Property name: Ballerup Town Hall
Property owner: Ballerup Municipality
Consultants: Rambøll Danmark

Total Concept method

Step 1. Creating the action package

Building and its use

Year built: 1975, renovated 2009 – 2010
Area: 16,321 m² (BBR).
Type of building: Town Hall, administration building

The building Ballerup Town Hall owned by Ballerup Kommune is located at Hold-an vej 7, 2750 Ballerup, Denmark. The building is divided into 6 sections F1, F2, F3, M1, M2 and M3. (only a small part of M3 is included in the simulation). The layout of ground and 1st floor consists of a mixture of mainly offices and meeting rooms. Basement is heated, and consists mostly of archives and depots. In the centre of the building there is an atrium. Heating system is with radiators. Ventilation is with VAV with chilled inlet air. Additionally chilled beams are installed.

Indoor climate

There is no known earlier assessment of the indoor climate.

During winter there has been reported draft through the façades. The west-façade has draft issues from doors. There is to some extent reported discomfort due to the chilled beams. It was reported that during summer (2013) the rooms in general were too hot.

The status of the building and its technical systems before measures

Building envelope

The building envelope consists of flat roof isolated with 400 mm mineral wool on the renovated areas, and 200 mm on the smaller, non-renovated areas. Atrium skylights are with 2-layer energy glass.

Element walls are around 250mm thick with 50mm insulation. Windows/glass doors are 2-layer thermo windows. Solar shading is with manually controlled outside roller blinds.

Basement outer wall above and below ground is constructed with 300-350mm concrete without insulation. Basement floor is non-isolated concrete slab.

Heating

Utility is district heating. The main heating system consists of radiators with local manual thermostats. Pumps are of newer type Magna or UPE, controlled by BMS. In in the atrium a heated floor is installed. Distribution is with a 2-string system. Supply temperature is controlled by outside temperature and wind.

All piping for water supply and domestic hot water is done with 30mm insolation. There are installed three hot water tanks, 263 liter preisolated hot water tank of in tech. house south, 208 liter preisolated hot water tank in roof house and 1000 liter new preisolated hot water tank of in basement.

Ventilation

The building is fully mechanically ventilated. In 2009-2011 the ventilation units and ducts were exchanged. The system is pressure controlled, with central cooling cooling coils. The units are BMS controlled and with heat recovery.

The building ventilation system consists of 12 Fläckt IV Flexomix VAV-systems with an average heat recovery of 80.8% and SEL 1.97 kJ/m³. Toilets are with separate exhaust ventilation. The atrium is naturally ventilated with solar shading. Part of the basement is naturally ventilated through leakages.

Cooling

The comfort cooling is done with chilled beams, type Lindab, controlled by BMS. Distribution of cold water is done with a 2-string system and 5 cooling mixing loops.

The cooling effect is from 9 units, placed on the roof. The average COP (EER) value is 3.44 and the total cooling effect is approximately 700 kW. The 9 systems are all from Uniflair. Four LRAC 180A, three ERAC 1222A and two ERAC 0721.

The two ERAC 0721 are placed in the basement for 40 kW cooling of server room.

Lighting

Lighting in offices, atrium and glazed corridors are with 28 W T5 tubes. In meeting rooms downlights integrated in ceiling with 28W low energy bulbs.

Daylight control sensors are installed in Offices, Meeting Rooms, Corridors, Atrium, and renovated basement. Mayor Meeting Hall and Basement is manually controlled, while lighting in WC's are installed with movement.

Equipment

The equipment in the building is typical office equipment and corresponds to around 100W/pers. There is serverroom with UPS in basement, and kitchen/canteen.

Control and monitoring system(s)

BMS is type Schneider, controlling ventilation and cooling. All radiator valves are with thermostatic valves.

Energy and resource use before measures

In the following the different energy end-users of the building are shown with their approximate contribution to the total energy use of the building.

The simulated energy end use is given in following figures (in MWh and in kWh/m2):

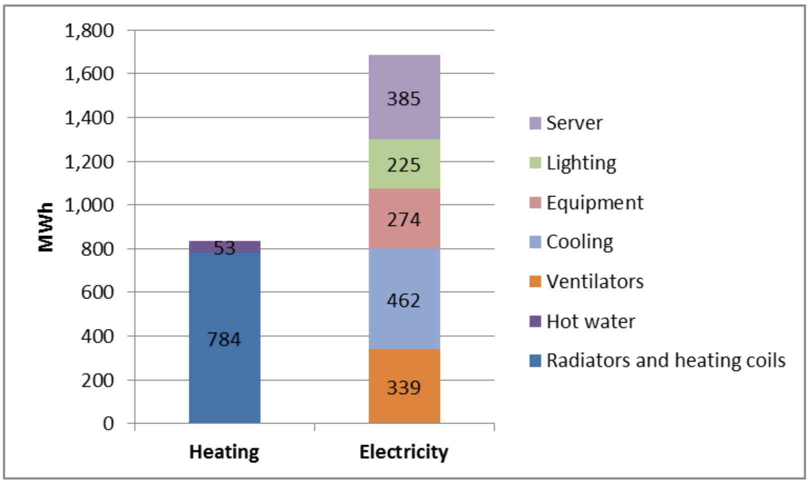


Figure 1. Energy end-use (MWh)

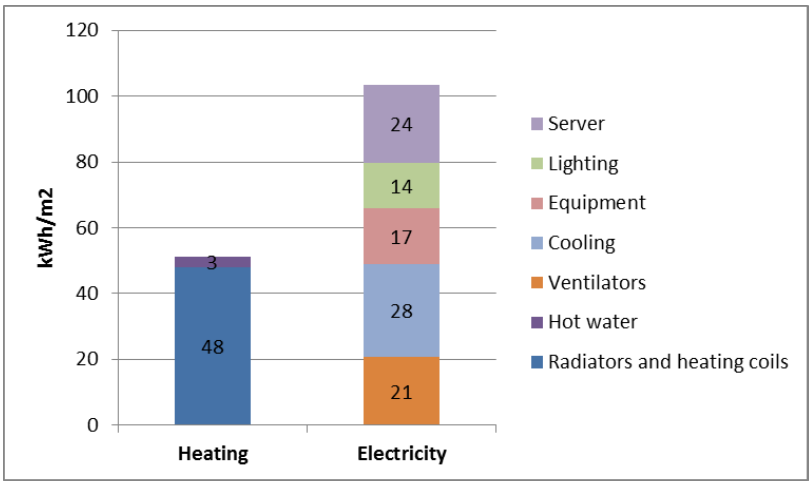


Figure 2 Energy end-use (kWh/m2)

Radiators and heating coils for ventilation make up the primary heating consumption.

The energy consumption for lighting, equipment and server room are **included** in the analysis and constitutes for the half of electricity consumption. Ventilation is approximately one fifth and cooling one third.

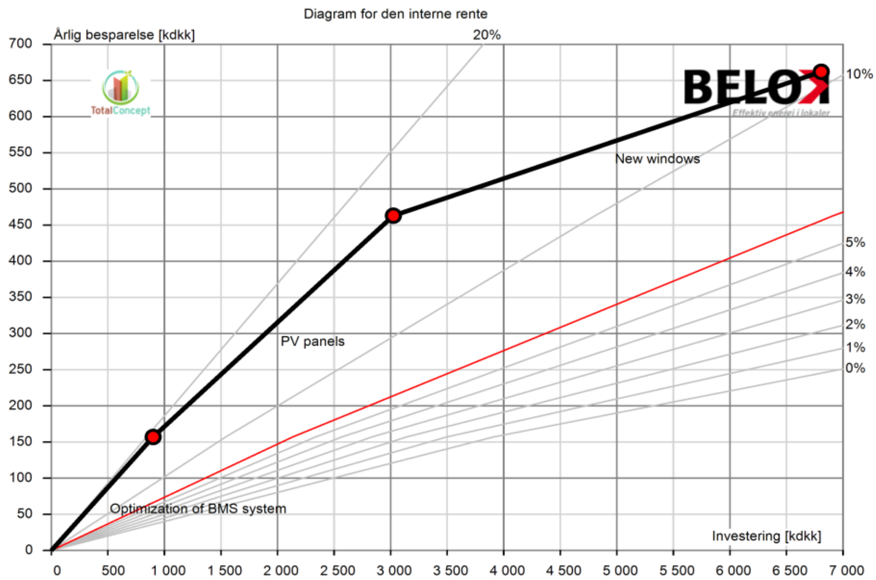
Identified energy saving measures

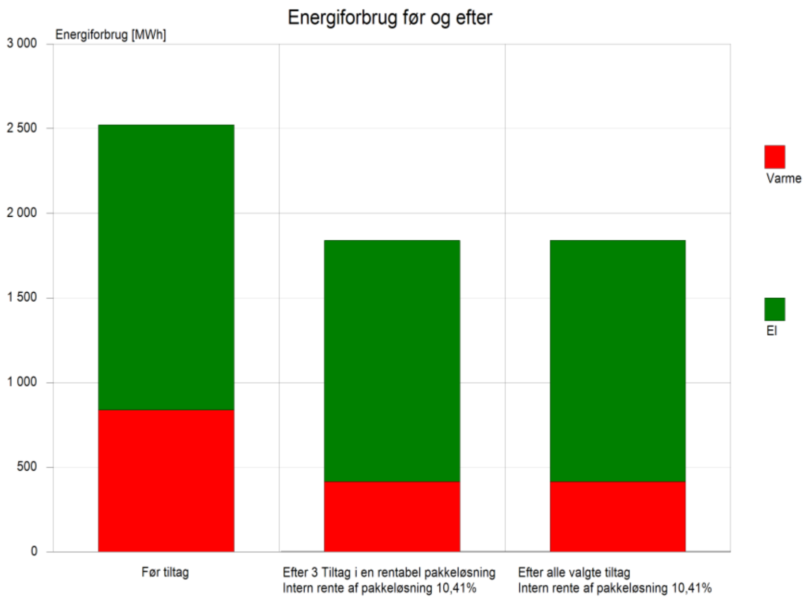
The following measures were identified:
5.1 Exchanging windows
5.2 Optimization of BMS system, including heating, lighting, ventilation and solar shading
5.5 Photovoltaic

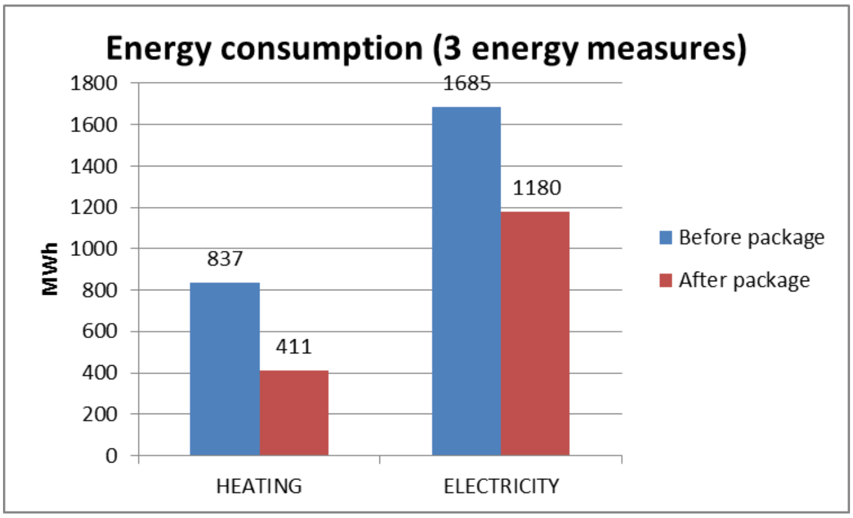
Following measures are not seen as potential energy saving measures

- Exchange of pumps – new pumps installed
- Ventilation units - new ventilation units installed
- Cooling system – chiller in a good condition and still with a satisfactory COP value
- Installed lighting effect is already rather low, and is not included as a potential energy saving measure.

The final action package is presented below:







The energy saving for the package that fulfills the owner internal rate of return is 50% for heating and 30% for electricity.

Summary of the measures in the action package

The calculations show that 3 energy measures are profitable and have a total internal rate of return of around 10%.
The upgrading of BMS system has a big impact on the future energy consumption. It is though crucial to design control strategy in the most optimal way so that simultaneous heating and cooling never occur. The control strategy should also include better use of cooling system – for instance supplying colder air instead of higher air volumes during warm periods.

The third measure – replacing windows can be problematic because of employees' relocation during construction work. It would though result in a massive heating energy reduction, decreasing CO2 impact and improving indoor climate in the building.