down draught and cold radiation. Includes:
  - Information
  - Ventilation, supply and exhaust air with heat recovery
  - Window replacement/renovation

A certain dynamic selection of measures is an important co-condition required for the packages. Some measures have already been implemented in many of the single-family houses. The packages may therefore need individual adjustments. At the same time, it is important not to make excessive adjustments as this is likely to affect the cost-efficiency of the implementation in the entire area. It is possible to adapt the packages to the actors who choose to participate in addition to adaptation to the needs of individual houses. This can be done to ensure the participating actors have a strong enough interest in participating to improve the energy performance of the single-family house sector. The adaption can include adjustments in the properties of the houses that are targeted, but also regarding which measures should be included in the different packages.

A recommendation regardless of how the packages are designed is that an individual information folder is produced for each house that carries out an energy renovation. The folder must be handed over to the homeowner and contain information on the measures that have been implemented, as well as submit a plan with measures for the coming years. In this way, the homeowner can have documentation and policies available to revisit easily, as well as a plan to continue the work with improved energy performance in the single-family sector in the future. The information is suggested to be provided in both a printed and a digital format.

STAKEHOLDER DIALOGUE

Stakeholder dialogue has been crucial already at the feasibility stage to prepare for a future project to test the suggested packages and business models. Several obstacles for realizing the energy-efficiency potential were identified in the initial study conducted by BeSmå (BeSmå, 2020a). One of the major obstacles is that most individual houseowners do not have sufficient knowledge of what measures are appropriate for their house. Another major obstacle is that individual houseowners may need to make many decisions and engage several contractors and entrepreneurs when implementing multiple energy-efficiency measures. It can also be difficult to make the multiple benefits of energy efficient measures visible to houseowners. An obstacle for contractors is that the order value of a single measure in an individual single-family house often is relatively small and that limits the efficiency of the work and the contractors' interest in submitting a tender to single-family houseowners. Joint procurement in energy-efficiency renovation can likely contribute to increasing the interest of more contractors providing energy-efficiency measures to single-family houseowners.

In the study, contacts have been made with relevant stakeholders to ensure that the study's full-scale project will be car-

ried out in collaboration with the market and to create and strengthen the connections among the actors who need to be involved in implementing the energy-efficiency packages business model on the market. Some of the stakeholders identified in the initial study were the Swedish Energy Agency, municipal energy and climate advisers (kommunala energi- och klimatrådgivare), the Swedish Houseowners Association (Villaägarnas Riksförbund) and trade organizations such as The Swedish Installation Federation (Installatörsföretagen), The Swedish Construction Federation (Byggföretagen), The Glass Industry Federation (Glasbranschföreningen) and the Federation for mineral wool insulation products Swedisol. Other important stakeholders are actors in the financial business and researchers working with energy renovation in the single-family house sector.

Experience from the stakeholder discussions shows that it is difficult to identify an individual stakeholder who is readily prepared to take on the overall responsibility and coordinate the practical offer of packages of energy-efficiency measures to houseowners. However, there is a consensus that clarity and simplicity are important factors for everyone involved. For the vast majority of single-family houseowners it is probably important to have a coordinating actor to rely on. Research has although shown difficulties for actors on the supplier side to motivate themselves to act as such a coordinator (Pardalis et. al., 2020). Cost efficiency is important for individual houseowners to carry out energy renovation on a larger scale, but it is also important that other stakeholders find the business model profitable.

To increase the interest in a package of energy efficiency measures in single-family houses, it has become clear that it is important to emphasize that there are many benefits with implementing the measures and that the measures should not only be implemented to reduce energy demand and climate impact. Other values that have been discussed are e.g. health aspects, aesthetic aspects, social aspects in the form of the neighbourhood effect[1], environmental values through circular economy, and recycling of materials and economic values such as increased property value.

On the financing side, conversations have been held with the financial institution Hemma. Hemma is a relatively new player on the market, and they want to develop targeted offers to single-family houseowners who would like to improve the sustainability of their house (Finansliv, 2020). In the draft of the EU taxonomy for environmentally sustainable investments, a reduction level of 30 percent has been proposed for primary energy. The EU taxonomy is mentioned as an important instrument for the future to clarify when renovation can be considered a green business. In this feasibility study, this has been taken into account by designing one of the packages to reduce the energy demand by slightly more than thirty percent. From this aspect, the house's energy performance must be monitored and verified to have improved by at least 30 percent.

BUSINESS MODELS

The study has shown that there are several ways to accelerate the pace of renovation in Swedish single-family houses through packages of energy-efficiency measures and services for energy renovation. Policy instruments are likely to be needed since many cost-efficient measures are not being implemented. The main features of the identified levels are (BeSmå, 2020b):

- Area level: Commitment from single-family house owners, e.g. through community associations. This alternative has the advantage that there is already some kind of relationship established between the single-family house owners in the area and that they themselves can have a major impact on how the business model is to be designed. However, this probably places a large demand on individuals/enthusiasts.
- Municipal level: At the municipal level, the local authorities' energy and climate advisers are established actors, and it may also be possible to involve municipality or privately owned energy utilities. Energy utilities may be engaged to develop services such as leasing PV cells to individual clients in the single-family house sector. At the municipal level, there is an opportunity to use local contractors. By starting in the municipalities where many of the housing areas with a number of identical houses have been identified, there is a better opportunity for companies to create profitability as a coordinating party.
- National level: The advantage of working with a package of energy-efficiency measures and joint procurement in single-family house areas at the national level is that there are well-known actors, such as the Swedish Energy Agency and the Swedish Houseowners Association, who have a strong foothold, a respectable brand and the opportunity to reach a large number of single-family house owners. Packages of energy-efficiency measures can be more widely disseminated by using these actors, or other actors with similar attributes, and their trustworthiness. However, a well-known local contractor is probably still important to carry out the energy-efficiency measures.

All levels are possible routes to accelerate the renovation rate. Which level to choose depends on the actors who choose to put the packages on the market for single-family house owners. The Swedish Energy Agency can step forward and participate to accelerate the renovation rate or provide incentives for other actors to provide these business models.

Conclusions

Efficient use of energy in buildings is important for achieving the national as well as international goals for energy and climate. Efficient use of energy in buildings is also important due to the structural transformation of the energy system, where electrification is seen as an enabler to reduce climate impact in the transport sector and the industry. Hence, increased energy efficiency in buildings can enable increased electrification of other sectors where reducing the climate impact in other ways is more difficult. The four packages for energy-efficient renovation can enable a faster transition of the single-family house stock in Sweden. This is important since there is a large cost-efficient potential for energy efficiency measures in single-family houses in Sweden. It should also be noted that additional single-family houses are built each year, but the existing buildings will continue making up the majority of the houses in the stock. It is therefore important to not only focus on building

1. The influence on an individual's behaviour and attitudes by the people in the neighbourhood.

new energy-efficient houses but to also increase the efficiency of the existing house stock.

The study has been conducted to create ideas on business models which can increase the rate of energy-efficient interventions in single-family houses in Sweden. Packages of measures provided by one actor or a combination of actors have been found as a solution to increase this rate. Contrary to multi-family houses and non-residential buildings, the single-family house stock consists of numerous individual owners. For an individual houseowner, an extensive renovation requires involving many different actors and it puts a large demand on the individual houseowner to ensure financing and that chosen individual solutions form a holistic functioning system. For installers and contractors, there are important challenges such as the fact that the work in individual single-family houses only comes with low order values. It can therefore be more interesting for them with business models such as the ones proposed in this study, to reach multiple single-family houses in an area at the same time. From an EU point of view, one-stop-shops have been advocated, among other things, in the EU Directive on Energy Performance of Buildings.

This study provides indications that the one-stop-shop solution may need support from the EU or the national government to gain real momentum and realize the energy-efficiency potential that exists in the Swedish single-family house sector. The EU Energy Performance of Buildings Directive requires all new buildings to be nearly zero-energy by the end of 2020, and this requirement is likely to get even more ambitious to respond to long-term goals for energy and climate. EU and the national government should therefore primarily support the net-zero package. For single-family house owners, there are more aspects than low energy demand and a low operating cost that are important. Design factors are a major contributing factor to initiating a renovation process. In addition to design, there are also health and other aspects. A significant part of the Swedish existing single-family house stock is poorly ventilated due to insufficient air flows (Boverket, 2008). This needs to be dealt with in an energy renovation to ensure that a good indoor climate is achieved. It is also important that the contractors who carry out the energy-efficiency measures do it professionally, to avoid creating other problems such as moist and mould.

In the Swedish budget bill for 2021, funds have been allocated for financial support for the energy efficiency of multi-family buildings, the grants will be available over the next three years (Government Offices of Sweden, 2020). This kind of support makes it possible to realize measures that are socio-economically profitable, but not profitable for individual houseowners. Electric heating is common in single-family houses from the periods that this feasibility study focuses on. Conversion to district heating and heat pumps is considered a socio-economically profitable measure. Conversation to heat pumps has been made to some extent, but electric heating is still used in many single-family houses. Converting these systems is not cost-efficient for individual single-family houseowners. A recommendation is therefore to target a socio-economic package towards measures to reduce the use of electrical heating. For the government to mobilize individual single-family houseowners to implement this measure on a larger scale, it is necessary to introduce policy instruments, e.g. similar support as the grants that have been allocated to multi-family houses in the latest budget bill.

The discussions held with market actors conclude that designing and implementing a pilot project is a natural next step to test some of the proposed solutions. How such a pilot project should be designed can be developed based on the results from this feasibility study. Although, it will be important to adjust the design depending on the actors involved and the chosen level of an area. At the same time as a pilot project is being implemented, the design of a strategy for upscaling should be further investigated. Further investigation of upscaling is necessary to understand how, and which actors can take the business models from tests at individual locations, or according to individual aspects, to include large parts of the Swedish single-family house stock. Examples of places where the concept could be tested have been identified from the Masterfile statistics, and are e.g. the cities of Växjö, Eskilstuna, and Borås. In these places, there are several areas with more than one hundred homogenous single-family houses per area.

The EU Renovation Wave aims to double the renovation rate to cut emissions, boost recovery and energy poverty. Other benefits of energy efficiency are likely needed to be showcased since the large potential of cost-effective energy efficiency measures in the single-family house stock is not being implemented. Several ongoing activities and initiatives to visualize and simplify the multiple benefits of energy efficiency measures have been identified in the feasibility study. Visualization and marketing should therefore be prioritized in the continued work to disseminate the measures and the packages to ensure more houseowners benefitting from them. An additional benefit of visualization is the single-family house market becoming more attractive for more contractors. Lessons should also, according to discussions with several actors, be taken from concepts and business models with solar PV.

The dialogue with several actors should be maintained and developed in the continued work. This study has shown that there are many projects and initiatives planned for a more energy-efficient single-family house sector in Sweden. Sharing experiences from these projects and initiatives are important to reduce the energy demand in the single-family house stock. The project "Accurate and profitable renovation" (Renovera rätt och lönsamt) is planning to organize a roadshow with local and/or regional meetings with the member companies of the participating industry federations in 2021 (The Construction Industry's Organisation for Research and Development, u.d.). There are opportunities for BeSmå to become involved in this work, and to investigate the construction industry's interest in single-family houses, focusing on these aspects can contribute to small and medium-sized companies working more with sustainable renovation in general and in single-family houses in particular. Support can also be found in existing models such as Belok's (the Swedish network for energy-efficient non-residential buildings) Total Methodology (Totalmetodiken) for developing packages of measures for energy renovation (Persson, 2015). The network BeSmå aims to create stronger collaboration between the research academy and the member organizations of BeSmå and, also with other actors linked to the single-family house sector. An ongoing update on energy renovation research will add valuable knowledge to the actors in the sector.

Close cooperation with research institutions is important both for BeSmå in general and continuing the work in this project. Interesting research connections can e.g. be to analyse how

the proposed energy-efficiency packages and business models affect the existing energy efficiency potential, to investigate the extent to which houseowners are affected by the measures that neighbours implement (the extent of the neighbour effect), and to engage researchers to create a continuous evaluation on lessons learned in the project.

References

BeSmå, 2019. Potential för energieffektivisering i småhussektorn. Obtained from: https://energieffektivasmahus.se/projects/potential-for-energieffektivisering-i-smahussektorn/.

BeSmå, 2020a. Hårda paket är det bästa klimatet vet. Obtained from: https://energieffektivasmahus.se/projects/harda-paket-ar-det-basta-klimatet-vet/.

BeSmå, 2020b. Kostnadseffektiva åtgärdspaket för energieffektivisering. Obtained from: https://energieffektivasmahus.se/projects/kostnadseffektiva-atgardspaket-for-energieffektivisering/.

Boverket, BETSI, 2008.

EU Commission, 2020a. Renovation Wave: doubling the renovation rate to cut emissions, boost recovery and reduce energy poverty. Obtained from: https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1835.

EU Commission, 2020b. EU taxonomy for sustainable activities. Obtained from: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en.

Finansliv, 2020. Ny tjänst ska ge grönare bolån. Obtained from: https://www.finansliv.se/artikel/ny-tjanst-ska-ge-gronare-bolan/.

Government Offices of Sweden, 2020. Regeringen tillför medel till stöd för energieffektivisering och renovering av flerbostadshus. Obtained from: https://www.regeringen.se/artiklar/2020/09/regeringen-tillfor-medel-till-stod-for-energieffektivisering-och-renovering-av-flerbostadshus/.

Pardalis, G., Talmar, M., Keskin, D, 2020. To be or not to be: What does it take to launch One-Stop-Shop for Energy Efficient Renovations? Working article.

Persson A. 2015, With A Bit of Help From My Friends – the importance of networks, Persson, A., eceee 2015 Summer Study, Hyeres, France.

Swedish Statistics, 1990. Masterfile. Database. Access obtained by Statistics Sweden.

The Construction Industry's Organisation for Research and Development, u.d. Renovera rätt och lönsamt. Obtained from: https://www.sbuf.se/Projektsida?project=7b41ebec-b9f8-4474-903a-20591ba76b13.

The Swedish Energy Agency, 2019. Energistatistik för småhus 2019. Obtained from: https://www.energimyndigheten.se/statistik/den-officiella-statistiken/statistikprodukter/energistatistik-for-smahus/.