Webinar 18. January 2022

Considerations about online modeling

About Fjernvarme Fyn

Key figures

Fjernvarme Fyn Holding A/S is owned by the municipality of Odense (97%) and the North Funen Municipality (3%)

Denmark's 3rd largest supplier of district heating

Supplies 200.000 citizens

Process customers (green houses) buy almost 20% of the heat

Almost 300 employees

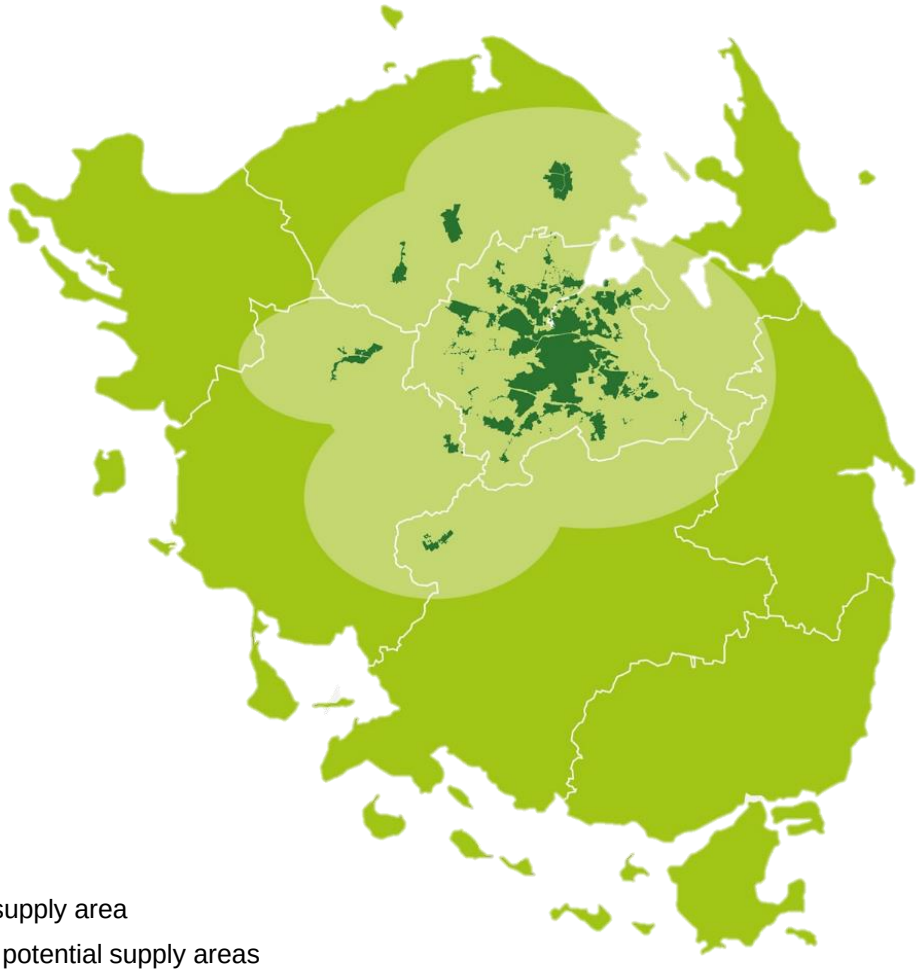
Strategic goals

Stop using coal in 2022

Competitive prices

Next goal

Climate neutral/negative in 2030



Company structure

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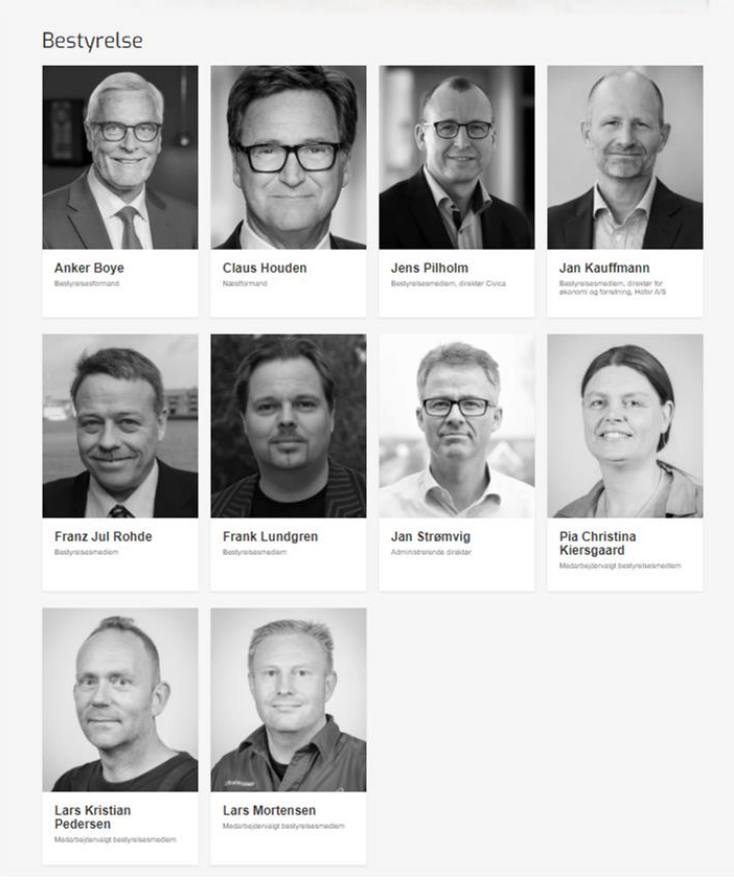
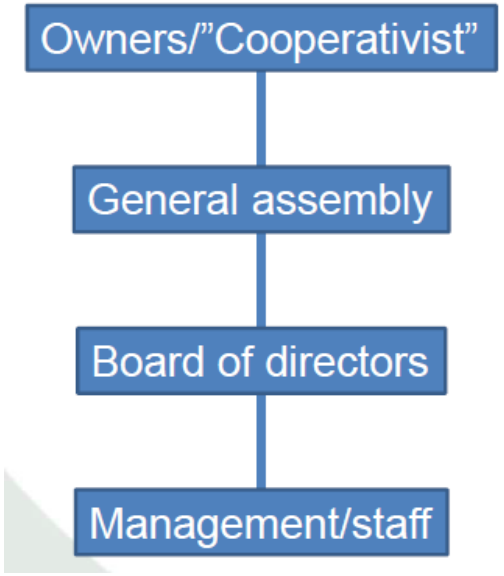
Fjernvarme Fyn Holding A/S

- Fjernvarme Fyn Affaldsenergi
- Fjernvarme Fyn Distribution A/S
- Fjernvarme Fyn Produktion A/S
- Fjernvarme Fyn Service A/S

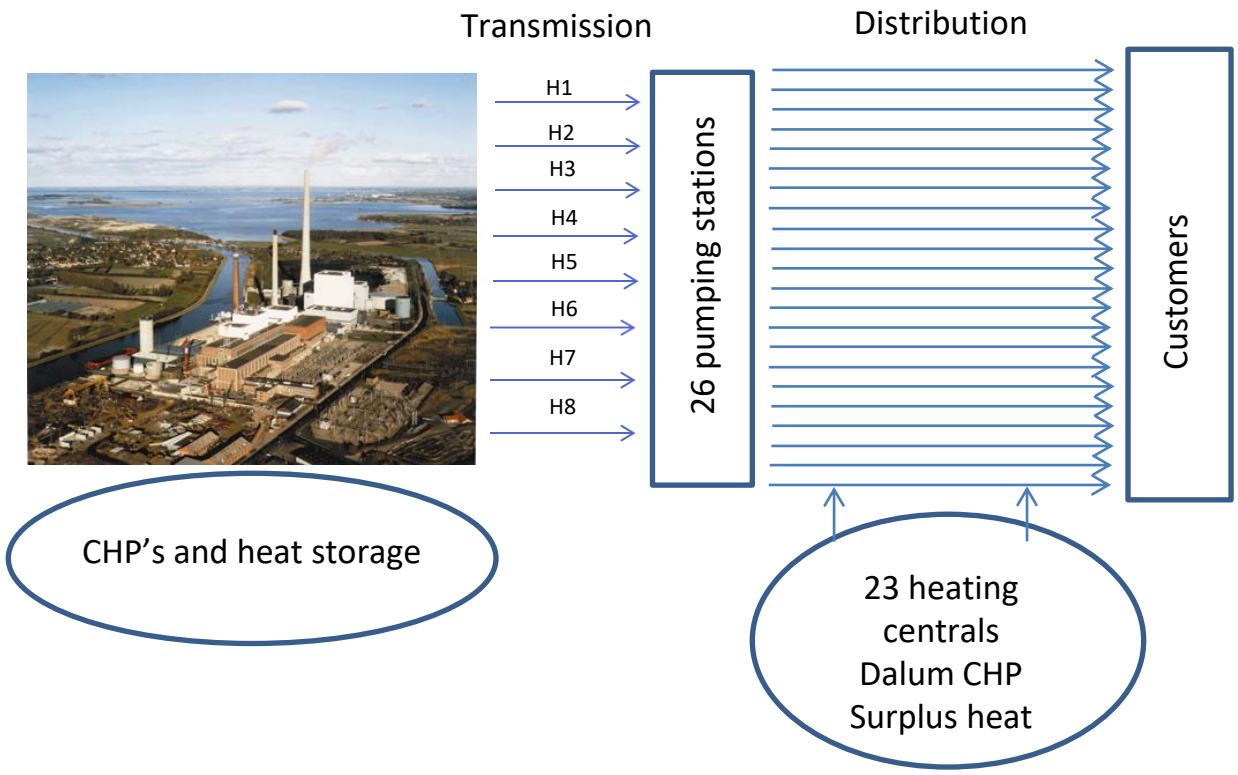




One of the worlds largest district heating grids

- 67.000 connections/ meters
- 120 km transmission lines (75-95 °C)
- 2200 km distribution lines (65-85 °C)

Fjernvarme Fyn is supplying heat from central heat production to distribution zones via 8 transmission lines



Source: Fjernvarme Fyn

Production: Straw fired CHP unit

Facts

- Co-production of heat and power (CHP)

- 32 MWe and 88 MJ/s heat
- 120 MJ/s heat only
- 200.000 ton straw/year ~ 100.000 ton coal

- Commissioned in 2009
- Heat pumps on flue gas in 2021

Production: Waste incineration

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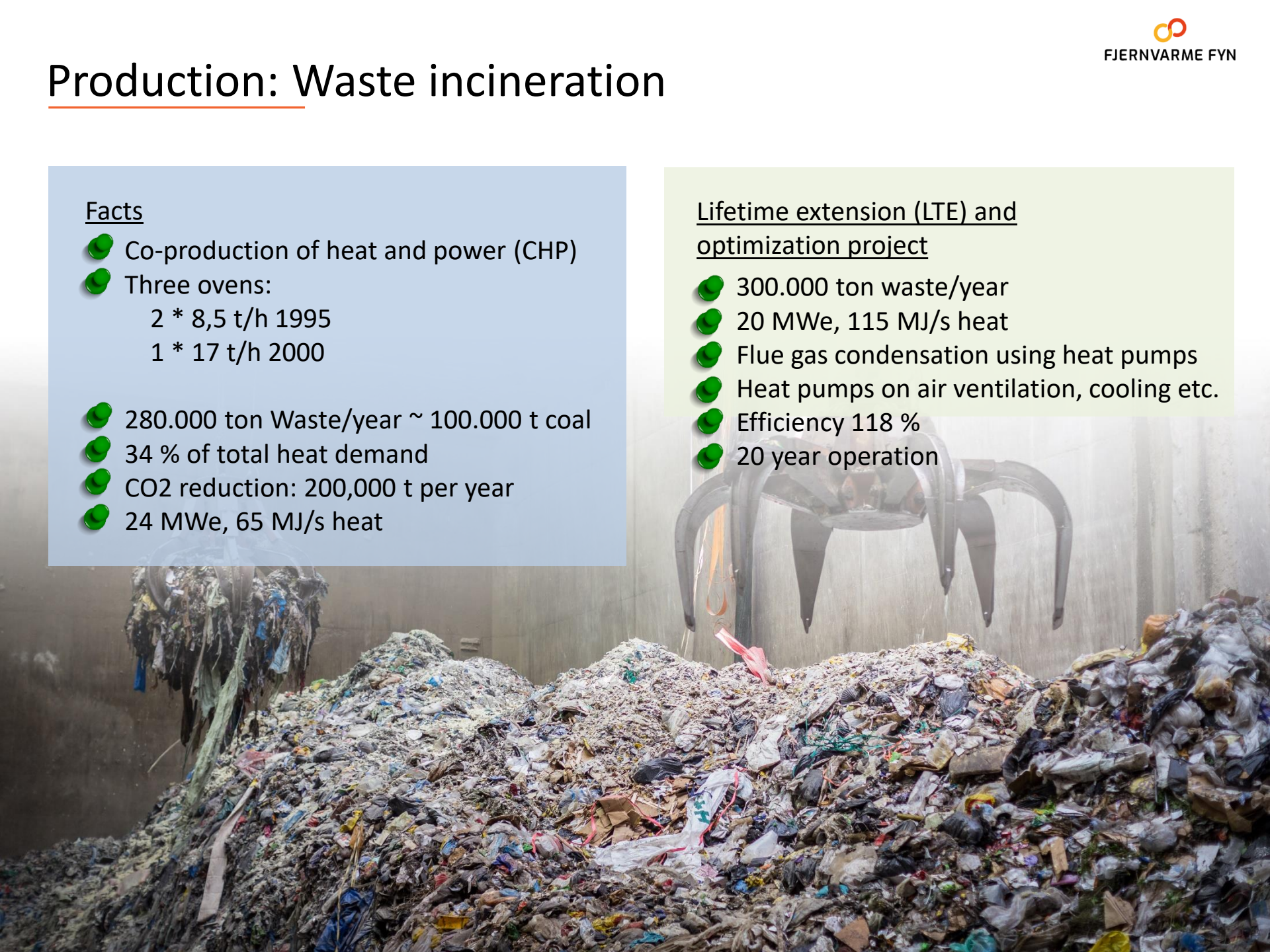
Facts

- Co-production of heat and power (CHP)
- Three ovens:
  - 2 * 8,5 t/h 1995
  - 1 * 17 t/h 2000

- 280.000 ton Waste/year ~ 100.000 t coal
- 34 % of total heat demand
- CO2 reduction: 200,000 t per year
- 24 MWe, 65 MJ/s heat

Lifetime extension (LTE) and optimization project

- 300.000 ton waste/year
- 20 MWe, 115 MJ/s heat
- Flue gas condensation using heat pumps
- Heat pumps on air ventilation, cooling etc.
- Efficiency 118 %
- 20 year operation



Production: Coal fired CHP unit – converted in 2023 to gas as an transitional solution until 2030

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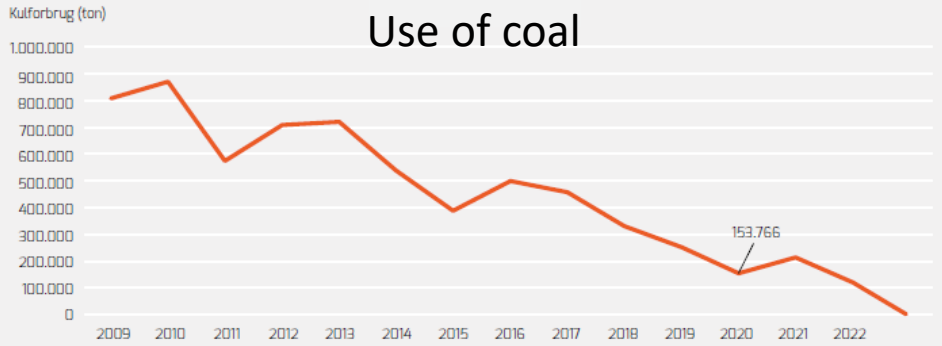
Facts

- Co-production of heat and power (CHP)
  90 pct. overall efficiency
- 410 MWe
- 610 MJ/s heat (overload)
- Consumption of 800.000 t coal/year
  in 2009 to 0 t in 2023
- Commissioned in 1990 – convertion
  to natural gas in 2023
- Heat pumps on internal cooling in 2020



New biomass CHP and electric boilers in scrapped coalfired unit. Planned commissioning 2023.

150 MW biomass, 100 MW electric boilers

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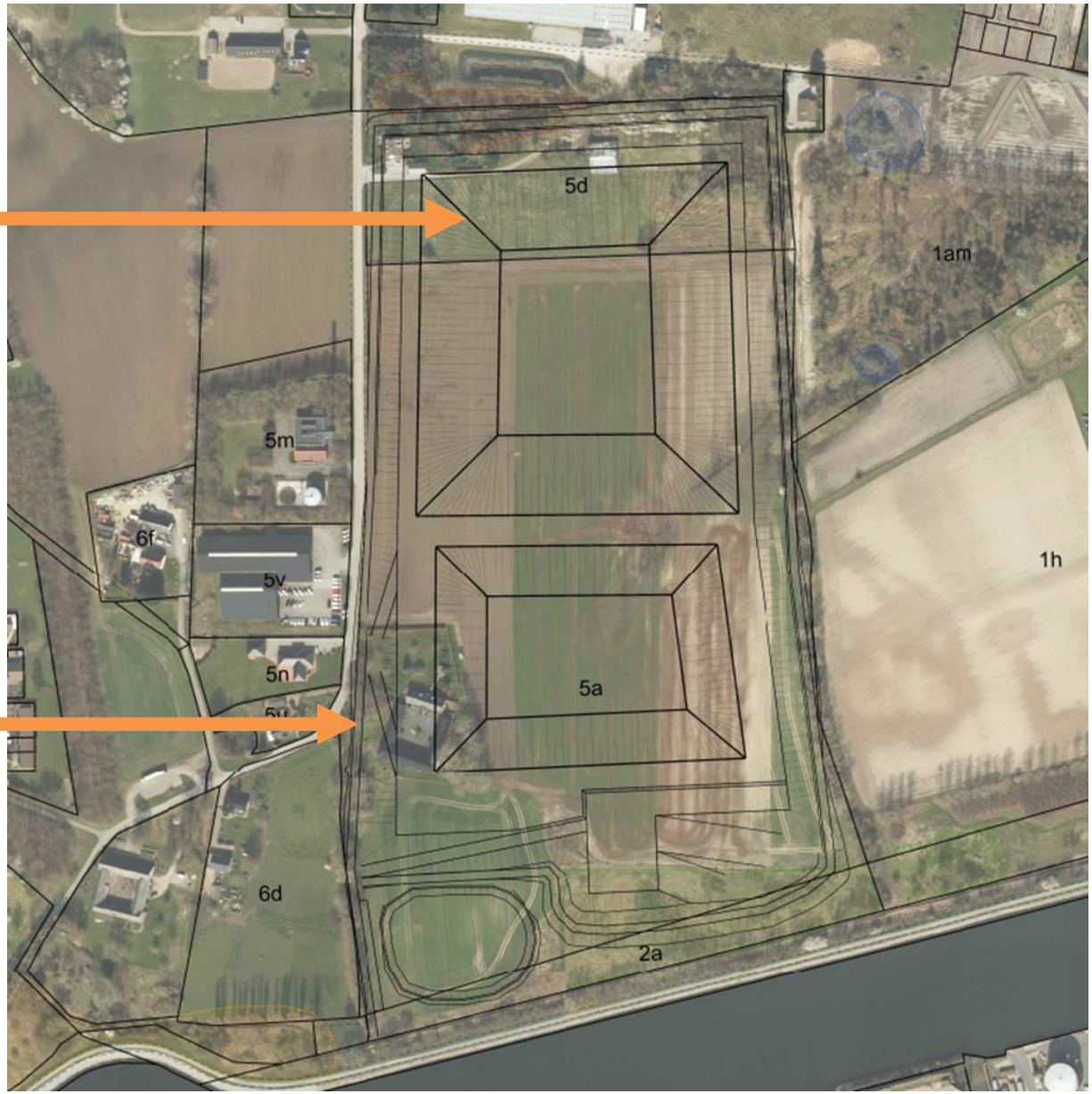
Large pit storage

Planning

- 1. storage ~ 700.000 m^3
- 2. storage ~ 300.000 m^3

Planned commissioning 2025



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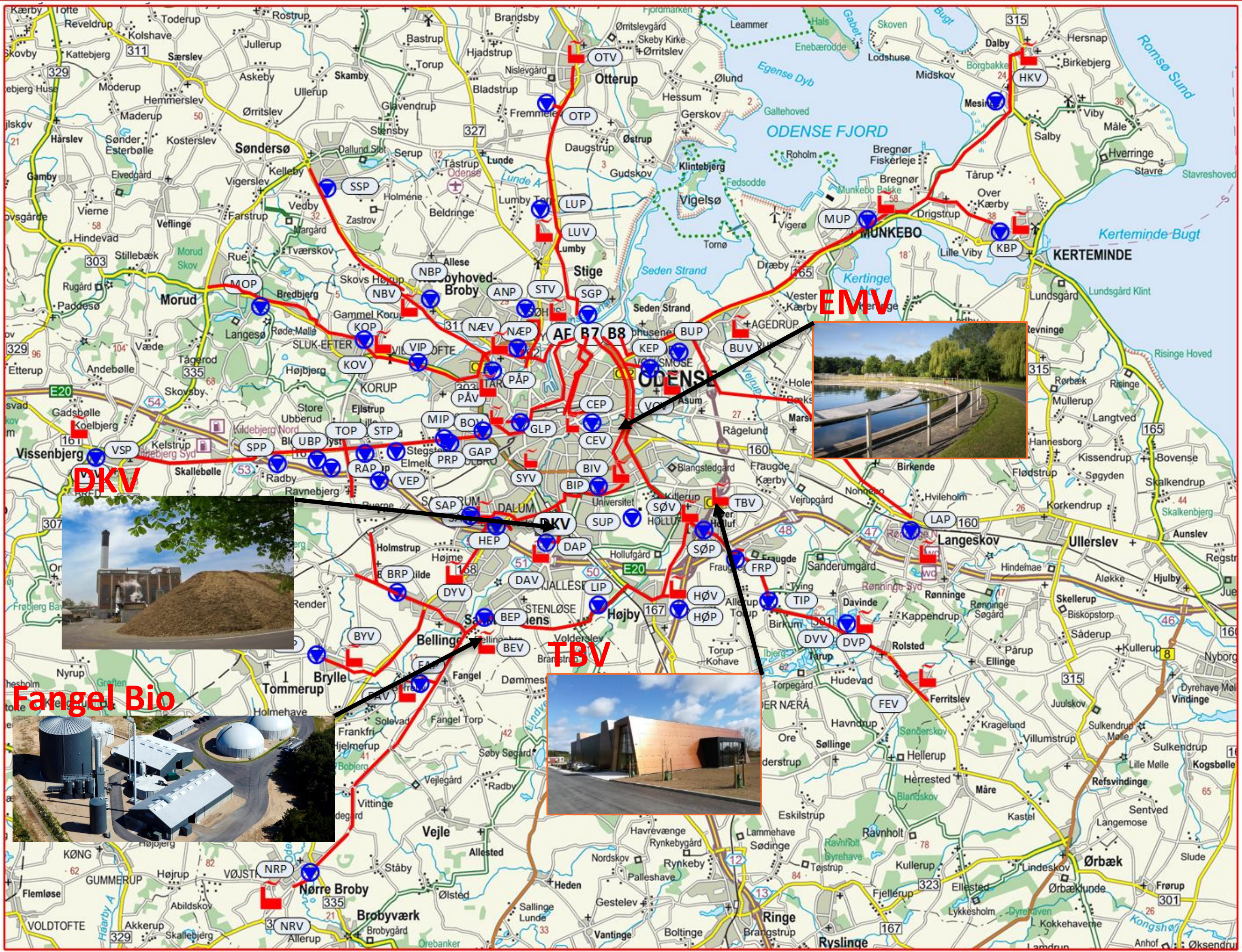
Decentralized heat production



Heat recovery from Facebook datacenter

In 2020, Fjernvarme Fyn inaugurated a new heating plant that converts surplus heat from the Facebook datacenter in Odense to district heat for approximately 11.000 households.

Fjernvarme Fyn already utilizes surplus heat from a growing number of local production companies.

"Arcitecture and design is also importent for industrial buildings"

Situation map of heat pumps and data center in Tietgenbyen, Odense SØ

Heat Pumps Tietgenbyens Varme Central (TBV)

Odense Data Center Facebook

Characteristics of DK system:
- **High security of supply**
- **High RES**
- **Stable data**

Low temperature district heating grid

Fraugde power station

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Expansion of Facebook and Tietgenbyen heat central (TBV)

Phase one (2020)

Facebook:	2 data buildings
TBV:	25 MW heat pumps
Agreement:	100.000 MWh surplus heat ~ 6900 households

Phase two (2021)

Facebook:	+ 1 data building
TBV:	+ 20 MW heat pumps
Agreement:	+ 60.000 MWh surplus heat ~ 4000 households

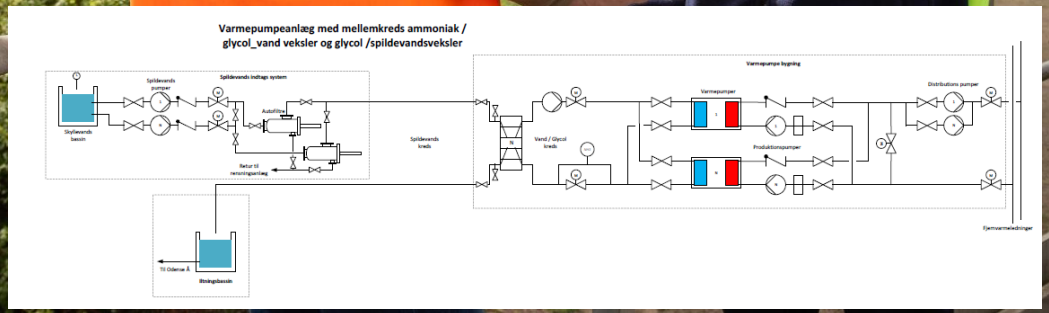
Phase three? (2025) Not decided

Facebook:	New land acquired - 2 data buildings
TBV:	Further expansions needed + new transmission line

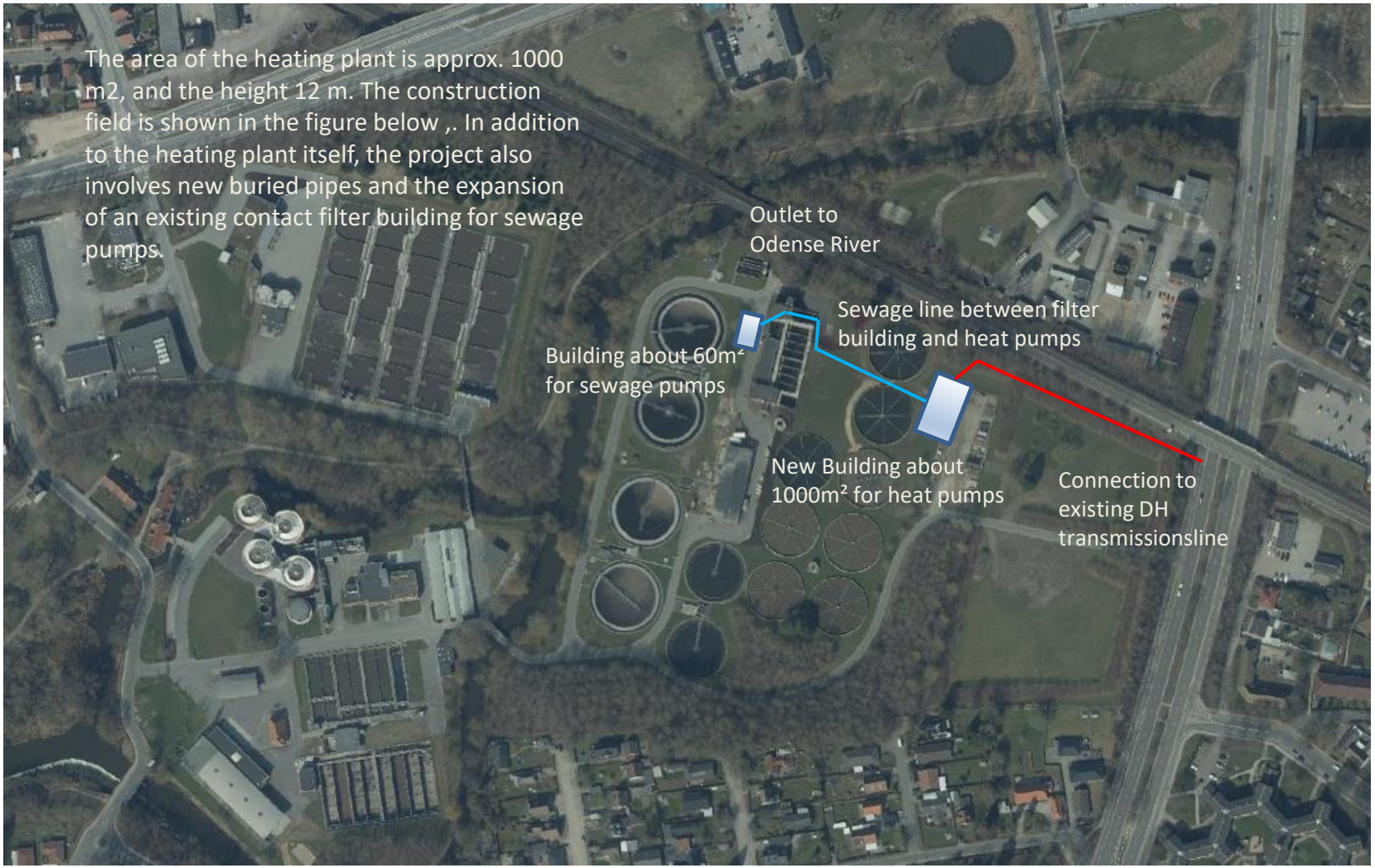
Source: Facebook and Fjernvarme Fyn

Heat pumps on waste water

Ejby Mølle Heatpumps – 19 MW
District heating heat pumps running on waste water.
(Heatpumps from Mycom)



Ejby Mølle – heat recovery from waste water treatment plant.



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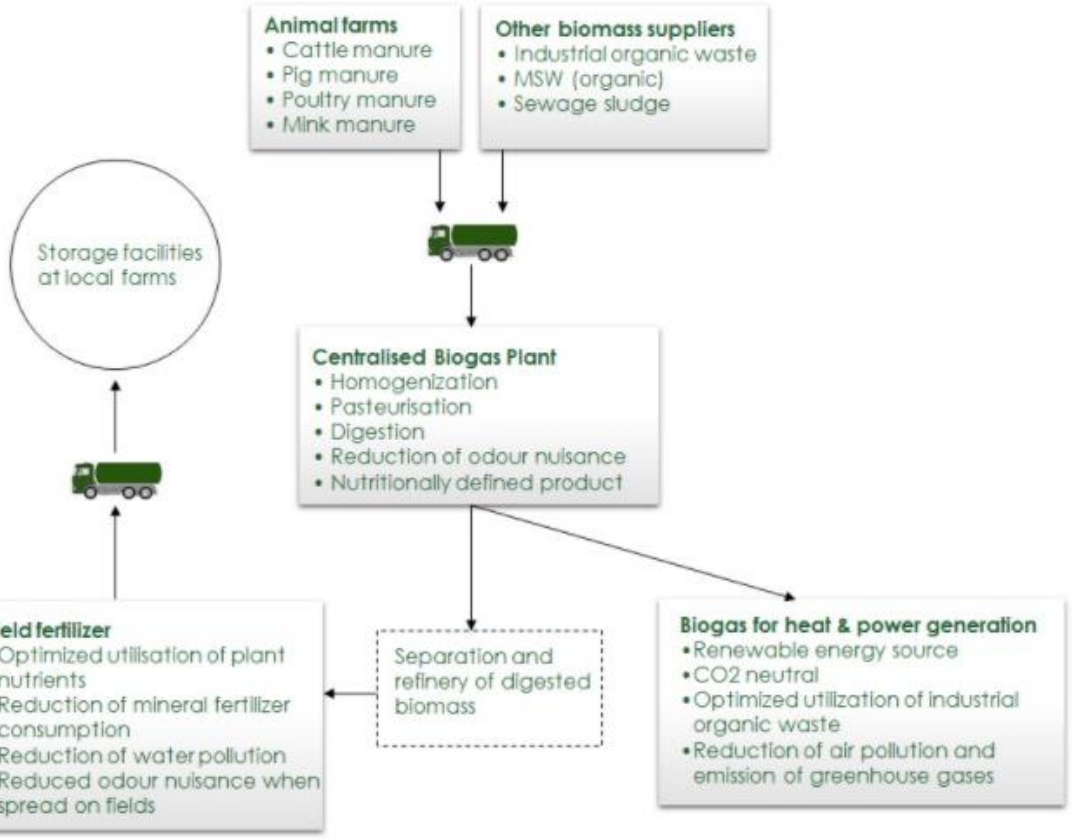
Production: Fangel Biogas

Biogas is produced from organic waste (carbon) which biodegrades by means of bacteria in an anaerobic environment.

The process is expedited at a process temperature of 38°C/100°F (mesophilic) or 52°C/125.6°F (thermophilic) in the plant's digester.

~ 12 MW



Heat recovery from companies in the supply area

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Facebook

KiMs potato chips

Envases (aluminium cans)

Tasso (cast iron specialist)

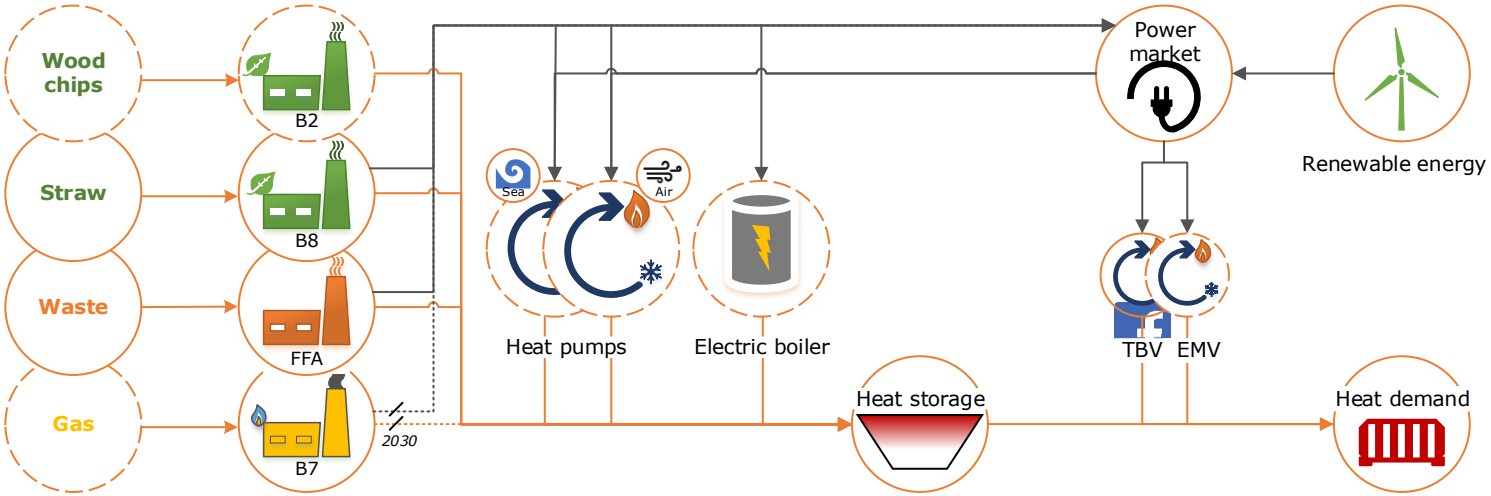
Supermarkets

Brewery

Nova print

Mette Munk (cookies)

Future concept for district heat production from 2023



- Synergies between large heat pumps, the thermal plants and a large heat storage
- Peak load supplied by gas on unit 7 (until 2029) as well as electric boilers

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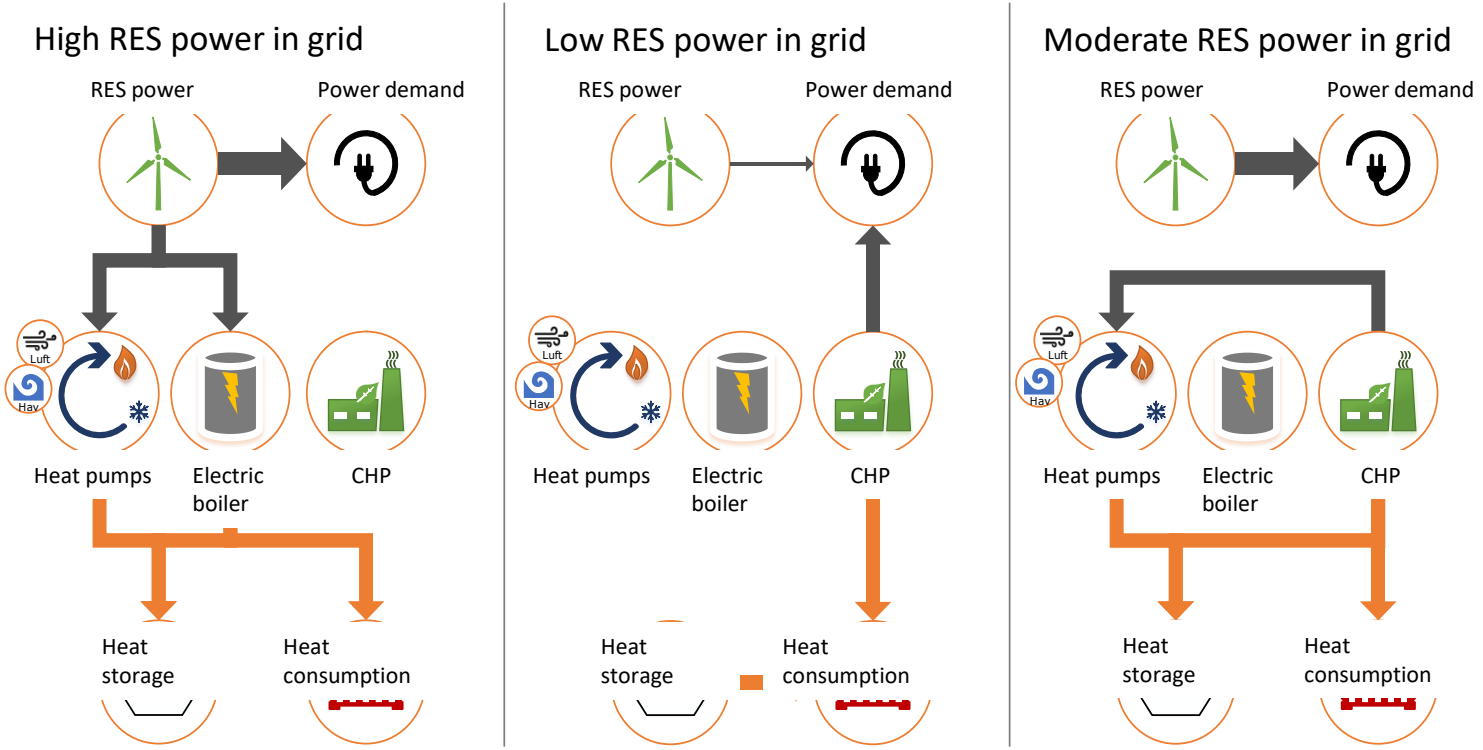
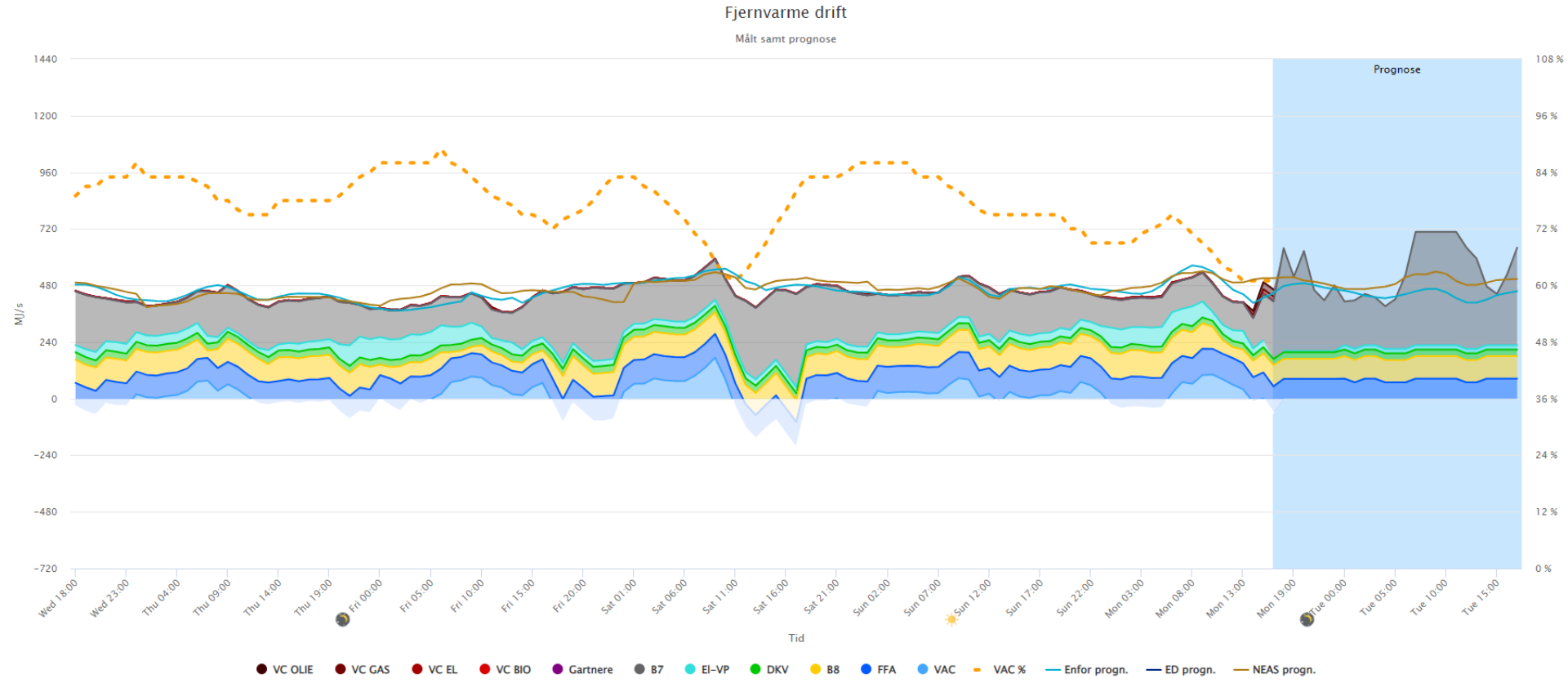
Future co-generation depend on RES power in the grid



Kilde: Fjernvarme Fyn

Production planning
Input: load forecast, electricity markets / -prices



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Hydraulic modeling

Current practice and status

1. Hydraulic models of distribution networks are used for design of network extensions and –renovations and scenario analyzes
2. Online modeleling used for calibration / validation of models and analyzes of operational problems in the network
3. Fjernvarme Fyn has used an old version of Termis software.
4. Fjernvarme Fyn has purchased Danfoss Leanheat Network Designer and Online
5. Implementation of Leanheat Network software is in progress

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Integrated planning of production and DH-network operation

Challenges / problems to be solved

1. Growing complexity in planning of heat production and network operations due to several decentralized production units
2. Stable delivery of decentralized heat production to DH network
3. Temperature optimization of transmission lines. Optimize efficiency of heatpumps by reducing supply temperature.
4. Pump optimization of transmission lines. Reduce pumping costs.
5. Temperature optimization of distribution networks

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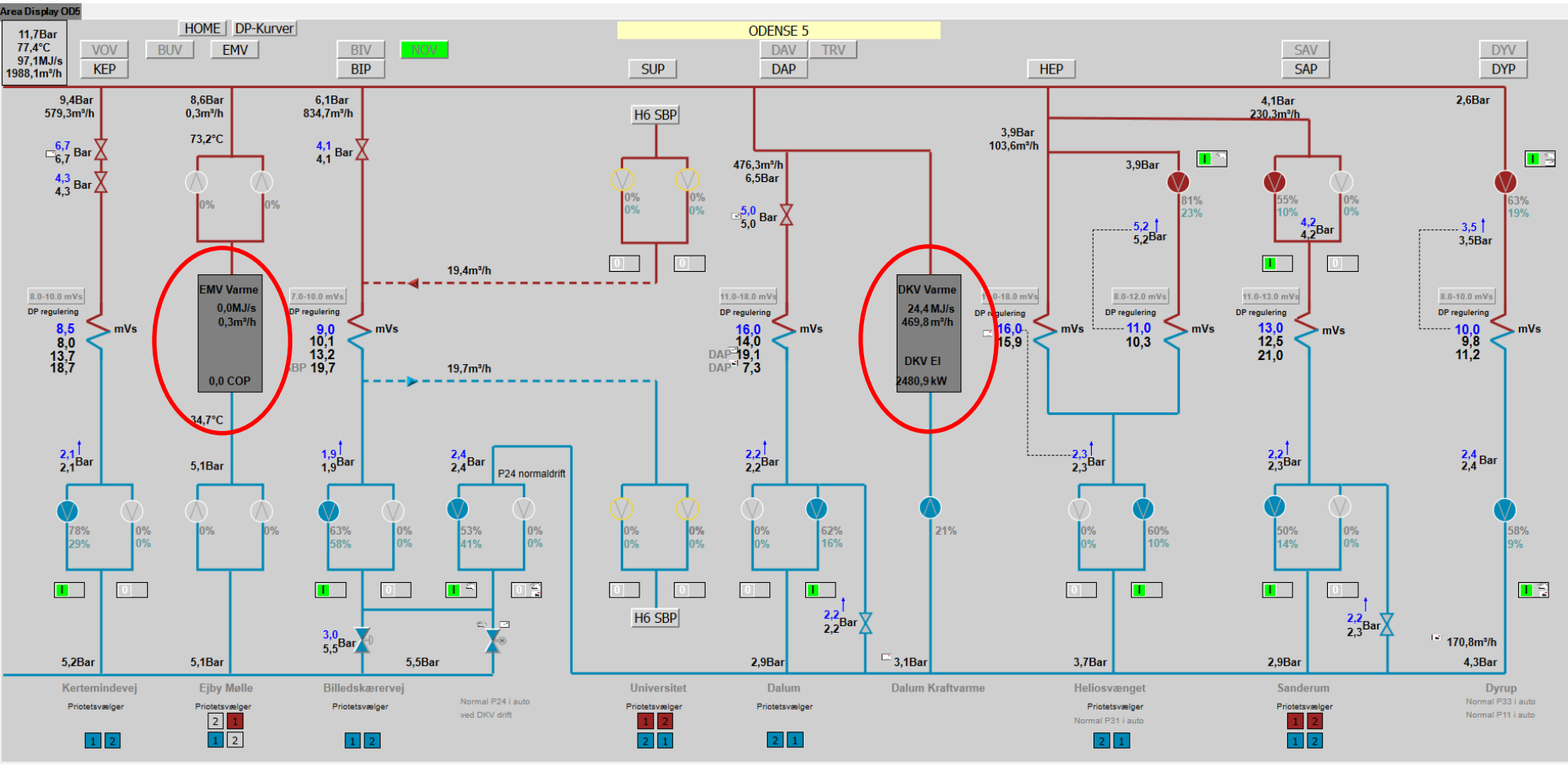
Operation of transmission line 5 (SCADA picture)



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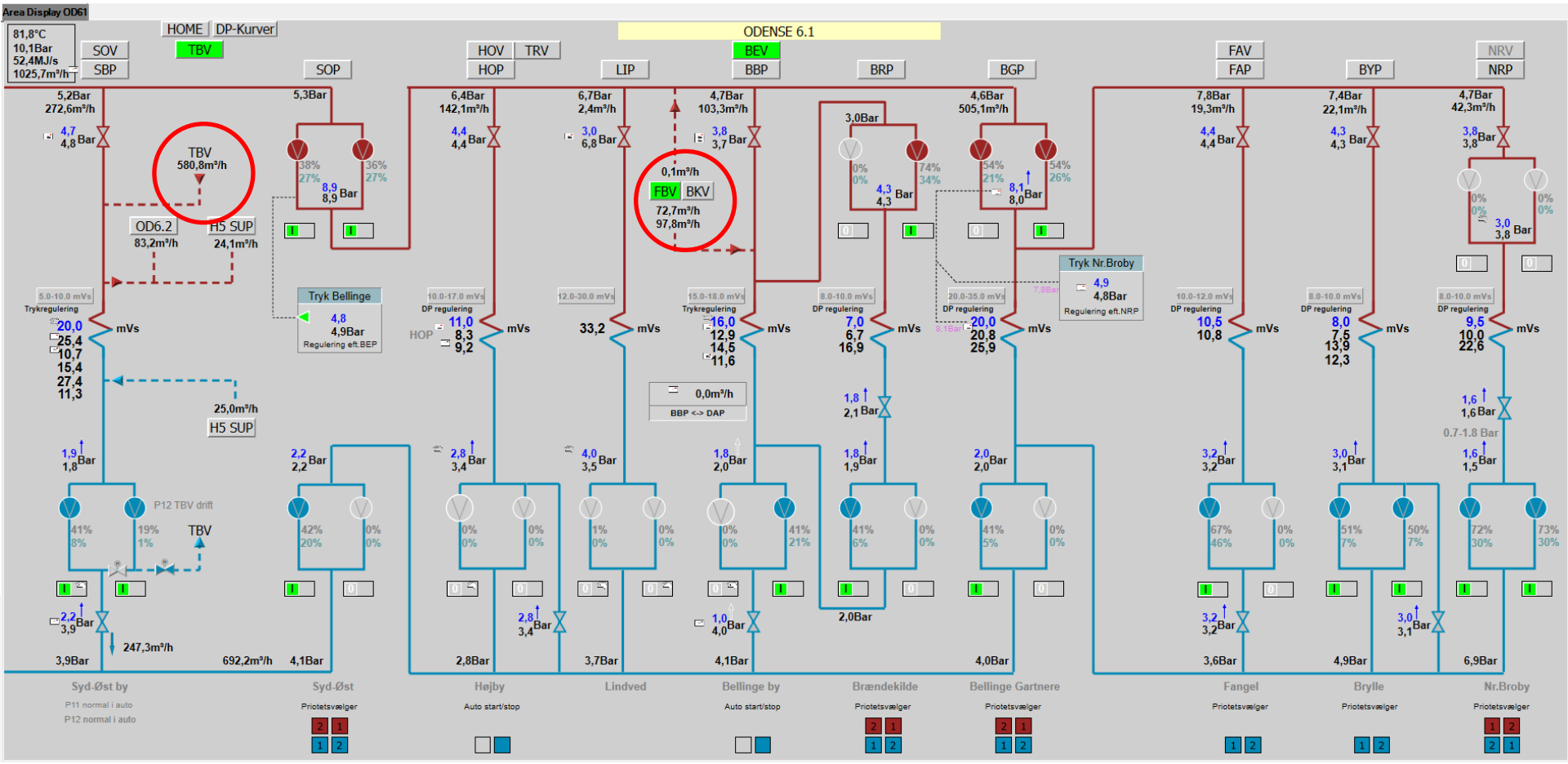
Operation of transmission line 6 (SCADA picture)



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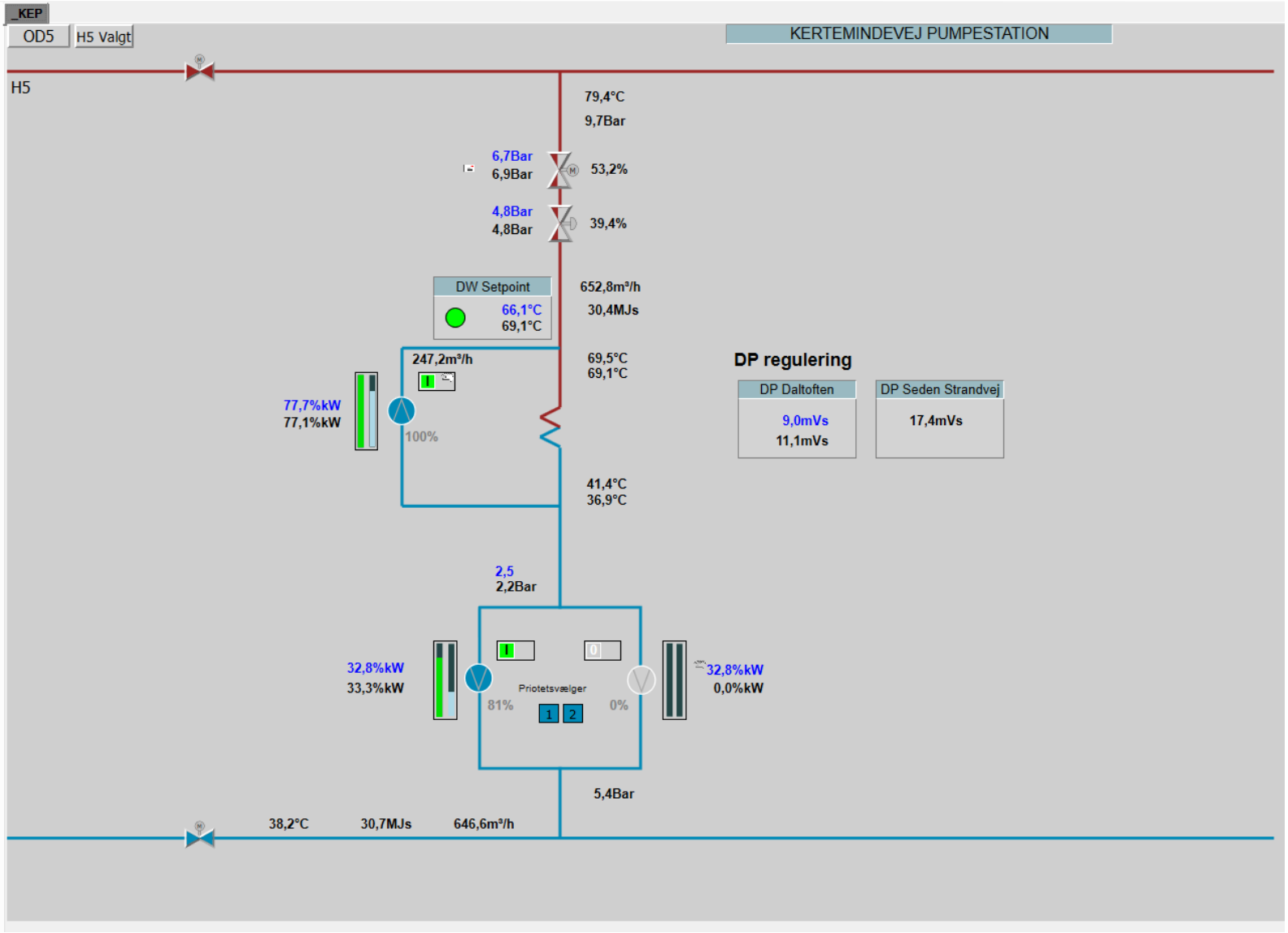
Temperature optimization of distribution zones



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Integrated planning of production and DH-network operation

Solution using online modeling

1. Hydraulic simulation of heat supply on transmission lines and distribution networks online and in future based on loadforecast and production plans
2. Planning of DH-network operation to avoid operational problems. For example changes of valve positions in the network and setpoints for pump operation.

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Thank you

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