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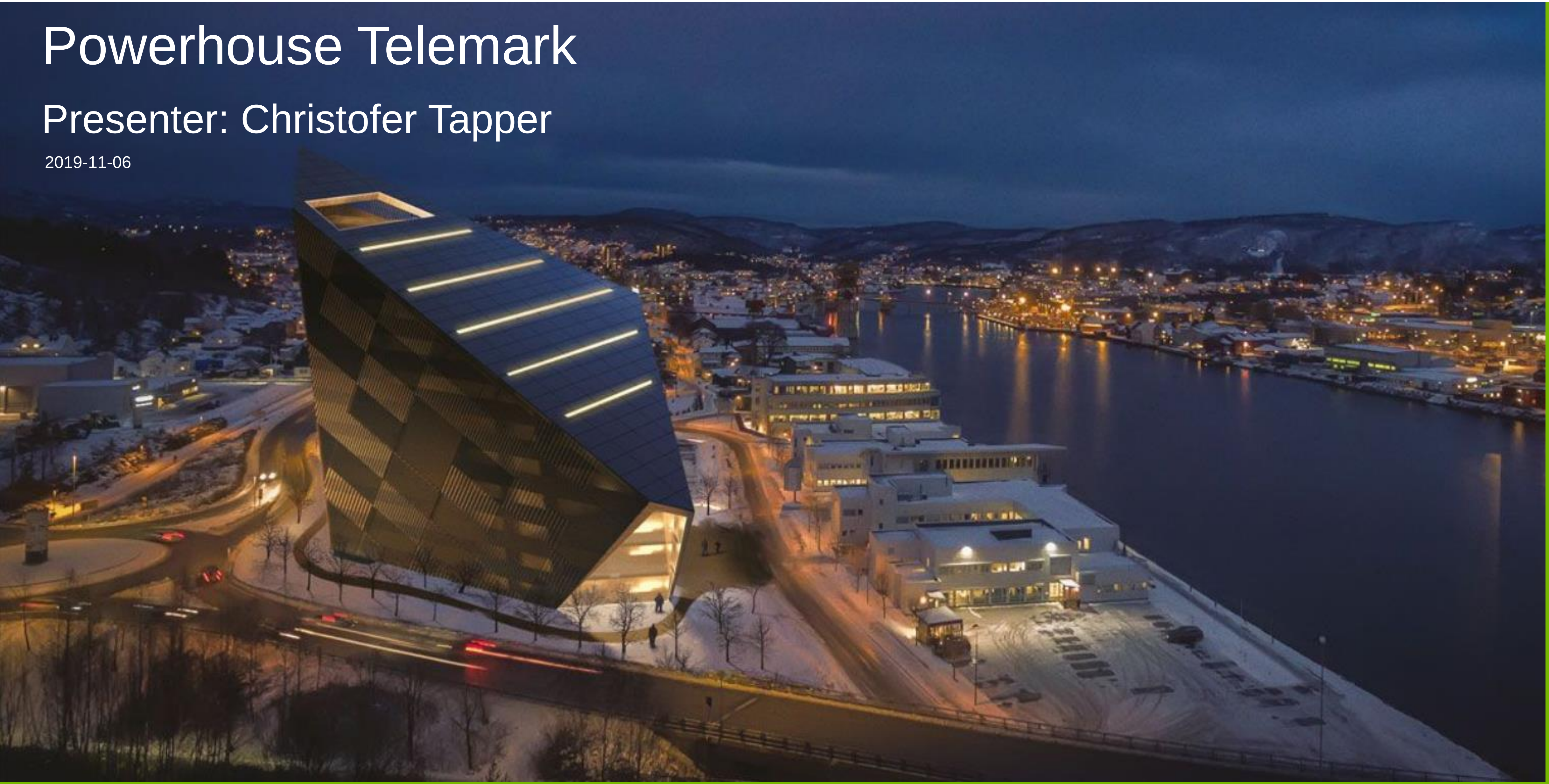
Powerhouse Telemark

Presenter: Christofer Tapper

2019-11-06



Project participants and partners

- Developer: R8 property
- General contractor: Skanska Norway AS
- Design group main participants:
  - Snøhetta (Architect),
  - Skanska Teknikk (Energy performance, Building Physics and BREEAM)
  - Asplan Viak (Structural, fire safety, Solar, HVAC)
- Other partners: ENOVA grant for ca. 12 MNOK

R8 SKANSKA Snøhetta asplan viak ENOVA

General project information

- 11 story office building
- Includes offices, open office landscapes, meeting rooms, canteen and a conference room
- Energy ambition Powerhouse plus energy building
- BREAM Excellent

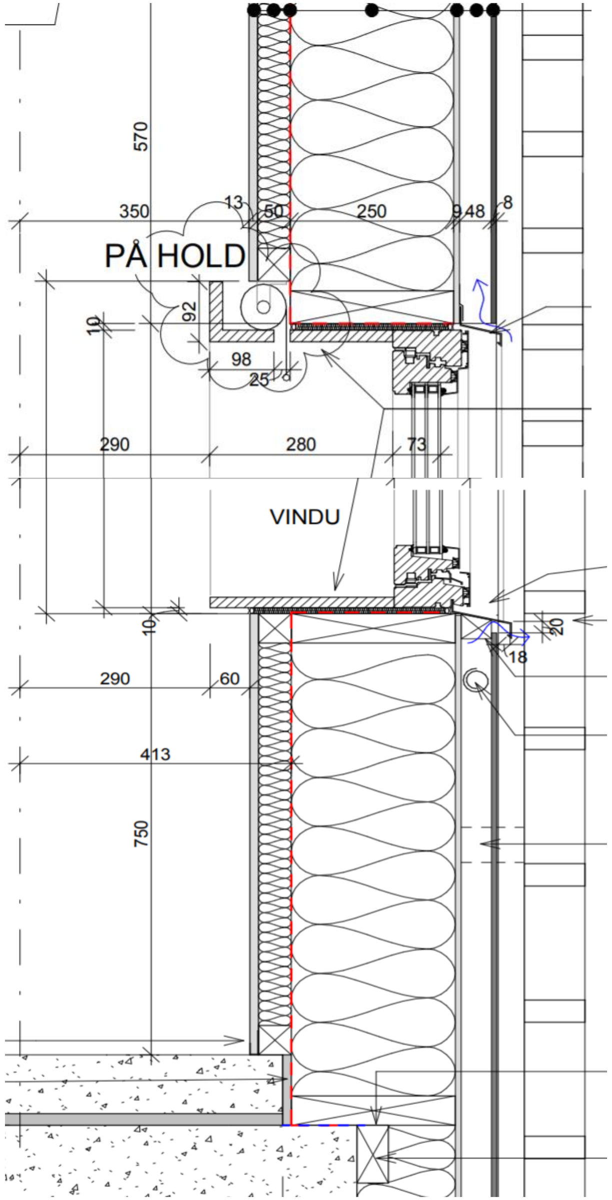
What is a Powerhouse?

- *Must produce enough renewable, locally produced energy to cover the following energy needs over a 60 year period:*
  - *Primary energy for operation*
  - *Primary energy for production of materials used in building*
  - *Primary energy used for transportation*
  - *Primary energy needed for renovations and demolition (assume normal refurbishment and improvements in solar cell efficiencies)*

Energy needed for plug loads are not included in the definition

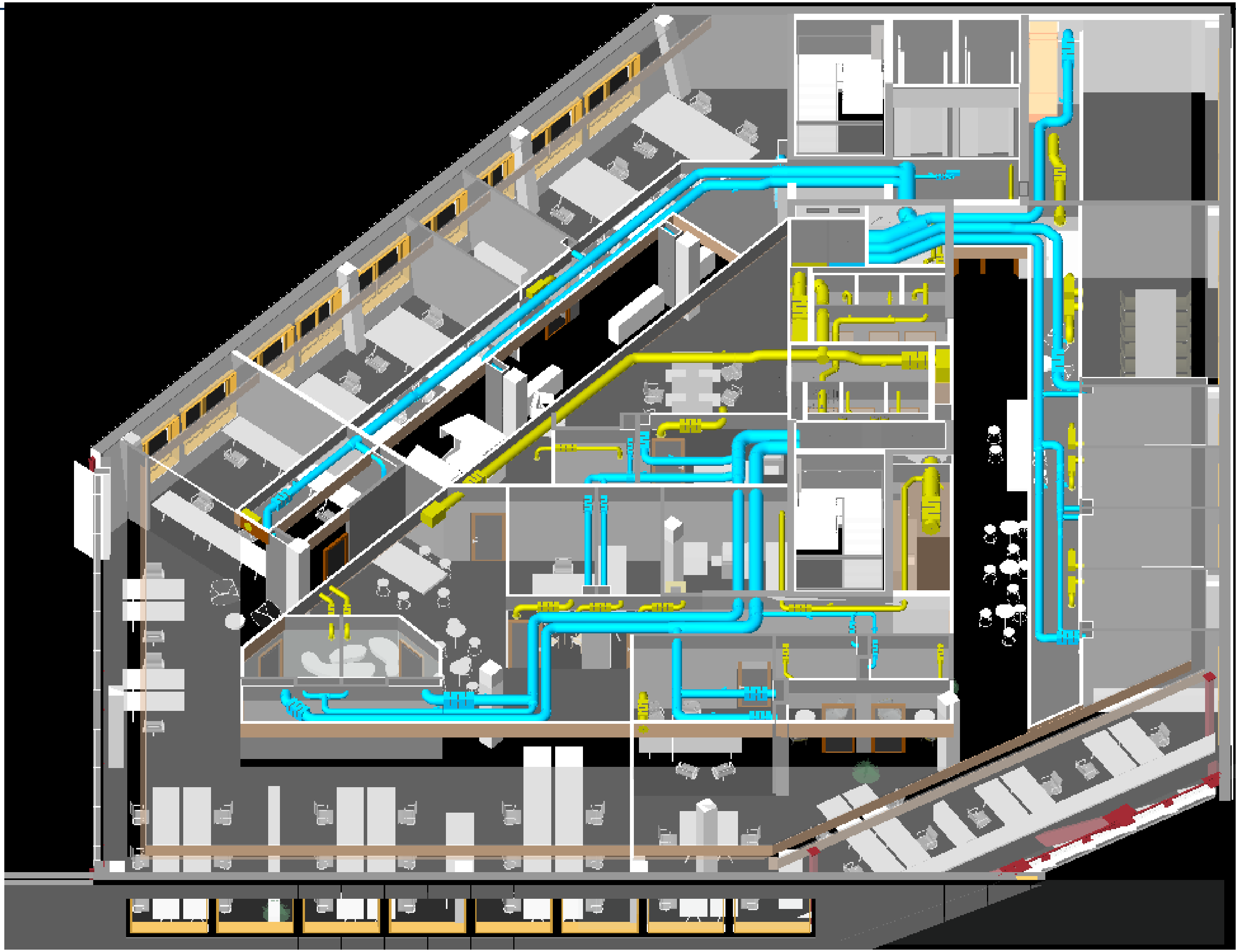
Climate envelope

- U-values
- Insulated concrete slab on ground 0,11 W/m²K
- Roof 0,10 W/m²K
- Wall type 1 0,15-0,17 W/m²K
- Windows doors and glass facades 0,79 W/m²K**
  - ** Includes frames and aluminum profiles
- Infiltration, 0,4 air exchanges at 50 Pa pressure difference
- Normalized heat loss through thermal bridges = 0,03 W/m²K



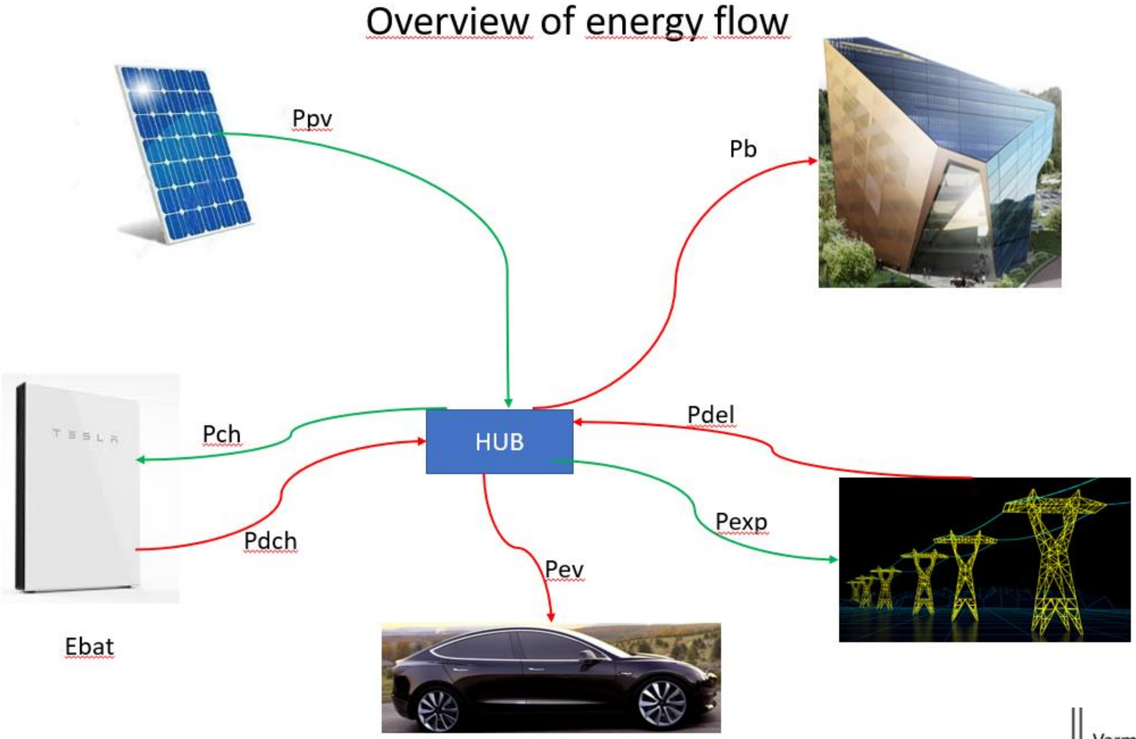
Ventilation

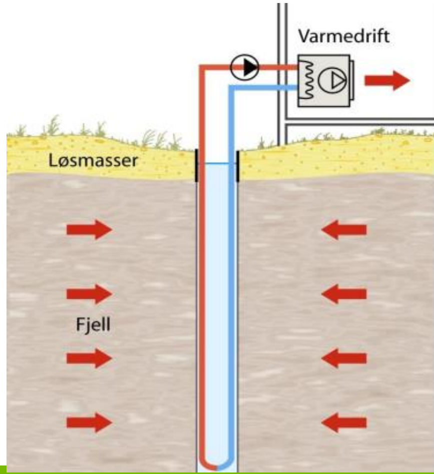
- VAV- displacement ventilation system
- Branches out from central duct in ceiling and supplied in occupancy zones.
- Distribution -overflow units.
- Average ventilation rate 5-6 m^3/m^2h for winter and summer
- SFP = 0,6-0,75 $kW/m^3/s$ winter and summer
- Rotating heat recovery system 85-87 % efficiency



Energy supply

- 9 thermal energy wells 300m deep connected to heat pump
- 100% heating energy need covered by heat pump
- Solar electric energy
- Grid energy
- Possibility for battery storage 130 kWh





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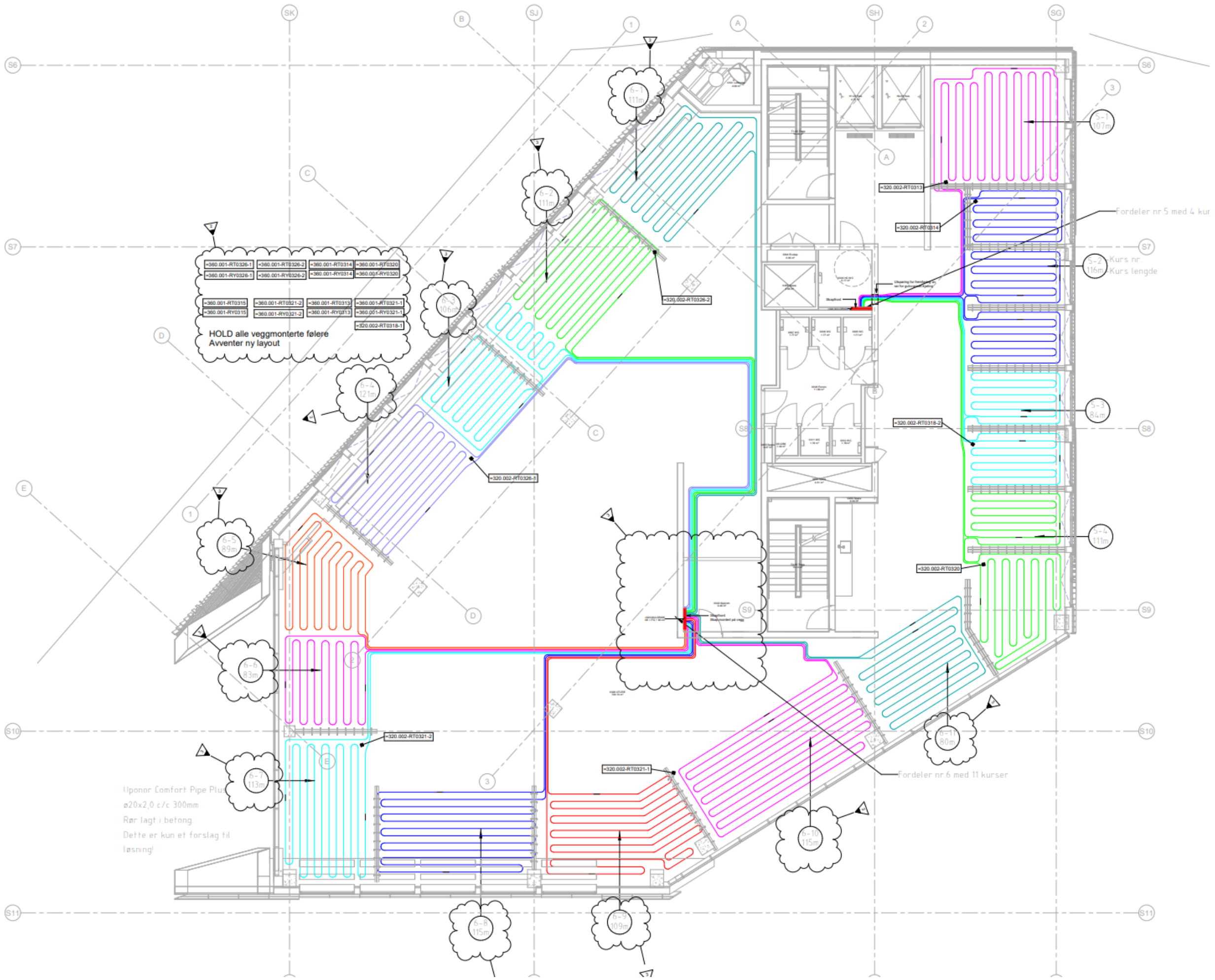
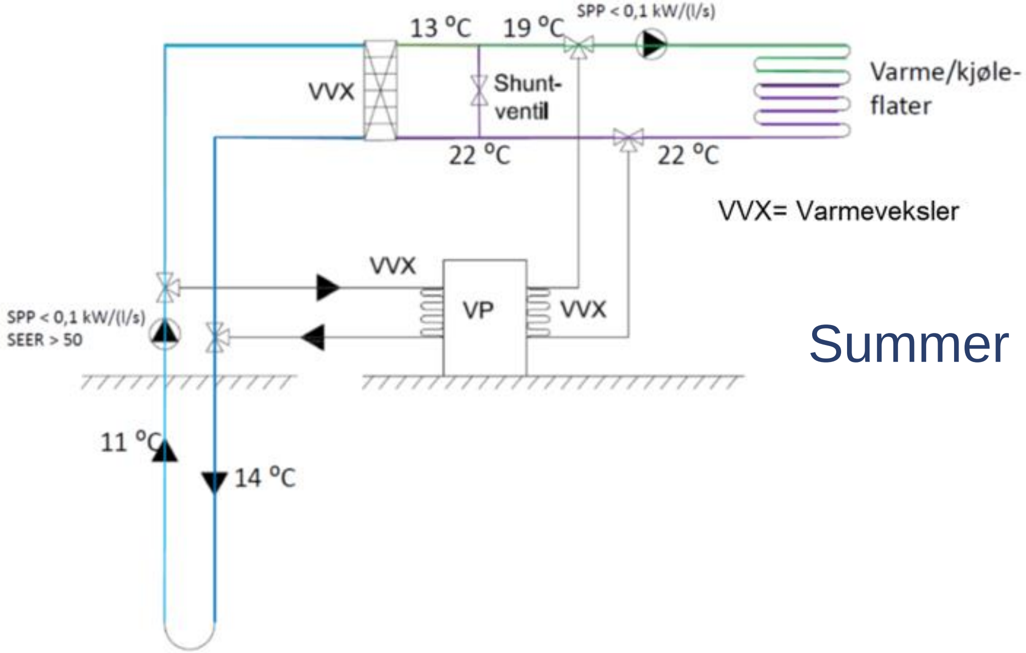
Heating and cooling

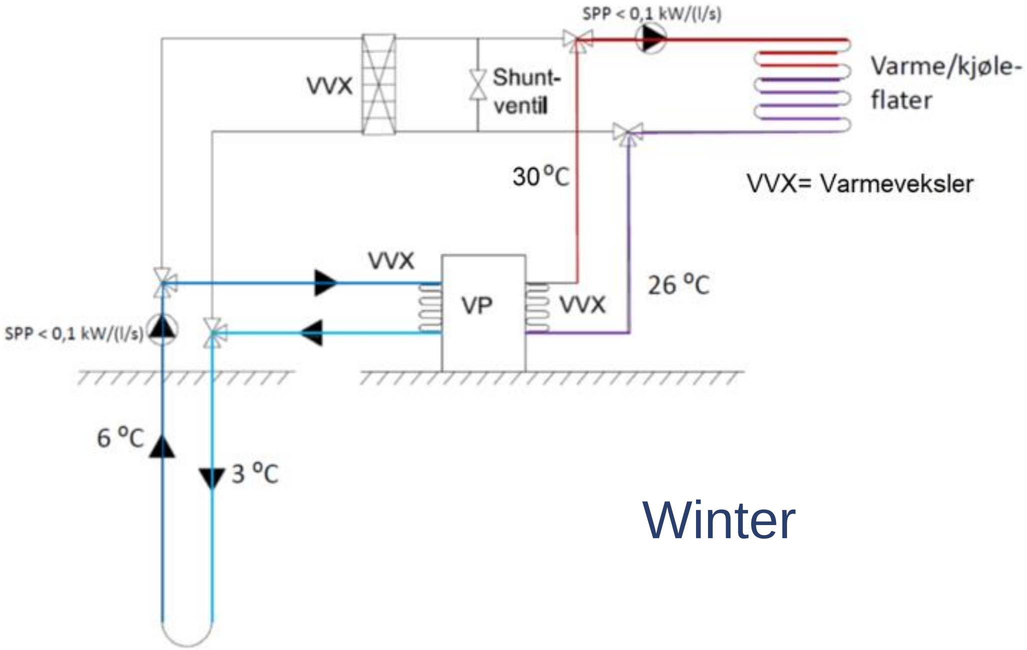
- Floor heating/cooling system (Lowex)
  4 m depth from the facade)
- Temperature stable at 21,5°C
- Supply temperatures heating 23-30°C
- Supply temperature cooling 19°C
- SCOP 4,5 for heating
- SCOP 20-30 for cooling
- Hot tap water local electric boiler



Lowex



Summer



Winter

- Low temperature heating
- High temperature cooling

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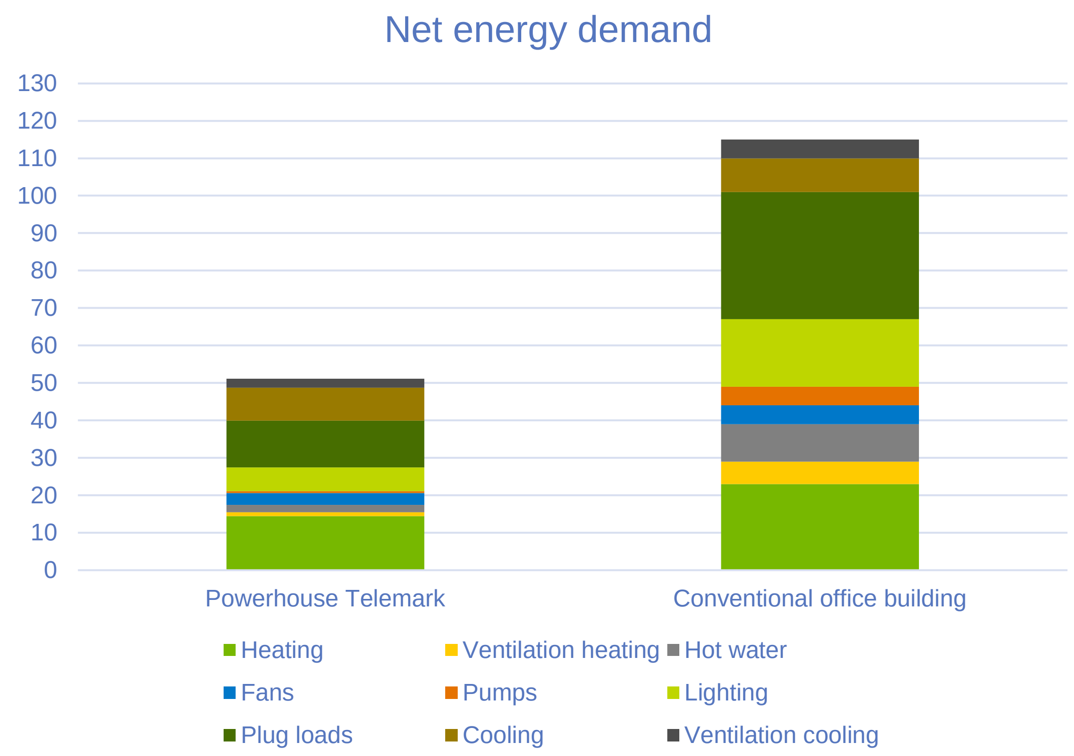
Lighting

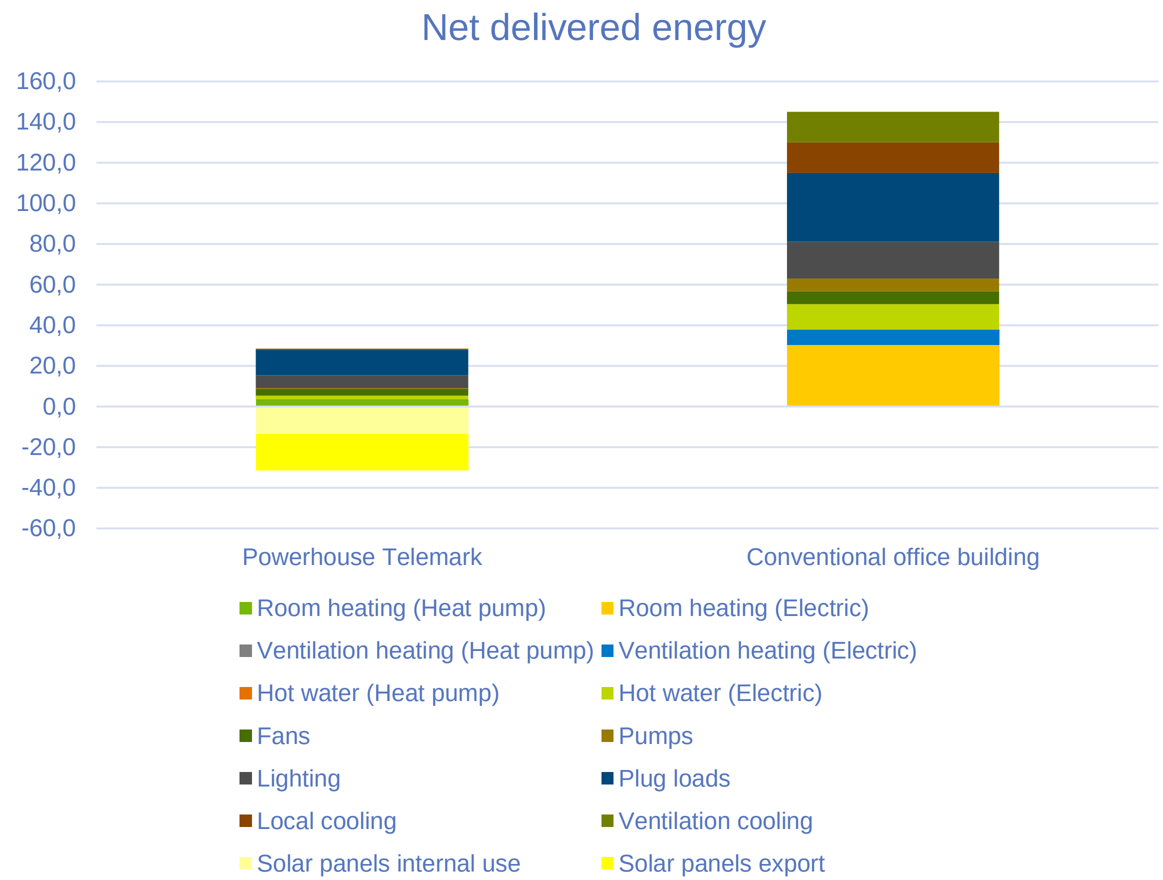
- Tailored lighting according to seating plan.
- Maximised use of natural daylight
- Commercially available LED 100 lm/W
- 6,3 kWh/m^2 ⟶ 2,3 W/m^2
- Daylight and motion activated sensors
- 300 lux at each work station

PV energy production

- Monocrystalline solar panels 22 % efficiency
- Approximately 800 m^2 on roof, 300 m^2 in façade and 300 m^2 on carport
- Total production 248 000 kWh/year
- Set up for 130 kWh battery

Energy Performance





Conclusion and lessons learnt

- Traditional problems; daylight vs thermal comfort
- Change of loadbearing structure from wood to low carbon concrete- changed foundation and plan layout
- Windows in the roof proved challenging- (snow, water and light and solar panels)
- Large areas needed for solar power production
- Office buildings are well suited for Lowex in Nordic climates provided normal internal thermal loads.
- Longer process more people involved in decision making (linked to BREEAM)