Needs of support for Swedish property owners to implement more energy-efficiency improvements during renovations

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Abstract. It is a well-known fact that the built environment in Europe is responsible for approximately 40% of the overall energy end usage and that this has to be reduced drastically for the building stock to be sustainable in the long term. A prerequisite to meet the EU 2020 and 2030 targets is significantly increased ambition among property owners regarding energy-efficient renovation.

However, it is not easy to regulate that large-scale energy-efficiency measures should be included in the ordinary renovation of buildings. In order to design the right policy instruments to influence property owners towards energy-efficiency-oriented renovation, deeper knowledge is needed on how property owners act and argue today. This study reviews several recently performed studies with the aim of obtaining an overview of how the decision-making process is conducted, and it makes comparisons between different categories of buildings.

The aim is to allow conclusions to be drawn on whether a financial incentive is important to bringing about energy-efficiency renovation and, if so, how such an incentive should be formulated.

The study shows that direct and simple subsidies are needed to bring about major energy-efficiency improvements in housing in connection with renovations, especially when it comes to additional insulation for facades. For non-residential property, there is little need for financial support, while other forms of support are needed. Current energy-efficiency improvements in connection with renovations are modest and a long way off the technical potential.

Keywords: energy-efficiency, buildings, incentives, control means, subsidy

1 Introduction

In Europe, the built environment is responsible for approximately 40 % [1] of energy usage, and this has to be reduced drastically for the housing stock to be sustainable in the long term. In the recast directive on energy performance of buildings [2], there is a demand for 'nearly zero-energy buildings' to be a requirement for the construction of new public buildings from 1 January 2019 and for all new buildings from 1 January

2021. However, a prerequisite to meet the energy-efficiency targets is significantly increased ambition among property owners regarding energy-efficient renovation. The recast directive also states that member states must undertake the measures needed to ensure that when buildings undergo a major renovation, the energy performance of the building, or the renovated part of the building, is improved so that it meets the minimum requirements regarding energy performance to the extent that this is technically, functionally and economically feasible. The requirement is to be applied to the renovated building, or the renovated unit, as a whole.

Many of the modernist, multi-dwelling buildings built in the boom years between the end of the Second World War and the start of the oil crisis are in need of, and awaiting, substantial renovation work [3]. The next opportunity, after this profitable rebuilding, may not be available for another 40 years.

Even though there appears to be considerable potential for energy improvements, the national statistics show only about 10-15 % energy improvement in the residential and service sector in the last ten years in Sweden [4]. To motivate complete renovation concepts in place of separate component measures, new renovation incentives are needed that raise the building owners' ambitions to carry out the renovation down to the 'nearly zero-energy buildings' level.

To determine if there is a need for a financial incentive and, if so, how it should be formulated, the government has set up an enquiry. In an initial report, it is confirmed that there is might be a need for financial incentive but that a continued enquiry is needed [5]. The present work is part of the continued enquiry.

2 Objective

This study aims to specify if Swedish building owners need financial incentives in order to make more extensive energy-efficiency improvements in connection with a renovation. If so, also specify how an incentive can be formulated, if requirements are needed for energy measures that otherwise will not be performed and how achieved efficiency improvements could be verified.

3 Method

The work is performed by a review of recent studies on how property owners in Sweden act with regard to energy-efficiency improvements of buildings. The reviewed studies were selected based on that they should have been considered implementation of energy efficient measures in renovation of Swedish buildings or they should have studied how Swedish property owners makes decisions regarding energy efficient buildings. The studies should not be older than five years. The methods in the reviewed studies are mainly interviews and questionnaires with property owners and users.

Focus of the review was to get an understanding of the process in which decisions are made and what the technical and financial options are. The review was focused on the following questions:

How are decisions taken on energy-efficiency levels for renovation? What supporting data are the decisions based on? Which measures are cost-effective and which measures are implemented? Is there a need for a financial stimulus such as loans, credit guarantees or subsidies?

Based on the review results the author discuss and makes conclusions on the need of financial incentives, how a stimulus for energy-efficiency improvements in renovations could be formulated and how achieved efficiency improvements could be verified.

4 Results

4.1 How are decisions taken on energy-efficiency levels for renovation?

Many property companies prioritise new production ahead of renovation as it is seen as more profitable, and it is common for buildings in need of renovation to be sold. Public property owners try to use existing buildings first, before considering new production, and tend to want to renovate to a greater extent than the private sector [6]. Energy-efficiency improvements on their own rarely lead to renovation.

Of the factors that lead to renovation of multi-dwelling buildings, the maintenance need dominates, with the components having reached the end of their life and the maintenance costs being high [7, 8]. Sometimes a renovation can be a result of an urgent need for maintenance measures, but the property companies try to avoid this as far as possible through good planning [6, 9]. This is followed by high operating costs and high energy use. Raising the standard is also an important reason for renovation. However, reasons such as changing function or flat partitioning, improved indoor environment, complaints from tenants and improved availability are among the factors that are least likely to initiate a renovation [7].

In the non-residential sector, adaptations for new or old tenants (business needs) or indoor environment problems are the main reasons for renovation [6, 10, 11]. This is followed by maintenance needs for climate shells and installations mainly associated with the indoor environment. Environmental certification can sometimes be a contributing reason [10, 11].

In companies with multi-dwelling buildings, renovation decisions are sometimes taken by the companies themselves (the MD or management group) and sometimes by the company board [9, 12]. In many companies, the board has set strategic decisions on required returns on investments and production or renovation volumes, while decisions on energy and environment issues are taken directly by the company board. The management department can highlight renovation needs but usually only decide on minor maintenance measures [9].

Some non-residential property companies have to comply with strategic decisions when carrying out renovations, but these are usually general and the level of ambition varies. It tends to be more common to have overall targets for all the building stock. Most non-residential property companies have voluntarily specified measurable energy targets, though they are expressed in slightly different ways. Targets are 10 to 20% reduction in energy use, heating or CO2 emissions by 2020. Most have met or expect

to meet their targets. One trend to meet the targets is to set tighter requirements for energy use for new production than the building regulations [6].

During project planning, before decisions are taken, the budget can be increased with extra investments if they meet the profitability requirements. If profitable solutions are identified after the start of a project, they rarely lead to any change in the plan [12].

4.2 What supporting data are the decisions based on?

The companies do not have any rules on or practices for the supporting data that must be available before a decision can be taken on energy-efficiency measures for new production or renovation other than that financial data are always required [12, 8, 13]. Even if the supporting data vary, they will include some form of investment calculations and value estimates. The calculation methods used for renovations are life cycle cost, cash flow, return, alternative cost and repayment period, and sometimes no method is used at all [6].

The financial calculations used by the property companies include operating costs, but they often use a standard value. This means that the return on the investment on a small net operating income cannot be seen and therefore no consideration is given to an increase in property value due to reduced energy costs or a reduced risk of future increases in the energy price [12, 13]. The motivation is that the renovation often involves complex systems that increase the staff operating costs [12].

Consideration is rarely given to an increase in property value from an improved indoor environment. Public property owners also do not usually consider the effect on property value as they are not going to sell their buildings.

In most big companies, it is the divisions for property development or management that produces the supporting decision data [6, 13]. In small companies, cooperative apartments and one-family houses, it is usually a consultant (sometimes a certified expert) who produces the decision data. Regardless of company, the MD, management or board rarely has detailed knowledge about the energy issue, and the supporting data are therefore crucial to the decision, and the level of knowledge of those who produce the data is of utmost importance. As well as the property owners themselves and their support organisations, other actors such as energy consultants and contractors need to have sufficient knowledge to implement and present an investment calculation in which the value of energy-efficiency measures can be shown as quantifiable comparisons [6, 9, 12, 13].

In almost all cases, there is a building envelope and a technical installation status assessment of the building [7, 6]. When it comes to energy-efficiency measures, the supporting data vary [6, 13]. Most non-residential properties have carried out some kind of mapping of their renovation needs, but there may not be a renovation or energy-efficiency plan at all [6].

A status assessment of maintenance needs is the basis for renovation decisions, and in addition, data are needed for energy-efficiency measures. The energy certificate and its proposed cost-effective measures can serve as a starting point for compiling decision data but is rarely sufficient, as every energy-efficiency measure is assessed individu-

ally. For larger renovations, the data for the energy-efficiency measures need to be assessed together in a package. This is because different measures affect each other practically and in terms of energy, and there can be further measures that would be profitable in a package or in connection with a renovation and its base costs [14, 15].

Other aspects that are important to renovation decisions are the possibility of evacuation or if the renovation can be carried out with the tenants in the building, technical experiences of different technical solutions, access to competent staff and labour and the ability to get loans even if the renovation is in itself profitable [6, 7, 8].

4.3 Which measures are cost-effective and which measures are implemented?

Transmission losses from walls and windows as well as ventilation losses are usually the biggest energy losses from residential properties. That is where the energy-efficiency potential is greatest, but they are also measures that require a high investment cost. Other energy-efficiency measures such as loft insulation, energy-efficient hot water fittings, energy-efficient lighting and adjustments are usually more profitable, though they do not generate such great energy savings individually. With regard to windows, there are as-good-as maintenance-free ones with good U-values at reasonable cost, so even if the measure in itself is not profitable, the previous maintenance costs are reduced. Adjustments to different systems, changing the lighting, insulating the loft and replacing windows are the measures that are carried out most [6, 7, 13, 14, 16, 17].

Facade insulation is a measure that often has high investment costs and is frequently set aside despite its big energy-saving potential. The high investment costs together with the fact that the measure often requires building permission and may have historic aspects that need to be considered means that property owners avoid it. More cost-intensive, non-standard-raising measures and partly technically and architectonically challenging energy-efficiency measures such as facade insulation are measures that are shown as rarely implemented in a number of surveys [6, 7, 13, 17].

Heat recovery can be installed using primarily two different technologies. The installation of an exhaust air pump is relatively easy and often profitable [14, 16]. It provides good energy efficiency but does not improve the character of the building itself to a low energy need. The other option is a heat exchanger that recovers energy from the exhaust air and returns it to the building in the supply air. Such an installation requires supply air channels, which, practically, is relatively complex and costly but, on the other hand, significantly reduces the risk of indoor environment problems compared with supply air inlets in the facade. When installing the technology, the supply air inlets in the facade are sealed, which improves sound problems from the outside, reduces the risk of draughts and the building is provided with warm filtered supplied air. It provides conditions to maintain a regulated air flow all the year round without risk of thermal discomfort [18]. Preheated air can also be combined with an exhaust air heat pump.

In most cases, it is finances, and to some extent the customers' ability to pay, i.e. chance to increase the rent, that control the choice of renovation measures. One study shows that if the households in multi-dwelling buildings choose from different renovation options with regard to cost and technical performance, they will choose a lower level of renovation despite a higher level being more cost-effective [19].

In non-residential properties, there are usually a number of measures that are relatively profitable and can be carried out together in a package in which, for example, profitable ventilation measures often help to support less profitable ones. Many different types of non-residential properties that have used the Total Concept method show that it is often possible to find relatively big energy savings with reasonable profitability [20]. However, in some types of non-residential properties, as well as multi-dwelling buildings, building envelope measures (for example facade insulation) often have great energy-saving potential but are a relatively expensive investment.

An interview study with property owners who together represented 25% of the multi-dwelling buildings, 15% of the offices and 18% of the schools in the total area of Sweden confirmed that a very low level of the potential for energy-efficiency improvements in connection with renovation is currently applied. The energy-efficiency measure that are carried out are a long way off the technical potential [6].

4.4 Need for support

When it comes to support, a few private companies stated that they do not need direct financial support and would rather see other control instruments such as housing allowances or support in the form of direct discounts on contract costs for renovation, which are much easier to administer. Most private and public residential property owners think there is a need for subsidies or grants [6]. A few property owners say that support is needed, especially if the legal energy-efficiency requirements increase. Support are primarily needed for building envelope improvements [6]. One study among non-residential property companies shows that the need for tools and support for decision-makers for renovations is seen as more important than tangible forms of financial support. They believe it is better that it is controlled by the market but that support may be needed to introduce new technology and for innovations to be tested by property owners [6].

In less attractive locations, it is more difficult to make the calculations add up and it can also be hard to get loans due to the uncertain market value of the building [6, 12]. There is therefore currently energy-efficiency support for rental housing in areas with socio-economic challenges [21].

Many public as well as private property companies mention one of the big obstacles as a lack of competent labour on the market. They generally have difficulties getting responses to tenders and good-quality tenders, and the tender prices are often very high due to the low level of competition. They also have difficulties recruiting competent staff, leading to a staff shortage to run renovation projects [6].

To raise the competence within the branch the Swedish Energy Agency supports several competences raising education programs, for example Energilyftet [22], Energibyggare [23] and Beställarkompetens [24] and the National Board of Housing Building and Planning has recently started an information centre [25].

5 Discussion and conclusions

Based on the review of previous studies, a few preliminary conclusions have been drawn that should not be seen as a final proposal for support or control instruments but a proposed direction for continued investigation. In further investigations and formulation of the subsidy rules it is important to assure that the energy renovation will be performed while the indoor climate quality and the function of the building must remain the same or be improved.

5.1 Financial support must be easy to administrate, have clear requirements and be guaranteed

Financial support, whether in the form of loans, credit guarantees or grants, must be easy to administrate and apply for. A property owner who plans a renovation often has many aspects to consider in a limited period of time. There is no time for long drawn-out application procedures.

For a financial incentive to influence a decision and get the property owner to implement energy-efficiency measures in connection with a renovation, it must be included in the decision data from the start. It is unlikely that a financial incentive that is not considered until after the renovation plan has been decided will lead to a change in the project plan even if it leads to an energy-efficiency measure becoming profitable.

Financial support must also have clear requirements to be granted and be guaranteed. There has previously been support for solar installations that involved the property owner joining a queue at the county administrative board to maybe get support. Experience shows that this does not contribute to decisions on investment. In the best case, the financial incentive contributed to the energy measure being included as a possible measure in the decision data, but if there are no guarantees that it will be paid it will be considered a bonus and do not influence the decision on whether the renovation measure should be implemented. In the event that a decision is taken on the renovation budget and scope, the financial incentive must be part of the calculation basis, and it must be guaranteed that if the set requirements are met, the support will be paid.

5.2 Packages of measures need to be considered

Direct support in the form of direct discounts on contract costs for renovation is recommended by several property owners. However, this assumes that the requirements to be implemented should be verified by a contractor, which may be difficult with regard to both competence and supporting data. Here, it may be possible to use the energy certificate directly for small houses, but this would hardly be sufficient for multi-dwelling buildings or non-residential property. For example, a subsidy for facade insulation would be expressed as a number of centimetres of additional insulation so that a contractor can easily verify that the requirement has been met. This would not be a sufficient contribution for the energy-efficiency targets, however, as every renovation should be preceded by a comprehensive investigation in which facade insulation is part of a package of other measures that together provide financial benefits. Practical aspects

should also be considered, for example whether windows also need to be replaced or renovated when scaffolding is put up anyway. The energy certificate alone is considered too simple as a basis for granting subsidies. There is a need for more comprehensive supporting data with the building undergoing a thorough basic inspection in which the energy and cost savings of different packages of measures can be assessed in relation to the investment and maintenance requirements.

5.3 Subsidy is needed for residential buildings

Subsidies are needed to get residential property owners to implement more extensive energy-efficiency measures in connection with a renovation. Better loan terms are not sufficient since it, today, is quite easy to get good loan terms. Furthermore, energy-efficiency measures that are important from an energy-saving point of view but that are rarely carried out should be included in the package of measures to be granted support.

These could be, for example, additional insulation of the facade of residential property and some types of non-residential property, and installation of supply air channels in multi-dwelling buildings. Insulation of the facade is an important energy-efficiency measure that is cost-effective, non-standard-raising, partly technically and architectonically challenging and requires a financial incentive to be carried out. The installation of supply air inlets and sealing of old air inlets provides conditions for good energy economy with an improved indoor climate and conditions for good air quality.

5.4 Requirements for a financial subsidy

A subsidy should have the following requirements to be really useful and contribute to meeting the energy-efficiency targets:

- the building should have relatively high energy use before the renovation
- a certain share of the energy use should be reduced
- energy-efficiency measures that are important from an energy-saving point of view but that are rarely carried out should be included
- a maximum amount per square metre, possibly dependent on a reduction in energy use

If the financial subsidy is formulated with different maximum amounts depending on the reduction in energy use, it could satisfy the requirements of different property owners. A small maximum amount and a low requirement for the total energy-efficiency improvement could be beneficial for small houses and cooperative apartments that rarely renovate in big packages but prefer to implement separate measures in stages, while a high maximum amount and requirements for total energy efficiency could be beneficial for private and public multi-dwelling buildings that make extensive renovations.

5.5 Generally non-residential buildings do not need financial support

Energy-efficiency improvements of non-residential property are generally deemed sufficiently profitable for financial support not to be needed. The implementation of more energy-efficiency improvements in connection with renovations requires good decision data and competence of the actors involved. Here the sector may need support to produce decision data, for the industry to develop better tools and for actors in the sector to be trained rather than direct subsidies.

A financial incentive, similar to that for residential property, could be effective for additional insulation for facades of buildings with similar conditions, i.e. with a significant heating requirement and limited internal loads from the operation, for example schools, retirement homes and prisons. For schools, such support could be effective as it represents 31% of the area of non-residential property in Sweden.

5.6 Supporting data for granting subsidies and reporting achieved results

For small houses, supporting data that show that the property owner is entitled to the subsidy may consist of an energy certificate with the building's energy performance and relevant proposed measures. For multi-dwelling buildings and non-residential property that may be entitled to subsidies, the energy certificate must be complemented with a basic report that assesses the cost and energy savings of different packages of measures together with the investment costs of the measures. In recent years, different methods have been developed to produce and compile the required data. There are a number of different variants, but most are similar and include inspection, energy and cost calculations and analysis as well as planning for verification [26, 27, 28]. The result can then be presented in slightly different ways. With the help of such data, the profitability of different packages of measures can be quantified and valued.

A new energy certificate with measured energy use may be sufficient for reporting on the achieved results in small houses. For multi-dwelling buildings and any non-residential properties entitled to subsidies, an energy-efficiency improvement report based on the supporting data report and the new energy certificate is needed. The report should show that all the measures included in the original application have been implemented correctly. The energy savings shall be reported and, if they do not meet the set requirements, a report should account for why the energy use deviates. There should not be requirements to repay the subsidy because the expected energy saving is not achieved, if all planned measures are implemented correctly, as that would act as a deterrent to applying for the subsidy. The energy saving made in connection with the renovation is not always directly measurable as the building may have had, for example, poor air flows before the renovation. When new ventilation systems are installed, the ventilation flow are set to requirements according to the regulation all the year round, which may lead to no reduction in energy use or a smaller reduction than in the energy declaration. Here, a comparison needs to be made with a reference case in which the building has required air flows before the measures. The energy-efficiency report is an important element for experience feedback for future renovations.

5.7 Other limiting factors

To meet the energy-efficiency targets that have been set, the ambitions and the speed of every renovation must increase. Financial incentives can help bring about more extensive energy-efficiency improvements in connection with a renovation. Financial incentives are, however, unlikely to speed up the pace of renovation, which is limited by the lack of competent labour on the market.

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