



ENGINEERING
TOMORROW

Danfoss

Producing District Heating with a Supermarket Refrigeration System

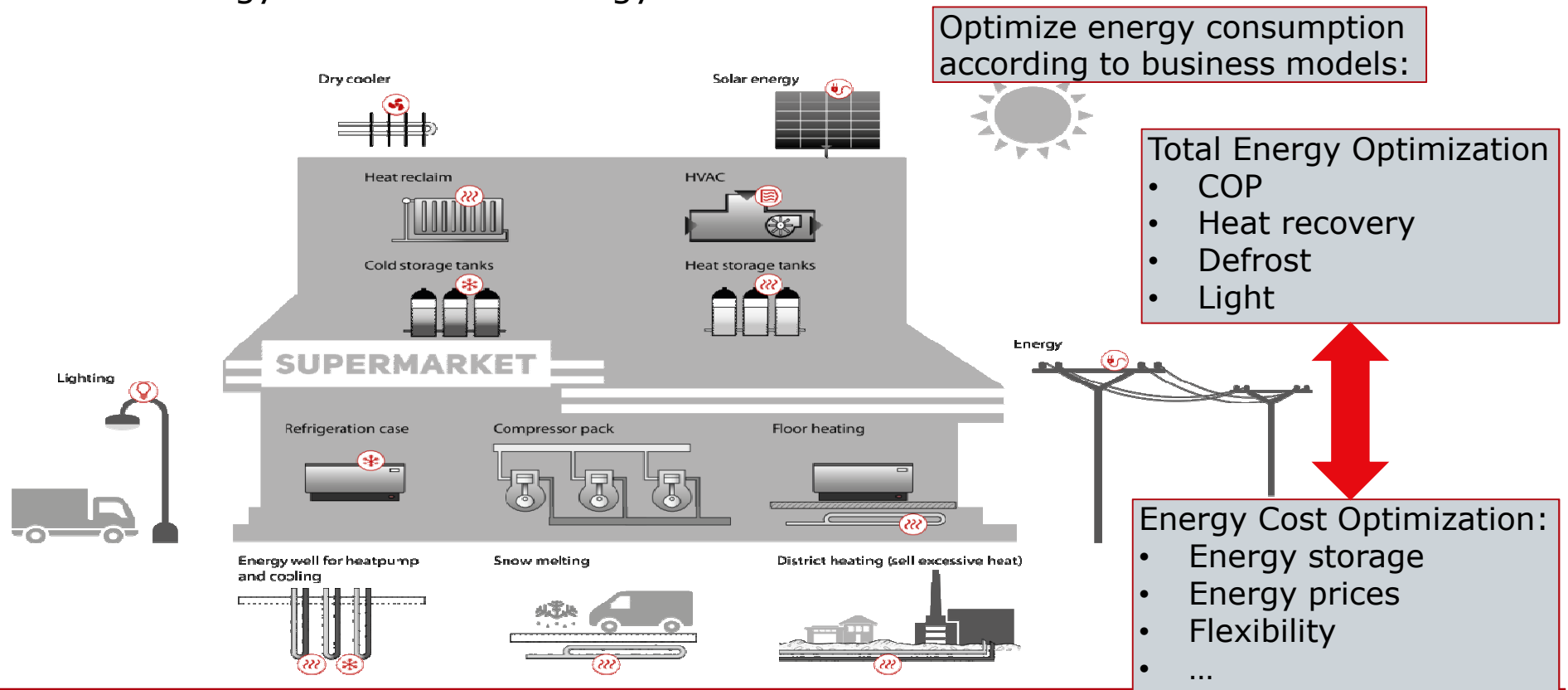
Presenter: Torben Green

Agenda

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

3 Focus areas to address Energy

From Energy Consumer to Energy "Prosumer"

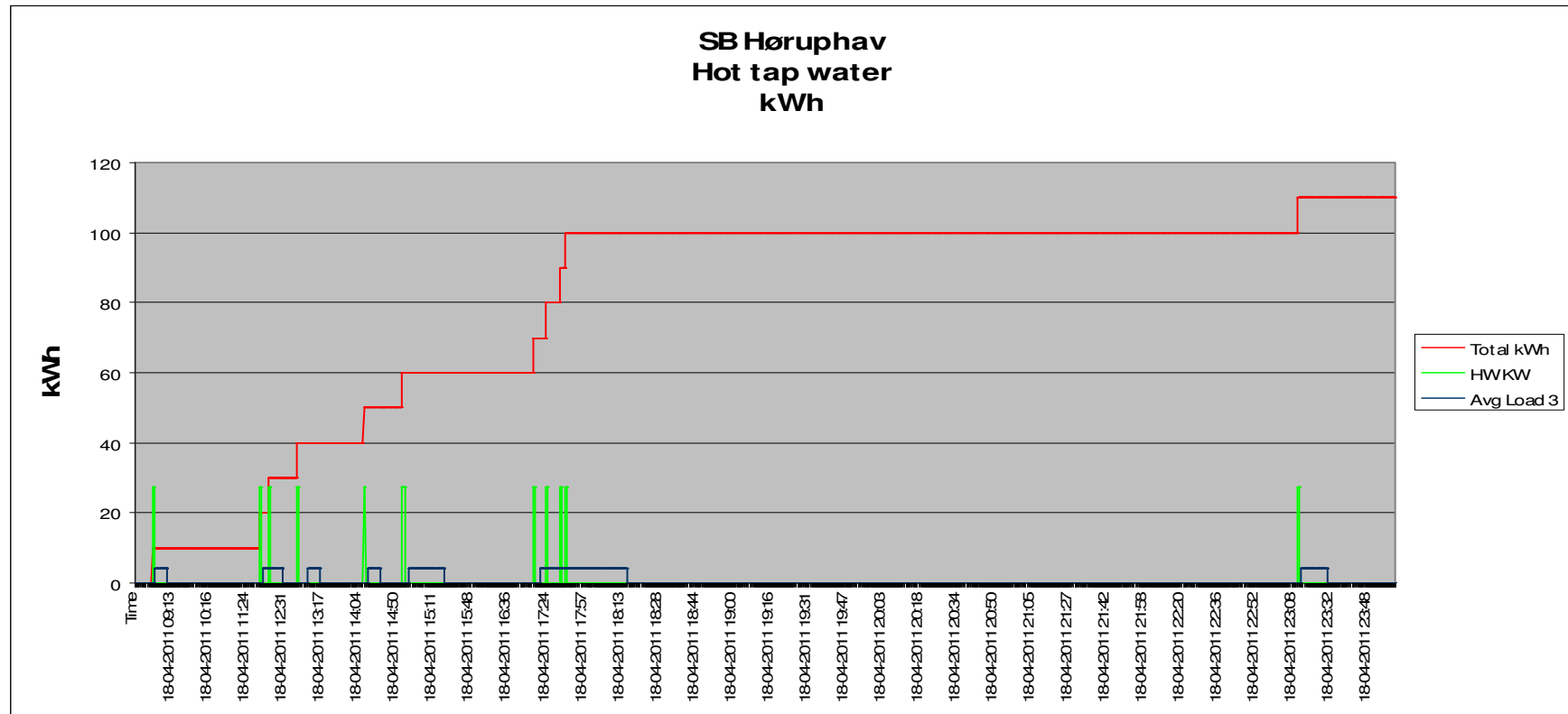


Story of the project

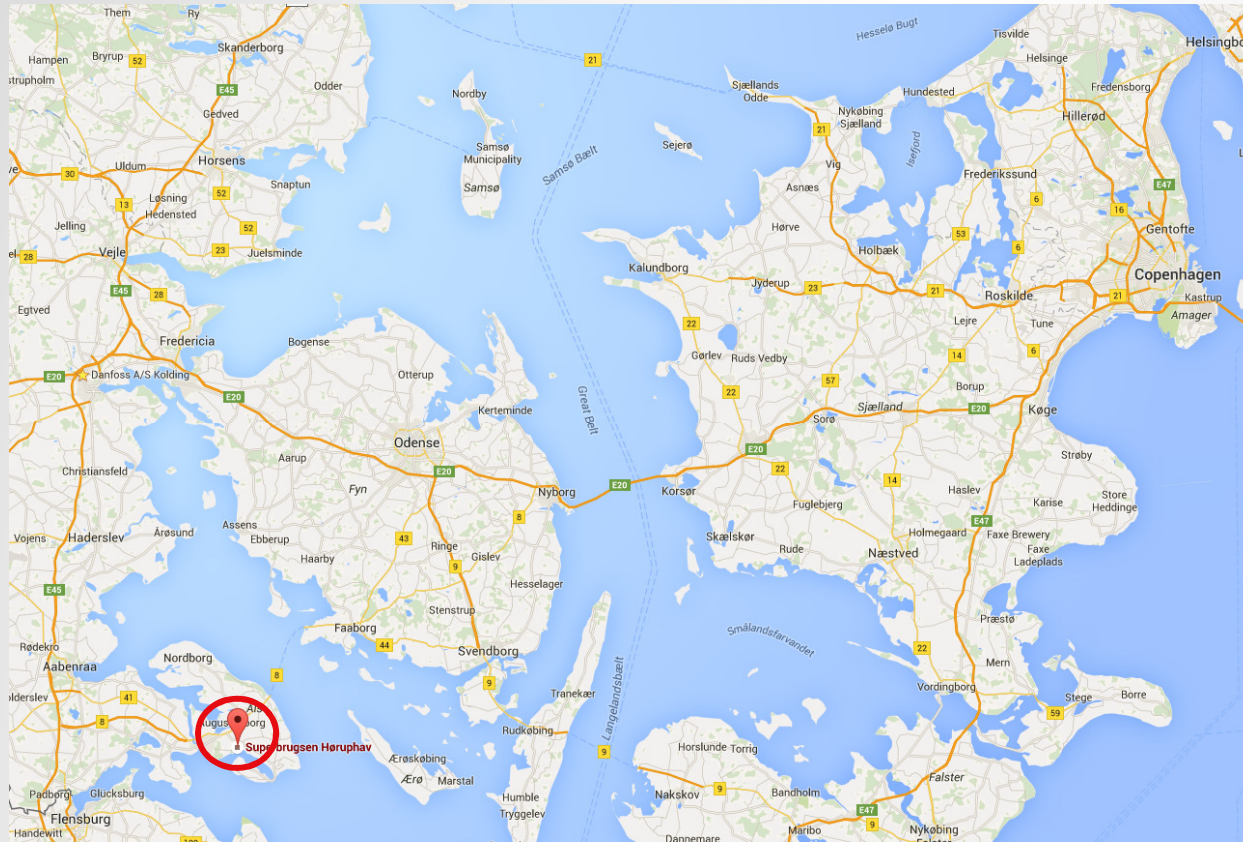
- The project idea originates from a Project Zero workshop.
 - Main idea of the project: Demonstrate that heat reclaim from a supermarket can be used for district heating production.
- The general idea was not new, but there was a lack of evidence.
- Open questions at the beginning of the project:
 - Can the system deliver the expected energy production?
 - How good a solution can our current products deliver and is the solution sufficient?

Heat reclaim, Data - Høruphav

- Hot tap water, tank 1800 L

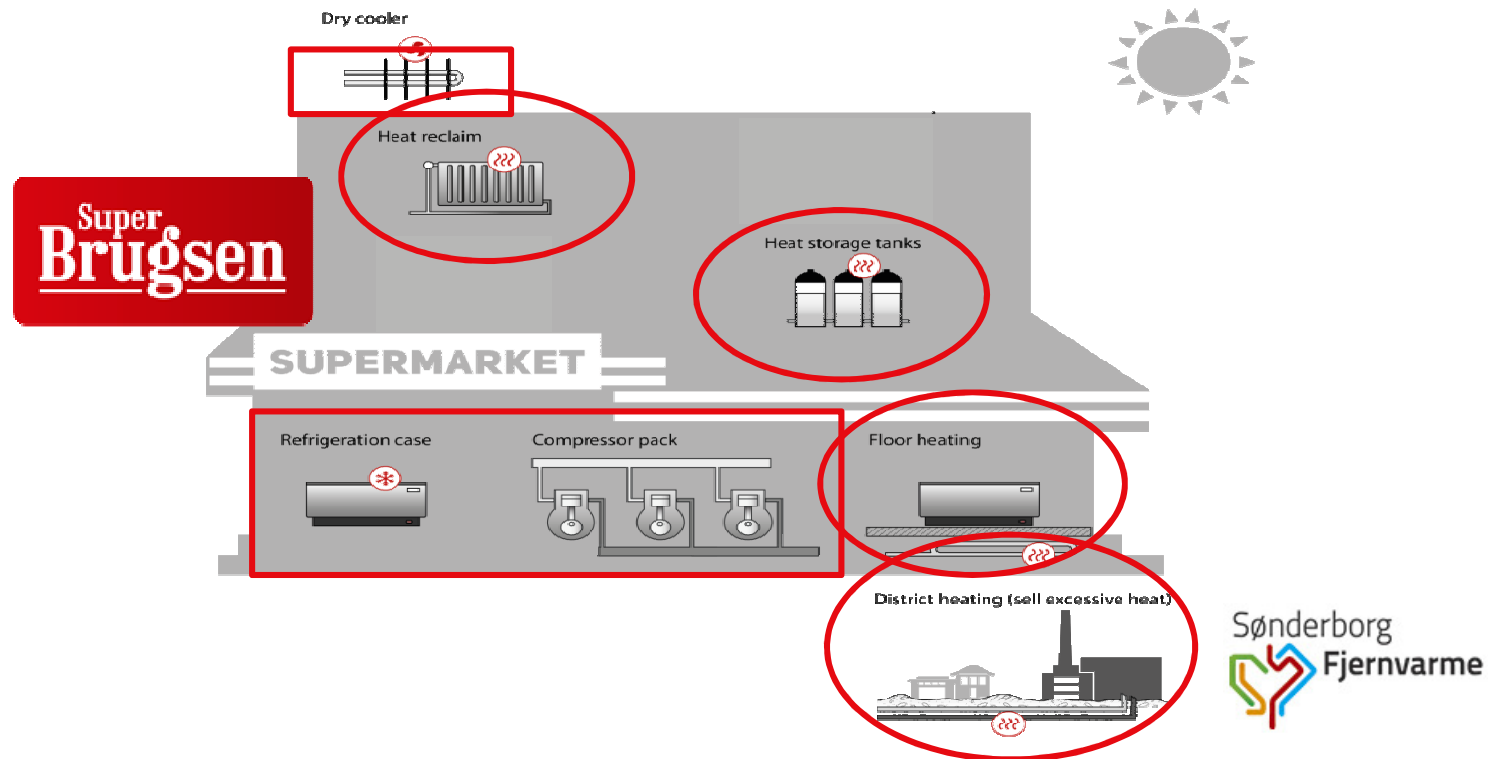


Where are we producing district heating?



What do we have in Høruphav?

From Energy Consumer to Energy "Prosumer"



SuperBrugsen in Høruphav



- Area: 1000 m² from 2010
- Compressors: 5 MT (1 VS), 4 LT
- Cooling Capacity: 160 kW
- Heating :
 - Sanitary water (1800 l tank (65 °C)
 - Floor heating/low temp coils (35 °C)
 - District heating production

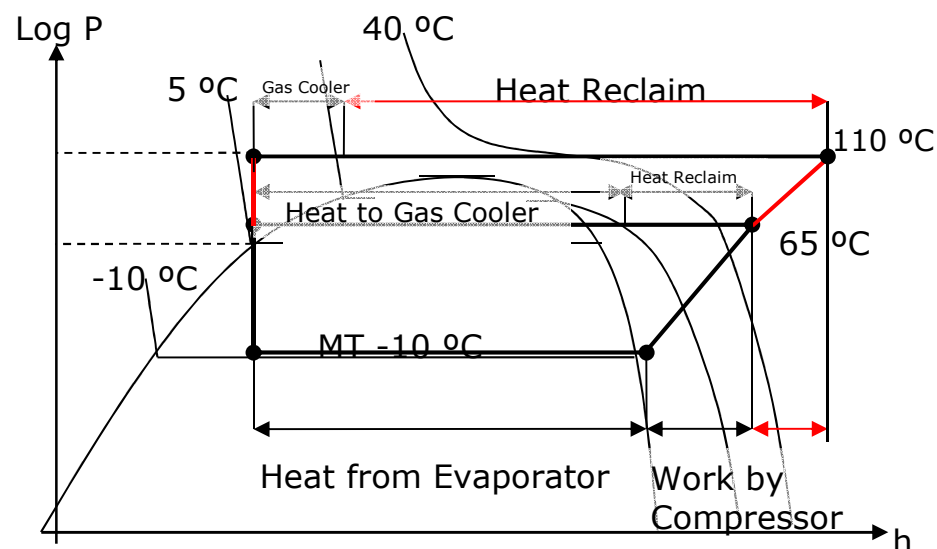
What's in it for the partners?

- 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

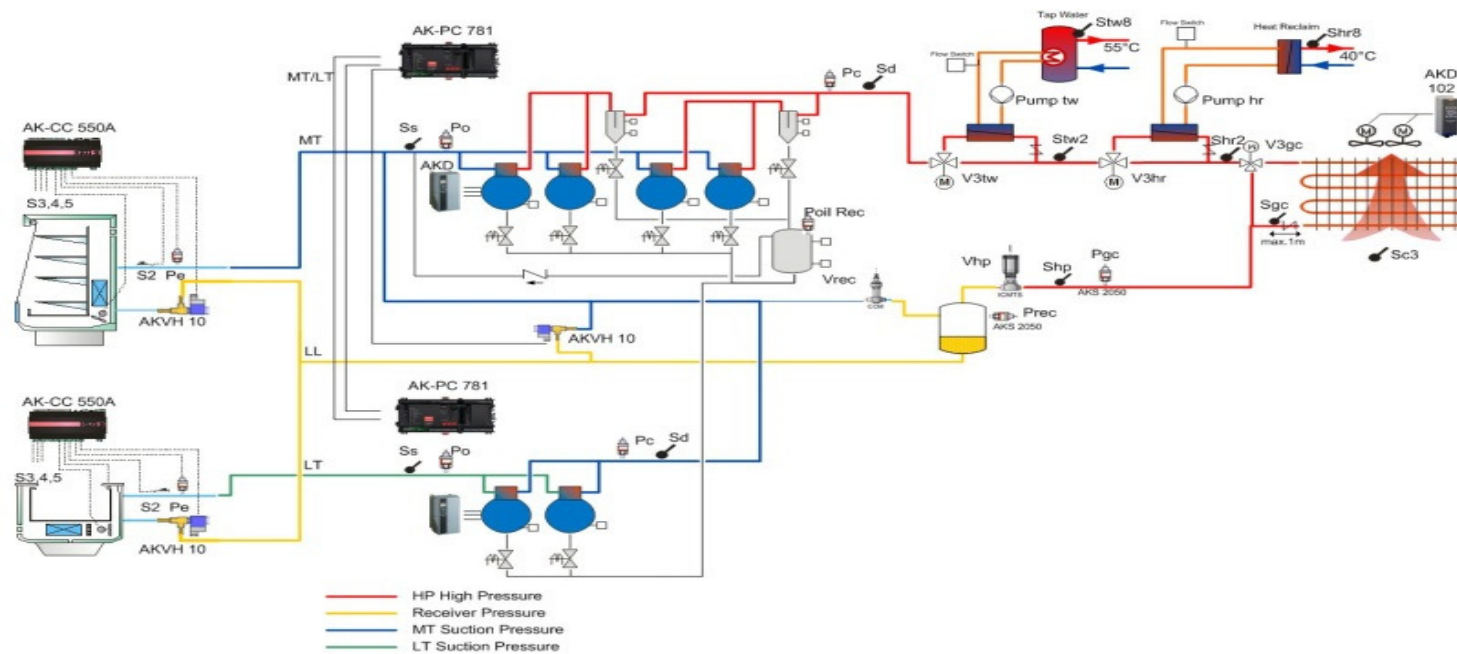
High discharge temperatures for CO₂ compression cycle

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



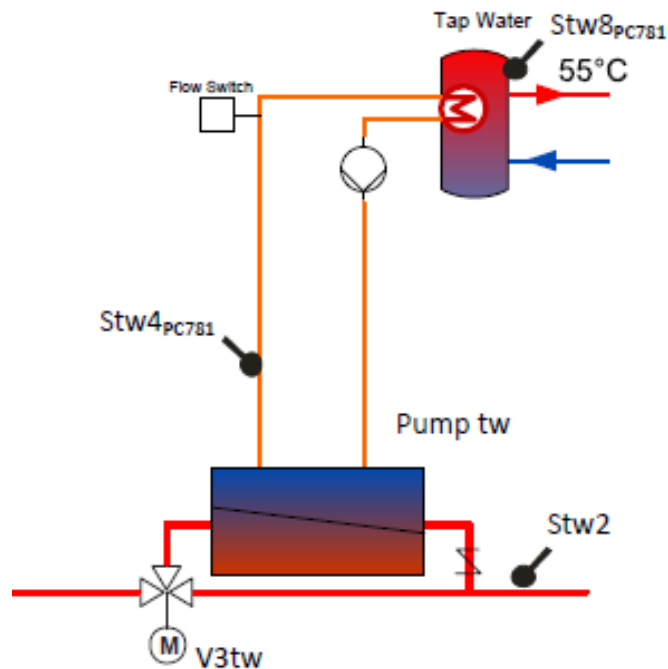
Simplified CO₂ refrigeration cycle

High Efficient Heat Reclaim SuperBrugsen – Høruphav, DK

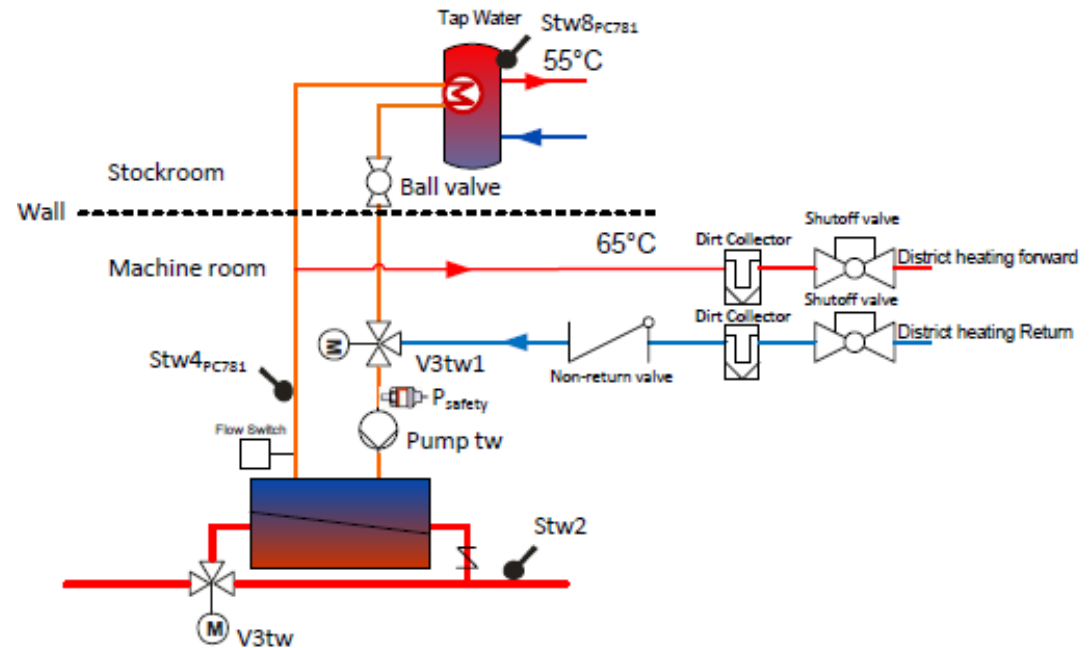


High Efficient Heat Reclaim including district heating connection

Old setup



New setup



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 – At the beginning of the project

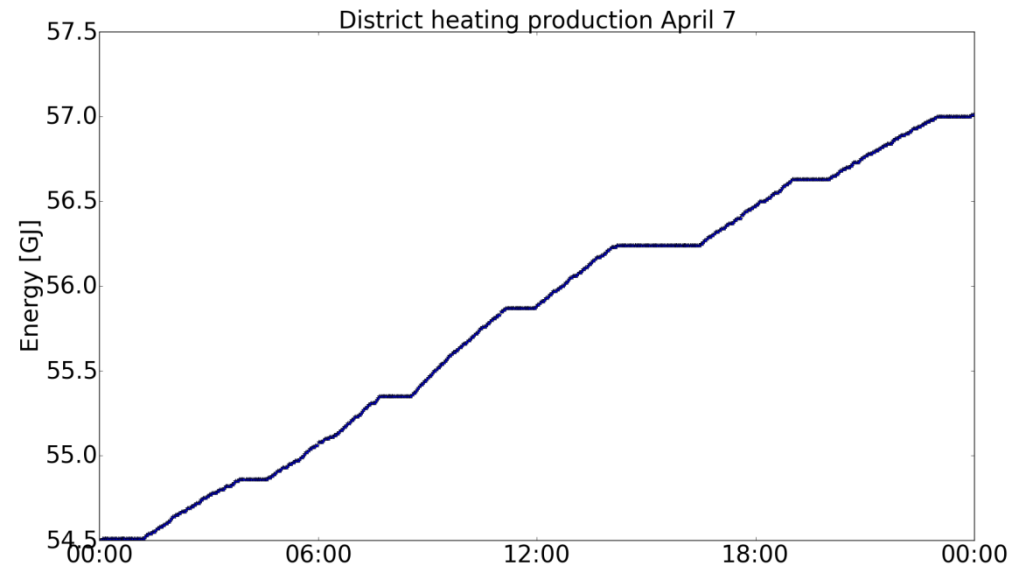
- Production of 1051 GJ per year, equivalent of 10% of the solar based district heating production
- Expected payback time around 4 years for the district heating production.
 - The paypack time for SuperBrugsen will be between 1-2 years
- The district heating production will be highest during summer
 - Not a problem, because that is actually good value for Sønderborg Fjernvarme in the Høruphav grid

Status of the project

- The district heating production is working and producing at a satisfying level
- Online data acquisition is setup
- Production from the store is being monitored by Danfoss

Preliminary results

- Average production is 1.87 GJ/day, i.e. 684 GJ/year
- Best production average 2.4 GJ/day, i.e. 854 GJ/year
- Higher energy production is expected during the summer
- District heating is only produced when the local requirements for the store are satisfied



Concluding remarks

- Production is running and the business case for SuperBrugsen is looking promising.
 - They have already asked us to help them with another store
- Danfoss is also participating in the Nordhavn project where we have proposed a similar setup

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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 approximately the same as the consumption of 15 households