District heating in Odense - Denmark

Visit from USA @ Fjernvarme Fyn

Palle Grøndahl, Team manager – Asset Management and Analysis

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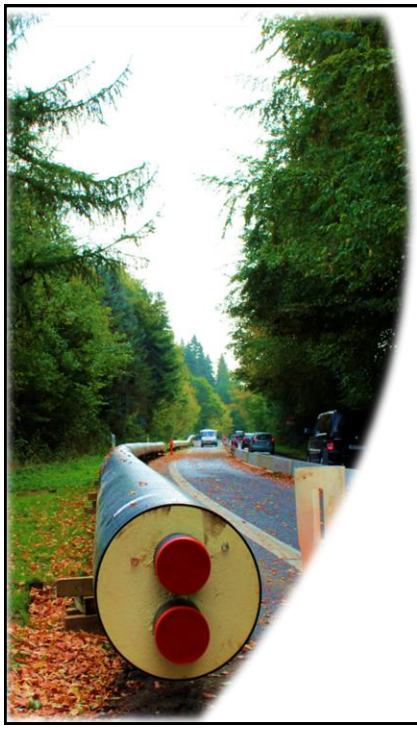

Topics

1. Introduction to district heating in general
2. District heating in Odense / Fjernvarme Fyn
3. Discussion

Tour: Fjernvarme Fyn waste heat recovery plant at Meta data center

4. Heat recovery from Meta data center / guided tour

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District heating in Denmark - Facts

- 1,843,774 Danish households are heated by district heating
  - 66 percent of all Danish households
- 76 percent of all district heating is based on renewable energy sources
  - Sun, wind, biomass, biogas, geothermal energy
- 60,000 kilometers (37,500 miles) of piping
- District heating companies are non-profit companies by law

Source: Dansk Fjernvarme

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District heating in Denmark - Benefits

- Economy of scale
- Flexible energy sources
  - Garbage, biomass, wind, solar, biogas, geothermal, coal, natural gas oil
- Use of renewable and waste energy resources

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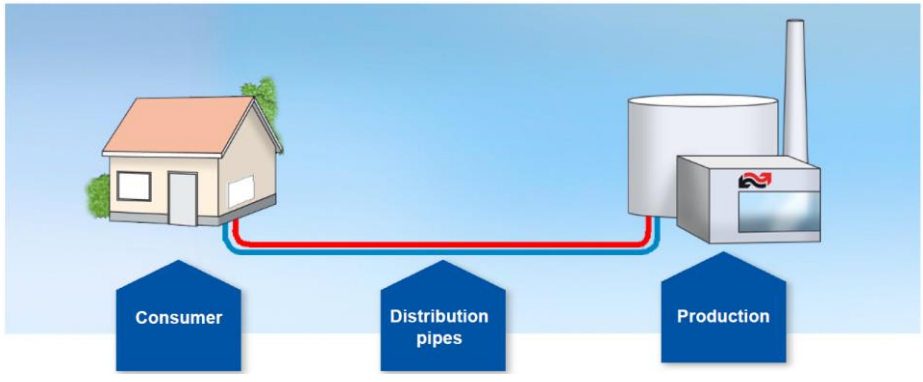
The three parts of district heating



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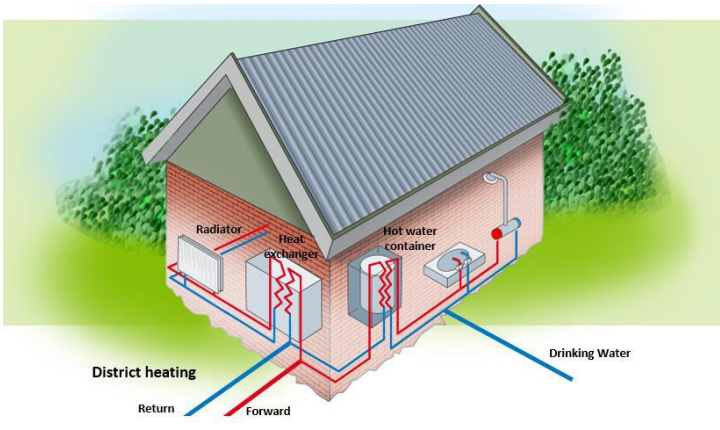
Consumer installation



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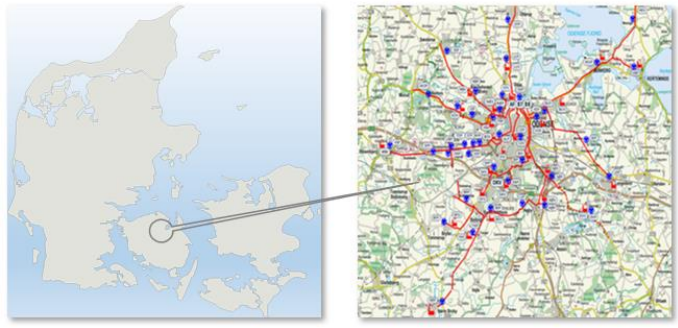
Fjernvarme Fyn
One of the worlds largest district heating grids

- DK's 3. largest district heating company
- Annual turnover (2022): 2.4 BDKK ~ 340 M$ (Heat, electricity, waste incineration)
- ~ 320 employees
- Owned by the municipalities of Odense (97%) and Nordfyn (3%)

- +70,000 connections / meters
- +100,000 households
- 120 km transmission lines (80-90 °C)
- 2400 km distribution lines (70-75 °C)

- We supply heat and electrical power
  - Heat: 10,000 TJ/year
  - Electrical power: 740 GWh/year
    - Equals 165,000 households of 2 adults and 2 children



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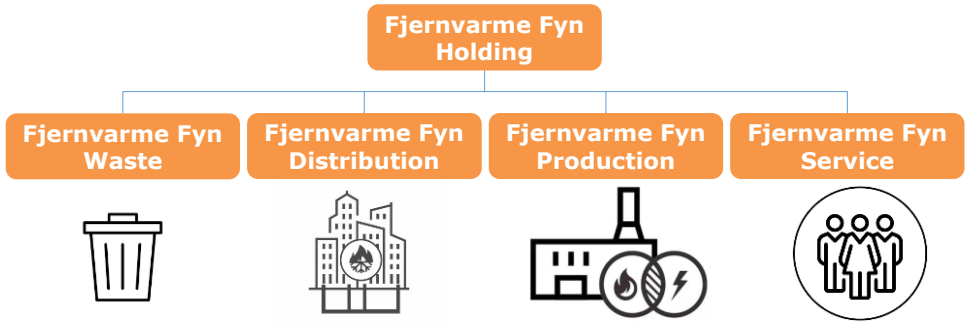
Our legal structure



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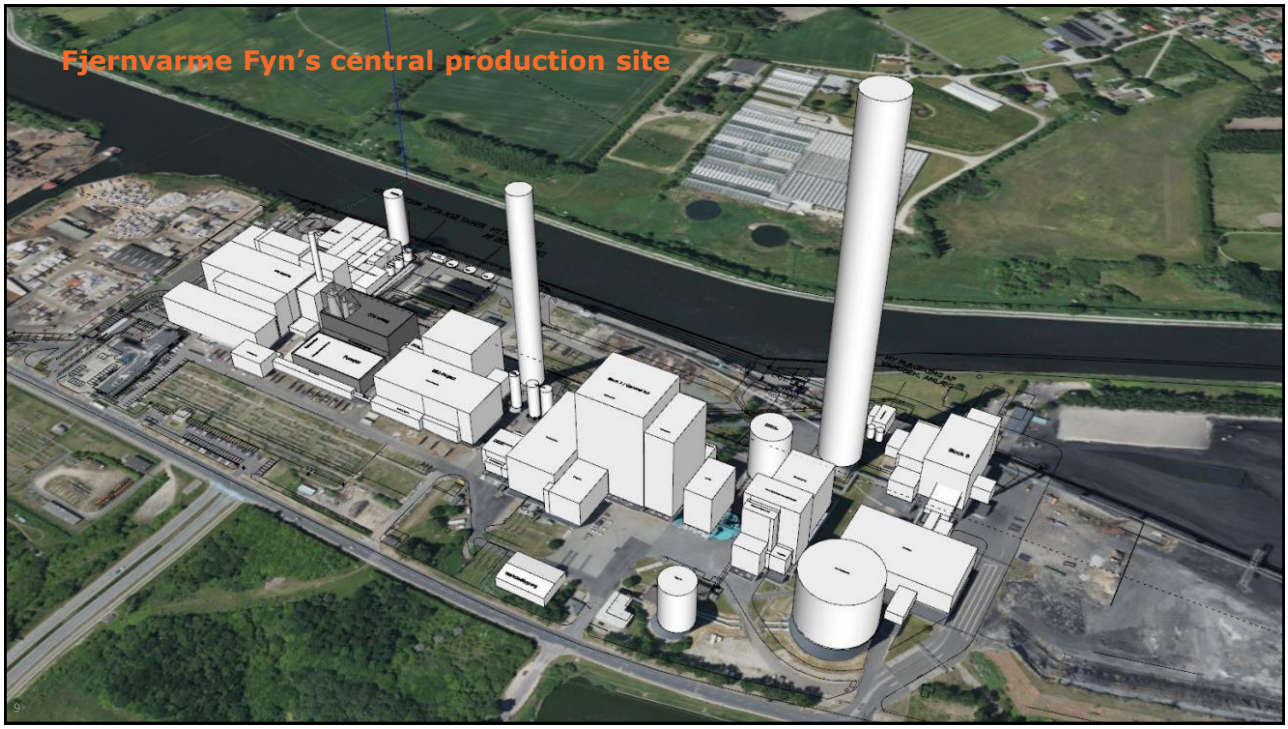

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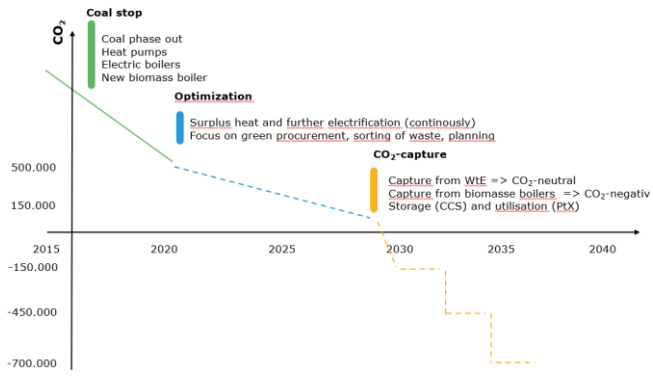
Carbon neutral district heating by 2030

Target

- An essential part of Fjernvarme Fyn's strategy is to be supplier of carbon neutral district heating at the latest by 2030
- The municipality of Odense is aiming for climate neutrality by 2030
- Carbon footprint has been significantly reduced over the last decade
- Remaining steps to achieve our goal of carbon neutrality are:
  - Unit 7 to be closed or converted to biogas by 2030
  - Carbon Capture on Waste-to-Energy CHP by 2029

Vision

- Negative emitter of CO2
- Carbon Capture on one or both biomass CHP



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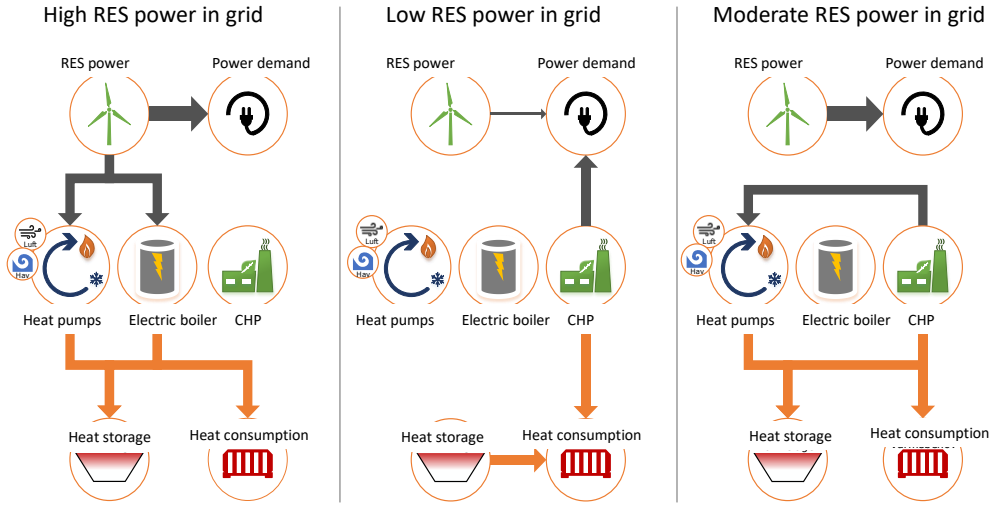
Heat generation depend on RES power in the grid



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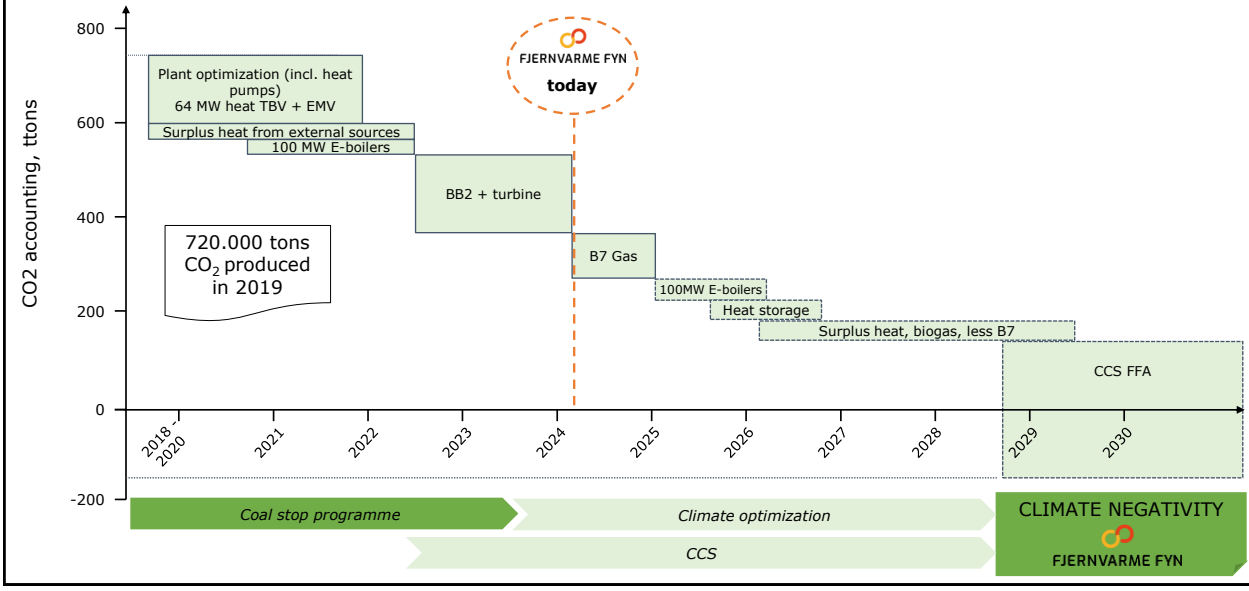
Our journey towards climate neutrality



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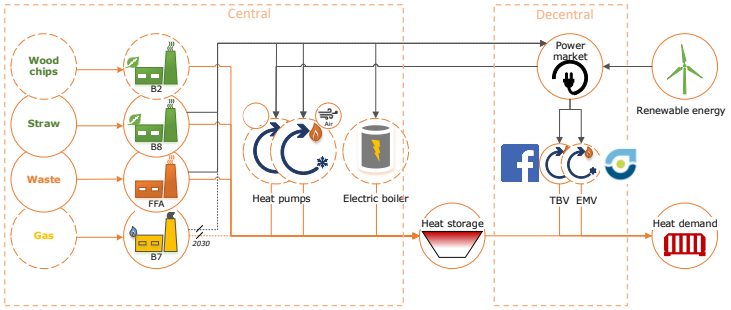
District heating based on electricity, surplus heat and waste products

Electric boilers (2 x 50 MW)

Heat pumps (100 MW)



CO_2-capture by 2029

CCS

Biomass CHP

Heat storage

Surplus heat from Meta

Heat from sewage water

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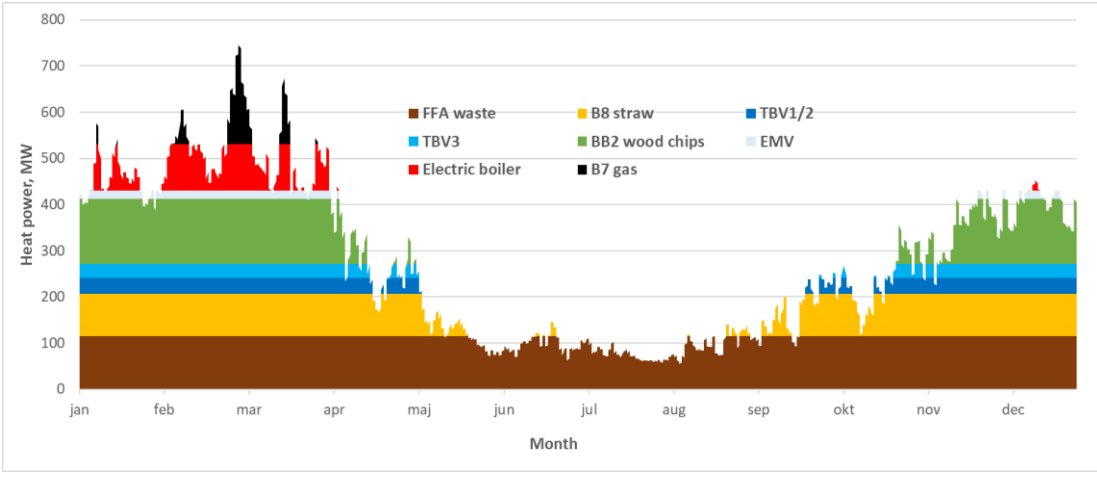
FVF energy system in 2025



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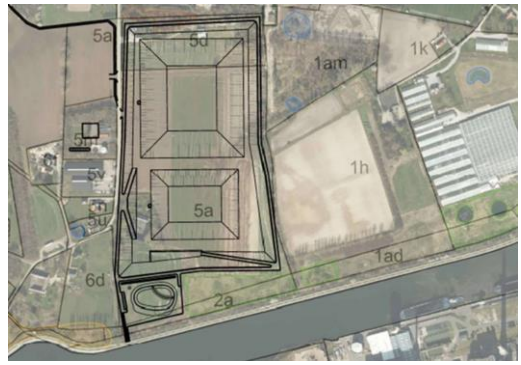
The future

Extra 100 MW electric boiler capacity



Pit heat storage (700.000 m^3 – 1.000.000 m^3), 150 MW

The future

Extra surplus heat pump capacity

Carbon capture