Åsa Wahlström and Mari-Liis Maripuu | CIT Energy Management | April 2017

A METHOD PRESENTING ECONOMIC RATIONALES FOR MAJOR REDUCTION OF ENERGY USE IN NON-RESIDENTIAL BUILDINGS

Total Concept

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Authors for this report have been Åsa Wahlström and Mari-Liis Maripuu, CIT Energy Management

Contact: asa.wahlstrom@cit.chalmers.se, mari-liis.aripuu@cit.chalmers.se

Contributions have been made by:

Norway: Mads Mysen, SINTEF Building & Infrastructure

Denmark: Graves Simonsen, Bygherreforeningen; Alireza Afshari, SBi - Aalborg University; Pawel Krawczyk, Rambøll

Finland: Tytti Bruce, Bionova Oy

Estonia: Mikk Maivel State real Estate Ltd; Kalle Kuusk and Aivar Uutar, Estonian Society of Heating and Ventilation Engineers

Sweden: Saga Hellberg och Tommy Lenberg, Byggherrarna

Project coordinator: Åsa Wahlström, CIT Energy Management AB, asa.wahlstrom@cit.chalmers.se

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Improved energy efficiency and decrease of the total energy consumption in the building sector has been on the agenda during the last decades in most of the European countries. The ambitious vision of energy performance of European buildings requires that all new buildings must be "nearly zero-energy" buildings by the end of 2020. Moreover, minimum requirements should be set when buildings undergo a major renovation, to the extent that this is technically, functionally and economically feasible. Consequently, in order to reach the 20-20-20 EUtargets, it will be essential to increase the ambitions among building owners to make renovations with energy performance towards nearly zero-energy buildings.

Even though the possibilities for energy improvements seem to be considerable, national statistics shows only a small (about 10-15%) energy improvement in the non-residential sector from 1995 to 2002 in Sweden and thereafter until 2010 the energy use has more or less been stable (Statistics Sweden). The question why greater improvements have not been performed were raised within the BELOK group. BELOK is a network connected to the Swedish Energy Agency with 20 large Swedish non-residential real estate owners, whom in total manage about 25 percent of the Swedish non-residential building stock (about 35 million square meters).

Interviews with the BELOK group showed that the reasons why greater improvements have not been performed were, among others, that easy measures which were profitable in a short term, "the low hanging fruit", had already been carried out. Additionally, there were no coordination of energy efficiency improvements within ordinary renovation. Also, there seemed to be a misunderstanding about the connection between saved energy in kWh and profitability in the communication between the technical department and the economical department. In practice, this meant that if the measures were to be carried out, they had to comply with the property owner's or the client's terms and conditions for long–term investments, and the technical department didn´t know how to present that.

The decisions were often based on profitability of single measures, whereas the feasibility was often evaluated with simple financial methods, which did not take into account the whole life costs of the total investment and rarely the changes in energy prices. With this approach, only the very profitable measures were commonly considered and carried out, "the low hanging fruits", while a number of possible measures with great energy saving potential were overlooked. It was realized that another kind of financial method was needed and a new and innovative working method was developed, called the Total Concept, which considers profitability of a package of measures taking into account economic lifetime of different energy efficiency measures. The Total Concept method aims to present how it can be possible to go further with more measures carried out and still meet the profitability expectations set by the building owner.

A NORTHERN EUROPEAN COOPERATION PROJECT

Total Concept includes economic realities a building owner has to take into account, while at the same time increasing the ambitions and making it possible to come much further with improving buildings' energy performance.

Because of the successful results of the Total Concept method implementation in Sweden, a cooperation project has been performed between five northern European countries. The aim has been to test, promote and further develop the Total Concept method and adopt it to the national conditions in Denmark, Finland, Estonia, Norway and Sweden. The reason why the action focused on countries in northern Europe is that they have similar needs in terms of climate conditions, technical solutions and policy strategies to adopt energy efficiency measures in existing non-residential buildings. The project run from April 2014 to March 2017.

THE TOTAL CONCEPT PROJECT AIMED TO:

Open up new opportunities for property owners to carry out major energy efficiency renovation in a profitable way and thus create a market driver for major renovation of existing buildings towards Nearly Zero-Energy Buildings.

Resolve one of the main non-technical barriers for finding economically profitable solutions for investments for energy performance improvements in the non-residential building sector.

Increase awareness and competence among different stakeholders to continuously work with the energy issues related to the building performance on both short and long term scale.

THE TOTAL CONCEPT METHOD

The Total Concept is a method for improving energy performance in existing non-residential buildings with the aim of assuring maximum energy savings in a profitable way. By applying a comprehensive approach, accurate investment & return forecasts and close follow-up, the Total Concept provides a reliable way to take informed decisions on your buildings' future. The Total Concept method presents the financial potential of energy efficiency.

The method is based on an action plan comprising a package of measures that as a whole fulfils the property owner's profitability requirements.

When forming the action package both the single cost-efficient measures ("low hanging fruits") and the costlier measures are considered. From an economic point of view, the single cost-efficient measures are related to and support the costlier measures. This way of working has shown that total energy savings of up to 50% are possible.

In order to make sure that the expected savings will actually be reached, a systematic approach is important throughout the entire building process of the energy efficiency renovation. The work process is structured into three main steps.

1

CREATING THE ACTION PACKAGE

Includes a comprehensive inventory in the building to identify all conceivable energy saving measures, whereas the data from the energy certificates can be used as a starting point. Various calculations and an analysis based on the compiled data lead to a profitable action package and provide an informed basis on which the owner of the building can make decisions.

2

CARRYING OUT THE MEASURES

The energy saving measures in the action package are carried out. The focus here is on the quality of the work and on making sure that the designed intent will lead to the expected energy savings. The functional and performance checks are significant in order to reach the expected results.

3

FOLLOW-UP

Involves measuring and checking procedures to ensure that the expected result has been achieved. The energy use during at least one year after renovations is compared to the energy use before implementation of the action package. Profitability results are checked.

THE ECONOMIC PRINCIPLES OF THE TOTAL CONCEPT METHOD

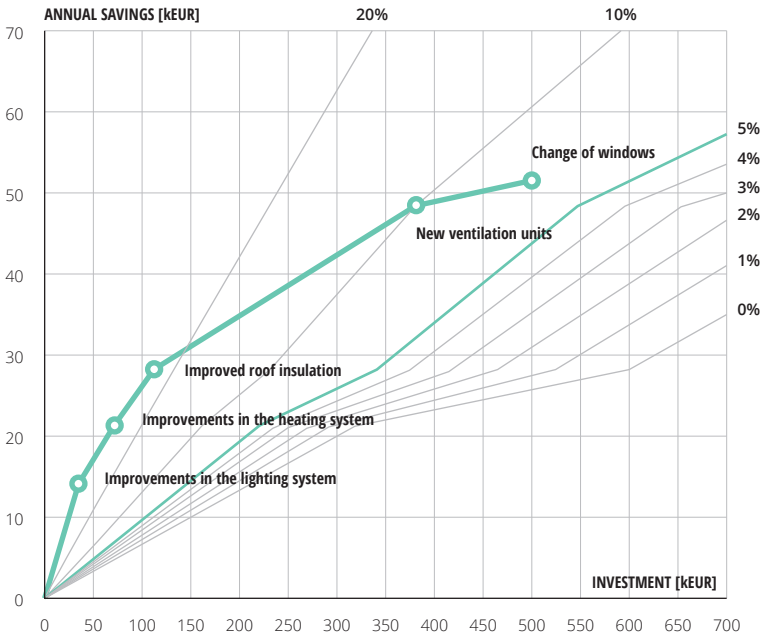
The profitability assessment in the Total Concept method is based on internal rate of return method, where each investment is assessed by the actual yields that it creates, expressed as an internal rate of return.

The action package is formed by arranging the different energy saving measures according to their profitability and calculating a common internal rate of return for a number of simultaneous measures, taking into account also possible future changes in energy prices and the specific lifetime of each measure. The criterion for how many measures are included to the action package is that the internal rate of return of the action package in its entirety is higher than the stipulated real calculation interest rate by the property owner.

This calculation can be easily done with the Total Concept tool, called 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. Every identified energy saving 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 the investment. In the example shown in the figure below the action package comprises five energy saving measures. The profitability requirement is here set as minimum 5% interest rate.

The complete action package in this example 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 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%.

INTERNAL RATE OF RETURN



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.

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 cost-efficient way.

WHO BENEFITS OF THE TOTAL CONCEPT?

The Total Concept method is aimed at stakeholders and actors in the property and construction sector who want to obtain benefits of major energy savings in existing non-residential buildings. Equally, these stakeholders and actors will need to be looking for attractive financial returns in the renovation of this type of property.

The benefits are financial, technical, comfort-related, carbon reduction and business opportunities for the following actors:

OWNERS AND ADMINISTRATORS

Owners and administrators of non-residential buildings used for offices, health care, shopping malls, administration, trade, schools and similar public purposes.

ADVISORS

Technical and financial advisors of the client and energy consultants, design engineers and architects who work professionally with the planning, auditing, calculations, analyses and design of these non-residential buildings, which are a presupposition for using the method and its associated tools.

COMPANIES AND DEVELOPERS

Large entrepreneur companies and developers of existing non-residential buildings who execute the construction work for the client or are able to use the concept directly in their own companies.

PUBLIC AUTHORITIES

Those public authorities who are responsible for the political, legal and financial frameworks for national energy-saving efforts.

Total Concept offers a method and a financial tool that can provide the information required by establishing an informed platform for decisions about investments in energy-saving measures.

WHAT CAN THE TOTAL CONCEPT PROVIDE FOR YOU?

MAXIMUM ENERGY SAVINGS

Achieve maximum energy savings in a profitable way through a systematic approach in order to identify the energy saving action package that suits best to your yield requirements.

BETTER BUILDINGS

Create better buildings for higher revenues by improving the overall quality of the building. You save energy costs, raise property value and enhance tenants' satisfaction! Total Concept can preferably be embedded in a wider renovation process.

ECONOMIC TOOL

Get an economic tool that is easy to understand and that reflects the actual yield of your investment, expressed as its internal rate of return. With the Total Concept Tool it is easy to identify an optimal renovation package, considering also upcoming energy price fluctuations and the specific service time of individual measures.

SECURE INVESTMENTS

Secure your investments in energy renovations through a comprehensive approach, including in-depth energy auditing, close follow-up through renovation process and in operation. Clearly defined working structures and responsibilities ensure that your targets are reached.

BETTER BUILDINGS

View the full potential with additional investments. A baseline is evaluated for your building in order to distinguish energy saving measures from required building maintenance. With the baseline, you can see how small additional investments in energy savings can provide high returns.

PILOT BUILDINGS

The Total Concept method has been implemented in twelve pilot studies, in five north European countries. Results after each step of the Total Concept method have been analysed regarding energy savings and cost effectiveness and experiences from the working process have been collected with interviews and questionnaires.

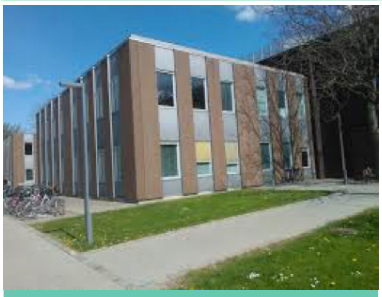
Description of the pilot buildings

		Country	Year built	Previous renovation	Heated floor area (m²)	Building owner
Office Buildings	Town hall of Ballerup	Denmark	1975	Major renovation in 2011	16 312	Ballerup municipality
	Lyngby Port	Denmark	1992	–	20 630	Nordea ejendomme
	Gonsiori	Estonia	1951	Windows/ insulated roof/ ventilation system	6797	State Real Estate Ltd
	Kiriku	Estonia	1900	–	1877	State Real Estate Ltd
	Steinkjer	Norway	1967, 1976, 1984	No larger renovation	4330	Statsbygg
	Högsbo	Sweden	1982, 1986	1993/ 1998	14 543	Harry Sjögren AB
School Buildings	Pärnu school	Estonia	1979	Windows	8 184	Pärnu City
	Kaarstad University	Norway	1922, 1982	New extension in 1982 incl. some renovation in the old building	2800	Statsbygg
	Segevång school	Sweden	1962, 2008	–	5 386	Malmö Municipality
Other buildings	Oulu Centre, health care	Finland	1933	1980: Major renovation 2005: HVAC 2009: New windows and doors	5 303	City of Oulu
	Tampere Hall, congress center	Finland	1990	Smaller renovations incl. cooling system and change to district heating	28357	City of Tampere
	Norrtälje Prison, Criminal institution	Sweden	1958	2002	8 030	Specialfastigheter

MEASURES PERFORMED IN PILOT BUILDINGS

Twelve pilot studies performed step 1 of the Total Concept method. Out of them three buildings performed step 2 and five buildings performed all three steps within the project frame of three years. In the Table below a short description of the energy efficiency measures for each pilot are given together with the results with achieved energy reduction and profitability for the final step performed.

Summary of measures and results

Pilot building	Measures carried out/ planned	Description of measures	Results
 Town hall of Ballerup (DK)	0/3	The following measures are planned: • Exchanging windows • Optimization of BMS system, including heating, lighting, ventilation and solar shading • Photovoltaic	After step 1: Reduced energy use: 37% Internal rate of return: 11%
 Lyngby Port (DK)	4/7	• Ventilators replaced • Extra insulation in the shaft ducts • New BMS system • New cooling system. Converting to district heating and solar panels are planned in spring 2017. The last measure - PIR sensors in the toilets might be implemented.	After step 3: Reduced energy use: 15% Internal rate of return: 4%
 Gonsiori (EE)	2/8	• New windows • new lighting system Because building is planned to be sold in 2018, the owner was interested only in doing measures which could help to increase indoor climate and decrease complaints.	After step 3: Reduced energy use: 4% Internal rate of return: 0%
 Kiriku (EE)	7/7	•Adjustment of heating curve •Insulation of the attic floor •New circulation pumps •Ventilation system with heat recovery •New windows •Insulation of ground slab •New T5 lighting	After step 3: Reduced energy use: 29% Internal rate of return: 0%

TOTAL CONCEPT

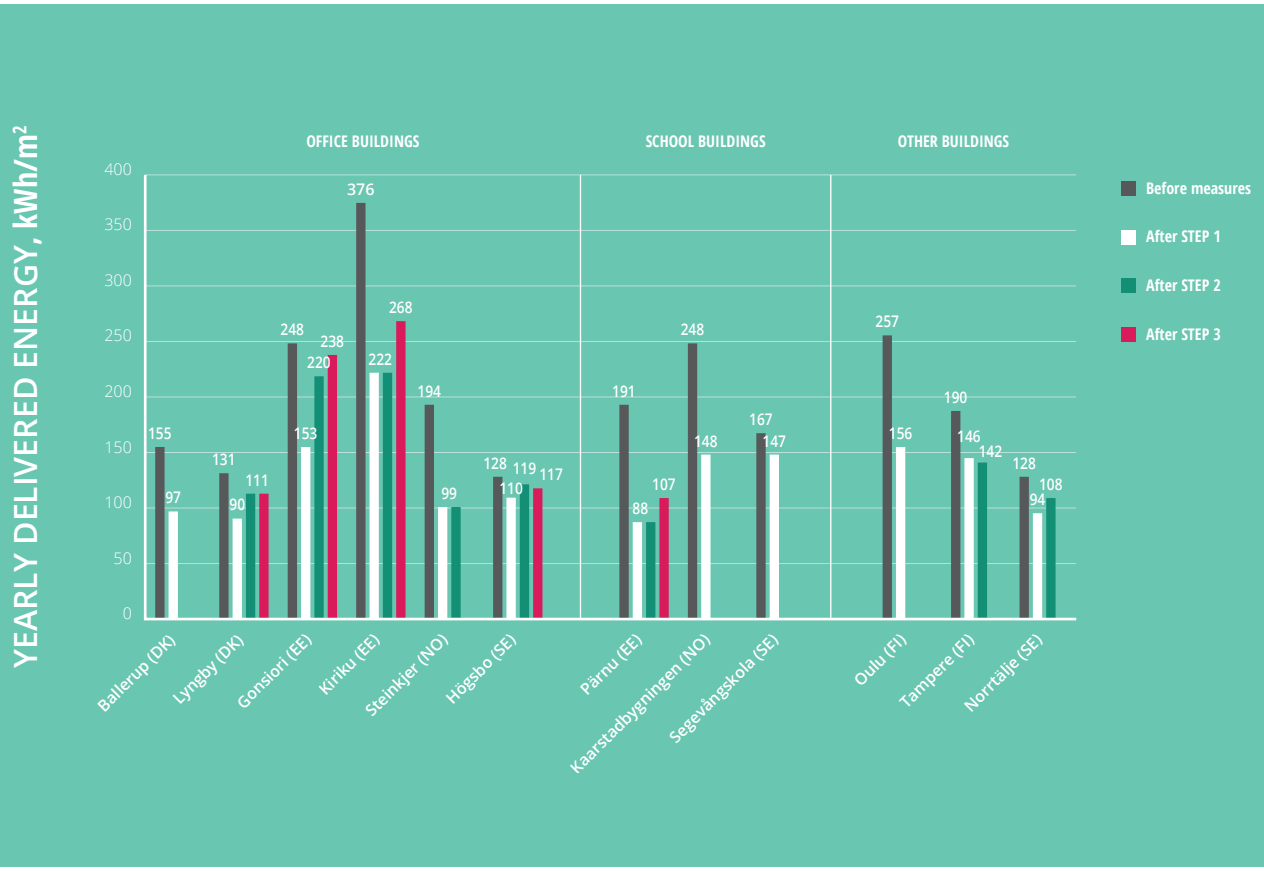
Pilot building	Measures carried out/ planned	Description of measures	Results
 Road office Steinkjer (N)	6/6	• Insulation added to walls • Insulation added to roof. • Windows and doors replaced. • Upgraded the ventilation system. • Upgraded the artificial lighting to demand controlled LED. • Replaced the air/water head pump with a ground source heat pump.	After step 2: Reduced energy use: 49% Internal rate of return: 8%
 Högsbo office building (S)	5/6	• New ventilation unit installed in Section C • New VAV-dampers installed in Section C. • Chiller replaced in Section D. • Heat system pumps replaced in Section D • Hydronic balancing added to heating system in Section D.	After step 3: Reduced energy use: 9% Internal rate of return: 8%
 Pärnu school (EE)	6/6	• New ventilation system • District heating as a heat source for ventilation • New heating systems • Lower SFP • Insulation of whole building envelope • Energy efficient lighting system	After step 3: Reduced energy use: 44% Internal rate of return: 7%
 Kaarstad building (N)	0/5	The following measures are planned: • Replace radiators and new thermostatic valves • Façade insulation • Roof insulation • Demand controlled ventilation • Occupancy controlled lighting	After step 1: Reduced energy use: 40% Internal rate of return: 6%
 Segevång school (S)	0/11	The following measures are planned: • Optimizing the ventilation system • New thermostats and hydronic balancing of the heating systems • Occupancy controlled lighting • Demand controlled ventilation with heat recovery • Energy efficient tap water fixtures	After step 1: Reduced energy use: 12% Internal rate of return: 2%

TOTAL CONCEPT

Pilot building	Measures carried out/ planned	Description of measures	Results
 Oulu Centre (FIN)	0/5-8	The following measures are identified in a profitable action package: • ventilation with heat recovery • temperature controllers • efficient fans • LED lighting • New faucets	After step 3: Reduced energy use: 29% Internal rate of return: 0%
 Tampere Hall (FIN)	5/7	• Replaced southern glass wall in the hallway • Replaced northern glass wall • New lighting system • Installed efficient heating system in the Moomin museum • Installation of heat recovery in the kitchen AC The package will be executed in three parts.	After step 3: Reduced energy use: 29% Internal rate of return: 0%
 Norrtälje Criminal institution (S)	2/5	• Four out of five large doors replaced • Lighting system in smaller areas replaced, ongoing in bigger areas Improved comfort ventilation with reduced airflows, extra insulation on facades and improved process ventilation will be implemented later.	After step 3: Reduced energy use: 29% Internal rate of return: 0%

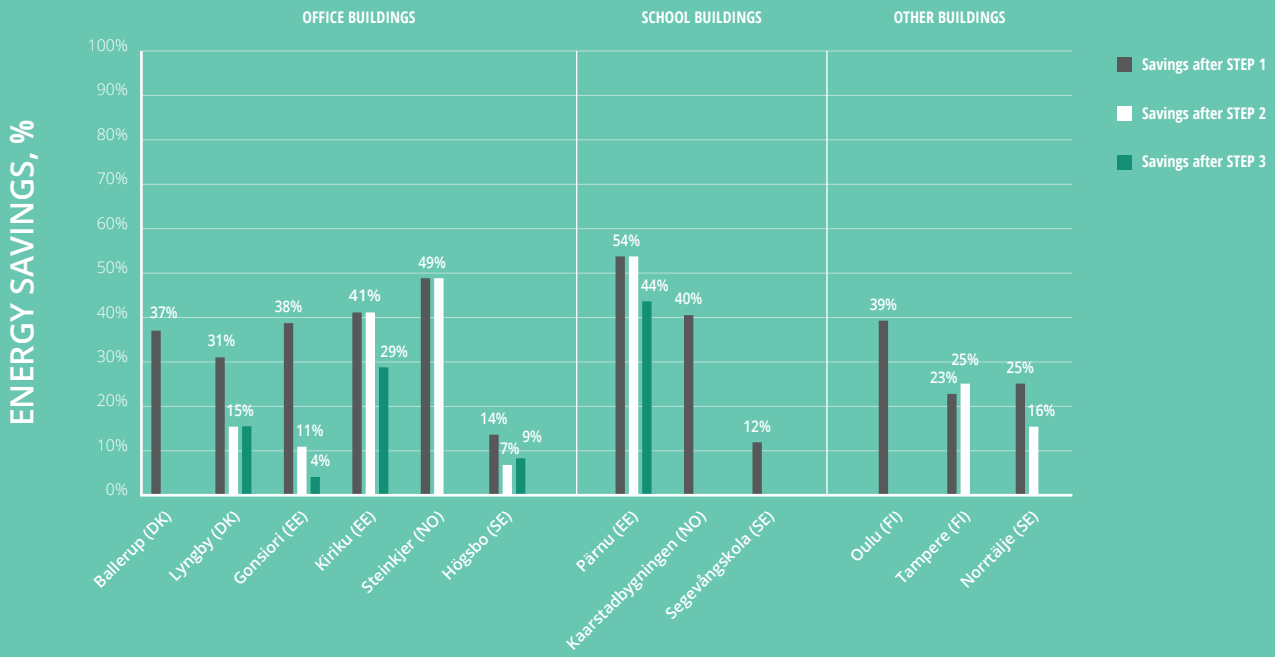
MAIN RESULTS

The diagram below summarizes energy use in the pilot buildings before the implementation of the energy saving measures (baseline), outcomes of Step 1 (after planned measures) and outcomes after step 2 and 3 (actual implementation of measures).



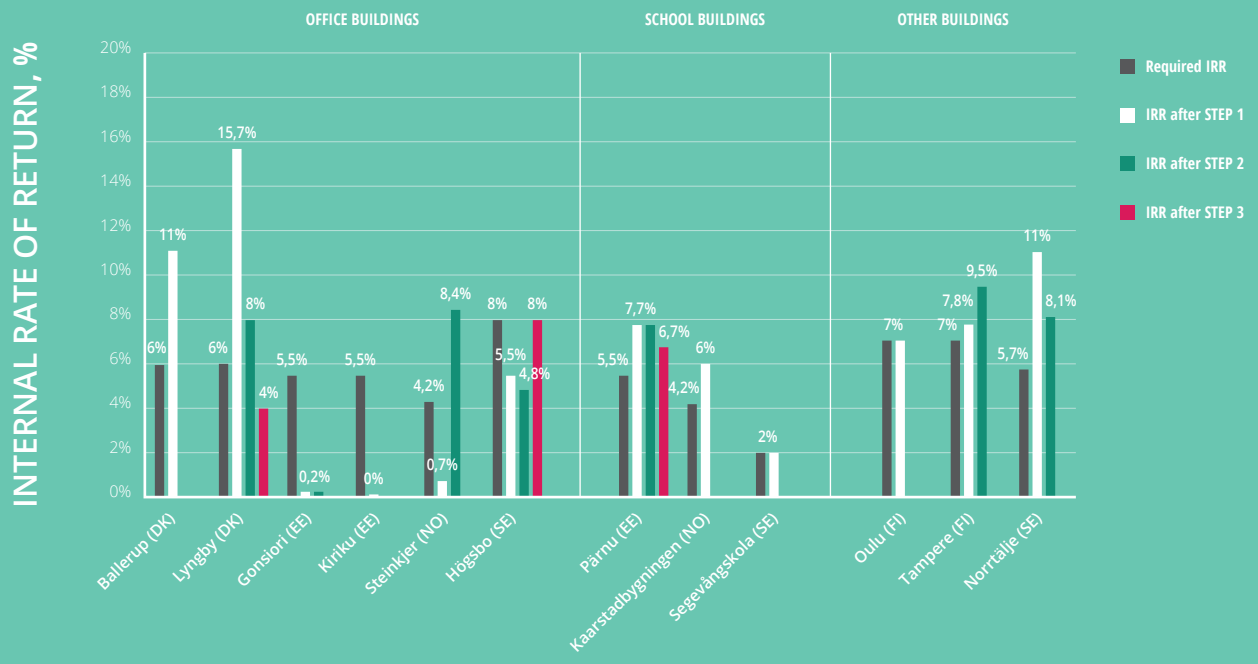
The estimations after Step 1 and Step 2 are shown in order to illustrate the changes after the renovation process. The average reduction in the yearly delivered energy use after Step 1 was 70 kWh per square meter and the average reduction after Step 2 was 60 kWh per square meter. The difference occurred because not all of the initially planned measures have been carried out yet. The measured energy use data for one-year period after renovation (after Step 3) is available for five pilot buildings with an average yearly reduction of about 47 kWh per square meter. There are different reasons for the deviation between the estimated and measured energy use, for example that the performance of the systems had not yet been adjusted accordingly or indoor temperatures were higher than design values.

THE REDUCTION OF DELIVERED ENERGY IN PERCENTAGES



The average estimated energy savings of the pilot buildings after Step 1 was 34% and the estimated savings after Step 2 was 27%.

REQUIRED AND REACHED INTERNAL RATE OF RETURN (IRR)



The results show that the profitability requirements were different in different countries, and were usually similar for the pilot buildings in the same country. In some cases, the internal rate or return (IRR) of an action package formed in Step 1 was lower than the initial requirement set by the building owner. In those cases, profitability is not the primary goal for the building owner. Other aspects were taken into account in the decision-making process: the building owner decided to do more renovation work than initially planned (Högsbo, Sweden); the building needed major renovation (Kiriku, Estonia); or renovation work was needed because of the poor indoor climate and tenants' complaints (Gonsiori, Estonia).

The differences in the estimated profitability of an action package between Step 1 and Step 2 is caused by the measures that were not carried out or due to more accurate construction cost data becoming available after Step 2. In Step 1, construction costs are estimated based on previous experiences and/or tenders. Actual construction costs will be available after the tendering process in Step 2 has been carried out.

LESSONS LEARNED

The experiences from the project consortium after implementing the Total Concept method in twelve pilot studies in five Northern European countries are presented below.

ENERGY EFFICIENCY IMPROVEMENTS NEED TO BE A PART OF OTHER RENOVATIONS

Energy use of the building itself is often not the driving force for the building owner to undertake renovation works. Energy prices alone are currently too low to be market drivers for saving initiatives. The main reasons are changes in the building use, change of tenants and problems with indoor climate. All of these reasons affect the choice of measures and methods for renovation work and thereby the expected profitability of the renovation project.

When renovation is planned for other reasons than just improving energy efficiency, it provides an outstanding opportunity to carry out a number of energy efficiency measures in a cost-efficient way. When replacement of systems is needed because of wear down or maintenance reasons then additional cost for choosing products that lead to better energy performance is often small compared to standard products. In the profitability calculations only the cost of upgrading from standard system to a very energy efficient system is taken into account. This approach is applied in the Total concept method, where the costs for energy efficiency improvements and upgrading the building are separated. This is an effective way to make the financial benefits with the energy efficiency improvements visible.

TO DETERMINE THE STATUS OF A BUILDING CAN BE CHALLENGING

Energy meters are often installed in order to debiting and divide energy costs between tenants, not to analyse the building's energy use. Furthermore, in many buildings, there may be only one energy meter for heating and another one for electricity. Therefore, it can be very difficult to determine the status of a buildings energy use during auditing, especially in buildings with different usage profiles. Therefore, installing additional sub-meters for energy use monitoring before starting the pre-study phase, Step 1 in the Total Concept method, is useful for more accurate energy saving calculations for the package of energy efficiency measures.

The evaluation of indoor climate and operating conditions of building services systems is also important. Reliable input data, e.g. operating hours, indoor climate conditions, possible changes of tenants, that is gathered during energy auditing, is crucial for achieving the expected results. Experiences from pilot buildings showed that in some buildings main reasons for not achieving the expected energy use were higher indoor temperatures than designed, longer operating hours of ventilation systems and inadequate control of the service systems. This means that monitoring of the service systems and indoor climate conditions may be needed during the energy auditing process in order to establish the correct baseline conditions.

GOOD QUALITY OF INPUT DATA TAKES RESOURCES

The survey results show that Step 1 in the pilot studies of the Total Concept project took a considerable amount of time (between 150 and 370 hours per project). One important reason for this was that for most of the participants these pilot cases were also study projects and they had no previous experience of the method.

For assuring the quality of outcomes Step 1 requires somewhat more effort when carrying out an energy audit (interviews with buildings owners, on-site surveys, collection of drawings, indoor climate measurements) and when putting together the action packages (energy simulations, investment cost estimations, economic calculations). The time for this process can probably not be significantly reduced because a number of pilot projects showed that one of the reasons for the differences between the calculated and measured energy consumption were wrong estimations and inadequate data. Step 1 is an especially complex task in buildings where there is no fixed user profile, the building services systems are controlled on daily basis by maintenance staff and when there is no sub-meters. Also carrying out Step 1 in a very large and complex building can be very time consuming and sometimes a less accuracy need to be accepted. This has to be taken into account beforehand and clearly communicated to building owners when planning to use the method in very large buildings.

A CORRECT BASELINE IS NEEDED IN ORDER TO SHOW IMPROVEMENTS IN INDOOR CLIMATE

In the Total Concept method, it is crucial to define a base case (baseline) with which the savings are compared to. The baseline is defined as a reference level for the energy saving measures, i.e. the energy performance of the building prior to the retrofit, which also takes into account that the minimum functional requirements for a building must be fulfilled. Existing energy measurements is normally used as a baseline to evaluate the impact of package of energy saving measures. However, if for example minimum requirements on indoor climate are not fulfilled, the property owner plans to increase the area rented out or increase the occupancy in the buildings, then the energy use before renovation does not correctly reflect the potential and impact of the energy saving measures.

It is important to prepare arguments for a building owner of other benefits that the energy renovation gives, for example improving indoor climate and quality of a building. While making an energy audit in Step 1, it is advised to schedule a workshop with the persons responsible for facility management to discuss the current situation with a building, collected data and controlling/BMS principles and to agree upon how the baseline will be set.

Energy savings that are expressed only in percentages can sometimes also be misleading and therefore energy efficiency improvements should also be evaluated based on the saved energy use per square meter. A small percentage of saving in a building that uses much energy can be as effective as a large reduction in percentages in already an energy efficient building.

THE VISUALIZATION OF PROFITABILITY ON AN INTERNAL RATE OF RETURN DIAGRAM HELPS TO CONVINCE BUILDING OWNERS

It can be challenging to convince building owners to use the method in the first place. Especially since the method is new and there are no local references. However, for those organisations that have chosen to test the method the results have been found to be useful and easily understandable. The building owners of the pilot projects have been convinced of the benefits that the method provides and they also use the tool to convince their tenants when needed.

The main strength of the Total Concept method is that it provides good basis for decision making and communication. Especially the profitability of an action package visualized on an internal rate of return diagram is much appreciated. The main benefit according to the technical departments of the real estate companies involved, is that the method has given them means to be able to convince the finance departments and the top management in the company to take decisions on larger investments for energy improvements.

THE TOTAL CONCEPT METHOD IS FLEXIBLE

It can sometimes be challenging to make the building owners to carry out the complete package of measures. However, if for some reason, it is not possible to do all measures at once then the Total Concept method provides a benefit to do a renovation plan for the next years, making it still possible for the complete package to be carried out.

Another important aspect to take into account is that sometimes it is not possible to move the tenants and renovate the entire building at once. The building owners often need to continue using at least some parts of the building. This means that carrying out the action package must be done through step-by-step renovation process, dividing the package into suitable smaller packages that can be executed at different times without disturbing the everyday use of the building.

A DETAILED FOLLOW UP IS CRUCIAL IN ENERGY EFFICIENCY RENOVATION

Renovation is often a long process with changes and fine tunings during the entire process. Adjustments in energy and profitability calculations need to be made throughout the entire process when more accurate input data becomes available. Shortcomings in commissioning and verification processes are often leading to non-compliance with designed energy savings. Verification procedures with detailed follow-up are part of the Total Concept method, which helps to reduce the risk of not achieving the expected outcomes. This is an important benefit for the property owners that need reliable results. A follow-up period including adjustments in control and operation of building services systems are needed at least once a year after the renovation work is completed.

EXPECTED SAVINGS

The average estimated energy savings in the pilot buildings after Step 1 was about 34% and after updates in Step 2 about 27%. The initial energy saving target in this project was about 50%. This was achieved only in one pilot building and one possible explanation to this is that energy savings are largely dependent on the starting point of energy use before renovation. Most of the pilot buildings already had a reasonably good energy performance. Several building owners already had performed some of the easy measures, "the low hanging fruit", which lead to difficulties to further decrease the energy use in a cost-efficient way. On the other hand, it was also noticed that the demands from the building users' side are increasing. More and more tenants require that the premises they rent or use should have a low environmental footprint, i.e. low energy use.

THE METHOD IS EASY TO ADOPT TO DIFFERENT NATIONAL CONDITIONS

There were no significant differences in the national conditions of the participating countries. There were no technical or legal obstacles to implement the Total Concept method. Technical solutions are similar and minimum energy efficiency requirements in national legislations do not restrict the adoption of the method. Some countries have component-based energy efficiency requirements in their buildings regulations that may affect the choice of energy efficiency measures. Measures related to the building envelope are more profitable for example in Estonia compared to Sweden, since the starting point is much different. Energy prices differ between the five countries and Denmark has significantly higher electricity prices than other participating countries. This makes on-site renewable energy production a profitable measure in Denmark. Only Sweden uses power tariffs (€/kW), which is an added value to total cost savings for several measures.

One of the important benefits of the Total concept method is that it gives a good overview of the status of a building and provides a good basis for decision making also for other aspects than energy, for example maintenance planning.

The project also identified the main barriers for major energy efficiency renovations to be non-technical barriers, for example low energy prices, lack of interest from the property owner's side, tenant and owner relationships, knowledge and awareness among stakeholders. The Total Concept method helps to overcome a number of these barriers.

NEW METHODS NEED PROMOTION AND TRAINING

Implementation of the method in different countries showed that good examples with measured outcomes are needed in order to make property owners interested. Only estimated savings based on the energy audits was not enough to make method interesting for the decision makers. One important prerequisite for successful projects is training of the energy consultants and involvement of property owners. Involvement of local authorities to fulfil the directive of energy performance of buildings can also create an important market drive.

Good training courses are important for new actors to start to use the method. However, experienced energy consultants are not always easily willing to adopt new methods as they already have their own systems and methods in place. Therefore, it is recommended in the future to introduce the method already on a university level and for energy auditors new in the field in order to increase the number of energy consultants who are using the Total Concept method.

RECOMMENDATIONS FOR FUTURE DEVELOPMENT

In the pilot studies part of this project, the method was mainly used for identifying measures for energy efficiency improvements. The method can also be used to promote and evaluate the measures for on-site renewable energy production. On-site renewable energy production reduces energy need from the grid and therefore reduces energy costs for the building owner. Calculation of the internal rate of return shows if the on-site renewable energy production is reasonable or not from the economic perspective.

It should also be noted that the Total Concept method helps to organise the energy efficiency work among different stake holders and key actors. However, the results are totally dependent on the persons involved in the process and their ambitions to follow the method and to give feedback with their experiences so that the method can be continually improved.

SUCCESS STORIES

The Total Concept method has been demonstrated in five countries. The results show that the method can be an effective tool within both decision making of size of renovation, to show indoor environment improvement benefits and to make sure that designed energy performance will be reached in the operation phase. Here some testimonials from the people that have used the Total Concept method.

Lennart Lifvenhjelm
Vasakronan, Sweden

"It has been clearly profitable to work with Total Concept. We reduced energy consumption from 287 to 124 kWh per m² per year and got an internal rate of return on 15%. We use the experiences from this case in a major rebuilding project, Klara C, in Stockholm, where the goal is 55 kWh per m² per year and LEED Platinum certification.

Total Concept is the right tool to use because of the holistic approach including construction, installation and economic rationales."

Mads Mysen
SINTEF, Norway

"With the Total Concept method, we got a totally new tool there we could show our client, Statsbygg, that the cost benefits with going from an ordinary renovation to set the goals for passive house standard."

Nikolaj Haaning
Ramboll, Denmark

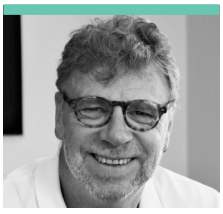
"The Total Concept has shown to be a good complement to offer our clients besides ordinary Energy Performance Contracting."

Tytti Bruce
Bionova, Finland

"Our pilot building in the EU-project showed us many challenges since it is very large and complex. This makes the step 1 of the Total Concept, the development of a package of measures, quite expensive. However, the pilot project owners have been convinced and they use the tool to convince their tenants. And they have already ordered their next project."

Mikk Maivel
State Real Estate Ltd.,Estonia

"We have now used the Total Concept for three of our renovation projects and we find the tool useful and communicative. Therefore, we have ordered step 1, package of measures proposal, for a number of more buildings."



Graves Simonsen
Danish Association of Construction Clients

"It is not easy to convince our members to use new methods or tools and therefore it is necessary to work with national demonstration projects first as we have done in the IEE project. But it is also a matter of timing and coordination with other national initiatives. The Danish Energy Agency has e.g. taken an initiative to develop an official guide (standard) for the implementation of energy retrofit projects in larger buildings, where the principles of Total Concept will be one of the reference methods. This will promote the use of Total Concept method and expectedly encourage professional building owners and consultants to use the method. The new guide will be published in June 2017."

Åsa Wahlström
CIT Energy Management, Sweden

"The method is more and more commonly used in Sweden. Last week I meet the energy controller of Västerås Municipality that told me that they have 20 projects ongoing. A brief investigation on the extension of the use of the Total Concept method in Sweden shows that over 150, probably 200 projects are ongoing."

GUIDELINES & TOOLS

The project website **www.totalconcept.info** contains a number of guidelines and free tools, which guide through the planning and implementation of the energy-saving project.

THE GUIDELINES AND TOOLS INCLUDE:

The Guidebook for Implementation and Quality assurance, which provides detailed information about the Total Concept method and provides step-by-step guidelines about the practical implementation.

Checklists and templates for energy consultants for carrying out Step 1, as well as templates for measurement and follow-up in Step 3.

Checklists for the property owner/client for collecting Information about the property and creating tender documents, to be used in the tendering of Step 1 of the Total Concept method.

And finally, **the TotalTool software**, which are used to determine the profitability of the action package.

Training Courses:

Twenty-eight national training courses about the Total Concept method has been carried out as part of this project. The courses were targeting property owners, consultants, technology providers, design engineers, energy strategists, etc. The national training courses and seminars will continue also in the future. Contact your national partner for more information.

CONCLUSIONS

This project aimed to open up new opportunities for property owners to carry out major energy efficiency renovation in a profitable way and thus create a market driver for major renovation of existing buildings towards Nearly Zero-Energy Buildings. The aim was to resolve one of the main non-technical barriers by showing that investments for energy performance improvements in the non-residential building sector can be economically profitable. Total Concept method has now been successfully introduced and adapted to national conditions of each participating country and is ready to be implemented in the energy renovation process.

Total Concept is a well-structured method for improving energy efficiency in existing buildings, with clear profitability evaluation and following up on the results. This project helped to develop further the Total Concept method and tools needed for adapting it to different national conditions. Detailed information materials, national guidelines and a tool-kit is available in each participating country.

The method has been successfully introduced to the five Northern European countries demonstrating that energy savings up to 50% are possible. The outcomes from the pilot studies show that there are no significant differences in the national conditions of the participating countries to implement the Total Concept method.

For the method to be implemented on a larger scale it is important to increase awareness and competence among different stakeholders to continuously work with the energy issues related to the building performance on both short and long term scale. Good examples with measured outcomes are needed in order to make the property owners interested. Involvement of local authorities to fulfil the directive of energy performance of buildings can also create an important market drive.

An important prerequisite for successful projects is training the energy consultants and involvement of property owners. Within this project almost 500 stakeholders and key actors were trained and the method was introduced to more than 1500 key actors representing property owners, consultants, technology providers, design engineers, energy strategists, etc.. Now it is up to these stakeholders and key actors to start using the method and include energy efficiency improvements as natural part of their renovation plans.

PROJECT PARTNERS

CIT Energy Management, Sweden (Project coordinator)

Swedish Construction Clients (Byggherrarna)

The Danish Building Research Institute at Aalborg University

Danish Association of Construction Clients (Bygherreforeningen)

Rambøll, Denmark

State Real Estate Ltd (Riigi Kinnisvara AS), Estonia

Estonian Society of Heating and Ventilation Engineers (EKVÜ)

Bionova, Finland

SINTEF Byggforsk, Norway

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More information
www.totalconcept.info