Delegation visit from the Lithuanian DH sector on 6 November 2025

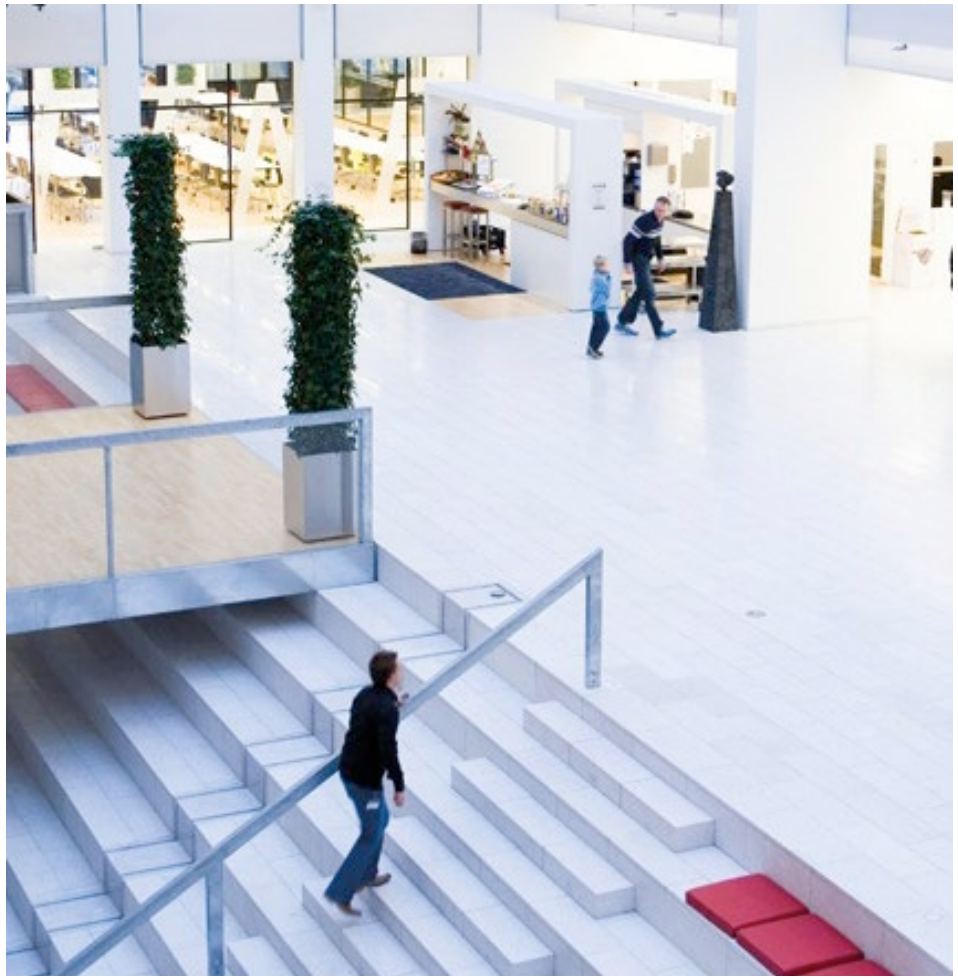
The Greater Copenhagen DH System and the path to CO2 neutrality:

- Main characteristics of the Greater Copenhagen DH system
- Future development including electrification strategy

Thomas Engberg Pedersen
Head of Section, HOFOR

THE COMPANY TODAY

- Denmark's largest utility company within our core areas
- More than 1,400 employees
- Approximately one million customers in Greater Copenhagen
- Approximately EUR 890 million in annual turnover
- Approximately EUR 310 million invested annually in pipelines, cables, wind turbines etc.
- Equity capital: EUR 2,100 million



ABOUT US IN BRIEF

- Albertslund municipality
- Brøndby municipality
- Dragør municipality
- Herlev municipality
- Hvidovre municipality
- Copenhagen municipality
- Rødovre municipality
- Vallensbæk municipality

- We are municipally owned
- Our utilities are regulated by law
- Our revenue and expenditure must balance out over time
- We focus on a sustainable supply and renewable energy
- We support community development

Sustainable cities

Greater Copenhagen Utility

Water

Wastewater

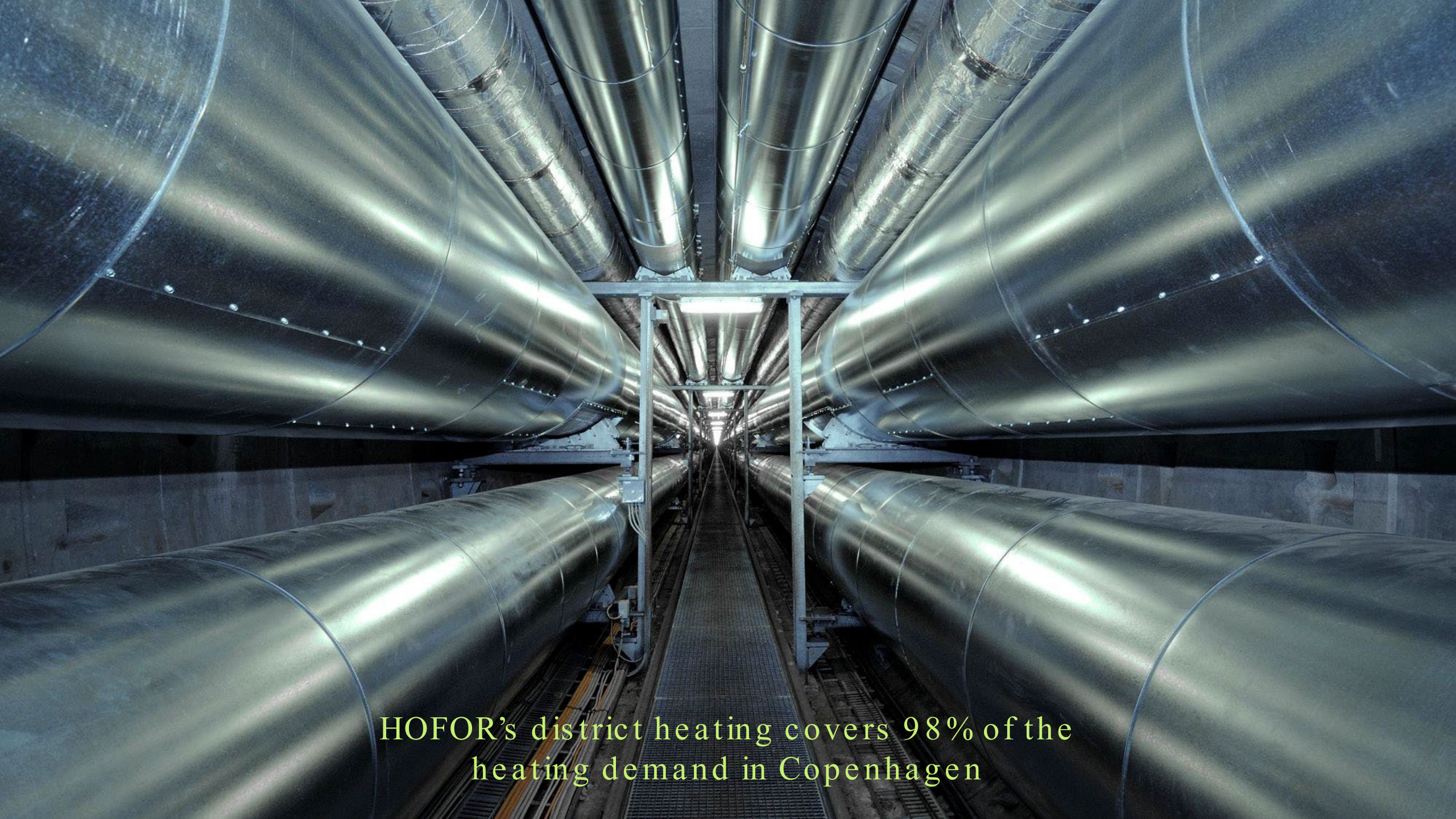
District heating

Combined heat and power (CHP)

City gas

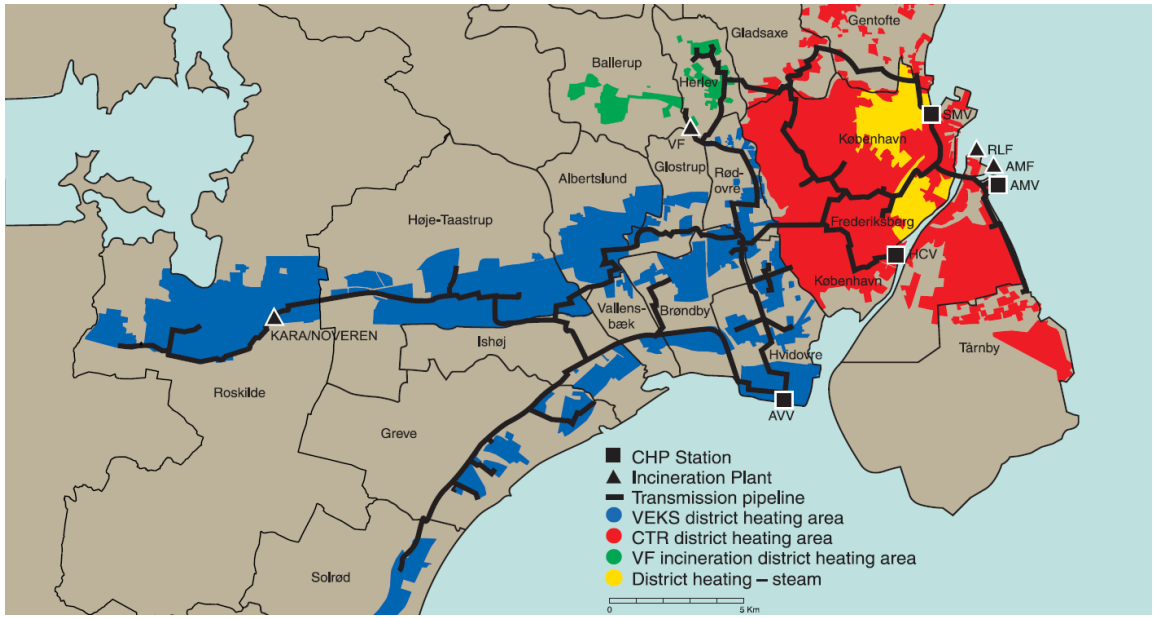
District cooling

Renewable electricity from solar &wind


HOFOR's district heating covers 98% of the
heating demand in Copenhagen

HOFOR is part of the Greater Copenhagen DH system

- One out of six large central DH areas in Denmark (covers app. 25 % of all Danish DH demand)
- Transmission grid with relatively high pressure and temperatures (110 -120 °C)
- A number of distribution grids with lower pressure and temperatures
- Annual heat demand: 40 PJ
- Peak load: 3,000 MW
- Pooled operation, i.e., coordinated dispatch / least cost optimization of the whole system
- Heat is used for both space heating and domestic hot water



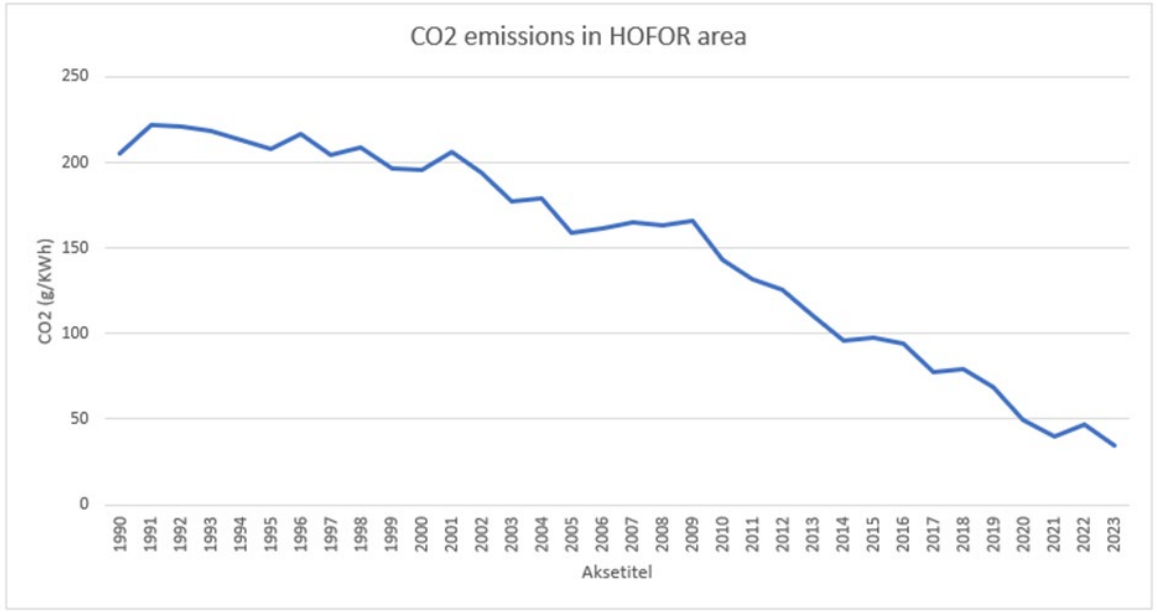
Base load capacity	**2.201 MW**
• Biomass CHP	1.665 MW
• Waste CHP	493 MW
• Electric driven heat pumps	54 MW
Peak- and reserve capacity	**2.293 MW**
Two heat accumulators	**660 MW**

Focus on a diversified and CO2-neutral DH supply

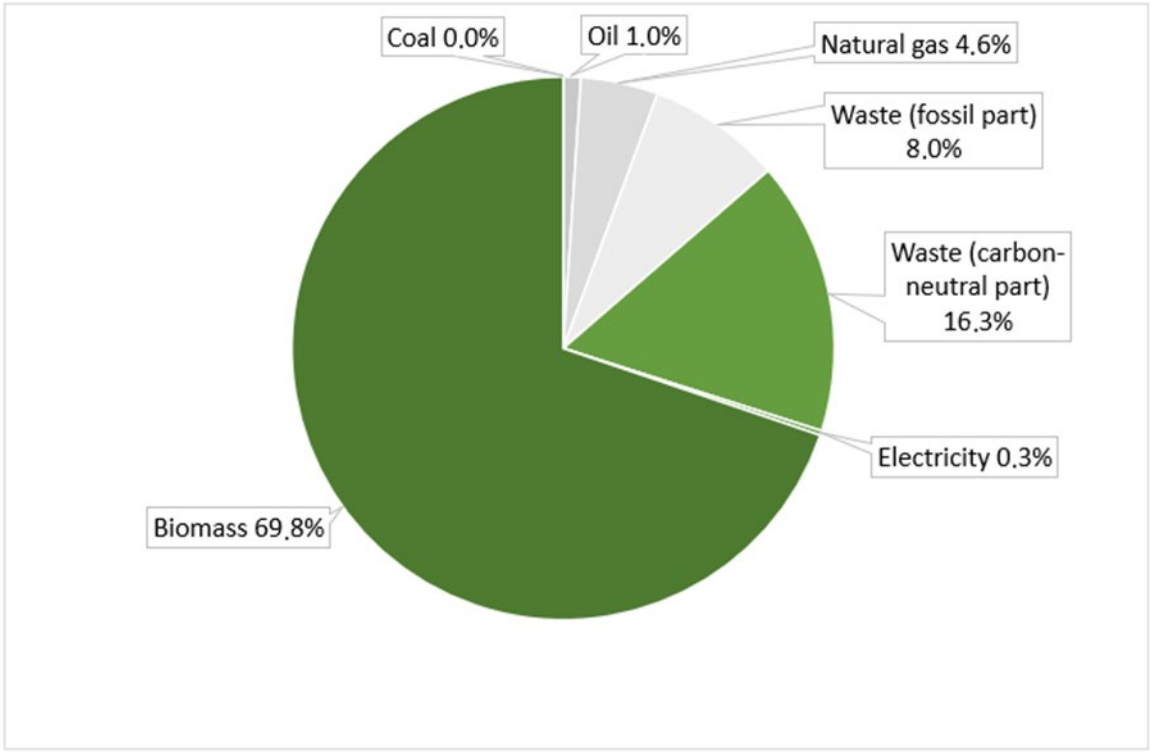
- Today, most of HOFOR's heat production is based on biomass and waste
- We want to have a diversified DH supply (robustness and flexibility) – therefore we also focus on other heat sources
- We want to support the City of Copenhagen's target of being CO2-neutral
- Today, the DH is 86 % CO2-neutral
- The average CO2-emission is 35 g/kWh
- This is a significant reduction compared to 10-15 years ago, which has been caused by replacing fossil fuels with biomass

CO2-emission and fuel mix for district heating in the Greater Copenhagen DH system

CO2-emission from district heating from 1990 to 2023 (g/kWh)

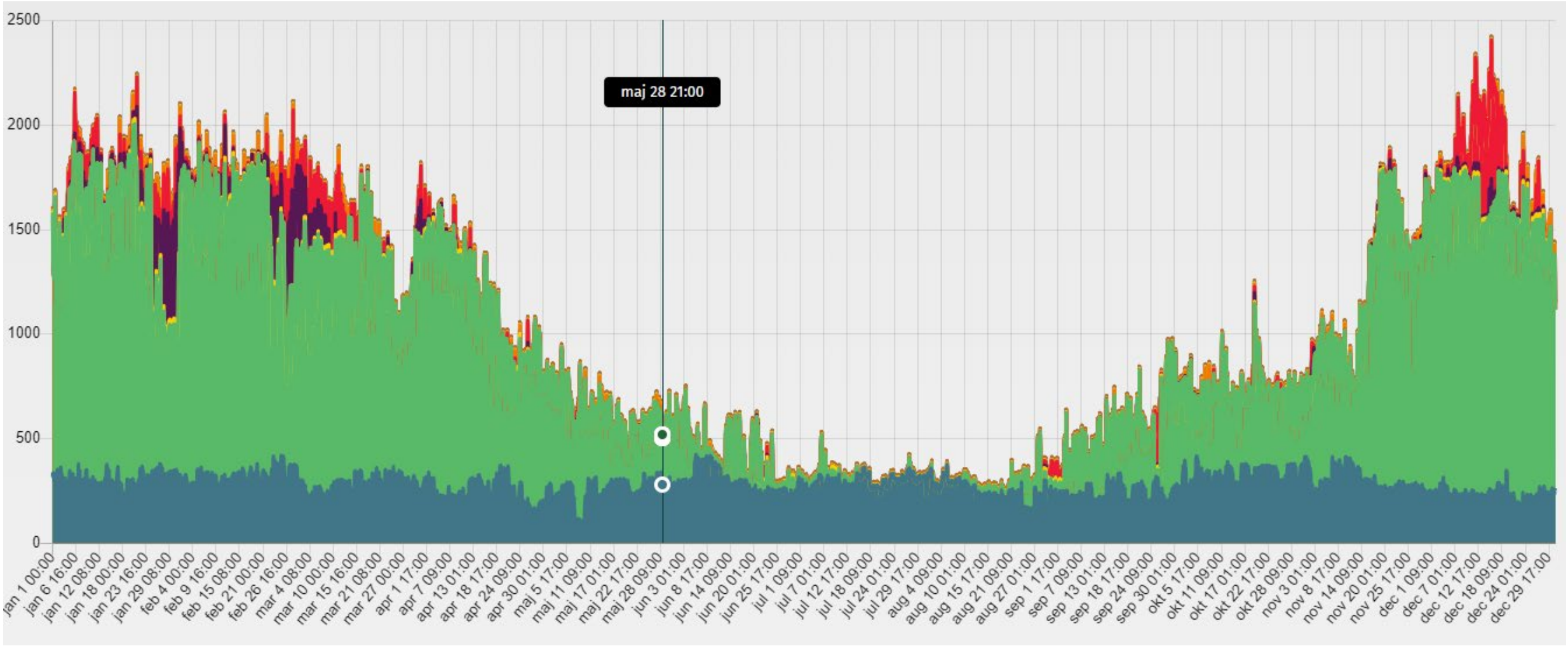


District heating production mix in 2023



Still a gap from 86 % to 100 % CO2-neutrality

Annual DH heat load distribution and production mix - Greater Copenhagen 2022



The district heating should be even more green

Approximately 14 % of the DH production still needs to be made CO_2-neutral.

Peak load: 6 %

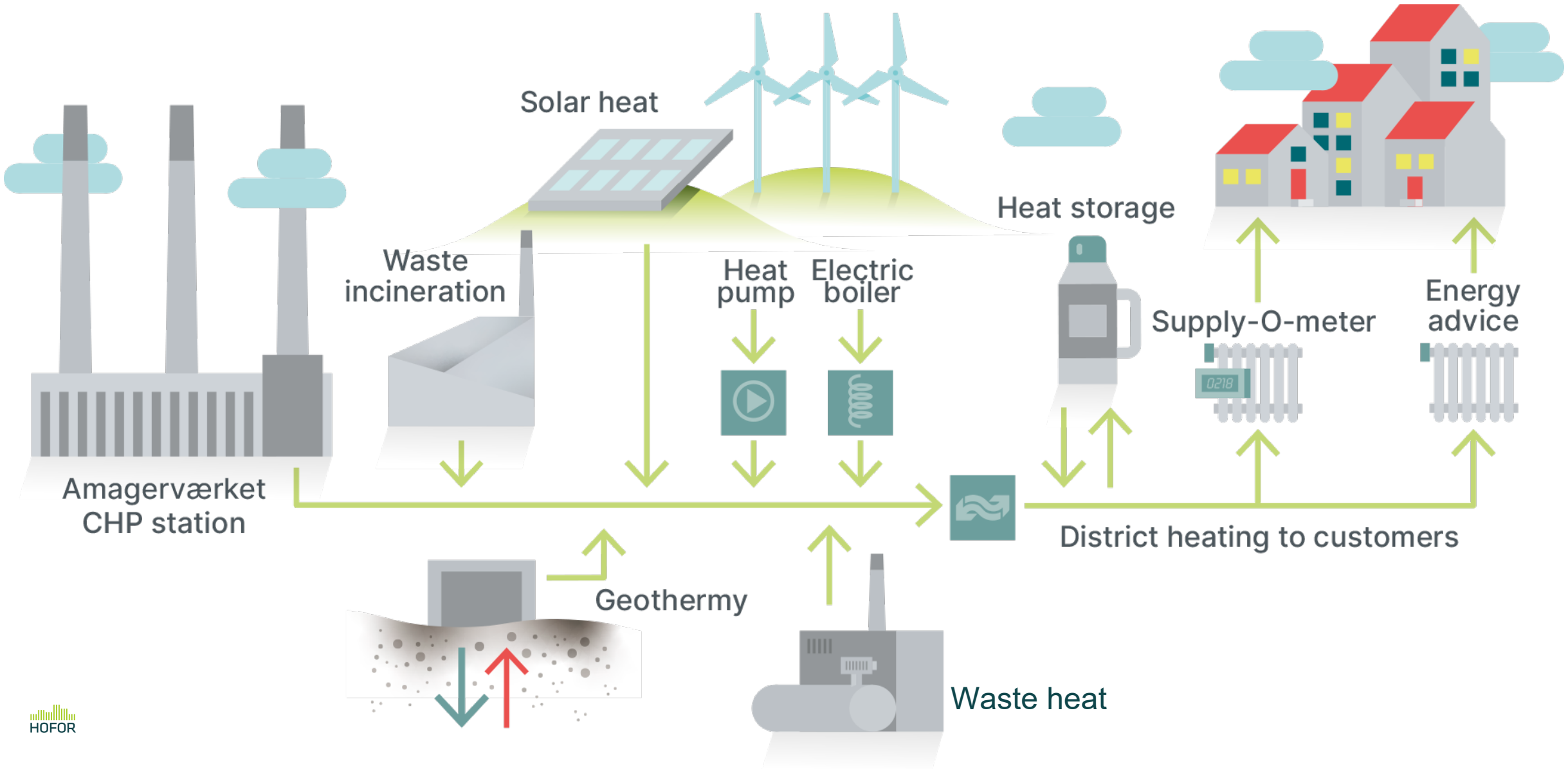
Possible solutions: Electrification, biooil, biogas, flexible consumers

Waste (fossil part): 8 %

Possible solutions: Increased sorting, carbon capture storage (CCS)

HOFOR

The DH must be diversified – it gives robustness and flexibility



Focus on new technologies in the DH system in order to be 100 % CO2-neutral

#1

Heat pumps and electric boilers

#2

Low temperature DH

#3

Geothermal energy

#4

CCS

#5

PtX

Denmark has a strong tradition for sector coupling of electricity and heat

- One example of sector coupling is combined heat and power production (CHP)

  - In Denmark, more than 60 % of all DH is produced in cogeneration with electricity
  - App. 80 % of all thermal power is produced in cogeneration with heat

➢ **High energy efficiency!**

CHP share of thermal power and district heating production

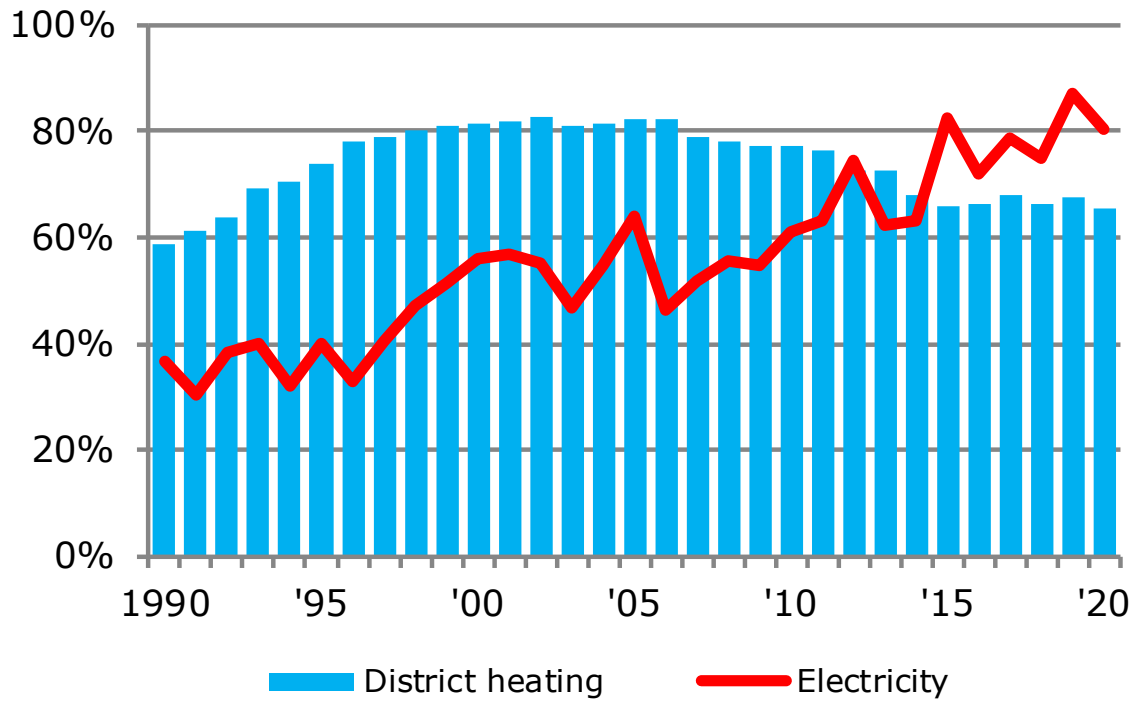
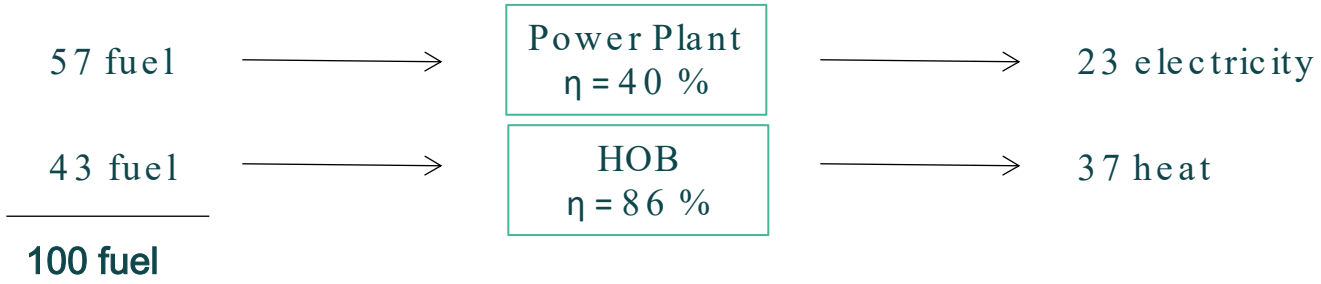
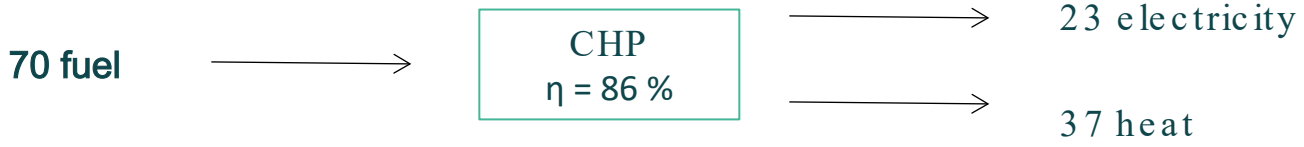


Illustration of how CHP significantly contributes to increased energy efficiency

☐ Separate generation of electricity and heat



☐ Combined generation of electricity and heat (CHP)



Fuel saving: 30 %

Electric driven heat pumps and electric boilers increase the flexibility in the DH system and reduce the use of biomass

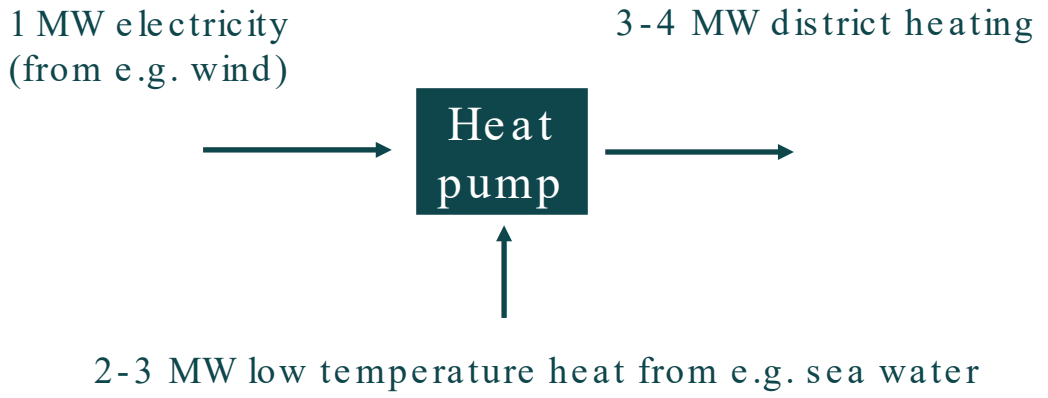
- Opposite to CHP plants, which **produce** electricity when producing heat, electric boilers and electric driven heat pumps **use** electricity when producing heat

- Thereby, electric boilers and electric driven heat pumps contribute to electrification of the DH sector which **supports the integration of even more renewable energy in the electricity sector** (wind turbines and solar PV)

Electric boilers and electric driven heat pumps

- **Electric boilers** convert electric to heat
- The efficiency of electric boilers is close to 100 %

- **Heat pumps** utilise low temperature heat sources as for instance ambient air, sea water or industrial waste heat
- Heat pumps are therefore much more efficient than electric boilers – heat pumps might produce 3 -4 units of heat by using only 1 unit of electricity (COP = 3 -4)



Different heat sources for heat pumps includes among others:

- Sea water
- Wastewater
- Industrial waste heat
- Geothermal water
- Groundwater
- Ambient air
- Data centers (heat from server cooling)
- Supermarkets (heat from cooling machines)

Electrification strategy with focus on heat pumps and electric boilers

Content of the strategy:

- Up to ten heat pumps with a total capacity of 300 MW in Copenhagen
- Up to 550 MW electric boilers in Copenhagen (in combination with heat storages)

The strategy will contribute to:

- A more diversified DH supply
- Reduced use of biomass
- Reduced use of fossil fuels for peak load and thereby increased CO2-neutrality
- Furthermore, the electricity-based solutions in the DH system support a further integration of wind turbine and solar PV in the power system – to the benefit of both the DH sector and the power sector

Large heat pumps operated by HOFOR today

HOFOR operates today four “large” heat pumps:

- 0,8 MW ground water heat pump (FlexHeat)
- 5,0 MW sea water / wastewater heat pump (SVAF)
- 4,0 MW heat pump utilising industrial excess heat from the production of enzymes (Novonesis)
- 5,0 MW heat pump in combination with district cooling (Tietgensgade)

- In total app. 15 MW
- Besides this, a number of new heat pumps are in pipeline

The next two large heat pumps – app. 50 MW

- 30 MW wastewater heat pump (Kløvermarken)
- 20 MW sea water heat pump (Kranparken)

In addition to this, HOFOR has further app. 250 MW large heat pumps in pipeline or under consideration

- 100 MW sea water heat pump (North Harbour)
- 70-100 MW wastewater heat pump (Lynetten wastewater treatment plant)
- 30 MW sea water heat pump (Svanemølle power station)
- 30 MW sea water heat pump (H. C. Ørsted power station)
- 10 MW sea water heat pump (Bådehavnsgade)
- 4 MW ATES-facility (Jernbanebyen)
- Various local excess heat

Efficient sector coupling of electricity and heat requires flexibility

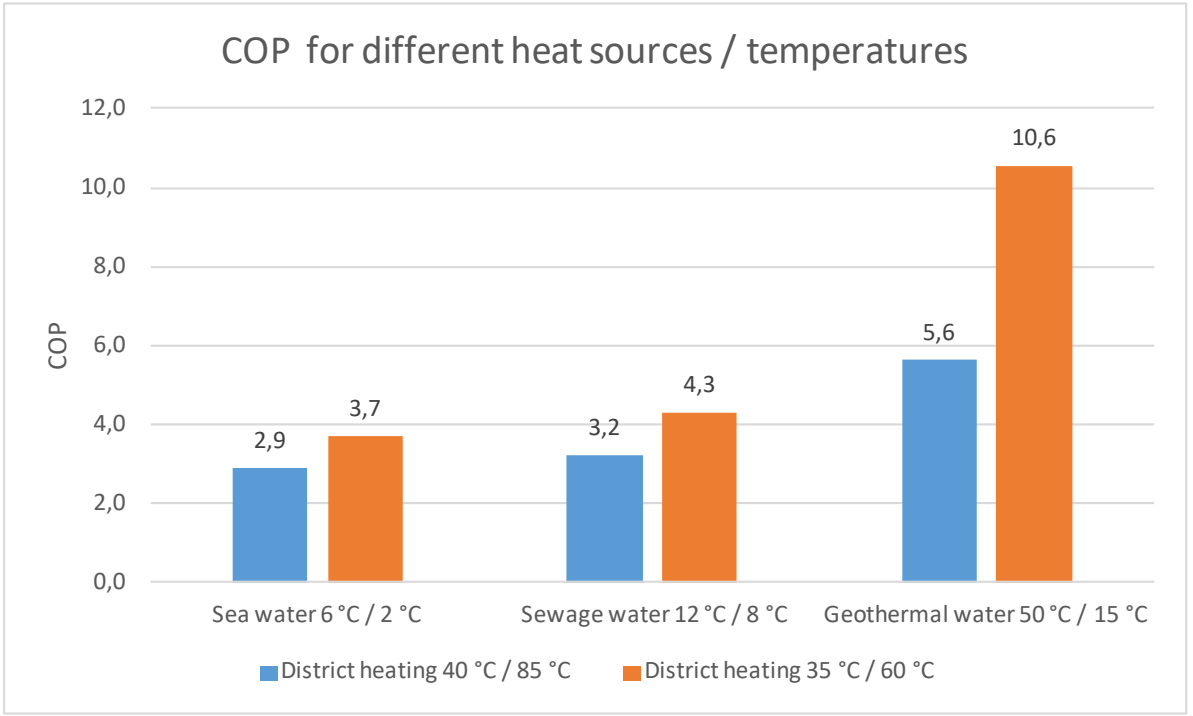
- It should be possible to produce heat at CHP units when electricity prices are high
- It should be possible to produce heat at electric boilers and electric driven heat pumps when electricity prices are low
- Therefore, all Danish DH systems including the Greater Copenhagen DH system have large **heat storages** so that the plants can be operated according to the need for electricity in the system – independently of the current heat demand
- Furthermore, production units should be **fast regulating** and have **low minimum load**, and CHP plants should preferably have **turbine bypass** to produce heat without electricity

Efficient sector coupling of electricity and heat requires optimal power and heat dispatch

- In the Greater Copenhagen DH system, the dispatch unit “ Varmelast ” optimizes the heat production on an hourly basis
- The heat production is optimized (least cost principle) according to among others heat demand, fuel prices, CO2 -costs and **electricity prices** .
- If electricity prices are high, the dispatch unit may choose to produce heat at CHP units
- If electricity prices are low, the dispatch unit may choose to produce heat at electric boilers or electric driven heat pumps

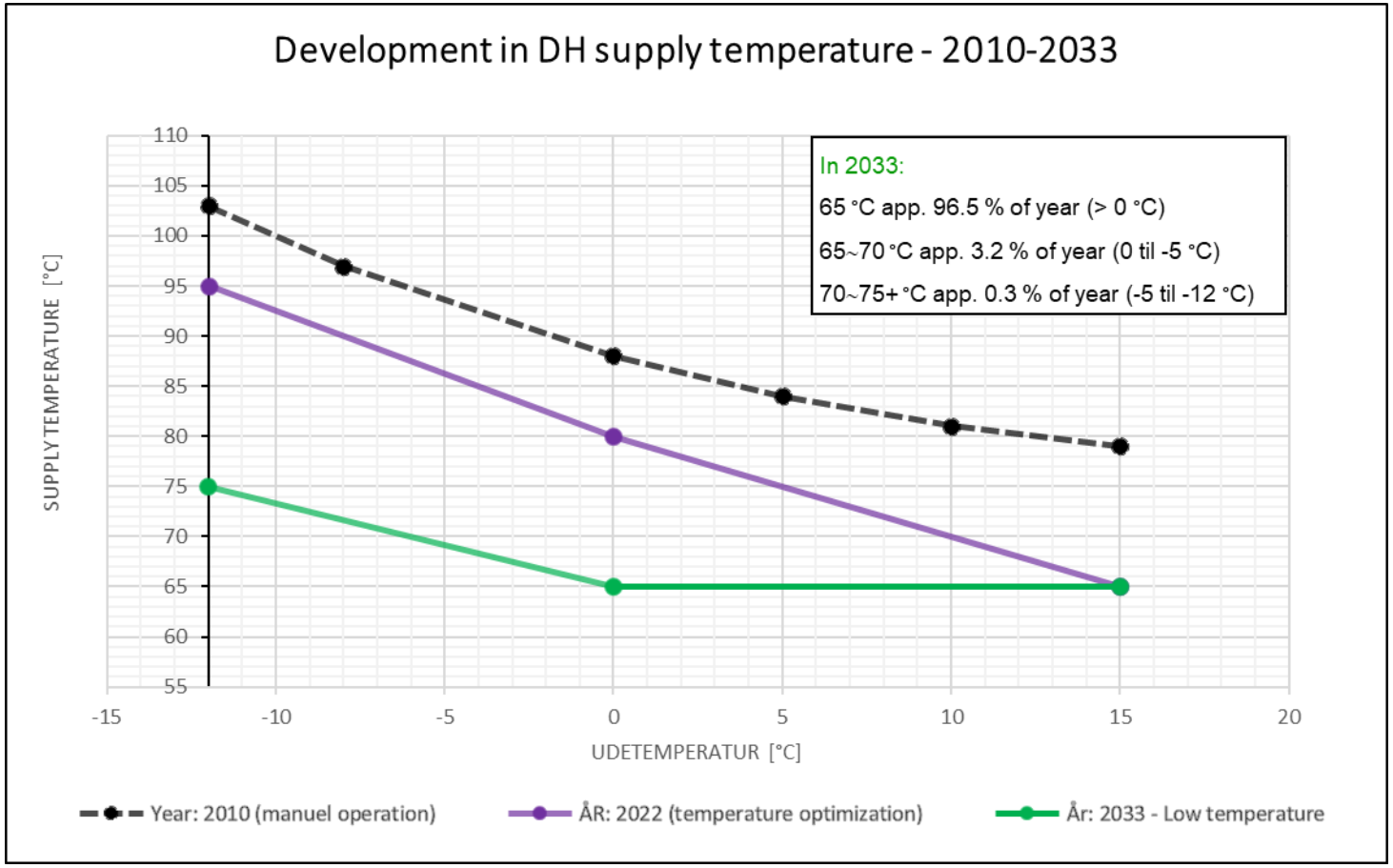
HOFOR focus on lowering the temperatures in the DH network

- **Efficiency of heat pumps (COP) depends on heat source temperature and DH temperatures**
  - High heat source temperature → High COP
  - Low DH temperatures → High COP
- Therefor focus on establishing heat pumps in areas with low temperature requirements in the DH network
- Also focus on reducing the temperatures in the DH network
- Lower DH temperatures also result in **reduced heat losses**



Current temperatures in the distribution grid

- Today, HOFOR deliver up to 95 °C to the end consumers (on the coldest day)
- We want to lower this in future
- We already supply with lower temperatures in new city areas (65 - 75 °C)
- One challenge in the old city area is that some of the consumer installations require relatively high temperatures



Thank you very much for your attention!

Thomas Engberg Pedersen
thep@hofor.dk