ENGINEERING TOMORROW

Danfoss

Producing District Heating with a Supermarket Refrigeration System

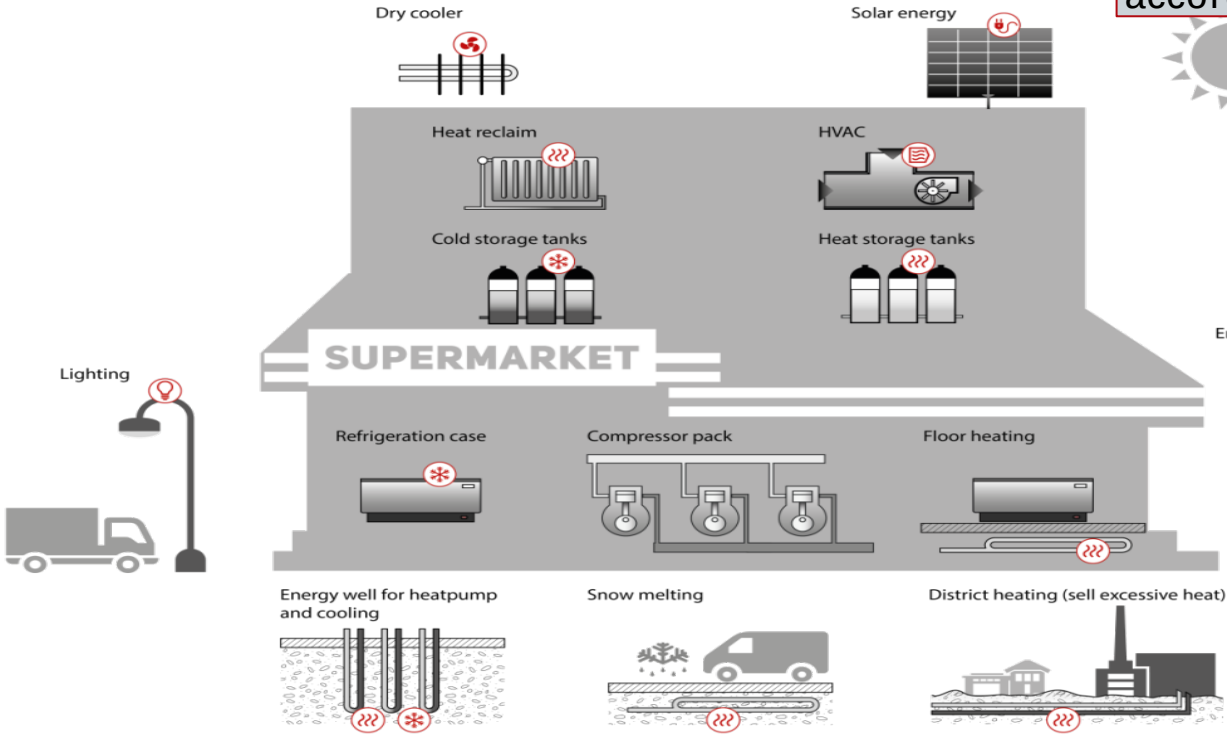
Presenter: Torben Green

Agenda

- Motivation
- Description of the project.
- Status and preliminary results

3 Focus areas to address Energy

From Energy Consumer to Energy “Prosumer”

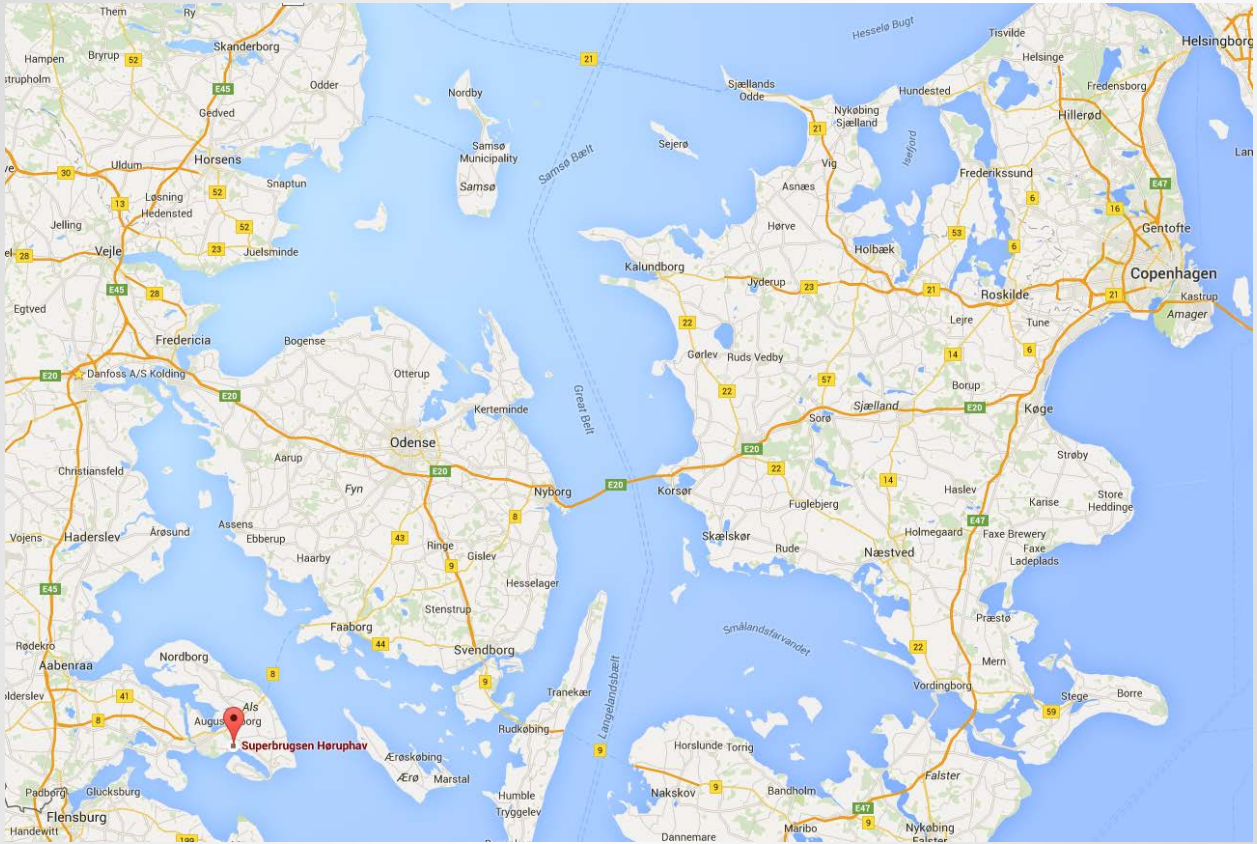


Optimize energy consumption according to business models:

Total Energy Optimization
- COP
- Heat recovery
- Defrost
- Light

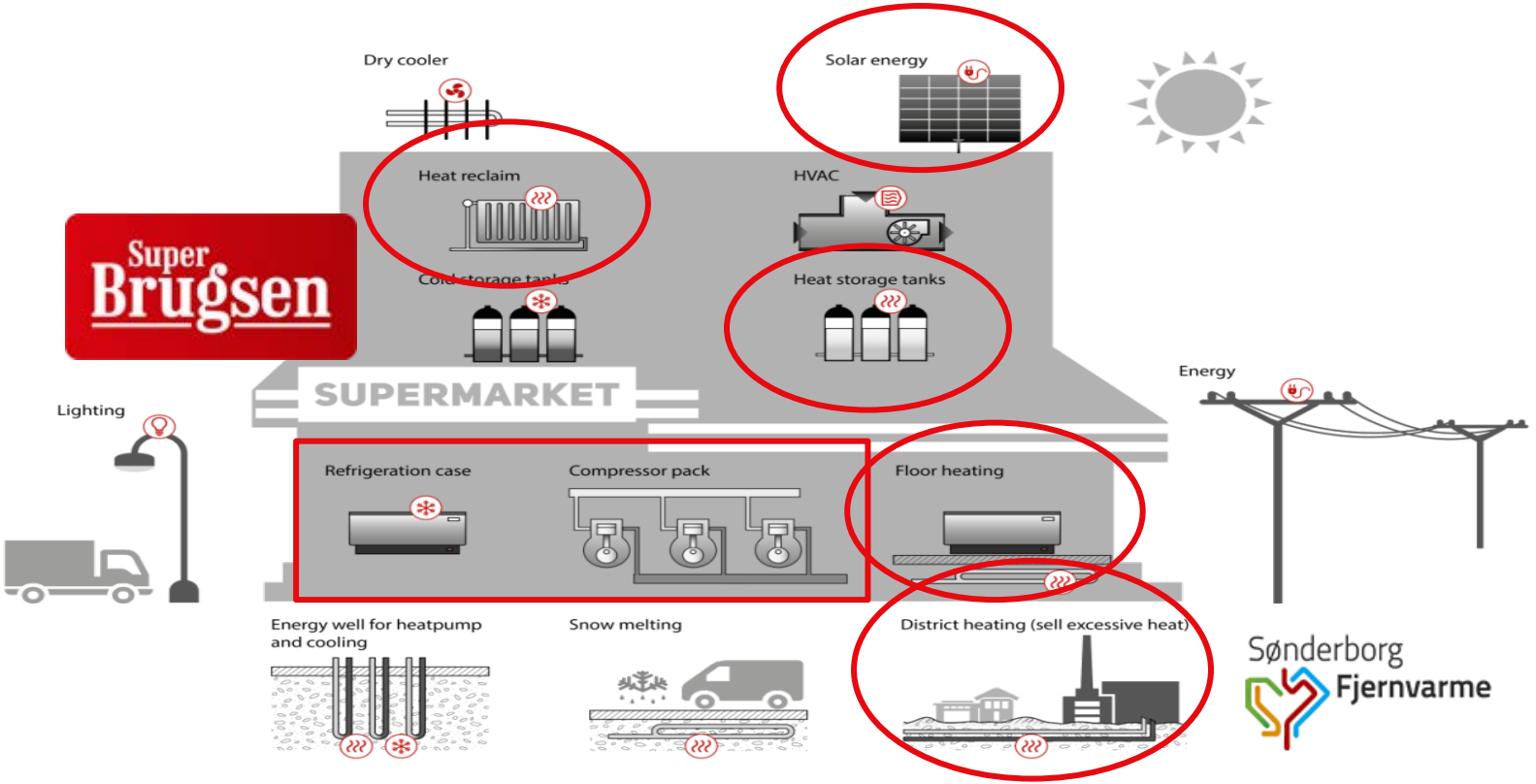
Maximize Flexibility:
- Energy storage
- Fast response
- Load shedding
- ….

Where are we producing district heating?



What do we have in Høruphav?

From Energy Consumer to Energy “Prosumer”



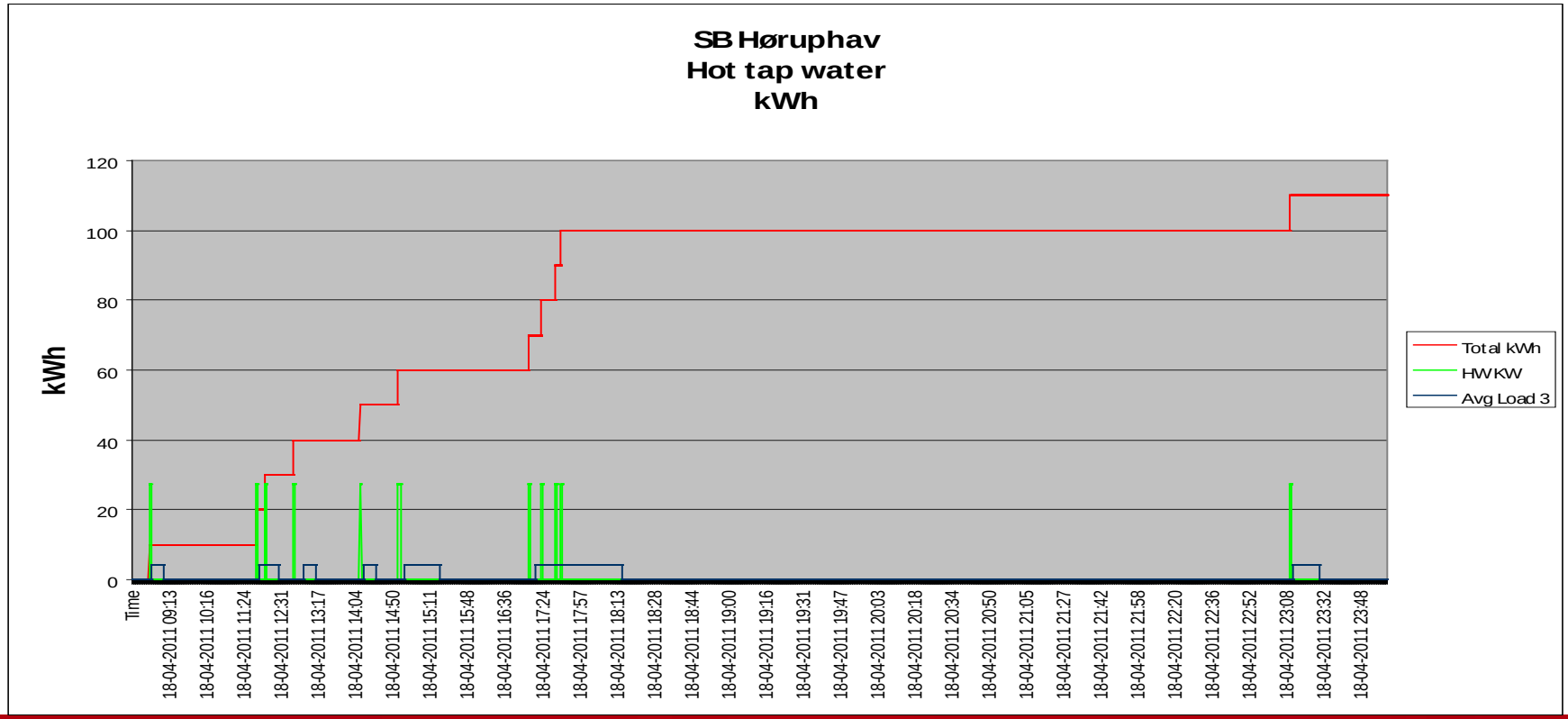
SuperBrugsen in Høruphav

- Area: 1000 m^2 from 2010
- Compressors: 5 MT (1 VS), 4 LT
- Cooling Capacity: 160 kW

- Heating :
  - Sanitary water (1800 l tank (65 ^oC)
  - Floor heating/low temp coils (35 ^oC)
  - District heating production

Heat reclaim, Data - Høruphav

- Hot tap water, tank 1800 L



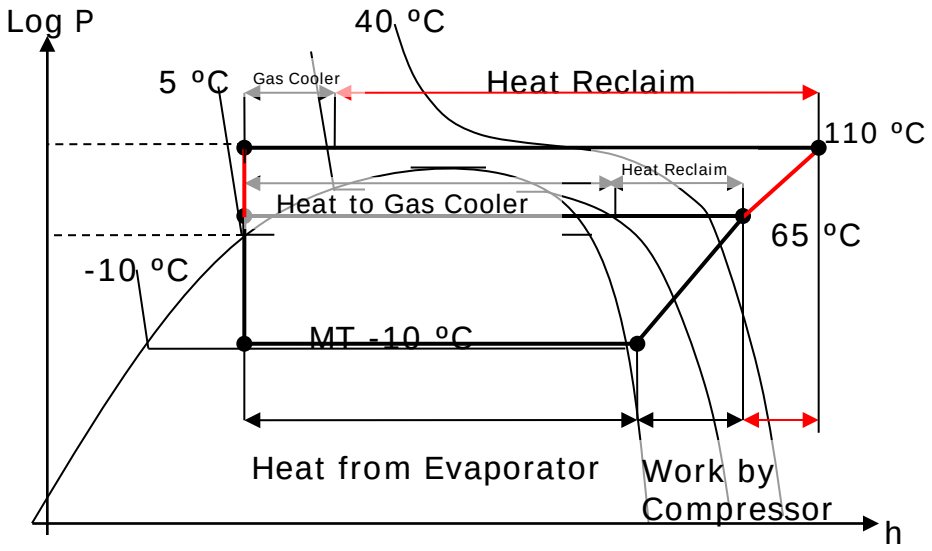
What’s in it for the partners?

- SuperBrugsen gets paid for energy that they would have otherwise thrown away.
- Danfoss gets an opportunity to investigate the business potential in developing a controller with a dedicated district heating application
- Sønderborg Fjernvarme continues their strategy of pursuing a greener production mix by decreasing the need for oil based production

Heat Reclaim explained

High discharge temperatures for CO_2 compression cycle

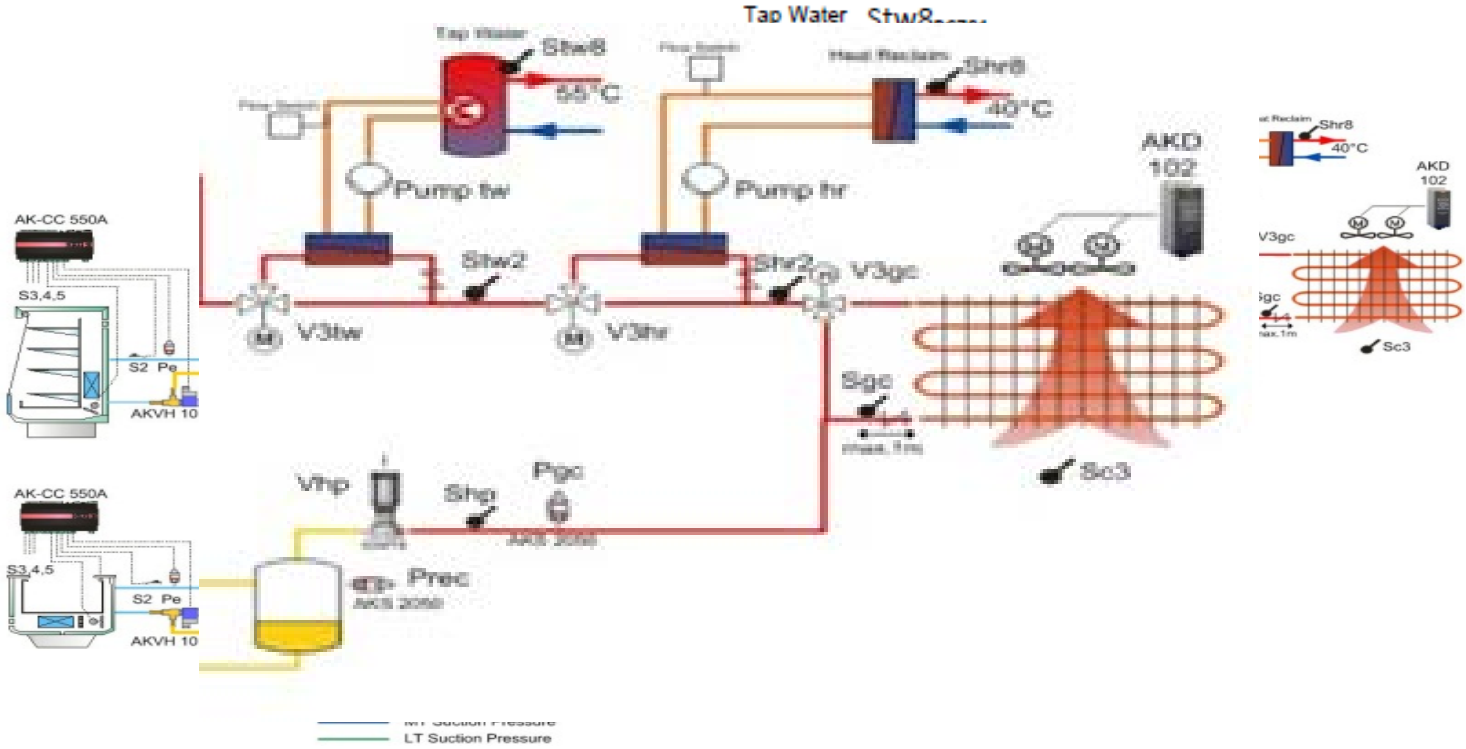
- Gas Cooler remove the heat from evaporator and compressor work
- In practice you get minimum 60-90 ºC even with minimum compressor load and reasonable low gas cooler pressure
- Heat reclaim above 65 ºC is only a limited amount of energy
- If High pressure is increased when demand is present the system can reach temperatures of 80-110 ºC
- Heat reclaim above 65 ºC will then be a significant amount of energy
- Gas Cooler only remove a small part of energy



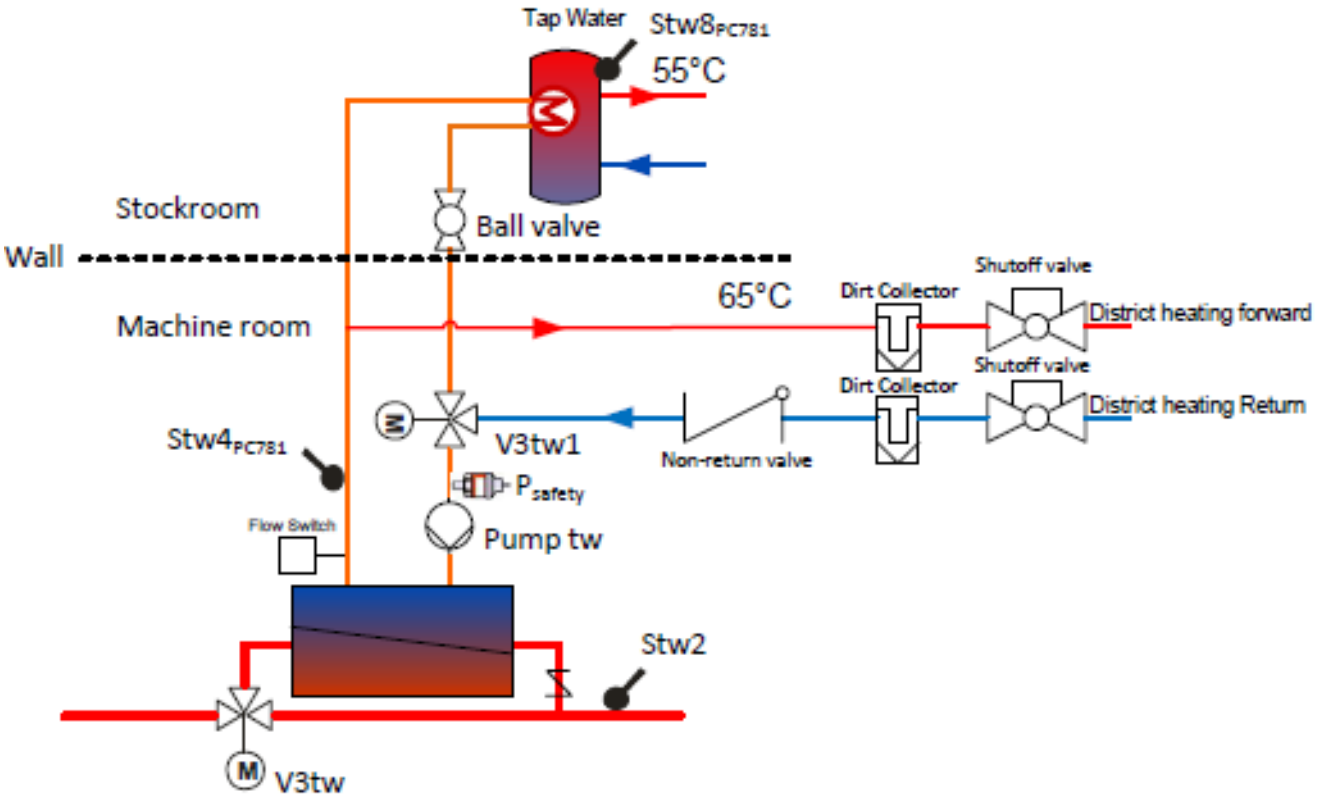
Simplified CO2 refrigeration cycle

High Efficient Heat Reclaim

SuperBrugsen – Høruphav, DK



High Efficient Heat Reclaim including district heating connection



Operation strategy for the district heating production

- The heat consumption of the store has priority
- Current district heating strategy is:
  - Sell all the heat that is not required by the store

Expectations

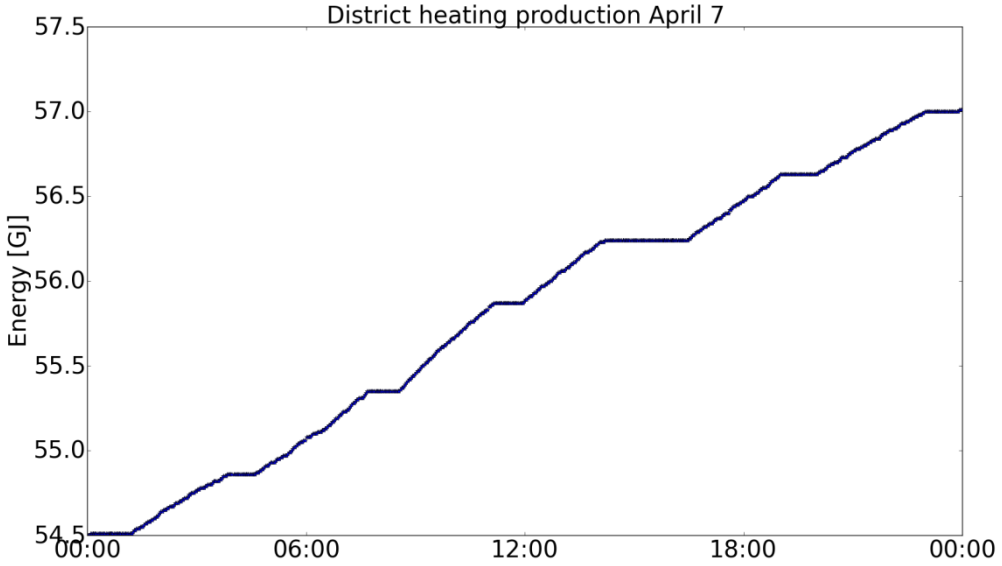
- Production of 1051 GJ per year, equivalent of 10% of the solar based district heating production
- Expected pay back time around 4 years for the district heating production.
  - The pay pack time for Superbrugsen will be below 1 year
- The district heating production will be highest during summer
  - Not a problem, because that is actually good value for Sønderborg Fjernvarme

Status of the project

- The district heating production is working and producing close the the expectation
- Online data acquisition is setup
- Data is currently being collected from the store

Preliminary results

- Approximately 2.4 GJ a day, i.e. 876 GJ per year
- Higher energy production is expected during the summer
- District heating is only produced when the local requirements for the store are satisfied



Relation to CITIES

- Investigation of more advanced district heating production strategies
- Investigation of time varying price schemes for the district heating production
- Investigation of production strategies based on actual demand from the district heating grid.
- Data from the site could be made available for relevant partners in CITIES

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BACKUP

Proportions

- Capacity of the district heating plan supplying Høruphav is:
  - 5 MW oil based
  - Production capacity if the solar plant is 2700 MWh/year or equivalent to the consumption of 150 households
- Capacity of district heating production from Superbrugsen is 40 kW
- The expected deliverable of 292 MWh/year is aproximatly the same as the consumption of 15 households