

Property name: Metsa 21, Pärnu school building
Property owner: State Real Estate Ltd.
Consultants: Estonian Society of Heating and Ventilation Engineers

Total Concept method

Step 3. Follow-up

Building and its use

Year built: 1978
Area: 8 184 m² Heated area
Type of building: School

School building has an I-shaped ground plan, partly 2-storey and partly 4-storey classrooms building, sports hall, a wrestling hall and a swimming pool. This work addresses only the classrooms building. The sports hall, swimming pool and wrestling hall are not covered in this study.

Since it is a school building, the building is mainly in use during the day and only on weekdays.



Indoor climate

The indoor climate was not monitored. Previously performed analysis concluded that indoor climate did not meet the requirements. Moisture issues and mould problems indicate that the ventilation system is insufficient. The heating system did not have the thermostatic valves and therefore it was estimated that the building was 1-2 °C overheated.

After the renovation, the indoor climate is in accordance with the 15251 II class, but the actual indoor temperature is slightly higher than expected in Step 2.

The status of the building and its technical systems before measures

Building envelope

Floors are built directly on the ground and are not insulated.

Exterior walls are built from autoclaved aerated concrete large-blocks (320 mm), which are insulated with 50 ... 100 mm expanded polystyrene and partially covered with plaster system and partially with profiled tin sheets.

Windows are replaced with new plastic frames and double glazed windows. Doors are also replaced.

Heating

The building has a one-pipe heating system, without thermostatic valves. The whole system is outdated and has exceeded its normative lifetime and requires full replacement.

The heating system is connected to the district heating network with substation. Substation was updated in 2004 and is in good condition.

Ventilation

New ventilation system with heat recovery was built in 2006 but that system had some major problems. Ventilation ducts are under- or overdimensioned and airflow rates did not meet the standards. The ventilation system also had electric heating coils for heating ventilation airflow.

It is estimated that the existing ventilation ensured 2/3 of necessary air change. Based on the design project, ventilation system had a SFP of 2.5 kW/(m³/s) and a heat recovery ratio of 0.65.

Cooling

There is no cooling system.

Lighting

There are no specific data about the lighting system, but because the large amount of electrical systems were not renovated, it can be assumed that the lights consumed considerably more electricity compared to the modern energy-saving lamps.

Equipment

Since it is a school building, the building does not have special energy consuming equipment. Teachers' offices have the usual office equipment such as a computers, printers, copy machine. Computer classes have computers.

Control and monitoring system(s)

There is no central control or monitoring systems.

Energy and resource use before renovation and baseline for energy savings

Specific energy use before measures 176 kWh/m², year

Whereas:

- Heat energy 128 kWh/m², year
- Electricity for building operation 48 kWh/m², year

Specific energy consumption of analysed school building is generally in the same range as other school buildings in Estonia. The relatively high consumption of electricity is due to the electric heating coils of the ventilation system.

Identified energy saving measures

The proposed package consists of the following measures:

- improving ventilation system heat recovery
- use district heating as a heat source for ventilation heating
- reduction of ventilation system SFP
- new heating system
- insulation of the building envelope
- energy efficient lighting

Summary of the measures in the action package

Results

With the help of the Total Concept method, an action package with six energy efficiency measures were found profitable. The measures are ranked after profit in Table 1.

Table 1. Cost and energy savings for the various measures

Measure		Investment cost [keuro]	Cost saving [keuro/year]	Energy saving [MWh/year]
1	Better heat recovery	0	8	104
2	District heating as a heat source for ventilation	11	1	-2
3	New heating system	80	12	216
4	Lower SFP	20	3	33
5	Insulation of building envelope	397	28	508
6	Energy efficient lighting	94	3	20
-	Sum	602	58	879

Summary of the outcomes and follow-up in Step 3

Figure 1 shows the measurement outcomes in Step 3 compared to estimated baseline in Step 1 and calculated values in Step 2. There is no split between electricity for building operation tenants.

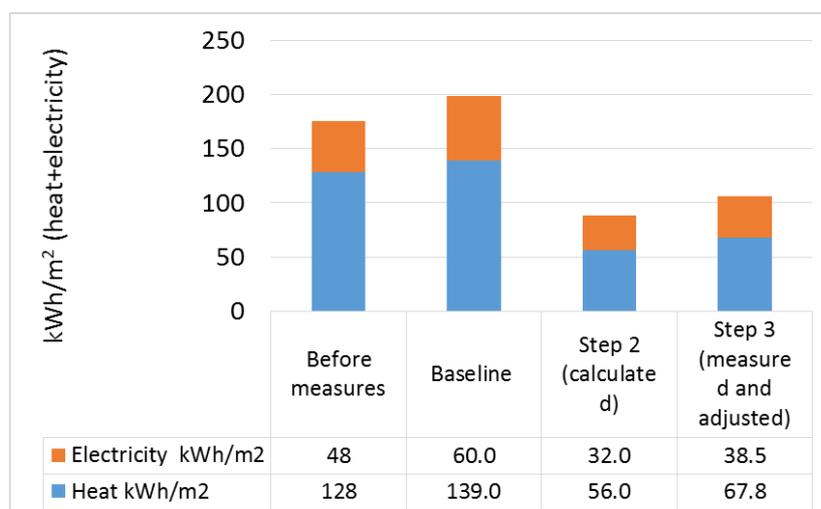


Figure 1. Outcomes after Step 3 compared to baseline.

According to the measurements outcomes of Step 3, the total adjusted net energy use is about 106 kWh/m².

The action package carried out in Step 2 estimated to reduce the net energy use about 56 % compared to the energy use before renovation/baseline. The measured outcomes in Step 3 show the savings to be about 46 %.

The actual profitability outcomes summarized in Table 2. Figure 2 shows the calculated profitability for the action package in Step 2 together with the true profitability that was calculated after Step 3. The calculated profitability for the package in Step 2 was 7.74 %. The actual profitability based on the actual costs for the energy efficiency measures and calculated savings from measured energy use in Step 3 is about 6.65 %, which was higher than building owner's profitability demand of 5.5%.

Table 2. Summary of the outcomes of the action package carried out compared to estimations made in Step 2.

	Step 2	Step 3
Total net annual energy savings:	56 %	46 %
Calculated energy savings – district heating:	657 MWh/yr	558 MWh/yr
Calculated power savings – electricity:	221.7 MWh/yr	169 MWh/yr
Total annual cost savings:	54.6 k€/yr	44.7 k€/yr
Energy investment cost:	602 k€/yr	602 k€/yr
Internal rate of return for the package:	7.74%	6.65 %

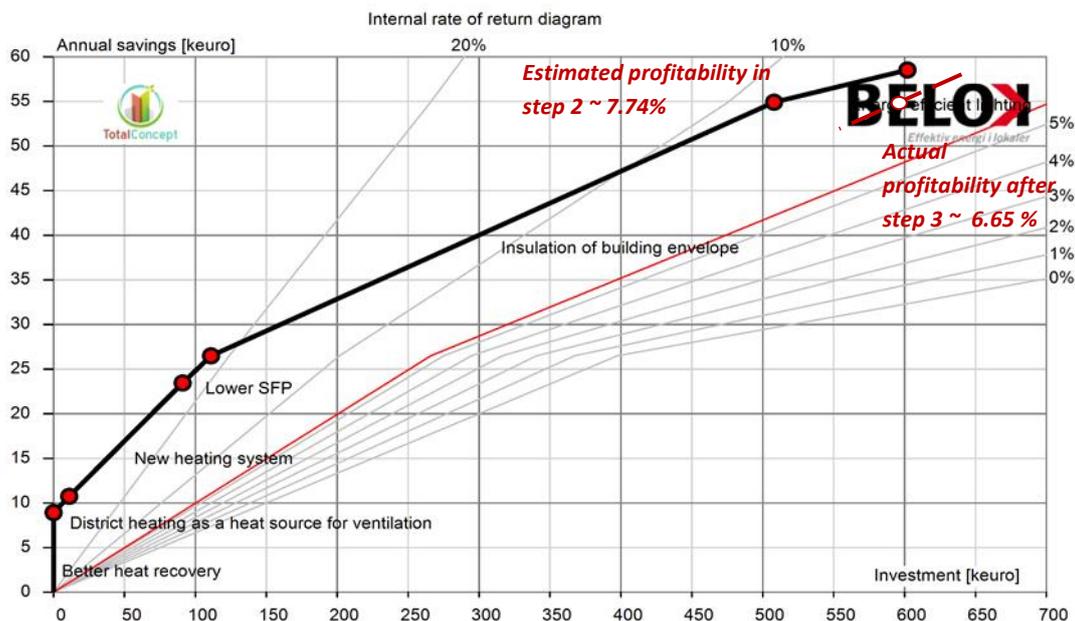


Figure 2. Outcomes of the profitability of the action package carried out at the Metsa 21, school building. Relative energy price increase is 2 %.