

The OPTIBUILD life cycle cost calculation tool.

Optibuild is a computer tool which can be used to optimise life cycle costs for buildings. The life cycle cost is the sum of the building cost, the maintenance cost and the operation costs. The Optibuild programme considers different options for the following energy saving measures:

- improved insulation of the building envelope
- improved windows
- heat recovery on ventilation air
- solar heating system for domestic hot water
- solar heating system of the ventilation air
- water savings
- improvement of the distribution system and the furnace

The energy calculation of the building is based on the European Standard PrEn832 - Thermal performance of buildings - Calculation of energy use for heating - Residential buildings. As cost and savings occur at different time a net present value method has been chosen for the optimisation process.

In the Optibuild calculation the computer calculates the value of all the possible energy saving measures. At the same time it has a database of investment costs based on experience. The programme now makes a list of the energy saving measures in the order where they are most profitable. It is then up to the user to judge how many energy saving measures that should be included in a profitable package solution.

A typical Optibuild calculation will show that the operation cost decreases when introducing new energy savings measures. At the same time capital costs for the investment and the maintenance cost increases, but together the total costs will often be smaller than for the reference situation.

The above mentioned calculations are very time consuming since each calculation can easily consist of 20-50 calculations of the yearly heat consumption. Besides it will often be necessary to change some assumptions as interest of the loans, the energy cost and the construction costs so the process has to be repeated. In the Optibuild calculation tool which has been developed by Cenergia this process is done automatically. A print out from an EU Save supported project in Torino (The TOTHER project with Citta di Torino and Metec Engineering) is shown in figure 1. The energy savings, the investment and the present value are shown together with the different kind of energy saving measures ordered with the most profitable one in the top of the list.

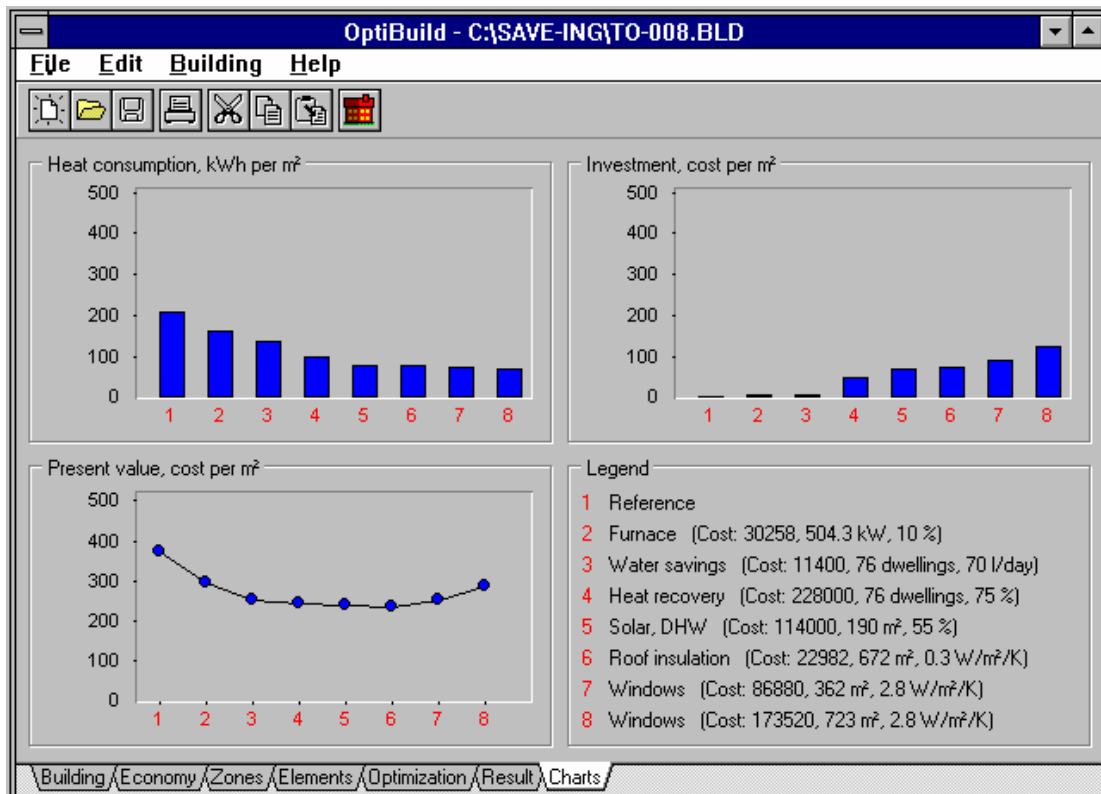


Figure 1.

Print out from Optibuild computer calculation programme. Here used in connection to a data base with 10,000 apartments in Torino.

In the following you can see an example of an Optibuild calculation in connection to a rehabilitation project with an old block of flats. Here are shown a total economy optimisation of the investments in different energy saving measures. The analysis includes three parts: 1: the investments, 2: expenses for supply and 3: maintenance and cleaning. The value of each initiative has been found by calculating the net present value over 30 years of the three elements. The result is shown graphically in figure 2. In figure 3 is shown the calculated savings of district heating for heating and hot water and in Figure 4 is shown the investments for the different energy saving measures.

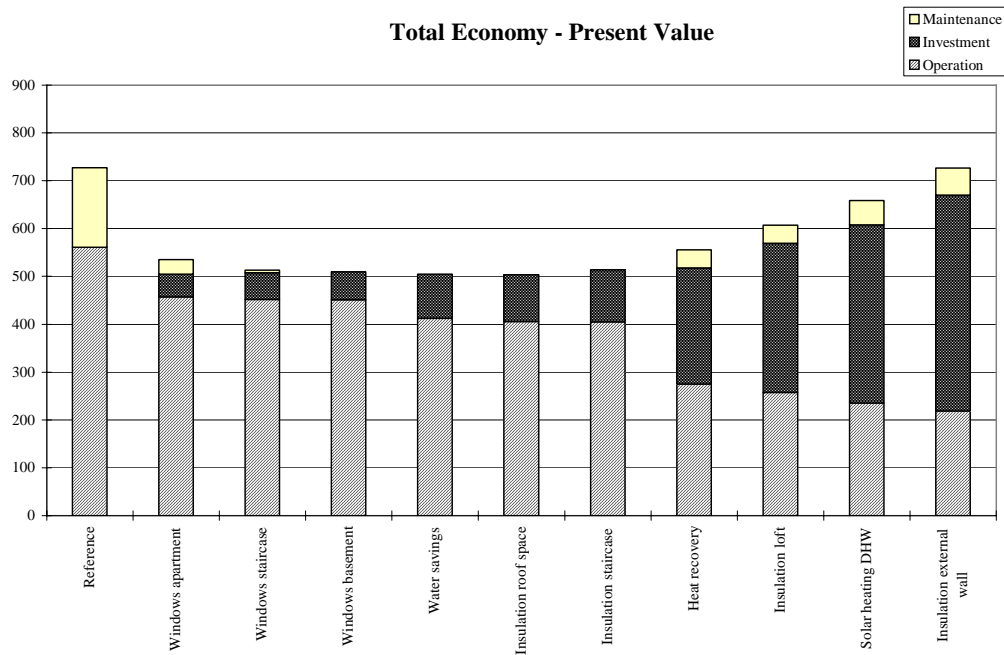


Figure 2. Total economy optimisation of sustainable and energy efficient rehabilitation of an old block of flats. The calculation tool “Optibuild”, which has been used here, includes a database of the expenses relating to different types of windows, thickness of insulation, ventilation systems, solar heating, etc. and on the basis of a number of calculations it assesses which one is the most profitable over a 30 years period. First it chooses the most economic solution (here low-energy windows). When this has been chosen it choose the second best until you have a list of all the measures and can see how they influence the lifecycle costs during 30 years. When the lifecycle costs increase you must pay attention to if it is worth to include the energy saving measures in the energy saving package. The total lifecycle costs must not reach or exceed what is stated for the reference building.

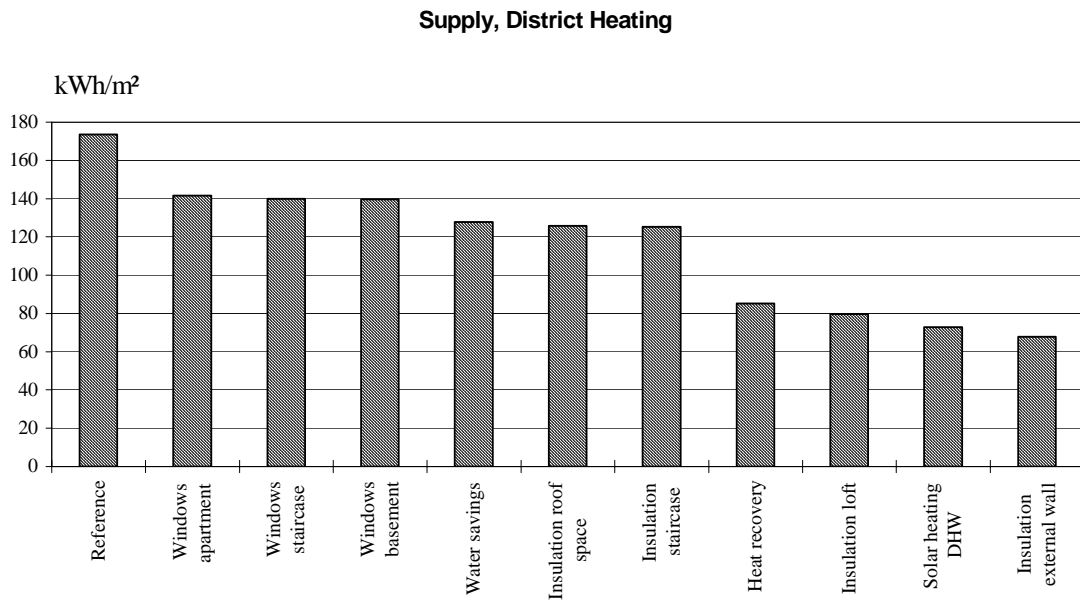


Figure 3. Optibuild calculated annual district heating consumption for domestic hot water and room heating.

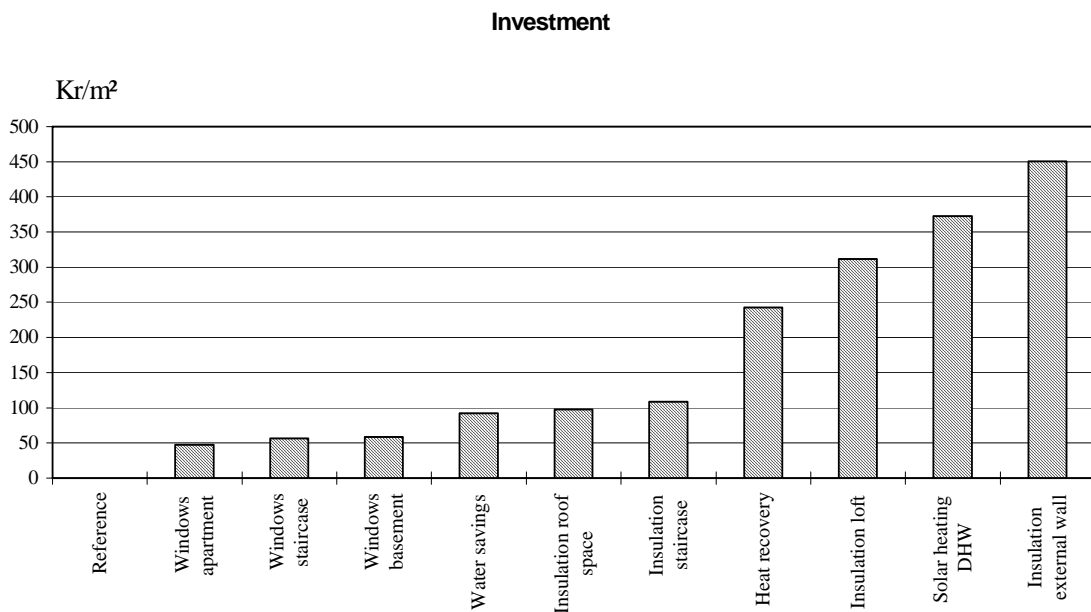


Figure 4. Necessary investments by introducing one or more energy saving measures.

By introduction of ventilation with heat recovery it should be noted from figure 2 that the district heating consumption is reduced considerably but also with a rise of the investments and somewhat increased running and maintenance costs. But it can also be

seen that the total "energy saving package", including heat recovery ventilation gives both a large energy saving and an improved total economy compared to the reference.

If you choose to introduce all the measures, figure 2 shows that the district heating consumption is reduced in return for an increase of the investments and a small increase of the operation expenses. The total lifecycle costs by introduction of all energy saving measures are not larger than the reference, thus there will be a saving of these even if all measures are introduced. But if you on the other hand choose to insert a low-energy level as a criteria for what is going to be introduced, the figures shows that a 50% saving will be obtained by realisation of all measures until and including heat recovery ventilation. At the same time it must be considered as the total economic best "package" of energy savings.

In figure 2 is shown the net present value of the energy savings for different energy saving measures and levels of savings. As long as the net present value goes down or becomes the same it is good to include the investment in the saving package. For this project it is seen that the net present value is rising for the 4 last energy saving measures.

If you compare with figure 3 it is seen that if you choose a package solution which includes heat recovery and ventilation air but excludes the 3 last energy savings then you will have at least a 50% saving of energy for heating and hot water and still have a good economy for the total energy saving "package" solution.

The total economic "positive list" for the Optibuild calculation is shown below:

1. Replacement of windows in the flats, type: low-energy;
2. Replacement of windows in the staircases, type: low-energy;
3. Replacement of windows in the basement, type: low-energy;
4. Water savings by new fittings;
5. Insulation of the cupboard under the roof slope, 50 mm, U-value = 0.39 W/m²K;
6. Façade insulation of the staircases, 45 mm, U-value = 0.46 W/m²K;
7. Heat recovery on ventilation;
8. Insulation of the ceiling, 50 mm, U-value = 0.39 W/m²K;
9. Solar heating for domestic hot water;
10. Façade insulation of flats, 45 mm, U-value 0.46 W/m²K.

The main result of the completed Optibuild total economy calculation is to get information of how the positive list for a given project will be. This can also be shown with information on investments, energy savings and simple pay-back time. The list describes which energy saving measures are the most profitable. The most profitable measure is on the top of the list. The following measures are chosen under the assumption that the measures mentioned above will be installed. The positive list does usually also show when you reach the lowest possible lifecycle cost (the optimised solution). The positive list can exceed the optimised solution because even if the lifecycle costs are getting a little higher, the energy saving measures below can have lower lifecycle costs than the reference situation. The Optibuild total economy

optimisation and the positive list can include just as much energy saving measures as the user would like.

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