

# Cost Optimal report<sup>1</sup> – introduction and summary in English

## Introduction

### The assignment

The government has given Boverket the assignment (N2012/2823/E) to retrieve material for the Swedish report of comparing calculations in consultation with Energimyndigheten (The Swedish energy agency) according to article 5 in the European parliament and council directive 2010/31/EU from the 19th of May 2010 on the energy performance of buildings about the energy performance of buildings. The purpose of the calculations is to investigate if the demand on energy management that occurs in the Swedish building legislation has cost optimal levels.

A progress report shall be accounted to the government at the latest the 15th of October 2012 and the finished report shall be presented to the government at the latest the 14th of December 2012.

The assignment in its entirety is presented in Enclosure 1.

### Implementation of the assignment

The practical work with answering the assignment started in August 2012 by formation of internal resources and identification of possible consult contribution that could be needed. Energimyndigheten (The Swedish energy agency) was contacted in this early phase for a meeting and run-through of the delimitations that was needed for the assignment. After that, the contact between the authorities has been frequent especially in times of establishment of the price of energy and expected energy price development. To compile the underlying information, Boverket has hired a small number of consultants (Enclosure 7). The consultants have been helpful with selecting and defining suitable reference houses together with contribution to CAD-drawings and technical material and advice in technical matters. One consultant has been hired to illustrate the established reference buildings and another consultant was hired to establish the costs for the different energy conservation measures that have been determined.

The work started with establishing suitable reference buildings that would constitute the base to make it possible to calculate if further energy conservation can be achieved with profitability. After that, energy calculations in all the cases with different measures that was to be tested

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<sup>1</sup> Boverket, Rapport 2013:2, Optimala kostnader för energieffektivisering, Dnr 502-2434/2012.

on each building, was initiated. After that, the costs of the energy saving measures were calculated. The energy calculations lead up to the economic analysis of each measure and package of measures. Boverket chose to carry out calculations with its own resources to gain time and to operate the work in its entirety.

During the working process a presentation was held during the autumn with Näringsdepartementet (the Ministry of Industry, Employment and Communication) which was represented by Fredrik von Malmberg at the meeting at the ministry. At the meeting the conditions for the implementation were reported, which Boverket and Energimyndigheten had agreed on and the time plan and the status in the project progression was accounted. Also the risks of the project was mentioned and evaluated.

The work has been operated according to the following basis and conditions. Calculations and analyses of the optimal cost levels for the demands on the energy usage in buildings are based on the conditions that are specified in the EU-commission delegated ordinance number 244/2012 (supplement to 2010/31/EU) and its belonging guidelines 2012/C 115/01.

Reference buildings have been defined for new buildings, one small house, one apartment block and one office. The buildings are representatives for each building category and implement the exact demands on energy management according to the building regulations of Boverket (BFS 2011:26), BBR 19. To estimate if the demand levels in BBR is cost optimal has energy usage and economic profitability been calculated for different varieties of each reference building where the building envelope isolation and size of the heat pump has been varied.

Two reference buildings have been defined for existing buildings in each building category; single-family dwelling apartment block and office. The reference buildings represent frequently occurring buildings when it comes to size and technical standard. After that, the buildings have been provided with different energy conservation measures to implement the demands of energy management on the occasion of renovation of a building according to BBR. To decide if these demand levels are cost optimal, the energy saving and the economical profitability has been calculated for energy conservation measures that is slightly lower than the demand level in BBR. These have later on been compared with measures that just about reaches up to the demanded level. After that, the value of the energy saving has been compared with the costs for the future investment for the energy conservation measure.

Calculations have been undertaken for the reference buildings which have electric heating or district heating. The reason why is because of the strict requirements on the buildings energy usage in BBR if the building has electric heating.

## Reading instructions

In segment 1 technical and economic starting-point for the accomplished calculations regarding energy usage and economical profitability is accounted. Demand levels for energy management according to BBR,

chosen limitations regarding reference buildings and energy conservation measures and price of energy, cost of capital and measure costs.

In segment 2 the results of generated, comparing calculations of cost optimal levels for minimum requirement regarding energy performance for buildings, is summarized.

In segment 3 detailed comparing calculations of cost optimal levels is accounted. The calculations contain measure costs and construction costs for each reference building.

In Enclosure 1-9 the assignment as a whole is accounted, EU-commission 2010/31/EU on the energy performance of buildings, constitution (EU) 244/2012 (supplement to 2010/31/EU), guidelines (EU) 2012/C 115/01, BBR segment 9 energy management, plans for chosen reference buildings, register of hired consultants, the energy price prognosis and a sensitivity analysis regarding the energy price development.

## Summary

The government has given Boverket, in consultation with Energimyndigheten (The Swedish energy agency), the assignment to bring foundation for the Swedish report of comparing calculations according to the EU-directive 2010 /31/EU on the energy performance of buildings. The purpose with the calculations is to investigate if the demands on energy management in the Swedish building code have cost optimal levels.

The EU-commission has in its guidelines (and by seminars in Brussels) given conditions for calculations of measures and profitability: A financial and macro economical calculation will be carried through, with specific interest rates, demands on sensitivity analyses etcetera, in purpose to accomplish comparativeness between the member states.

For new buildings, three reference buildings has been defined, one small house, one apartment block and an office. The buildings are representatives for each building category and fulfil the exact demands on energy management according to the building regulations of Boverket (BFS 2011:26), BBR 19. To decide of the demand levels in BBR is cost optimal the energy usage and economical profitability has been calculated for different variants of each reference building where the building envelope isolation, the heat-exchanger for ventilation and the size of the heat pump has been varied.

To existing buildings two reference buildings have been defined to each building category; small houses, apartment blocks and offices. The reference buildings represent buildings that frequently occur in matters of size and technical performance. After that, the buildings have been provided with different energy saving measures to fulfil the demands on energy management which is required, according to BBR, when renovation is performed to a building. To decide if these demand levels are cost optimal, the energy conservation and the economical profitability, has been calculated for the energy conservation measures that is a bit lower than the demand levels in BBR. These have later been

compared with measure that just about reaches up to the demand level. After that, the value of the energy conservation has been compared with the costs for the coming investment in the energy conservation measure.

The calculations have been carried through for reference buildings which have electric heating or district heating.

The method that has been used for the cost calculations is an investment calculation. All the costs for the tested measures and energy have been discounted to a current value and a life-cycle cost has been received. Quotations of prices to chosen measures have been obtained from an external construction calculation company. Prognosis over the price of energy for the period has been provided by Energimyndigheten. Indirect measure costs as costs for maintenance/repairation, service and possible fees for investments and energy efficiency measures has not been included in the calculations nor in the so-called developer's administrative costs.

Accounted measure for energy efficiency measures beyond the demands in BBR for new-built small houses shows that it is hard to reach the same profitability for these houses. This also concerns apartment blocks. For new-built offices, the calculations show that certain measure can be profitable.

On the occasion of renovation of a building the demand levels which appear of BBR has been used as reference levels in energy calculations. Accounted measures costs are therefore the further costs that emerge to reach beyond the reference level. The calculations for efficiency measures for small houses and apartment blocks show that it is difficult to reach profitability. On the occasion of renovation of an office buildings there are some measures where the calculations show good profitability.

In Enclosure 9, sensitivity analyses are accounted, where the levels on the price of energy increases with 20 per cent.

On the occasion of the choice between which of the four calculation alternatives which will be used (financial calculation, 6 % and 4 %, and macro economical calculation, 3 %, and 4 %) the financial calculation with the calculation interest, 4 %, is advised. From a national economical point of view, it is not enough with the cost categories that the commission includes in the macro economical calculation to receive a national economical efficient distribution of resources.

With a starting-point in the building costs, prices of energy, prognosis for the energy price development and calculation interests which have been available the calculations carried out show that the energy requirements in the Swedish building code (BBR) are in a predominant part within the frame for the cost optimal levels. The evaluation is based on the given assumptions about interest rates, price prognosis and measure costs.

The report has been made in collaboration with Energimyndigheten.