

Property name: Perukmakaren
Property owner: Vasakronan AB
Consultants: GICON

Total Concept method

Step 3. Following up

Building and its use

Year built: 1966
Area: 9 881 m² Heated area
Type of building: Shops, hotel and garage

Perukmakaren is the name of one of the selected pilot building for Sweden. It is located in Gothenburg and was constructed in 1966 and was totally refurbished in 2011-2014 and will be certified according to LEED (Leadership in Energy and Environmental design) with the aim of rating Gold. The building is owned by Vasakronan AB and the total area is 26 000 m² with a heated area 9 881 m². It is used for multiple activities which include hotel, shops and garage. Perukmakaren is a six store building where the basement and the first level is used for shops. The top floors (3-5) are used for hotel and garage where the main part is garage. Of the total area, 62 % is garage, 28 % shops and storage and 10 % is hotel.



Indoor climate

The aimed temperatures in the building is between 20-23°C in the shops and 21-23°C in the hotel. The garage is not heated and has the temperature of outdoor air.

The indoor climate system is designed to give a PPD less than 10 %, CO₂ levels should not exceed 1000 ppm more than temporary and levels of formaldehyde (30 minutes mean value) should not exceed 0.05 mg/m³.

The status of the building and its technical systems before measures

Building envelope

During the refurbishment in 2014 all the exterior walls were improved and thermal bridges were reduced. The façade U-value are now 0.23 W/m²K and the façade towards the garage is 0.35 W/m²K (1.05 W/m²K before refurbishment). The façade at the ground floor, where the entrances to the shops are located, consist of mainly windows. The windows have an average U-value of 1.1 W/m²K (2.2 W/m²K before refurbishment) and about 23 % of the total surface consist of windows. The roof now has a U-value of 0.15 W/m²K (0.30 W/m²K before refurbishment).

Heating

The building is connected to the district heating system and the heat is distributed with radiators and through the ventilation.

Ventilation

The ventilation system in the building consist of four air treatment units (LB 10, 20, 30, 40). A requirement for the new units were a minimum thermal efficiency of heat recovery in the ventilation of 80 % for rotating and 70 % for plate heat exchanger.

Cooling

The building is connected to the district cooling and the cooling is distributed with the ventilation air. Supply air temperatures are about 17 degrees Celsius for cooling. Cooling is done with outdoor air and hardly any district cooling input is needed, except for the really hot months when cooling with air is not sufficient.

Control and monitoring system(s)

All the technical systems are connected to a central control and monitoring system.

Other technical systems

A big part of the internal heat gains in the building comes from the lighting in the shops. Heat gains from people is estimated to be 7.5 W/m² in the shops and hotel.

Energy and resource use before measures (2010)

Specific energy use before measures	185 kWh/m ² ,year
Whereas	
Heat energy	108 kWh/m ² ,year
Electricity for building operation	64 kWh/m ² ,year
District cooling	13 kWh/m ² ,year

The building initially used about 185 kWh/m², yr not included tenant's electricity.

Summary of the measures in the action package (Step 2)

The following measures were implemented in the package:

Renovation of façades with improved U-value

The offices area in the building is renovated to a hotel. The facades are renovated and isolated.

Isolation of floor structure between shops and unheated garage

Since the garage is not heated, the floor between heated the area and the garage is isolated.

New windows with a lower U-value and better solar factor

The main part of the windows are replaced with new ones with a better U-value.

New ventilation systems

The old ventilation systems are replaced with new air handling units with new fans with lower SFP and more efficient heat recovery for heat exchangers, new air channels and new air diffuser that allow lower inlet temperature.

New district heating substation

New heat central is installed with a new heating systems for the new hotel.

New district cooling substation with new pumps

A new substation for district cooling is installed with new pumps and new shunt sections.

New control and monitoring system

The control systems is replaced with a new central control and monitoring systems (BMS) from Siemens. In the monitoring system instantaneous meters for heating and cooling is installed to provide hourly data.

Better control of lighting

Parts of the lightning systems is changed and equipped with presence control or regulation of illumination.

Energy efficient lighting and daylight control in the garage

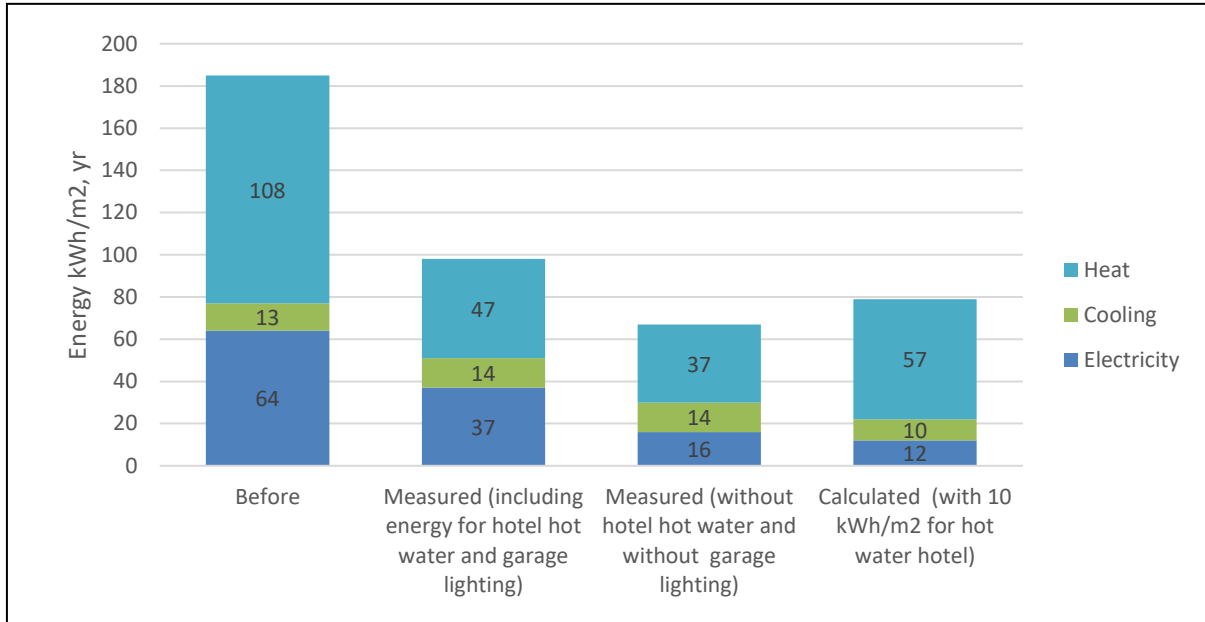
The lighting in the garage is equipped with daylight control to reduce energy use.

A measure that was not included was installation of thermal solar panel for hot water since it was not cost effective.

Energy and profitability calculation were performed on an overall basis and not on each specific measure. The most important requirement in the project was to reach the aimed energy use of 80 kWh/m².

Measure	
1	Renovation of façades with improved U-value
2	Isolation of floor structure between shops and unheated garage
3	New windows with a lower U-value and better sun screen
4	New ventilation systems
5	New district heating substation
6	New district cooling substation with new pumps
7	New control and monitoring system
8	Better control of lighting
9	Energy efficient lighting and daylight control in the garage

Summary of measurement and follow-up in Step 3



The follow up took place during 2014 and 2015. The aim of the renovation was to achieve total energy use of the building maximum 80 kWh/m² (excl. tenants). This goal was very well achieved and the measured energy use after the first year were 67 kWh/m² (if excluded 10 kWh/m² for hot water in the hotel, 21 kWh/m² for lightning in the garage and 12 kWh/m² that belongs to tenant’s electricity.) The energy used for heating is 37 kWh/m², yr, for cooling 14 kWh/m², yr and for electricity 16 kWh/m², yr. Total reduction of energy use is about 64 % (excl. tenants energy). Large part of the energy savings come from heat and electricity while the use of cooling is actually higher due to a very hot summer with a big demand for cooling.