Shifting the Technology mix to decarbonise District Heating

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Introduction to Vattenfall

100%
Owned by the Swedish State

8 million
Electricity customers

1.0 million
Electricity network customers

2.1 million
Heat customers

2.3 million
Gas customers

20,995
Employees

Location of our operations and major plants

Wind

Biomass

Hydro

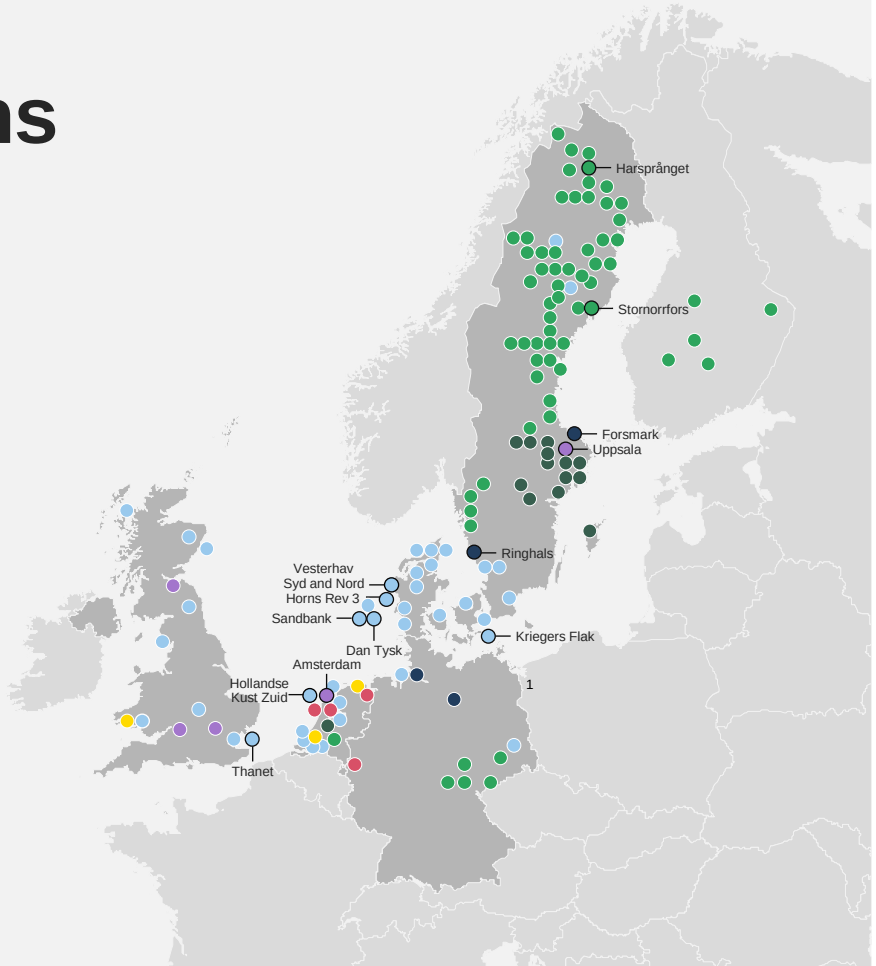
Gas

Nuclear

Solar

District heating

◯ Largest facilities marked with a circle



[1] Heat Berlin has been divested to the State of Berlin during 2024

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Our commitments toward Net Zero

-52%
Emission intensity reduction since 2017

1.5°C
Target for own emission reductions – alignment with 1.5˚C trajectory

Net Zero
Emissions in our full value chain

2023 → 2030 → 2040

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District Heating Technologies

Today's Technology

Diemen 33

- Capacity 250 MW_e/180 MW_{th}
- Efficiency η_e=52% η_{th}=82%
- Gas turbine GE GT13E2
- Start operation 1995
- Operating hours (2024) ~3500 OH/a

Diemen 34

- Capacity 440 MW_e/260 MW_{th}
- Efficiency η_e=59% η_{th}=88%
- Gas turbine Siemens SGT5-4000F
- Start operation 2013
- Operating hours (2024) ~6500 h/a

Gas Boilers

- 5 x 35 MW_{th}
- Efficiency η_{th}=90%
- Start operation 2006-2010
- Operating hours (2024) <1000 h/a

Heat Storage

- Storage capacity 1800 MWh_{th}
- Charge/discharge capacity 220 MW_{th}
- Start operation 2015

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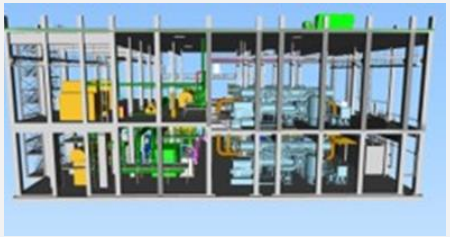
District Heating Technologies

New Technologies

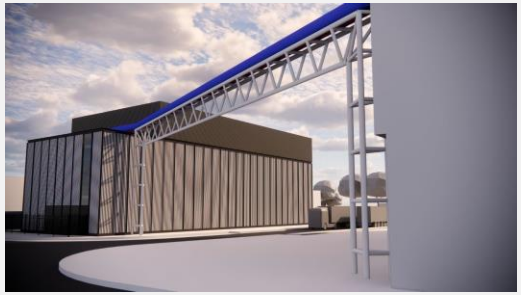
E-Boilers

- Operate with high renewables input (low E-prices)
- Combine with storage
- Strong grid connection required
- 150 MW in commissioning in Diemen



Aquathermal

- Base load operation
- Heat Pump required for increasing temperature
- Location near suitable surface and sewage water sources

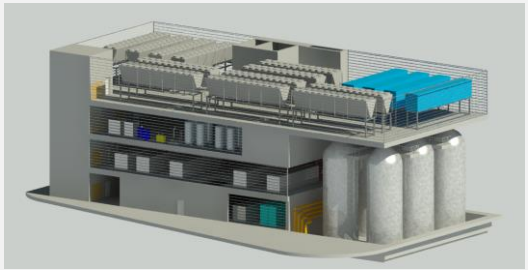


Data Centers

- Base load operation
- Heat Pump required for increasing temperature
- Location near data center
- Several under development

Geothermal

- Base load operation
- Heat Pump required for increasing temperature
- Development ongoing in Amsterdam and Lelystad
- Location near wells



Air Source Heat Pumps

- If no waste heat nearby
- E-boilers for peak load
- Storage is advantageous
- Noise to be considered

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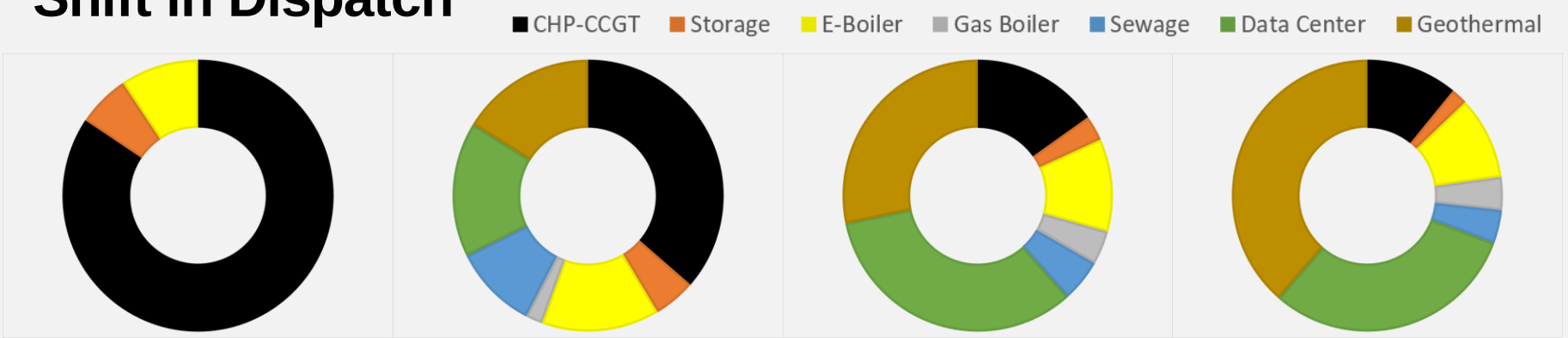
Shift in Dispatch



2026

- E-Boiler in operation
- E-Boiler used when E prices low (high production of PV and Wind), good fit with CCGT
- CCGT ~6500 OH

2030

- Introduction new base load heat sources:
  - Aquathermal
  - Data Center
  - Geothermal
- Strong reduction dependency on CCGT

2035

- Further growth new base load heat sources:
  - Aquathermal
  - Data Center
  - Geothermal
- Further reduction dependency on CCGT
- CCGT and gas-boilers on renewable gas (H_2 or green gas). CCGT ~1500 OH

2040

- Base load delivered by:
  - Aquathermal
  - Data Center
  - Geothermal
- Mid load by CCGT & E-Boiler and storage
- Gas-boilers for peak & backup

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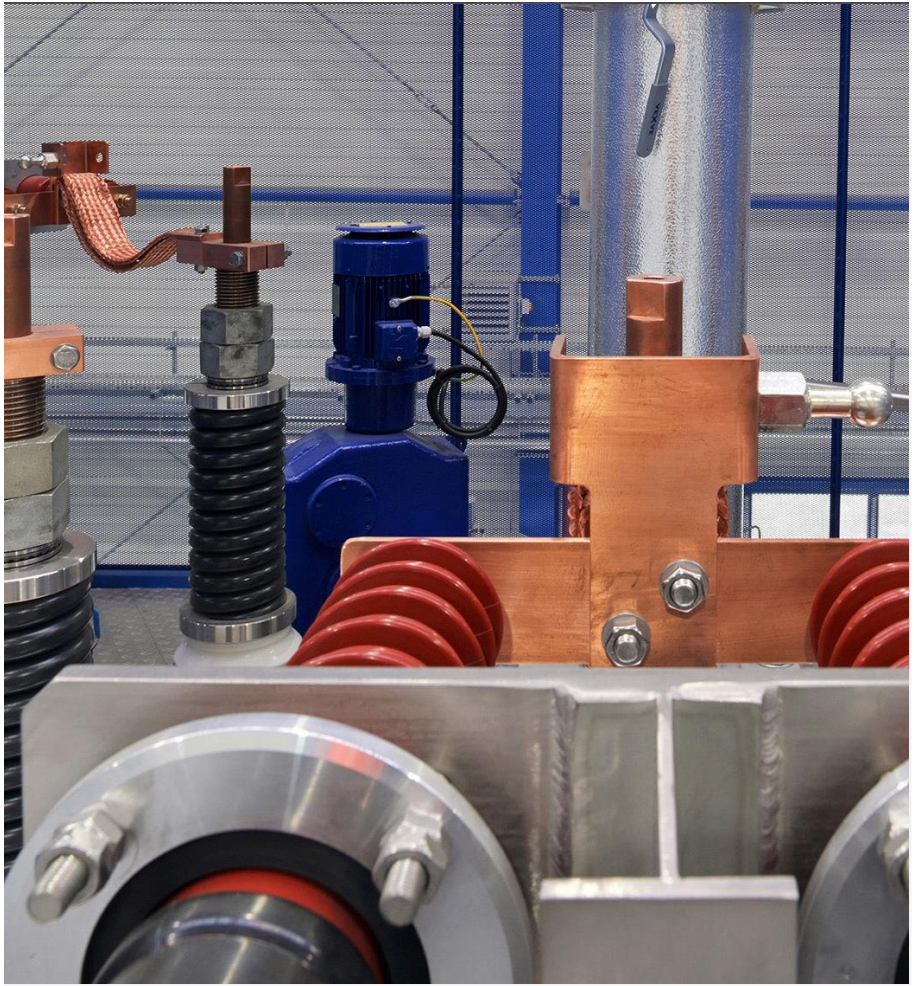
Summary

- New heat sources will be introduced over next decade
- Many sources will require a (high temperature) heat pump to increase temperature levels
- Tie-ins of new heat sources need to be near the source and can offer hydraulic benefits (closer to demand)
- E-boilers in combination with storage allows to integrate cheap excess renewable electricity and offer good fit with CCGTs
- Traditional role of CHPs and CCGTs in particular will change from base to mid and/or peak load



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