

Major energy renovations with the Total Concept method



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Property owners' ambitions to carry out major energy retrofitting projects needs to be increased in order to meet the energy efficiency targets in the building sector. The Total Concept method helps building owners to understand the financial benefits and opportunities with energy retrofitting, making it possible to come much further with energy improvements.

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In order to reach the 20-20-20 EU-targets it is essential to dramatically lower the energy needs in a large proportion of existing buildings. This, however, has been a great challenge in most of the European countries. The investments required for retrofitting existing buildings are often expected to be carried out by property owners, but how can their ambitions to considerably improve energy performance of their buildings be increased?

It is relatively easy to identify a number of individual measures each of which can reduce energy needs in a building. Although some of these can be carried out at little cost, the measures that significantly reduce energy needs often entail considerable investments. Previous, there has been little support provided to the property owners regarding how to make the best investment decisions. The decisions are often based on profitability of single measures, whereas simple economical methods are often used which does not take into account economic life times of measures nor changes in energy prices. Often only the very profitable measures are considered and carried out, leading to rather modest energy savings.

To change the mindset and motivate property owners to carry out major energy renovation a method, called the Total Concept, has been developed and successfully applied on a number of renovation projects of non-residential buildings in Sweden. The method has during the last three years also been successfully introduced to other Northern European countries. Total Concept aims is to be a market drive for major energy renovation and thereby increase business opportunities in the sector.

Drivers and barriers for major energy renovation

A market analysis carried out in Finland, Denmark and Sweden shows that decreasing energy use in a building is seldom a reason for renovating a building [1]. Based on the interviews with a number of local property owners the most common reasons for retrofitting are change of (large) tenants, the deterioration of existing systems or building's envelope, as well as problems with indoor climate.

Energy is relatively cheap in Nordic countries and, therefore, this is a significant obstacle for starting energy renovation projects. The property owners, especially

private ones, are very much profit oriented. Besides low energy prices, another important barrier is the risk of not receiving the whole profit from the energy measures. This is particularly relevant when tenants pay their utility bills. Without a special agreement, benefits of an investment may go directly to a tenant and not to the investor.

Additionally, budgetary limitations as well as a fear of carrying out long-term investments and lack of good economic models are also considered as barriers.

The main barriers for energy retrofitting pointed out during the interviews are illustrated on **Figure 1**.

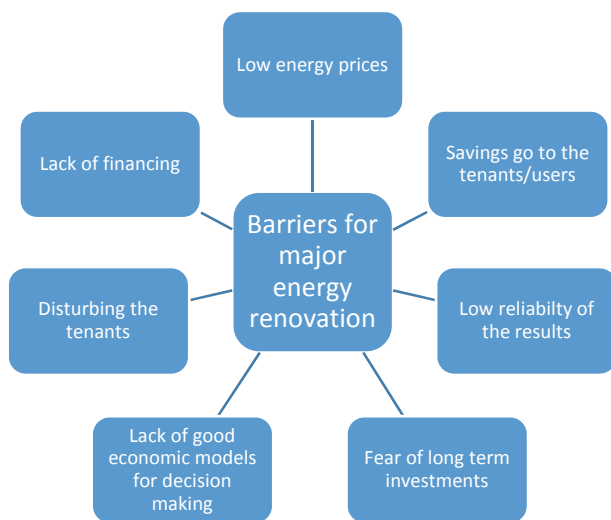


Figure 1. The main barriers for major energy retrofitting in Sweden, Denmark and Finland.

The market study has shown that there is a high demand for energy renovation methods that can provide building owners a comprehensive approach, reliability of the results that energy and financial savings are achieved and that they are based on easy-to-understand economic models. The study couldn't identify any other method available on the Nordic market that can adapt to this demand. Most companies and services commonly focus on single or few issues or solutions.

Total Concept method in brief

- Total Concept is a method for improving energy performance in existing non-residential buildings.
- The method applies a comprehensive approach to work with energy issues in a building with the aim to achieve maximum savings in a profitable way.
- The method is based on an action plan comprising a

package of energy efficiency improvement measures that as a whole fulfils the property owner's profitability requirements.

- The work process of the Total Concept is divided into three steps in a systematic approach covering the entire retrofitting process, from pre-study phase to follow-up phase, and ensuring that energy saving targets are actually reached.
- Quality and function of the building must remain the same or be improved.

The profitability assessment in the Total Concept method is based on an internal rate of return method, where an investment is assessed by the actual yields that it creates, expressed as an internal rate of return (IRR). First a comprehensive inventory is carried out in the building to identify all possible energy saving measures, both the single cost-efficient ("low hanging fruits") and the costlier measures. Then, an action package is formed through step-by-step energy and profitability calculations. The criterion for how many measures are included to the action package is that the combined internal rate of return of the whole package must be higher than the real calculation interest rate stipulated by a property owner. How the different measures affect each other when carried out as a package and different economic lifetimes of measures are also taken into account [2].

The profitability calculations are done with the Total Concept tool, the TotalTool, where the outcomes are illustrated in a simple-to-understand way for the decision makers, by using an internal rate of return diagram. The decision maker can see what impact each measure has in the overall profitability and supports the decision to carry out a package of measures instead of single profitable measures.

An example of an action package on an internal rate of return diagram is illustrated in **Figure 2**. In this example five energy efficiency measures were identified during auditing. Every measure leads to certain annual net savings in operating cost (k€/year), requires certain investment cost (k€) and can be represented by a line in the diagram with a certain length and angle. This angle represents the internal rate of return (%) of an investment. The profitability requirement is set as 5% real interest rate.

The formed action package provides a combined internal rate of return of 7% and leads to halving the annual energy costs, which approximately corresponds to a halving of the use of energy. The most profitable

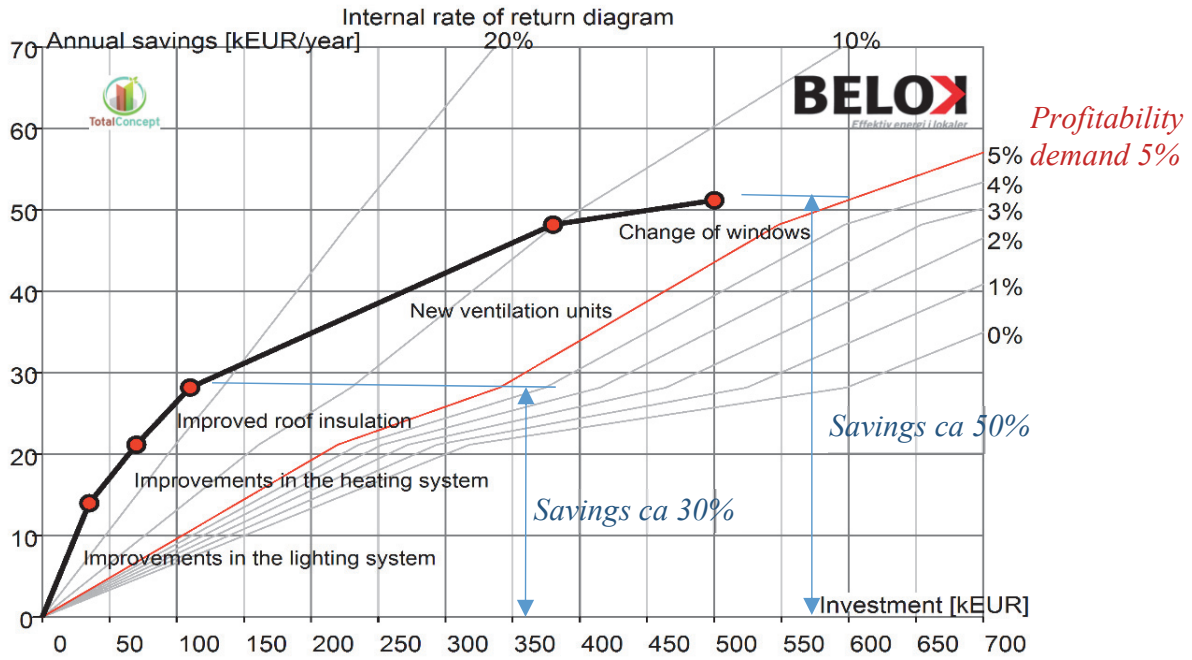


Figure 2. Presentation of a package of measures with five measures in an internal rate of return diagram. The property owners' profitability requirement for the investment is an internal rate of return of 5% (based on real calculation interest rate). The whole package of measures in the example gives an internal rate of return of 7% and leads to halving the annual energy costs.

measures make up for the less profitable measures while the complete action package will fulfil the profitability frame set by the building owner. If only the measures that were profitable on their own were carried out, the first three measures, the savings would have been only 30%. This is the main essence of the Total Concept method that it provides a method to take one step further with energy savings in a profitable way.

Examples of renovation projects and lessons learned

In Sweden, the Total Concept method has been implemented in a number of retrofitting projects in office buildings, schools, hospitals, sports facilities, railway stations and universities [3, 4]. The outcomes show that annual savings over 50% are possible within the profitability frames that property owners have, which is often in between 5% to 8% return on investment. The savings achieved are strongly dependent on the buildings energy performance before the renovation. **Figure 3** presents the expected energy savings in percentage and internal rate of return of the action packages in a number of projects carried out in Sweden. Total investment cost in these projects has been in average about 70 €/m², mean annual savings about 6 €/m²yr and internal rate of return in average about 10%.

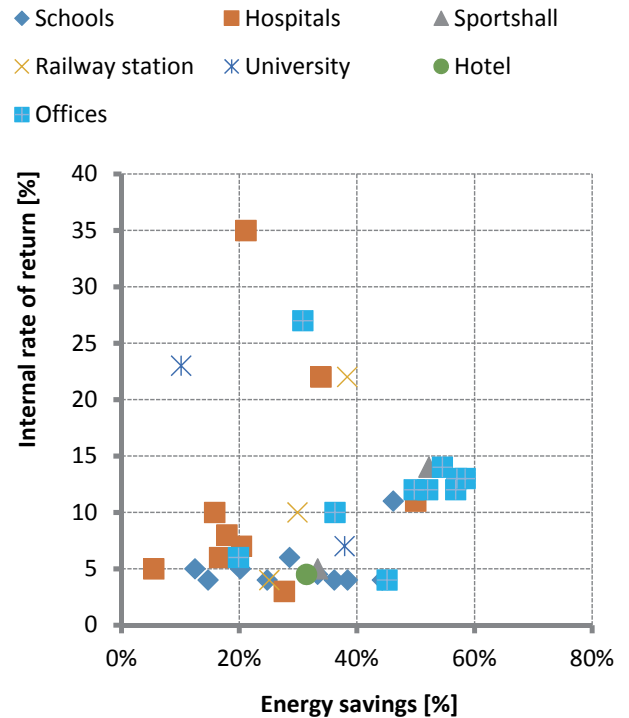


Figure 3. Total energy savings and internal rate of return in Total Concept projects carried out or planned to be carried out in Sweden.



Year built	1989
Renovated	2015–2018
Heated floor area A_{temp}	16 238 m ²
Energy investment cost	1 535 000 €
Total energy savings	ca 55%
Total cost savings	172 000 €/yr.
Energy use before (incl. tenants)	231 kWh/m ² yr.
Estimated energy use after (incl. tenants)	105 kWh/m ² yr.
Internal rate of return	11%

Figure 4. Total energy savings and internal rate of return in a major renovation project in an office building in Gothenburg. Improving energy efficiency at the same time based on Total Concept method will lead to total energy savings about 55%.

The Total Concept method can easily be included in the overall retrofitting process of a building, in which the additional investments required for achieving better energy performance is analysed. One example of such a project is an office building in Gothenburg, where a total renovation is carried out in order to adjust the building for new tenants. The proposed package with 15 energy efficiency measures will lead to energy savings about 55% with an internal rate of return on investment of 11%. Renovation works are in progress and will be finished by 2018. The summary of the outcomes action package is presented in **Figure 4**.

Feedback from the Nordic reference projects highlights the following main strengths of the Total Concept method:

- applying a comprehensive approach in energy retrofitting;
- having a good economic tool for decision making;
- making early plans for commissioning and follow-up are important for assuring that expected results are achieved;
- follow-up period is very useful for additional system optimization and for noticing any malfunctions of the systems that can have high impact on the building's energy performance.

Market potential and business opportunities

Retrofitting projects based on the Total Concept method offers business opportunities for a number of key actors in the building sector, such as energy

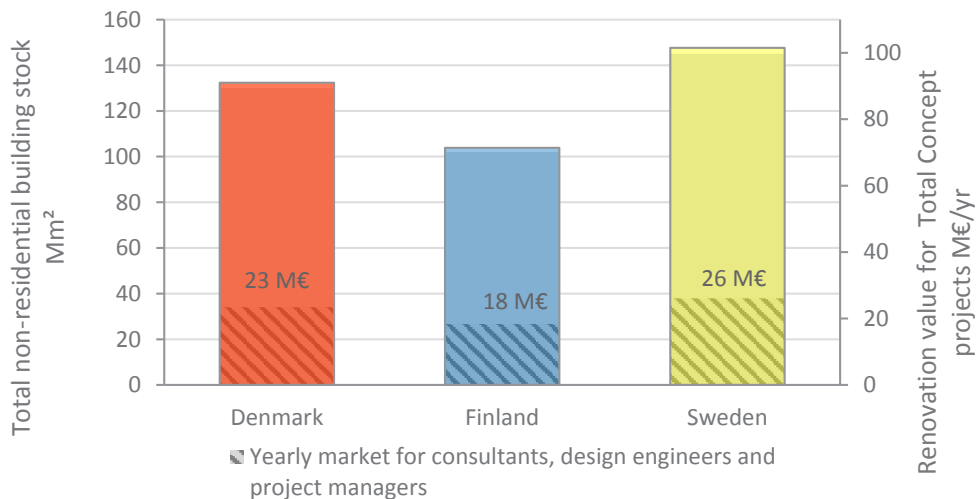


Figure 5. Estimated size of the renovation market for the Total Concept method in Northern Europe.

consultants, design engineers, contractors, energy controllers and project managers.

In Denmark, Finland and Sweden the area of existing non-residential buildings is estimated to be in total about 380 million m². Assuming that about 1 percent of the existing building area would be annually renovated using the Total Concept would mean that the yearly volume of renovation would be about 4 million m². This would correspond to the total investment volume up to 260 M€ per year in the three countries, assuming that the total renovation cost is about 70 €/m² in average [1]. For the key actors involved in the pre-study phase (Step 1), design work and project coordination during construction phase (Step 2) and follow-up in monitoring phase (Step 3) the annual market volume is estimated to be about 70 M€. This is based on the estimation that the consulting, design work and project management share is about 18 €/m² from the total renovation cost. Estimated size of the renovation market for the Total Concept method in the three Nordic countries is illustrated in **Figure 5**.

There is a high demand for energy retrofitting methods on the market that can provide building owners reliable results. Total Concept method includes economic realities which building owners need to consider, while at the same time it aims to increase the ambitions and making it possible to come much further in improving buildings energy efficiency and in improving the overall quality of a building. The Total Concept method has a great potential to become a market leader for large scale energy renovation projects. ■

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