Property name:	**Healthcare Centre, Oulu city centre**	Total Concept method Step 1. Creating the action package
Property owner:	**City of Oulu**	
Consultants:	**Bionova Oy**	

Building and its use

Year built: 1934
Area: 5 303 m² Heated area
Type of building: Healthcare centre

The building was erected in 1934 as a public school in the centre of Oulu. The southern part of the building is three floors high and has a cellar half-way underground, the northern side is two floors high and has no cellar; they are connected through the main entrance and staircase in the middle of the building. The southern side was enlarged shortly after construction and a canteen was built at its southern end in 1952.

The current gross floor area is 5.303 m2, 4.288 m2 are heated. The total volume is 19.560 m2. The last major renovation goes back to 1980, when the building was transformed into a health centre. Parts of the HVAC system were modified/replaced consecutively in 1980, 1997, 2000 and 2005 (see section 3.4). In 2009, a new set of windows was installed. In 2012, electric cooling devices were installed in a number of rooms.

The building is owned by the city of Oulu (Oulun tilakeskus) and currently used as a health centre. Daily activities involve social and psychological counselling, minor medical interventions, dentistry and laboratory measurements. Additionally a sports hall (making up most of the northern building) is rented to a fencing club. In the cellar, the kitchen receives ready-made food and serves it in the canteen. About half of the building's cellar was meant as food storage space, but is now unused. The division of the building area is summarised in the table below.

The health centre is operating from Monday to Friday. The laboratory department is open between 7.00 and 15.00, the main building is open from 8.00 to 17.00. 90 persons work in the centre, while the number of visitors varies daily. Per year, approximately 50.000 patients are treated in the centre.

Indoor climate

The indoor air quality has not been formally assessed but it is considered to be globally sufficient for daily work. The lighting level was found to be sufficient for the different purposes of the building. However, interviews with members the personnel revealed that the air quality was insufficient at some places.

In the laboratory department, the ventilation system installed is not able to cope with the number of visitors and the large amount of heat produced by the electrical devices; the air flow is likely too low. On the southern side of the building, temperature variations around the year are not comfortable. The rooms are hot in the summer, while some employees need extra electric heating devices in the same rooms during winter time.

In 2012, electric air cooling units were installed in 19 rooms throughout the laboratory and dentistry department to provide adequate cooling in the summer. Their impact on indoor conditions has not been assessed.

The status of the building and its technical systems before measures

Building envelope

The current envelope of the building is very much its load bearing structure. The walls are made of plain brick, they are 60 cm thick in the original building and 50 cm thick in the extended southern part of the building. The roof is a flat, 3-layer concrete structure insulated with a 35 cm air gap and 10 cm of sand. It is covered with two layers of bitumen. There is no modern thermal insulation.

The canteen was built later (1952). Its walls are made of two layers of plain brick (1 brick outside, ½ brick inside) with a 5 cm layer of mineral wool between them. In some places, a 5 cm cork board was laid on the inner side of the walls before the surfacing. The roof structure of the canteen is unclear, but it is likely to be made of a concrete slab, on top of which a wood frame supports the metal sheets. Insulation was not checked, but it is likely to be wooden boards or saw dust.

The floor slabs consist of concrete, are not insulated. The foundations are made of concrete poured on site, water insulation layers were not checked and it is unlikely that there is any. However, there are no signs of humidity infiltration in the building.

Due to the important thickness of the building envelope, the air tightness of the building was considered to be high, so n50 = 3,0 for air infiltration calculations.

In 2009 almost all windows were changed. The new windows, including their frame, have a U-value of 1,1 W/m2.K, according to the manufacturer's drawings. The overall light permeability (g-value) of the glass is 57 %.

Ventilation

The current air conditioning system has six devices.

IV01 and IV05 serve the main building's office, treatment and dentistry rooms on the three floors. IV01 serves floor 1 and 3, IV05 serves floor 2. They were installed in 1997. Though they are running permanently, they are operated with a frequency changer and their activity is regulated according to the CO2 concentration of the extracted air. Both have a heat recovery unit, whose efficiency was calculated to be 45 %. IV01 is the buildings most important ventilation device, with a designed air flow of 3,75 m3/s, IV05 is designed at 1,5 m3/s. They are located in the same room in the centre of the third floor.

IV02 covers the sports hall on the first floor of the northern the building. It is a two-speed, constant air flow device installed in 1978 and has no heat recovery system. The device is said to be running from 8.00 to 21.45 at full power, the rest of the time at half power. A timer button allows manual activation of the device when the sports hall is used. The designed air flow is 0,82 m3/s.

IV03 serves the laboratory department on the ground floor of the northern building. It is a similar device as IV02, installed in 1978 and with no heat recovery system. The device is running permanently at full speed and displaces 0,25 m3/s. This device's low air flow rate is responsible for the insufficient air quality in the laboratories and the neighbouring rooms. It is located at the ground floor of the building in the same room as IV02.

IV04 is the ventilation device for the kitchen and the canteen in the cellar of the southern building. It was installed in 1988 and has no heat recovery system. The device is running from Monday to Friday between 2.00 and 3.00, 6.00 to 16.30 and 22.00 to 23.00. On weekends, the device is on from 8.00 to 10.00 and 22.00 to 23.00. It was designed and installed at the time when the kitchen was still preparing the meals it served. Since 2009 however, the kitchen is used only to wash the dishes and keep some aliments cool. The hot food is distributed by communal services. From 3,75 m3/s originally designed, only a fraction of it is actually used. Especially the lack of heat recovery units leads to important energy losses.

IV06 covers the storage rooms in the rest of the southern building's cellar. It is the most recent device, installed in 2005, and is controlled by a frequency converter. It is designed for an air flow of 0,45 m3/s, and is running from Monday to Friday between 7.30 and 16.30 at full power, and from 5.00 to 7.30 and 16.30 to 18.00 at half power. It is probably the most adequate device in the building, although the efficiency of the heat recovery unit, at 45 %, is not any more standard.

Heating

The building is connected to the local district heating network; the heat exchanger is located next to the kitchen in the cellar of the building's southern part. According to temperature readings, it is considered to be in appropriate condition. The spaces are heated through two networks of hydronic radiators. The consumption is measured at the entrance of the system, there is no sub-meter in the network. The heating system is found to be well balanced, the temperature of the radiators being even throughout the building.

Cooling

Since 2012, 19 rooms are fitted with electric cooling devices. The two in the laboratories are connected to an outdoor unit on the western side of the northern building, while the 17 remaining devices are located mainly in dentistry rooms on the second floor of the southern building, connected to an outdoor unit located on its roof. The devices use the refrigerant R 410 A.

Lighting

The lighting system is mainly composed of fluorescent tubes and compact fluorescent lamps. The lighting is mostly for general purpose and the indoor surfaces are mostly bright. Loistelamppuvalaisimissa on liitäntälaitteena käytetty elektronisia liitäntälaitteita. The lights in the office rooms are switched on and off by the occupants. In the hallways, the light is controlled by the automation system on a time programme. Outside the time programme, the lights can be activated manually.

Ulkovalaistus on toteutettu pääasiassa pylväs- ja seinäasenteisilla kaasupurkauslamppuvalaisimilla. Ulkovalaistusta ohjataan hämäräkytkimen ja rakennusautomaatiojärjestelmän aikaohjelman perusteella. Päivänvalo-ohjaus on energiataloudellinen ohjaustapa ja johtaa noin 4000 tunnin vuotuiseen käyttöaikaan.

Equipment

The building is has an elevator located next to the main staircase. Each room has an IT set consisting of a computer, a monitor and a printer. Five copy devices are located in the different hallways. The four rest rooms for the personnel have each a set of kitchen appliances (coffee machine, water boiler, microwave oven) as well as one or more fridges and an electric stove. The devices in the rest rooms are old.

The dentistry rooms are each fitted with a robotised dentist chair and special medical luminaires. In the middle of the southern building's second floor, the sterilisation room contains several steam cleaning machines running every day, and two compressors run intermittently to provide pressure for dentistry tools. The laboratories in the northern building have centrifuge and sterilisation devices.

The kitchen has a large amount of devices, of which only a few are used daily: the two fridges are powered all the time, and the dishwashing belt runs about 4 hours per day. The devices are recent.

Water supply and warm water

Water is heated with district heating using a heat exhanger. The share of warm water from total water consumption has been calculated based on the energy audit conducted in 2008. Heating energy for water heating had been estimated to be 50 MWh per year. The energy audit included propositions for calculating the warm water consumption. In this report the heating energy for warm water was estimated to be 45 MWh per year. The estimate is 6 % smaller compared to the previous estimated in 2008 due to the change in the kitchen use.

Control and monitoring system(s)

The building's control and consumption monitoring take place manually at the location. Schneider Electric is responsible for monitoring, compiling and weather correcting consumption values each month. Consumption logbooks and yearly reports are available on Schneider Electric TAC intranet.

Energy and resource use before measures

Specific energy use before measures	211 kWh/m²,year
Of which	
Heat energy	146 kWh/m²,year
Electricity for building operation	65 kWh/m²,year

By converting this to primary energy and using the net area as divisor the results can be compared to the Finnish building regulation's value for office buildings. The building's primary energy consumption is 260 kWh/net m2. The minimum required E-value for new office buildings is 170 kWh/net m2. Hence it can be concluded that the current energy consumption of the building is average when its age considering. Compared to a convetional office building, the results in this case are effected by the large gymnasium and basement area. On the other hand, the entire building does not have cooling and the use frequency of the kitchen facilities is low, which reduces the energy consumption compared to many other office buildings.

The reduction in consumption after 2008 follows an energy consumption assessment by Schneider Electric at the end of that year. The facility management modified the timetable of several ventilation devices, decreased the district heating volumetric flow rate to match actual use. In addition, since 2009 the kitchen is only there for cooling aliments and washing the dishes. No cooking is done there anymore, and the ventilation has been adapted consequently.

Identified energy saving measures

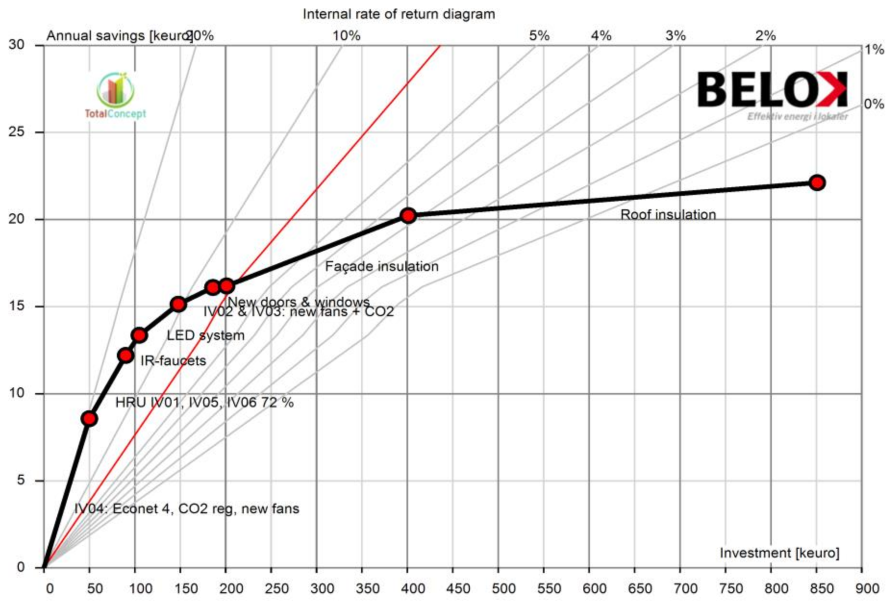
The identified profitable energy saving measures are related to the building technology. The largest savings potential is in the ventilation system as the equipment did not include heat recovery or it could be replaced with more efficient equipment. In addition, the energy consumption of the equipment could be reduced with changes in control method and by replacing old, energy intensive fans with new, more efficient ones.

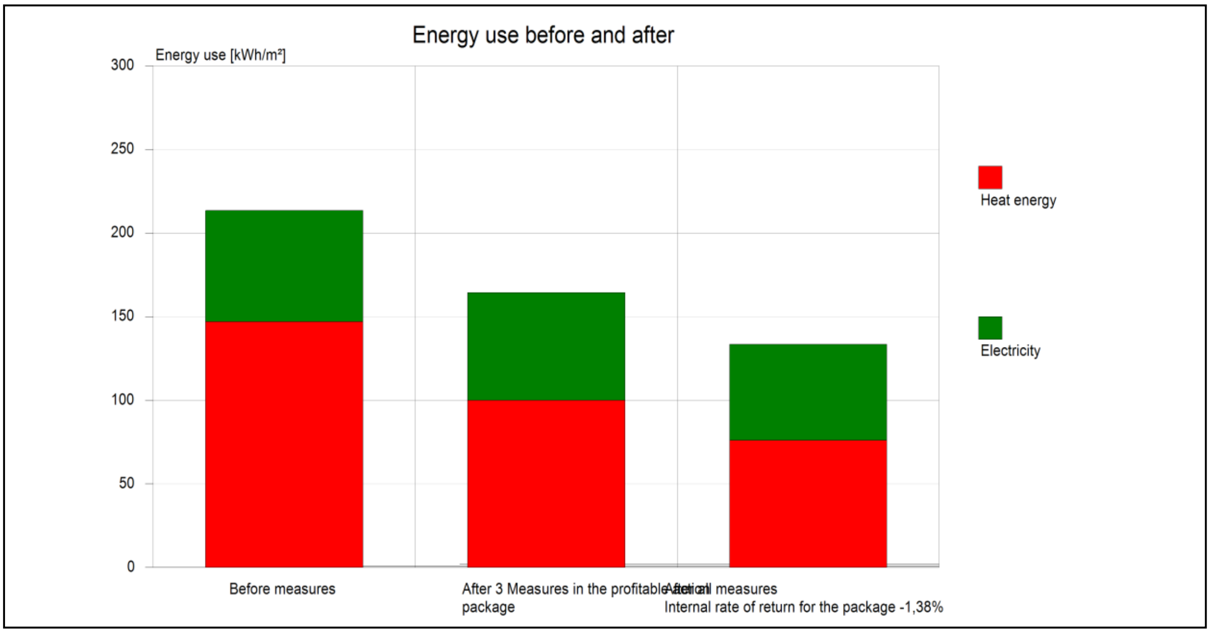
In addition to the ventilation devices, profitable energy saving measures were also identified in replacing the existing lighting with more energy efficient LED lighting and changing faucets into electronic ones.

The package also included calculations related to structural changes; additional insulation was added to the roof and facade and main doors and some original windows were replaced with new ones. However, the measures conserning the roof and facade did not prove to be feasible enough to be included in the final package.

Summary of the measures in the action package

Measure		Invesment cost keuro	Cost saving keuro/year	Energy saving MWh/year
1	IV04: Econet 4, CO2 reg, new fans	50	8	175
2	HRU IV01, IV05, IV06 72 %	40	3	77
3	IR-faucets	15	1	6
4	Façade insulation	200	4	87
5	LED system	43	1	17
6	IV02 & IV03: new fans + CO2	38	0	16
8	New doors & windows	15	0	1
10	Roof insulation	450	1	41
-	Sum	851	22	424





Results

As a result of the analysis an action package that provides substantial saving possibilities on the agreed interest rate of return (7 %) was identified. The report creates a basis for the City of Oulu to make decisions to go further to the second step of the programme, i.e. the realisation of the action package.

The identified measures that are part of the profitable action package are mainly related to building technology. The most profitable measures are related to the air conditioning system. The efficiency of the ventilation system is improved by adding heat recovery or improving existing ones, improving electrical efficiency of fans and changing the controlling system to variable one to optimize the used air flows. In addition to ventilation, profitable measures were also found in the areas of lighting and water equipment. The results show that 26 % energy savings are possible in a profitable way.

The results show that it is possible to reduce the amount of bought energy for the health care centre by 37% if all the measures proposed in this report would be carried out. However, given current profitability requirements and projected energy prices, it will not be profitable. It has to be noted that the price of heating energy in Oulu is low in comparison with other district heating providers, and this is an important limitation to the profitability of certain measures of the package. The same type of building configuration elsewhere could be economically viable.

Also, currently structural measures (insulation of the roof, insulation of the façade) are not viable due to the good condition of the building. However, in the coming years it will be relevant to inquire whether combining the insulation works to the renovation ones would be profitable.