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WP 4.1.2 Two models for Life Cycle Cost in Växjö, Sweden

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1. Background

The municipality of Växjö has decided to calculate life cycle costs as the basis for selection of measures for energy efficiency of their buildings. The two models being advocated at one of the municipal housing companies have been designed by "Belok," a Swedish networking and collaboration between the national Energy Agency and sixteen of the largest property owner with a focus on premises. The report will describe the two models and how the municipal officials have resonated in the municipality of Växjö on LCC in the selection of measures for energy efficiency. The content is based on free translation from the webpage of Belok and on discussions with officials in the municipal organization of Växjö.

2. The network ”Belok”

The Swedish Energy Agency started BELOK 2001. The mission is to be an objective part to foster development projects with energy efficiency and environmental issues as a common base among its members in their buildings. The results and experiences of the projects are published as reports on their web-page (www.belok.se) and are free to take part of. All companies in the industry, even those who are not members, can benefit from BELOKs work and results. The group's 16 members are all large property owners, both public and private.

40 percent of the energy consumption in Sweden originates from the real estate sector. BELOKs mission is to accelerate progress towards energy efficient buildings in pursuing development projects. The projects are about testing new approaches, tools, products and systems in reality with the members. An equally important task is to bring experience from the projects to the rest of the industry.

BELOK is an important factor for Sweden to reach the energy goals. "We have the leading property owners as members. We are a group that has great expertise and we can set standards, "says Per-Erik Nilsson, coordinator of BELOK.

The goal for the network is to get energy efficient systems and products on the market earlier than the case would have been otherwise. In parallel with increased energy efficiency, development projects also will improve the indoor environment in the premises and be economically viable. The projects are realized with sustainable economic calculations in the back and the tenants' comfort in the mind.

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3. Two models for financing energy efficiency measures

The first model described below, in figure 1, is a general model for calculating life cycle costs and can be used when there are options between alternative investments such as energy efficiency measures. It is also available as a calculation tool for different types of installations in buildings, where the calculation also requires taking into account the various specific parameters of the various installations. The second model, figure 2 and 3, gives an overall picture of the overall economic outcome of the various energy efficiency measures. You can, for instance, see which actions are profitable down to a certain cost of capital.

3.1 The model "Belok LCC"

The model Belok LCC is a tool for cost and energy calculations for alternative investments, known as life cycle costs. With the help of LCC, Life Cycle Cost, one can compare the cost of competing systems or equipment throughout their life cycle, the so-called life cycle cost. BELOK LCC is therefore an appropriate tool to use before making an investment. To make the calculations manageable, does the program exclude items that are not expected to affect the comparison.

BELOK LCC is produced for the following types of investments:
General calculation
Pumps
Fans
Filter
Illumination systems
Windows

BELOK LCC is web-based and free to use, (www.belok.se) but totally on the responsibility of the user. The picture below shows the so called general calculation. This program makes it possible to compare the life cycle costs for different investments in general. The other programs for e.g. pumps are formed for special conditions for that kind of gadget, in that case yearly total running time, power requirement and the factor for corrosion.

In the fields for conditions you decide the period of the calculation, the real cost of capital, current energy price and real annual energy price increase. The model is limited to compare three different alternatives. In the fields for capital costs you can choose investment costs and the economic value at the end of the calculation period for the three different alternatives. Other costs means the amount of energy yearly and the costs for maintenance yearly, which you can choose for the three different alternatives.

The chart to the right at the top of the figure shows the life cycle costs for the three different alternatives, where you to the left can see the specific life cycle costs for the energy demand. The bars in the middle indicate the life cycle costs for the maintenance. Finally the bars to the right in the figure show the total life cycle costs.

The chart to the right at the bottom of the figure shows the sensitivity analysis of the life cycle costs for different costs of capital, in this case from 2,1 % to 3,7 %. In this special case it is most advantageously, from an economic point of view, to select alternative 2, the green one, independent of the value of the cost of capital between 2,1 to 3,7 %. Another option is to look at the sensitivity analysis of the life cycle costs for different energy prices.

The equations, on which the charts are based, is available in the program, which means that the calculations are transparent and furthermore they are easy to understand. It is easy to get a fast response in the charts when changing one or several of the input values.

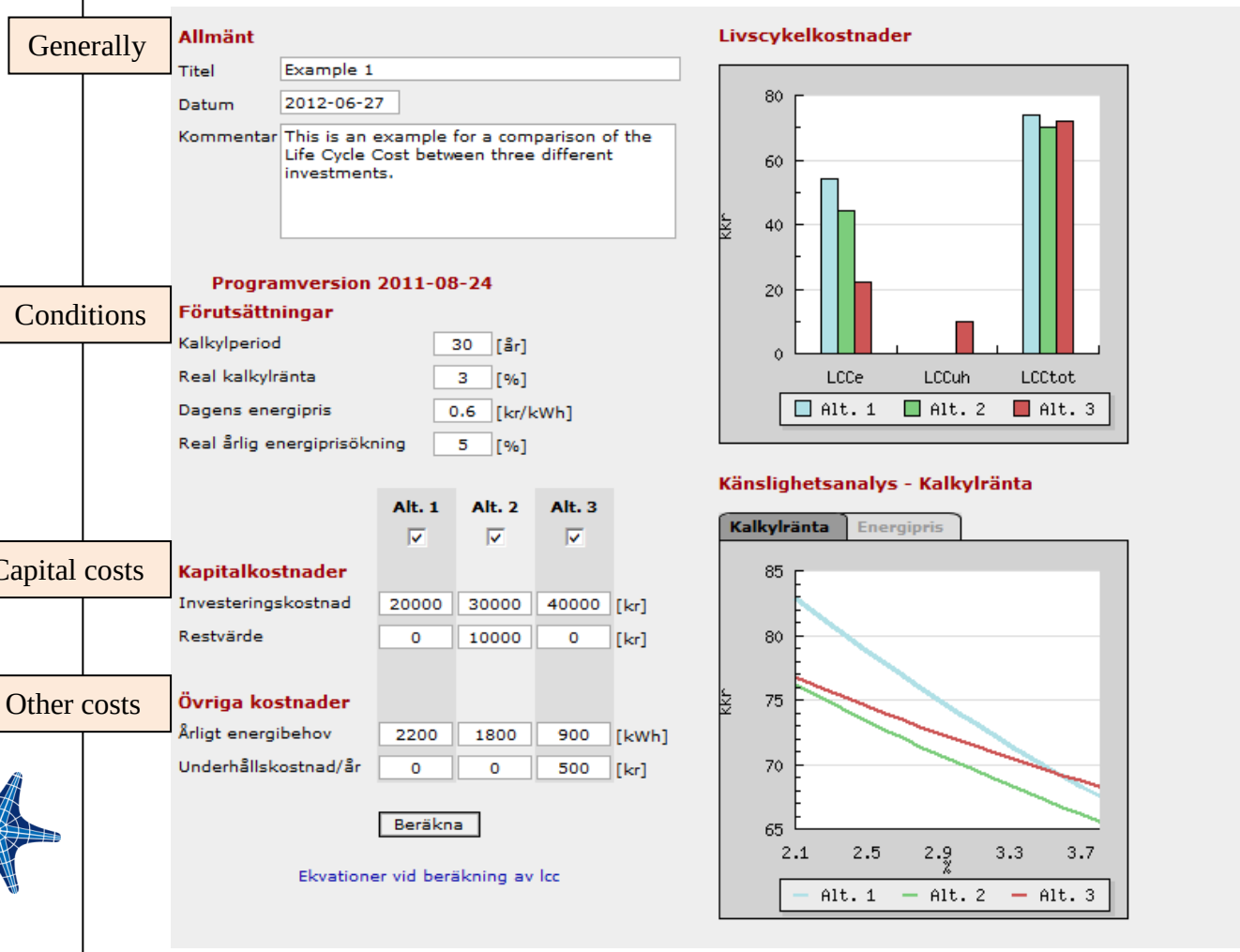

Figure 1: The model "Belok LCC"

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3.2 The model "Belok Totalverktyg"

For most of existing buildings you can, with little effort, identify a number of measures that can reduce energy requirements. Each action in itself provides some reduction of the
energy demand for a given cost. If you select and subsequently implement energy efficiency measures only from an energy-reduction most profitable point of view, the measures will be profitable, but from an energy perspective it will be a rather limited number of measures. If you instead are forming and implementing a package of measures, which together
meet the property owner's demands for investments profitability requirements, the decrease
of energy requirements will be substantial. This potential for energy demand reductions is the background for this tool, or model.

BELOK Totalverktyg (Totaltool) is a central part in the so called total-projects. The program is used in step 1, when you have identified all the possible energy saving measures in a building. The model calculates the financial outcome of the different actions as a base for the decision on implementation. BELOK Totaltools offers the internal rate of return in a graph with axes Investment - Annual cost savings. The prerequisite is that you have identified a number of energy saving measures in a building, and calculated both the investment required (€) and the value of energy savings that will be obtained (€ / year). For each measure comes to both the investment as the potential annual savings must be calculated according to that other measures also can affect them.

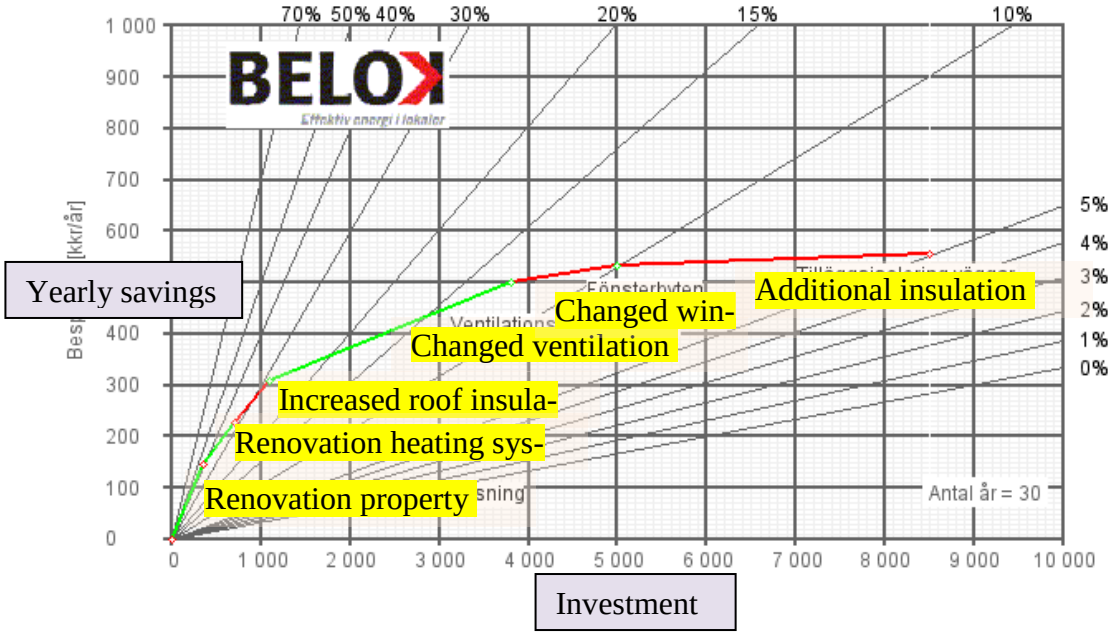

Figure 2: The model "Belok Totalverktyg"

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The economic outcome of different actions in figure 2 are calculated in other specific models. Figure 3 shows for instance the calculation for the action of changing windows. The economic outcome of this specific action is shown as one part of the line and is marked as “Changed windows” in figure 2. Renovation is the action which is most viable (steepest slope of the curve). The model is based on the time of service for 30 years. With a cost of capital of 5 percent, all the six different investments in figure 2 will be viable together. The property owners will hopefully be aware of the economically viable investings in more than not only the lowest hanging fruits.

In figure 3 you can see that the action of changing windows costs 1 200 000 SEK, the saving on electricity is 1 MWh/year, the saving on heat is 58 MWh/year, no savings on district heating and that the time in service is calculated for 40 years. You are also able to choose where in the specifik graph this action will be placed in figure 2. In this actual case we have choosen that the action, which is most viable (steepest slope) will be printed first, “Renovation property light”.

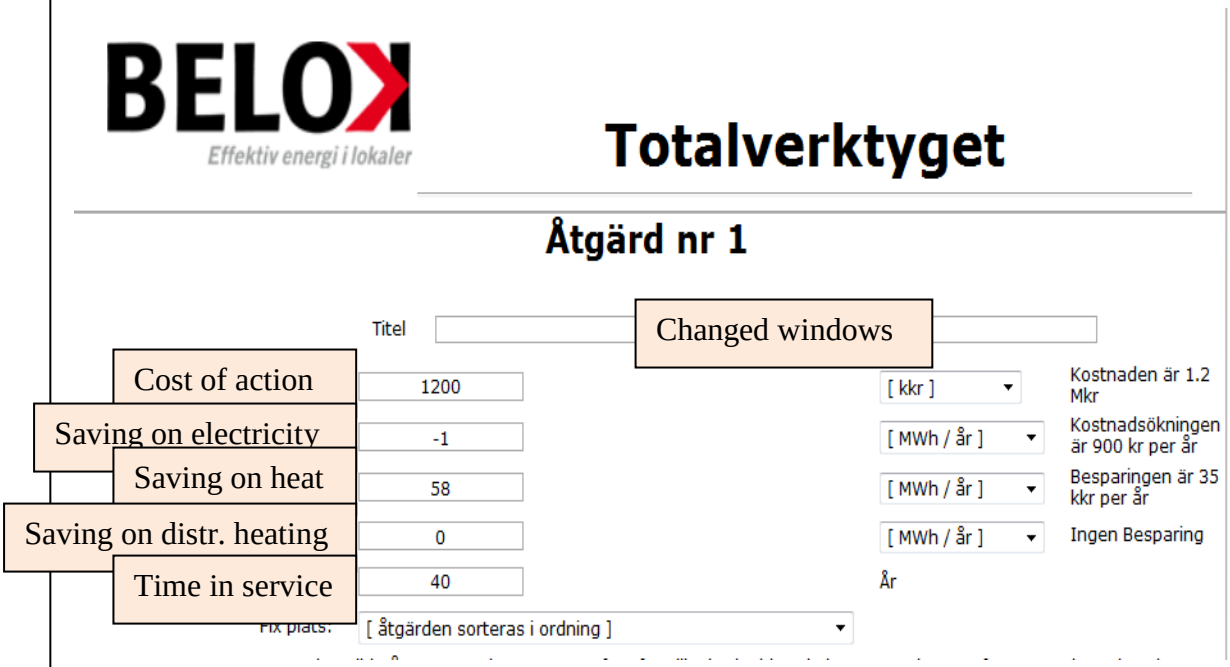

Figure 3: One example of the basic calculations for the model "Totalverktyg"

4. Implementation of the models in the municipality of Växjö?

The municipality of Växjö and its municipal corporations in recent years have increasingly begun to consider life cycle costs for different choices of new installa-

tions and renovations. This way of thinking is relatively new within the municipality and is not fully applied yet.
Växjö has developed an energyplan in 2012. An action listed is: "City of Växjö is investigating how renovation / rebuilding of homes and premises, with the aim of reducing energy use, more clearly will be done with a life cycle cost perspective," The energyplan for the municipality will provide a common municipal internal model, a model based on Beloks.

The following text is a summary of the interview done with Mr Bruno Birgersson, official in the municipality of Växjö working with energy efficiency measures in the official buildings for one municipal estate corporation (VöFAB). The interview was conducted on the 27th of June 2012.
There are decisions in this corporation that strives to focus on life cycle costs for new installations and renovations. Here is a statement from the internal text:
"VöFAB must use their own templates developed after Belok LCC web-based templates that are free to use. Ten calculation examples of these templates should be presented, where the environmental cost in terms of carbon-dioxide shall be presented separately."
Mr Birgersson appreciates the models produced by Belok. It is important that the models are quite simple and transparent in a big municipal organization with several municipal estate corporations. All equations for the basic calculations are available for all users. For most similar models, the basic calculations are not available. He appreciates the few parameters in the models, as well. It is important to make it possible to compare different proposed actions for the different corporations in the municipality. It makes it possible to learn from each other and to optimize the proposed actions for the most relevant corporation. In this case you may say “the easier model, the better”.
He explains the possibilities with the model, where it sets options for different measures against each other or one existing solution with an alternative. The sensitivity calculation is valuable. The graphical appearance appeals to him because it is easy to understand. In a large and complex organization with many professional groups involved, it is important that the model is easy to comprehend.

Mr Birgerssons opinion is that the models are used too little today, but there is a striving to use it more at his company, and then within the municipality as a whole. To optimize the advantages with such easy-comprehensive models, it is valuable that it will be used in the whole organization. The different municipal companies shall be free to extend the models to use for different professional groups or decision takers, when the models once have been introduced and applied in the organization. Many municipalities have gone further, in some cases with their own models. In this respect, Växjö is not a lead municipality.