Utilisation of moist exhaust air for preheating a swimming hall ventilation system with a heat pump and heat recovery technology

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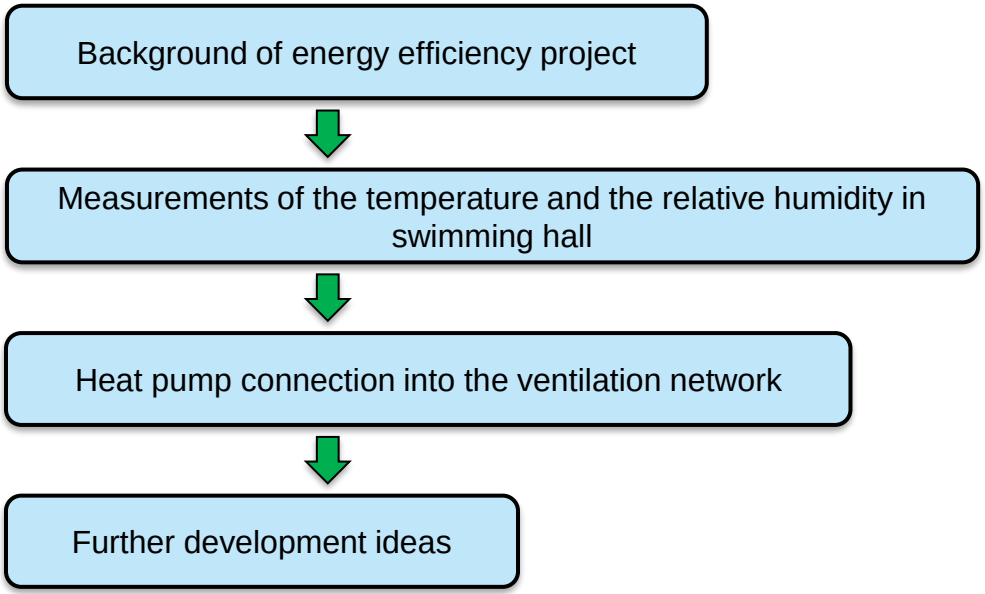
XAMK

Summary

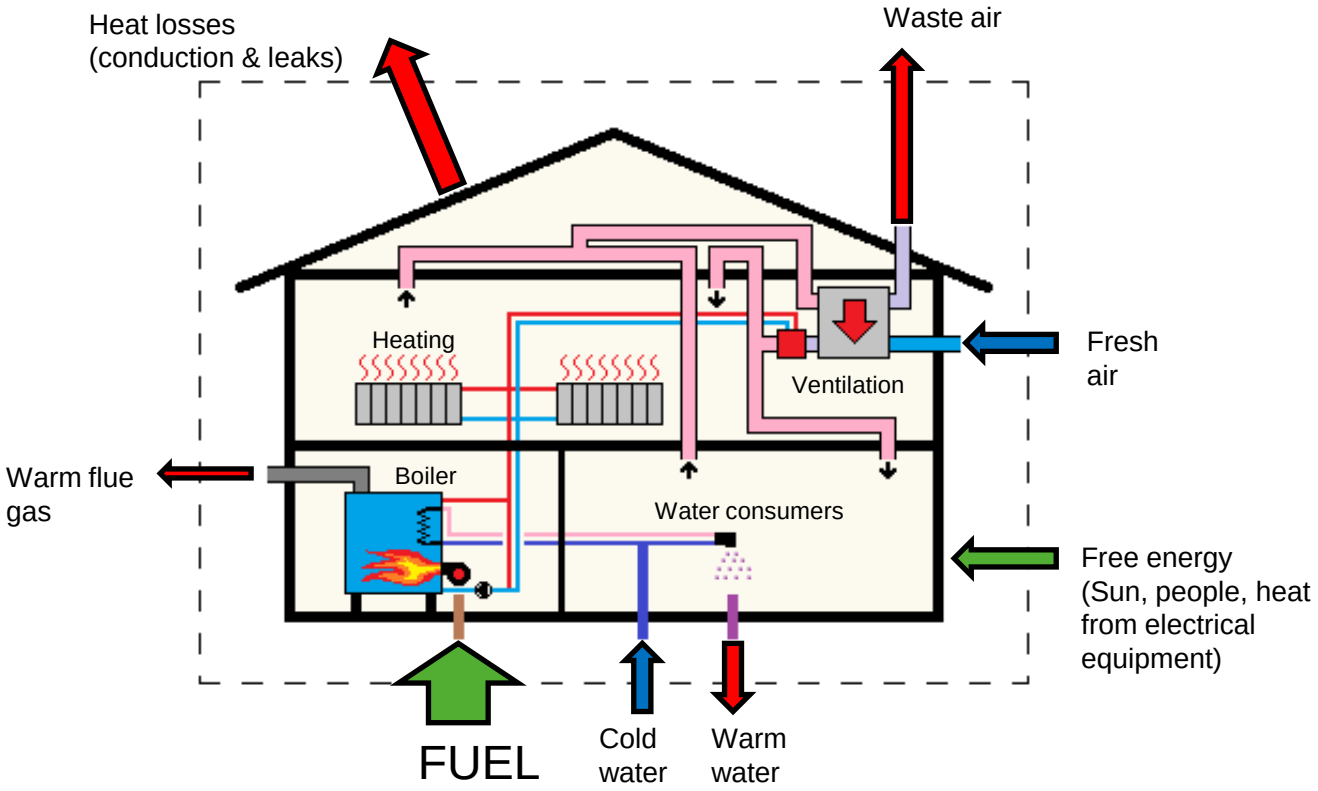

Background of energy efficiency project
Measurements of the temperature and the relative humidity in swimming hall
Heat pump connection into the ventilation network
Further development ideas

Background of the project

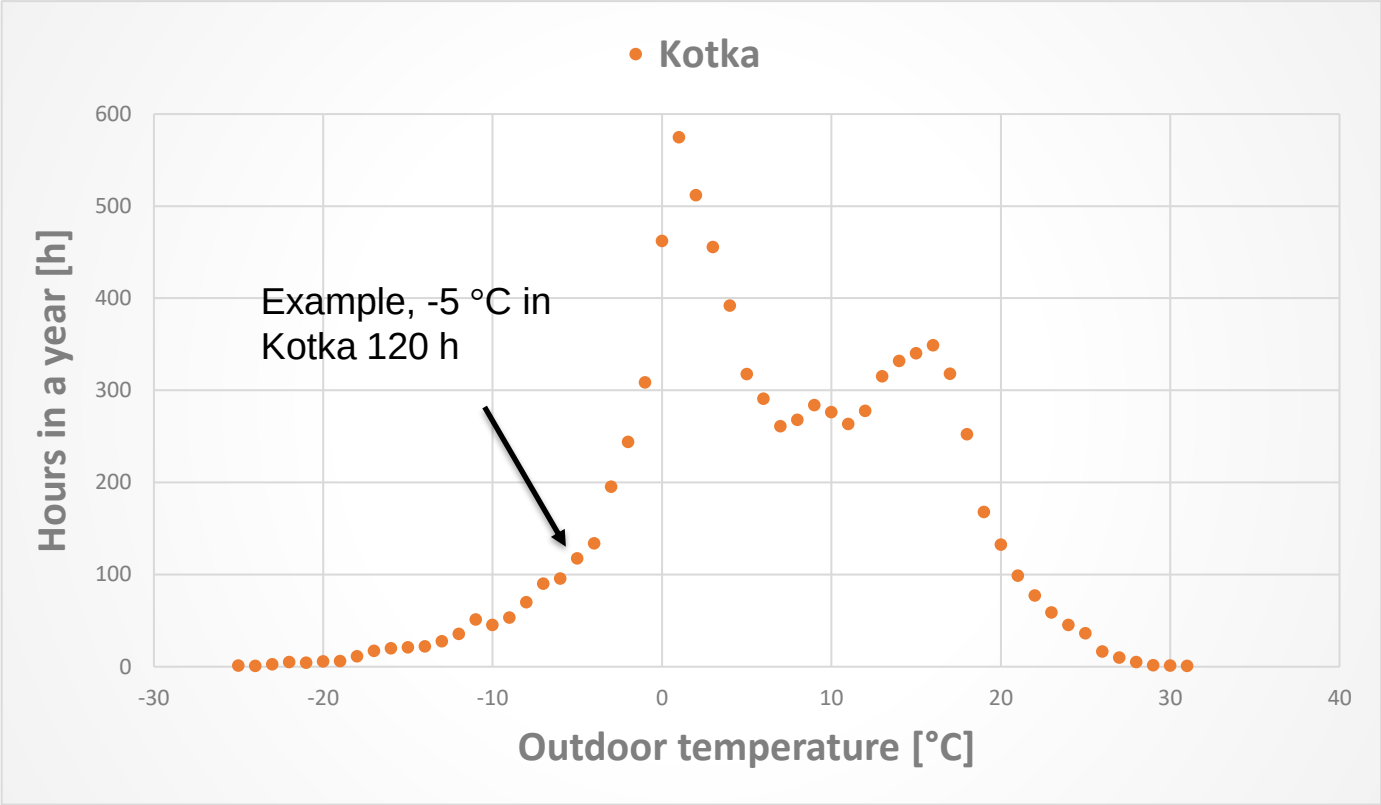
- Study of waste heat sources and it's utilization solutions in Kymenlaakso region in Finland
- Swimming halls are large consumers of energy → improving the energy efficiency brings correspondingly large savings
- A lot of waste heat is generated through moist exhaust air and grey water
- Total thermal energy (district heat) consumption has been 1200 MWh/a, of which ventilation corresponds to 700 MWh/a, in the Karhula swimming hall

The Karhula swimming hall (Piispa 2021, Aeria)

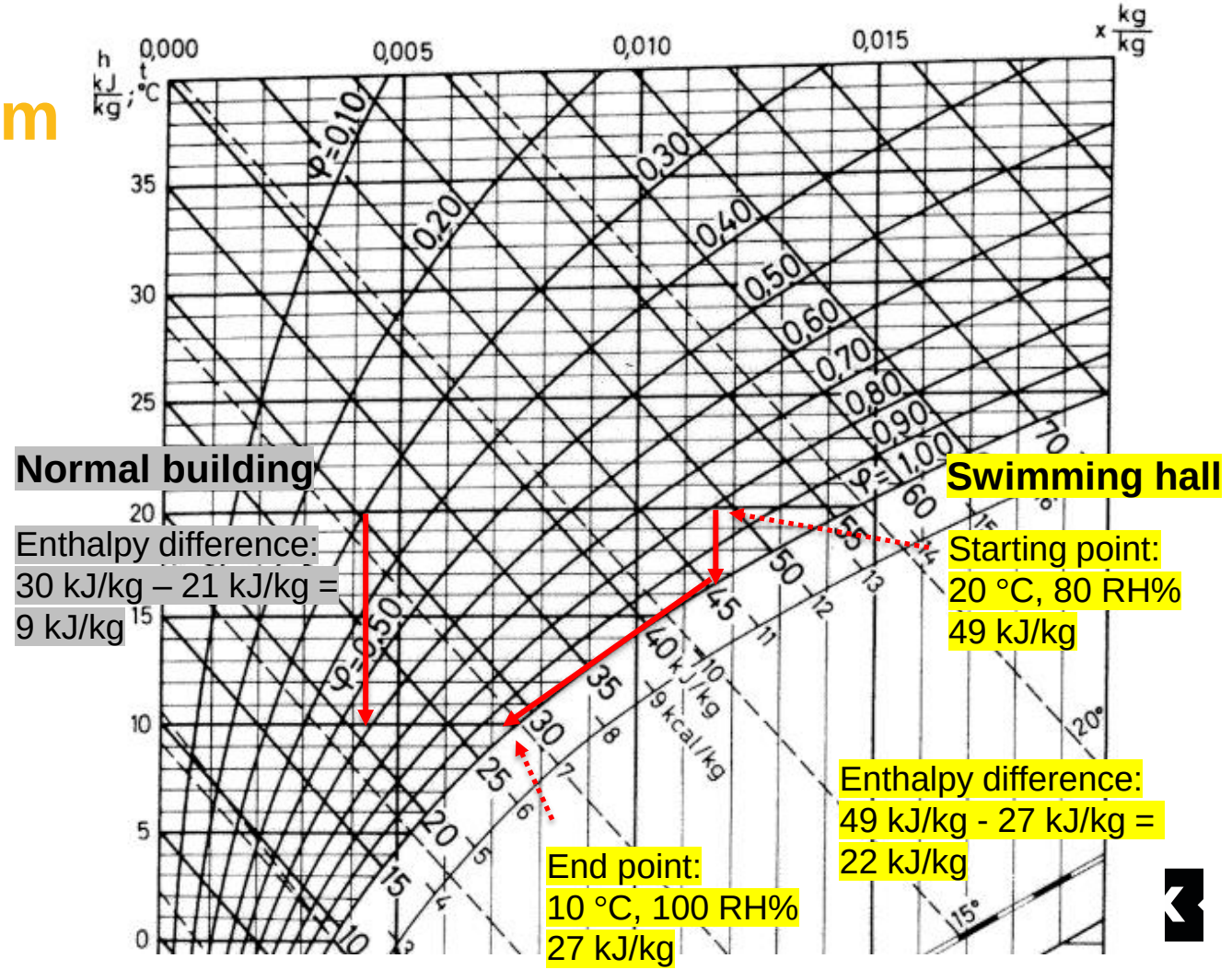
Typical building's thermal energy balance

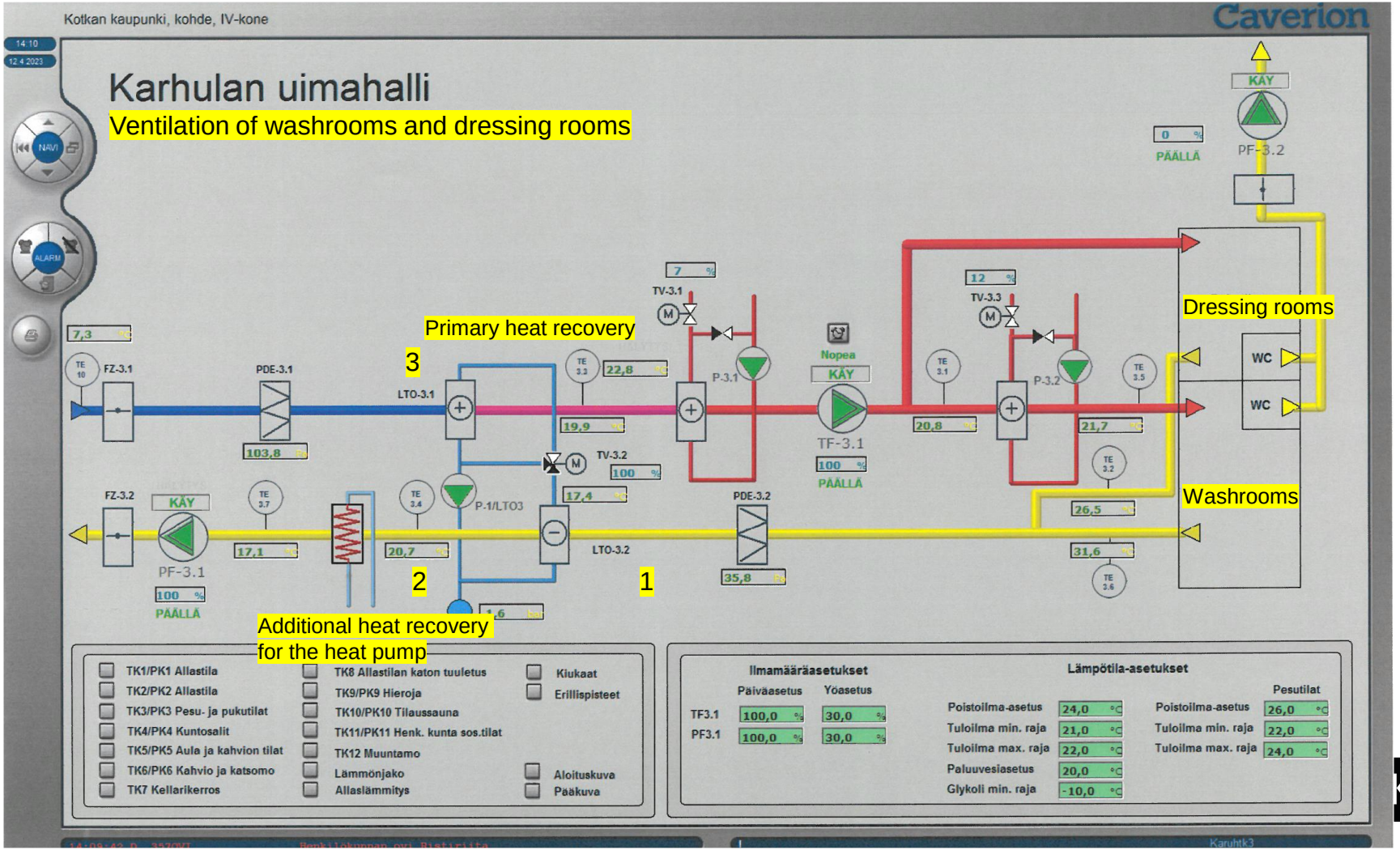


Distribution of outdoor air temperature



Mollier diagram example



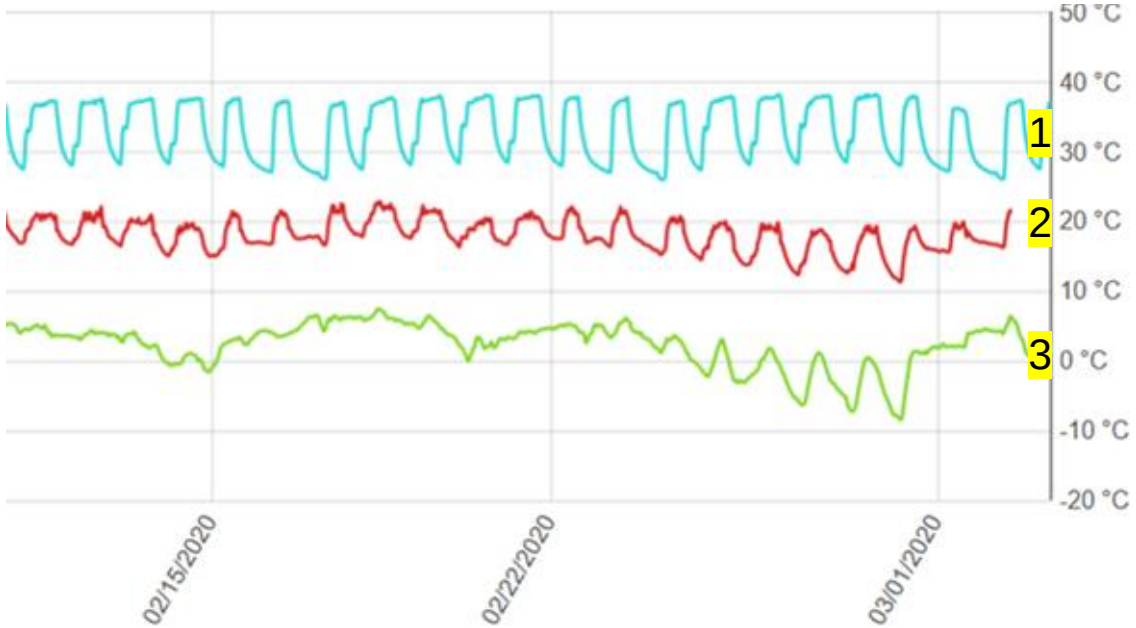

Kotkan kaupunki, kohde, IV-kone
Caverion
14:10
12.4.2023
Karhulan uimahalli
Ventilation of washrooms and dressing rooms
Primary heat recovery
3
2
1
Additional heat recovery
for the heat pump
Dressing rooms
Washrooms
WC
WC
KÄY
PÄÄLLÄ
0 %
PF-3.2
7,3 °C
TE 10
FZ-3.1
PDE-3.1
103,8 %
LTO-3.1
TE 3.3
22,8 °C
19,9 °C
7 %
TV-3.1
P-3.1
Nopea
KÄY
TF-3.1
100 %
PÄÄLLÄ
TE 3.1
20,8 °C
12 %
TV-3.3
P-3.2
TE 3.5
21,7 °C
TE 3.2
26,5 °C
31,6 °C
TE 3.6
TV-3.2
100 %
17,4 °C
P-1/LTO3
LTO-3.2
PDE-3.2
35,8 %
FZ-3.2
KÄY
PF-3.1
100 %
PÄÄLLÄ
TE 3.7
17,1 °C
TE 3.4
20,7 °C
1,6 kW
TK1/PK1 Allastila
TK2/PK2 Allastila
TK3/PK3 Pesu- ja pukutilat
TK4/PK4 Kuntosalit
TK5/PK5 Aula ja kahvion tilat
TK6/PK6 Kahvio ja katsomo
TK7 Kellarikerros
TK8 Allastilan katon tuuletus
TK9/PK9 Hieroja
TK10/PK10 Tilaussauna
TK11/PK11 Henk. kunta sos.tilat
TK12 Muuntamo
Lämmönjako
Allaslämmitys
Kiukaat
Erillispisteet
Aloituskuva
Pääkuva
Ilmamääräasetukset
Päiväasetus
Yöasetus
TF3.1
100,0 %
30,0 %
PF3.1
100,0 %
30,0 %
Lämpötila-asetukset
Poistoilma-asetus 24,0 °C
Tuloilma min. raja 21,0 °C
Tuloilma max. raja 22,0 °C
Paluuvesiasetus 20,0 °C
Glykoli min. raja -10,0 °C
Pesutilat
Poistoilma-asetus 26,0 °C
Tuloilma min. raja 22,0 °C
Tuloilma max. raja 24,0 °C

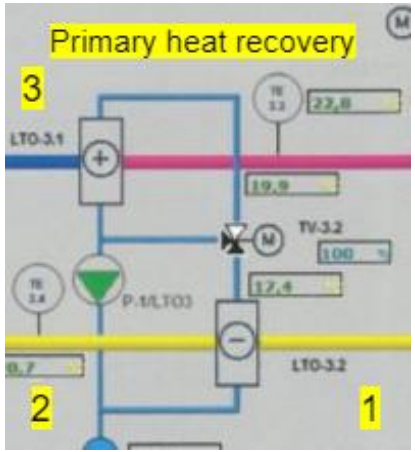
Measurement of the exhaust air temperature before the additional heat recovery

testo 160 IAQ_51600882 [°C] = after heat recovery (HR)

testo 160 IAQ_51601102 [°C] = before HR

testo 160 IAQ_51601116 [°C] = outdoor temperature



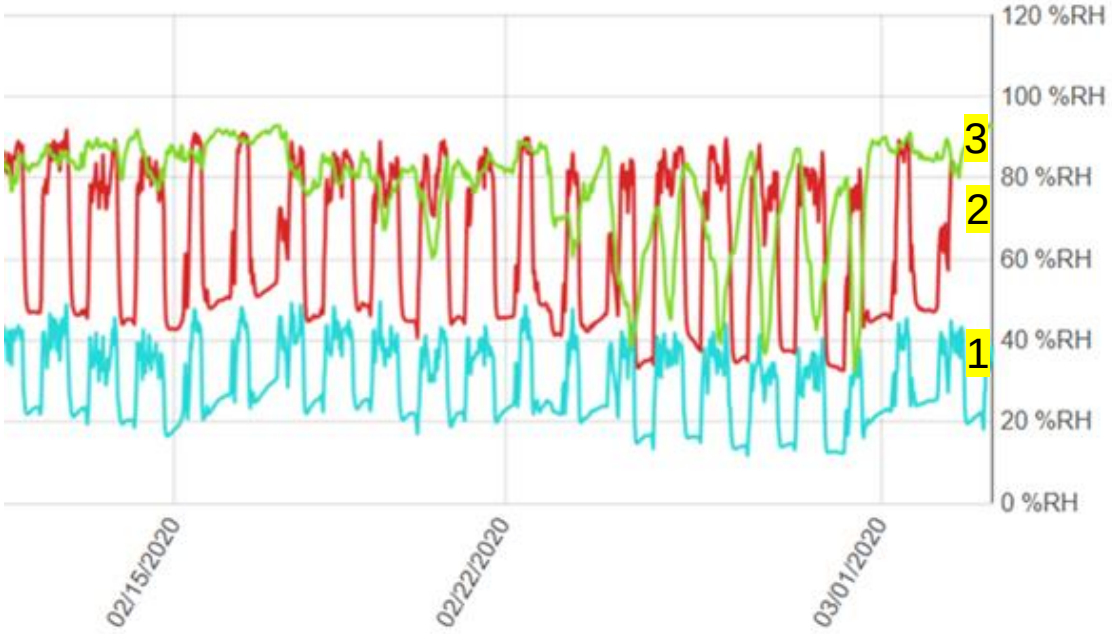


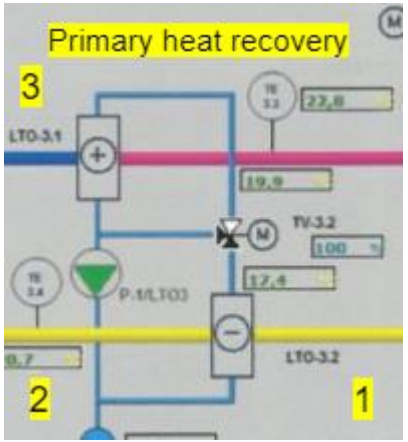
Measurement of the exhaust air relative humidity before the additional heat recovery

testo 160 IAQ_51600882 [%RH] = after heat recovery (HR)

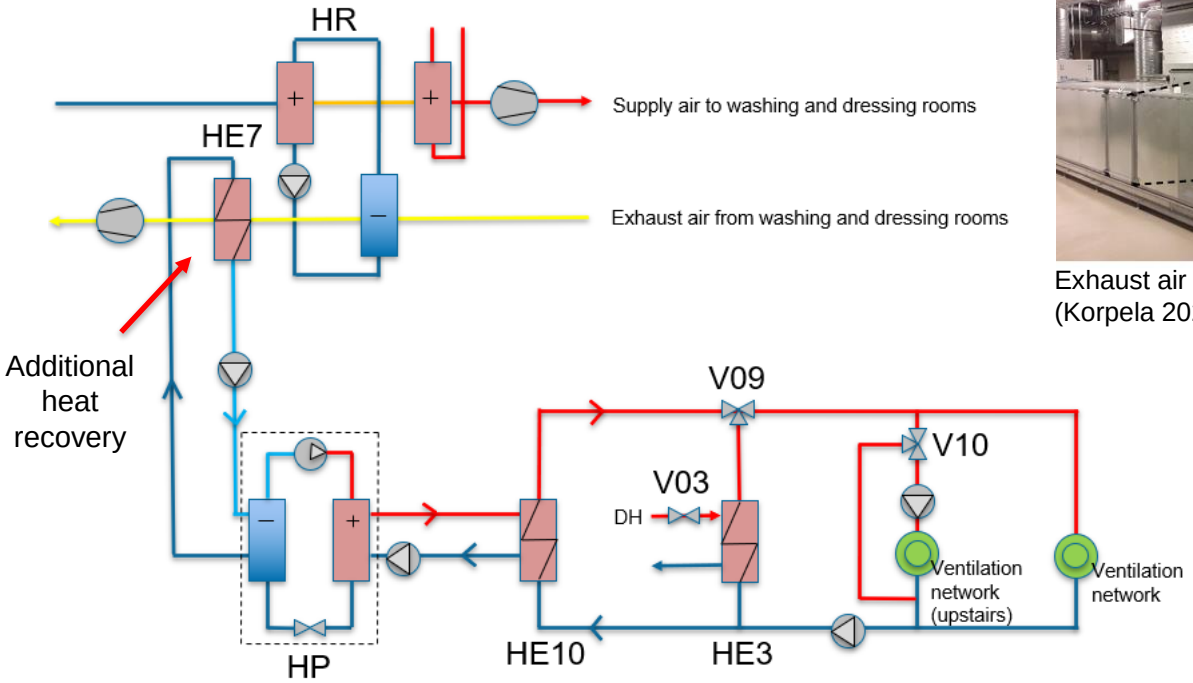
testo 160 IAQ_51601102 [%RH] = before HR

testo 160 IAQ_51601116 [%RH] = the relative humidity of the outdoor air





Schematic diagram of heat pump connection into the ventilation network

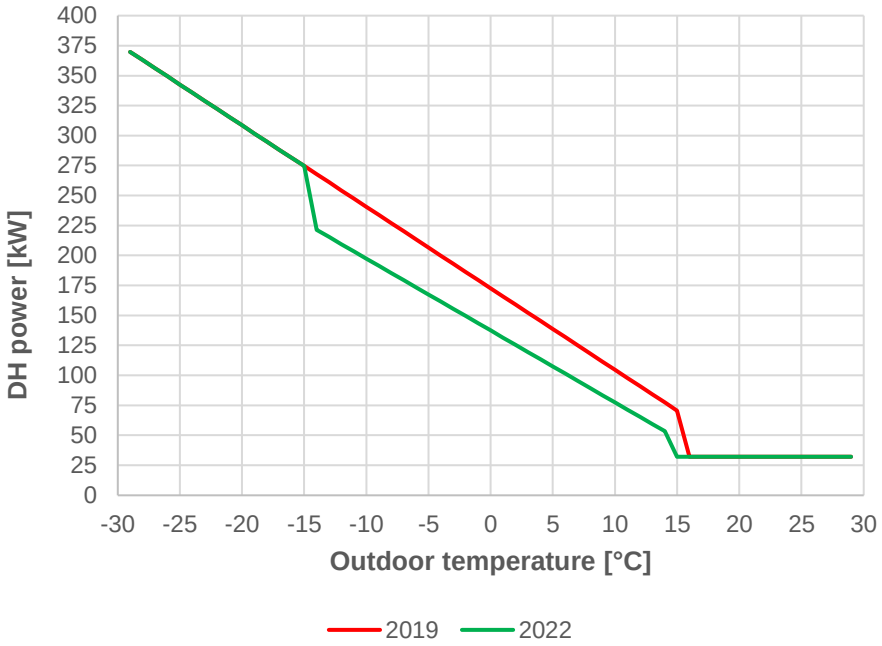


Exhaust air ventilation and the additional heat exchanger (HE7) (Korpela 2021, Xamk)

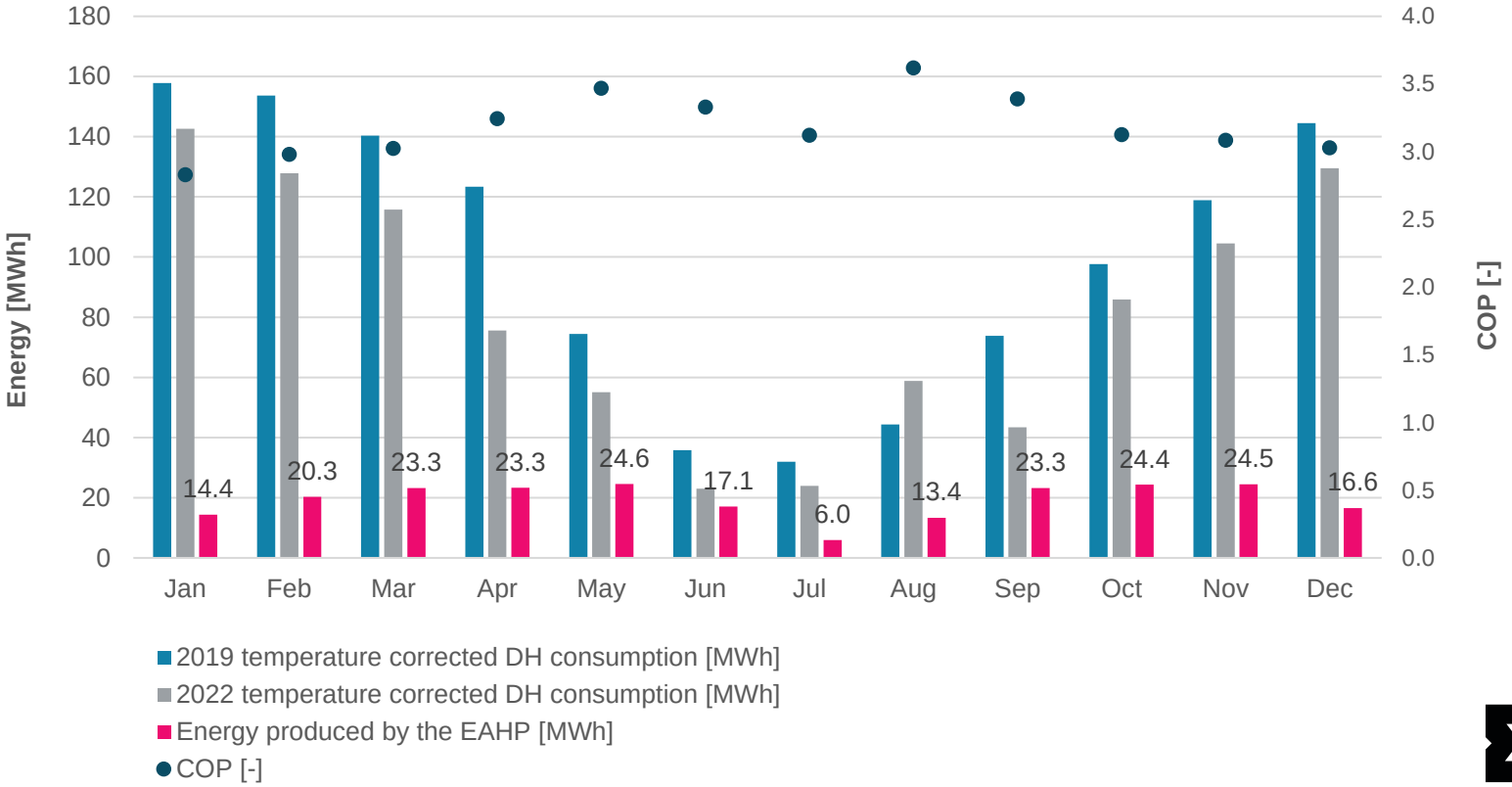
Heat pump (HP) Gebwell T2 32 kW (Kuosa 2021, Xamk)

Operating values of the heat pump (HP)

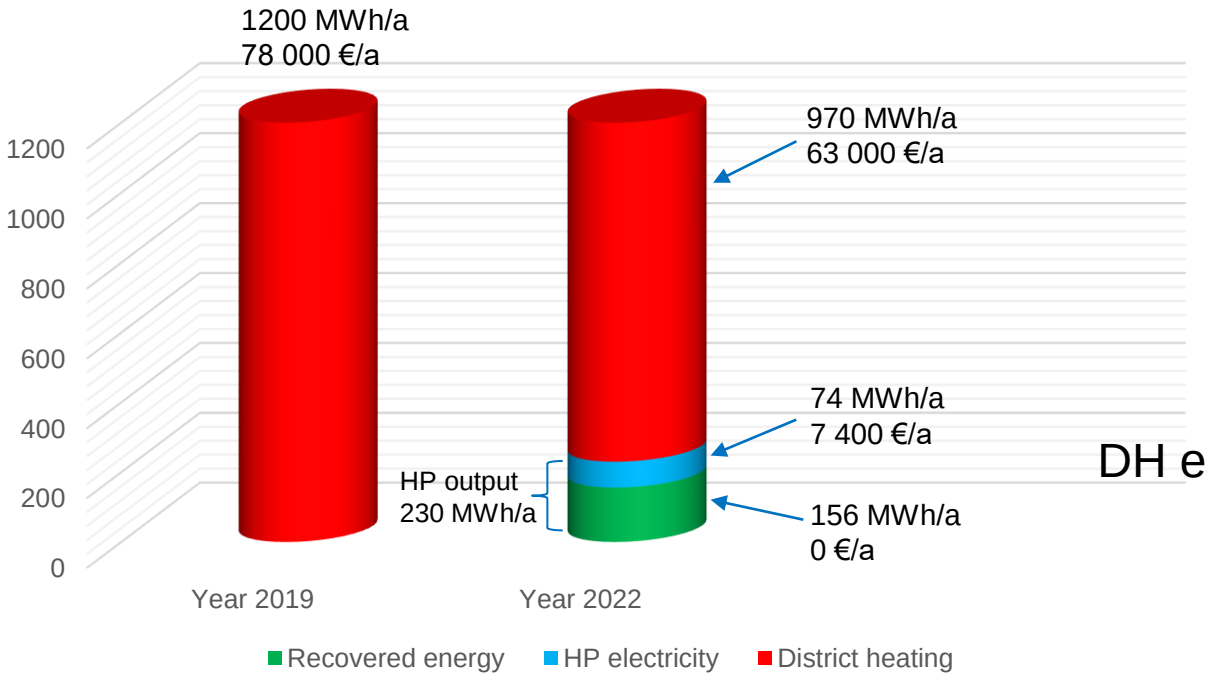
- HP operational from 11/2021
- 20–25 kW power is continuously obtained from the exhaust air during the heating season
- HP heating power 32–38 kW
- Exhaust air temperature decreased from 20 °C to 10 °C
- HP heating output 230 MWh/a
- Electricity consumption 74 MWh/a
- SCOP 3,1
- Savings 7300 €/a (VAT24)



Energy consumption - before and now



Comparison of energy consumption



DH energy saving 20%

Further development ideas

- To improve the operation and profitability of the EAHP during the cold seasons.
  - either by partially bypassing the heat recovery of the ventilation unit
  - or by limiting the heat recovery efficiency with adjustments

  → allows the EAHP to operate for longer periods in winter

- A new energy audit for the swimming hall

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Tunne huominen - All for the future.