District Heating

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Danish Energy Agency

Agenda

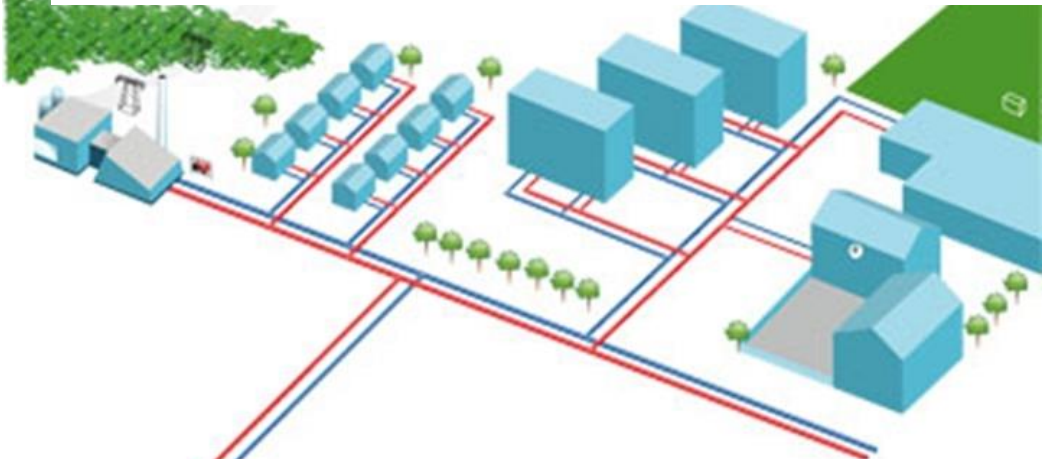
- Technology (it is simple) and history
- Why District heating: Positive side effects
- Considerations and requirements – what GC tell the world
- The Danish Solution
- Green recovery and DH
- Country cases

Agenda

Technology (it is simple) and history

What is Distric Heating as technology?

District Heating is centrally heated water distributed in insulated steel pipes.



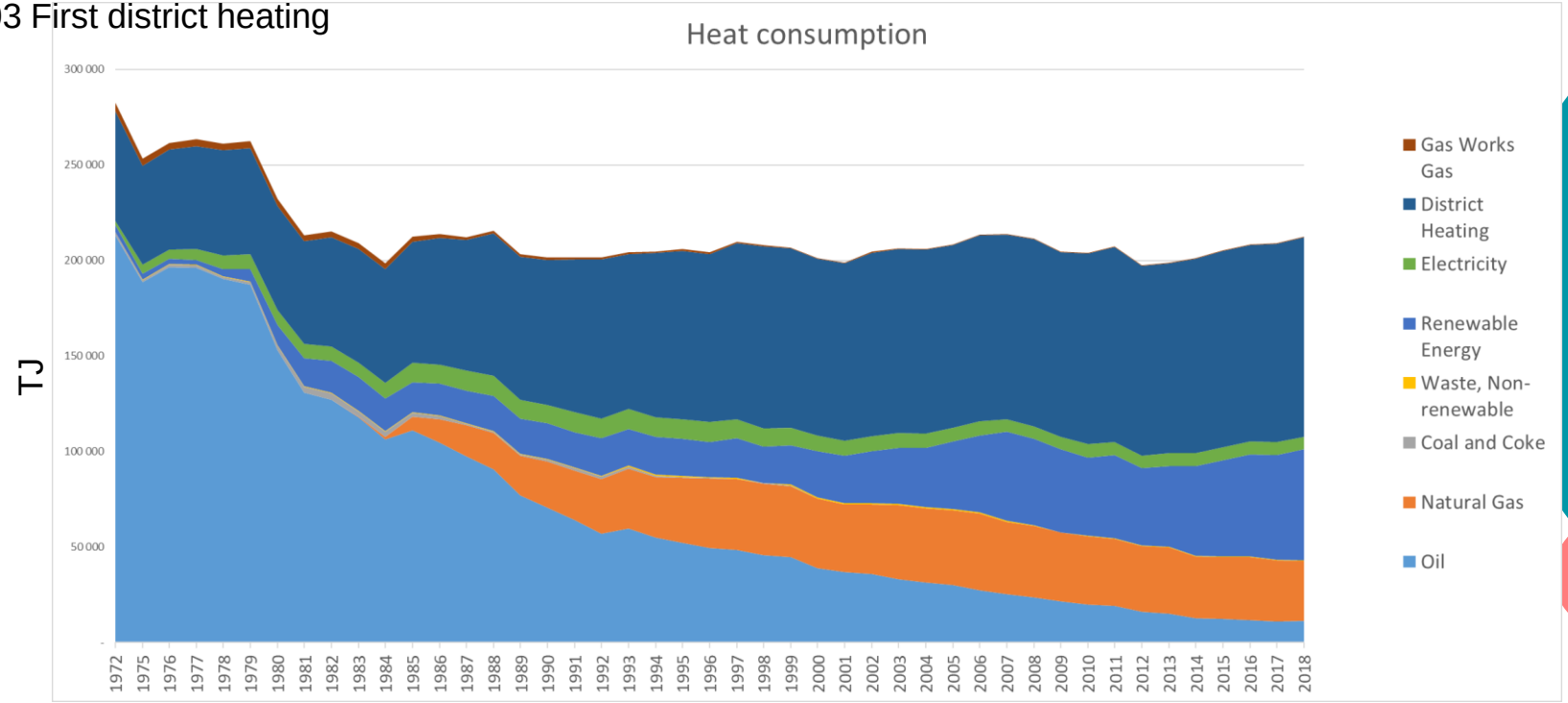
And the technology is simple

The State of District Heating

- 5.6 million inhabitants
- 33,000 km. district heating pipes (trench) all over Denmark.
- 64% of all houses DH-heated. Roughly 50 % of heat demand
- Average heat consumption: 8.3 MWh per person per year.
- District Heating = 17% of DK's final energy demand.
- Annual heat sale: 2½ Billion Euro (= 2/3 % of GDP).
- Direct Employment = 2,000 persons. 10,900 persons incl. suppliers.

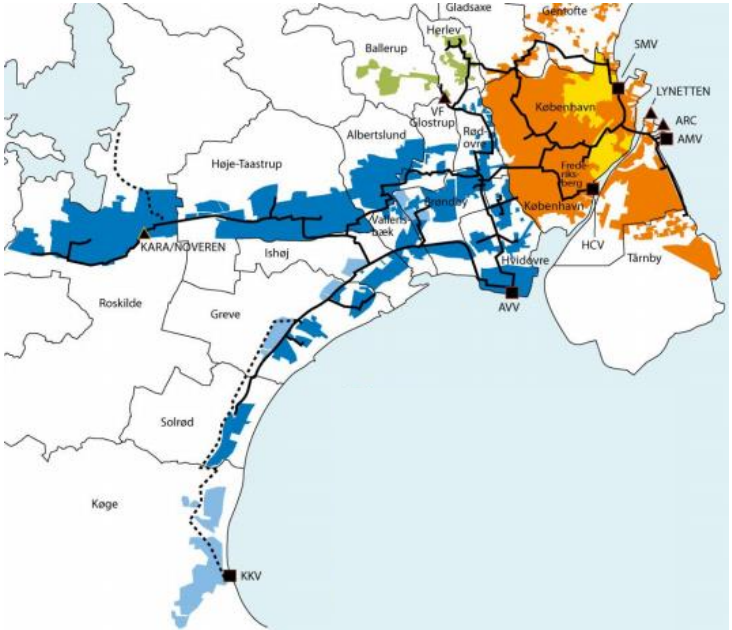
Development in heat consumption

1903 First district heating



Greater Copenhagen heat supply has a wide range of generation sources

GREATER COPENHAGEN HEAT SUPPLY



HEAT SOURCES

- Waste incineration CHP,
- Wood pellets CHP,
- Wood chips CHP (from 2020),
- Natural gas CHP,
- Coal CHP, Oil,
- Heat storage

- CHP plant
- Waste incineration plant
- Transmission line district heating
- Transmission line DH under construction
- VEKS supply area
- VEKS convertion area from natural gas to district heating
- CTR supply area
- Vestforbrænding supply area
- Steam based district heating

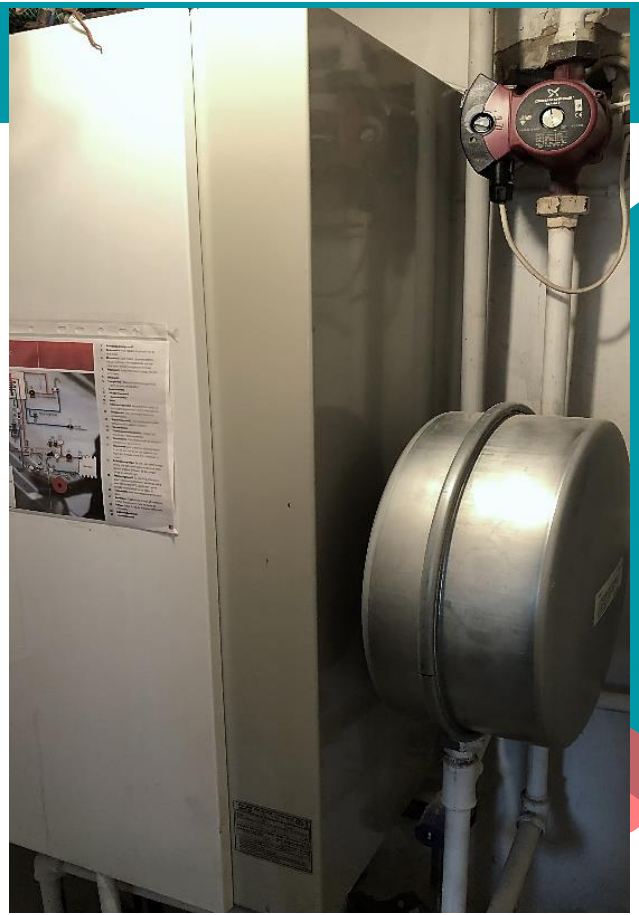
Why District heating: Positive side effects

Why is District any good?

- Cheap (If done right)
- Safe, easy and reliant for consumers
- Fuel efficient
- Enables transitions
- Supports the rest of the energy system
- Security of supply and greater independence in fuel imports

Safe, easy and reliant for consumers

- Only a small heat exchanger and a pump is needed
- Minimum O&M costs
- Heat is transported in closed water loops at max. 80 C
- No risk of explosion, gas leaks, electrical shock or fire

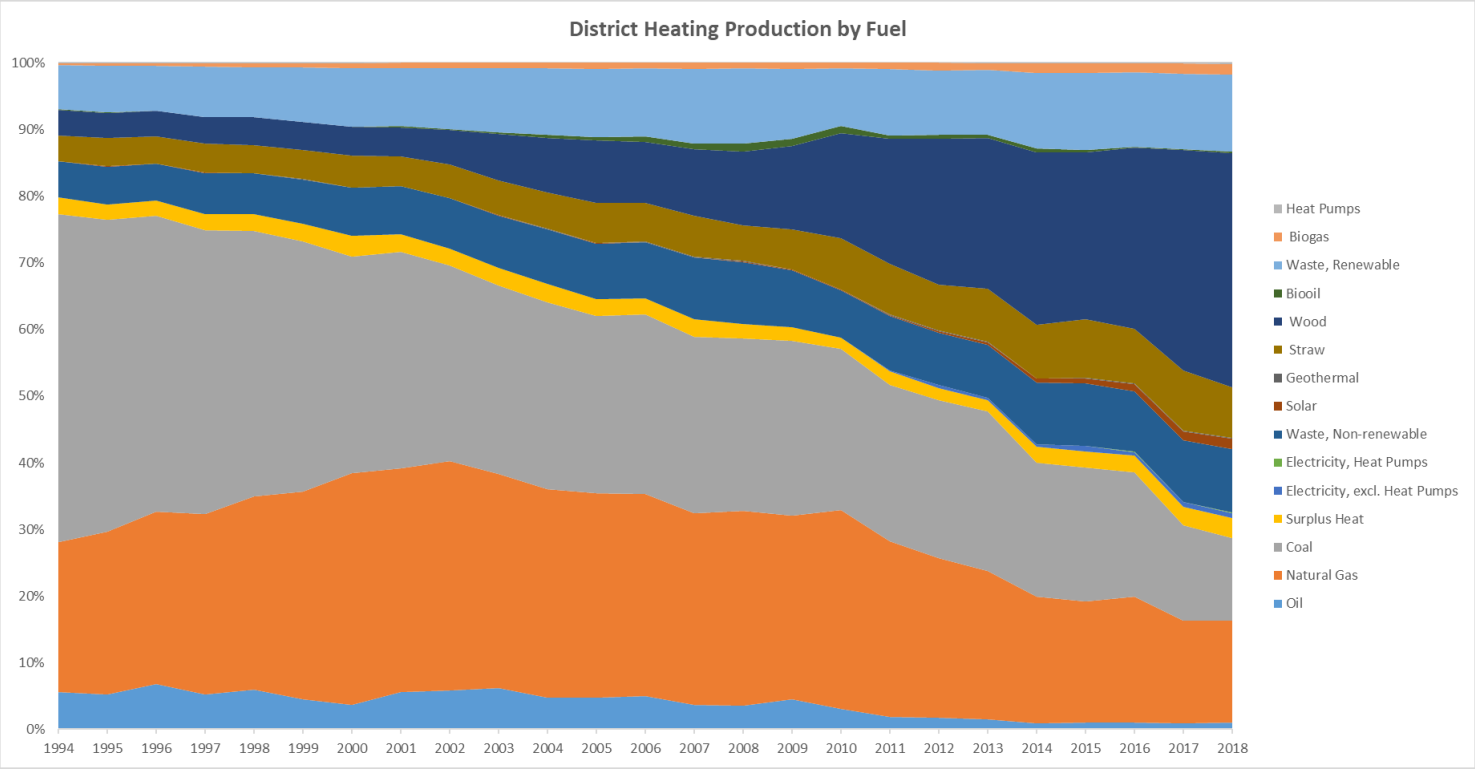


Efficient

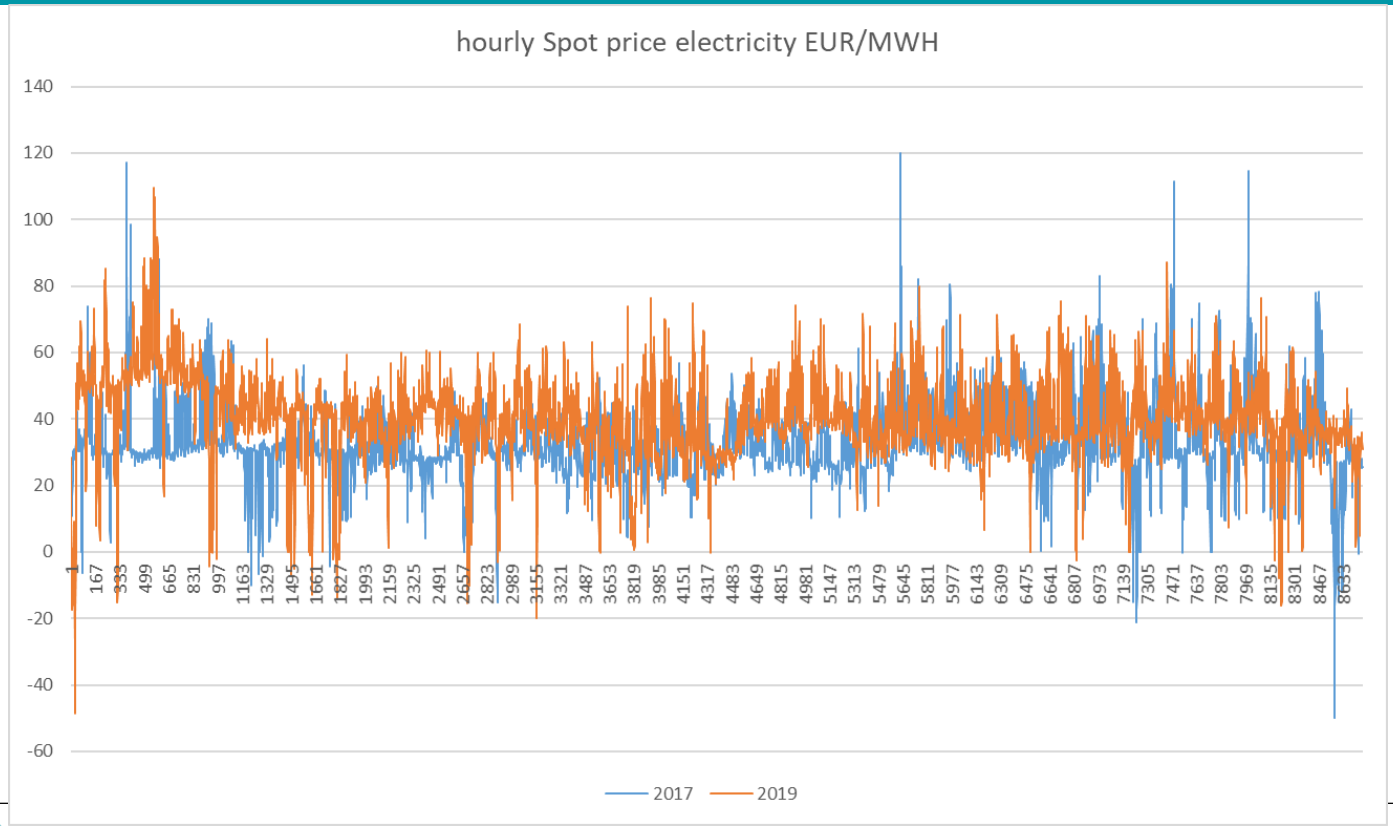
- Combining heat and power: Much higher efficiency as surplus heat is utilised
- Less heat production capacity installed as not everybody need to install peak capacity
- Combining fuel sources
- Using waste heat from multiple sources

Enabling transition

From oil
to coal
to natural gas
to biomass
to…

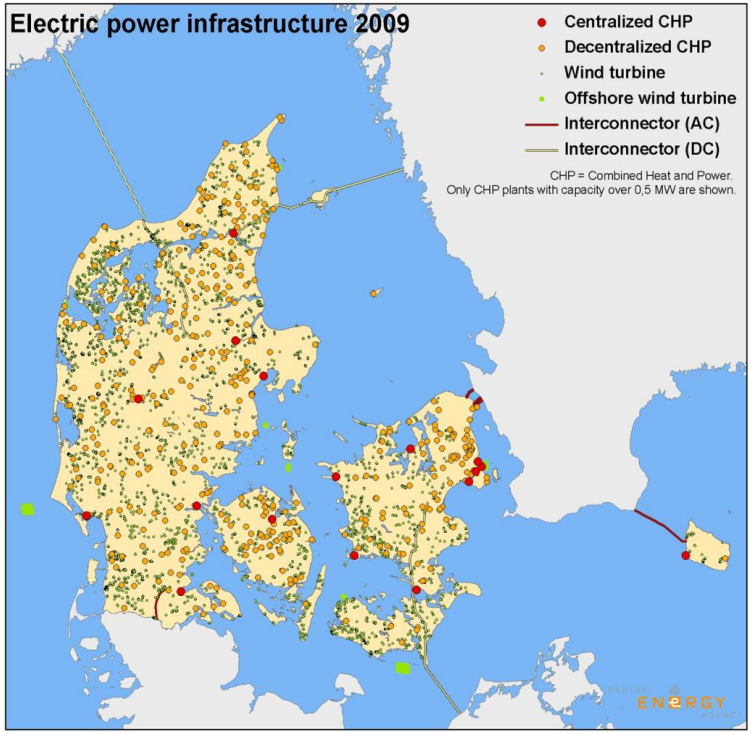


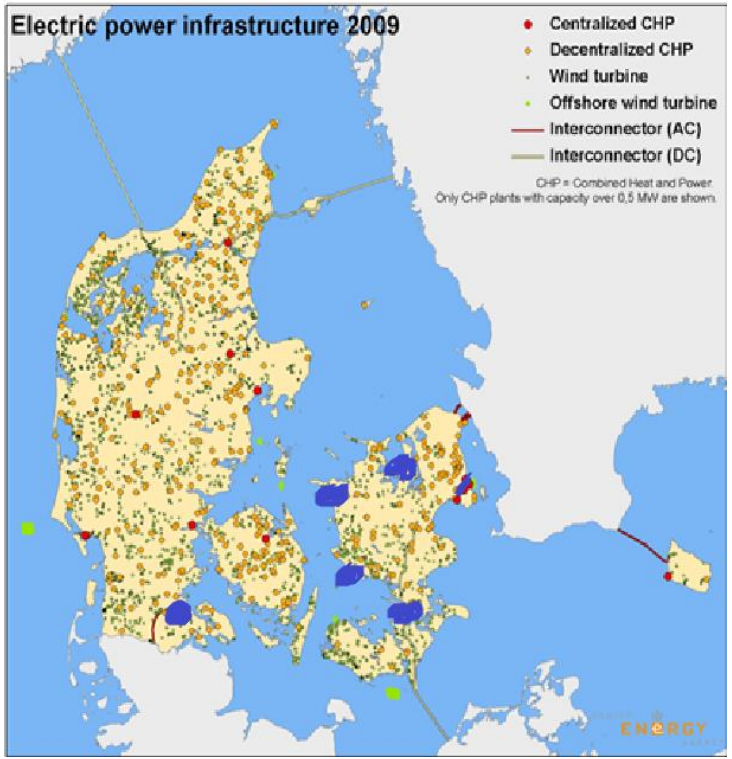
Supporting the electricity system The problem



Supporting the electricity system

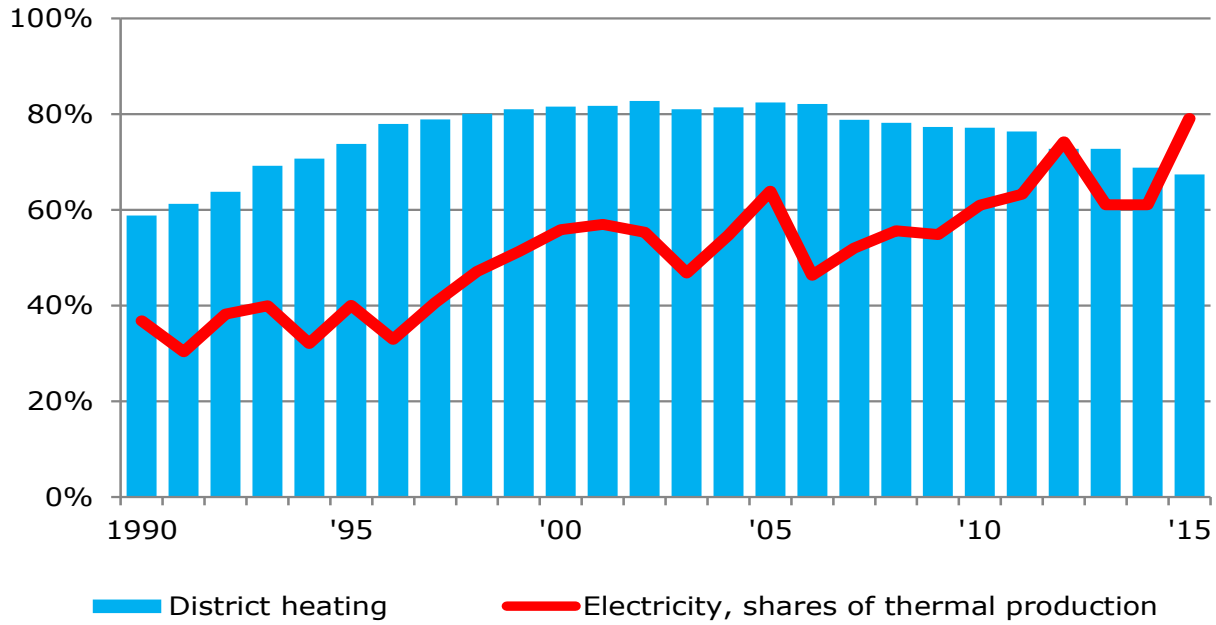
Thermal electric capacity saved by district heating





Supporting the electricity system

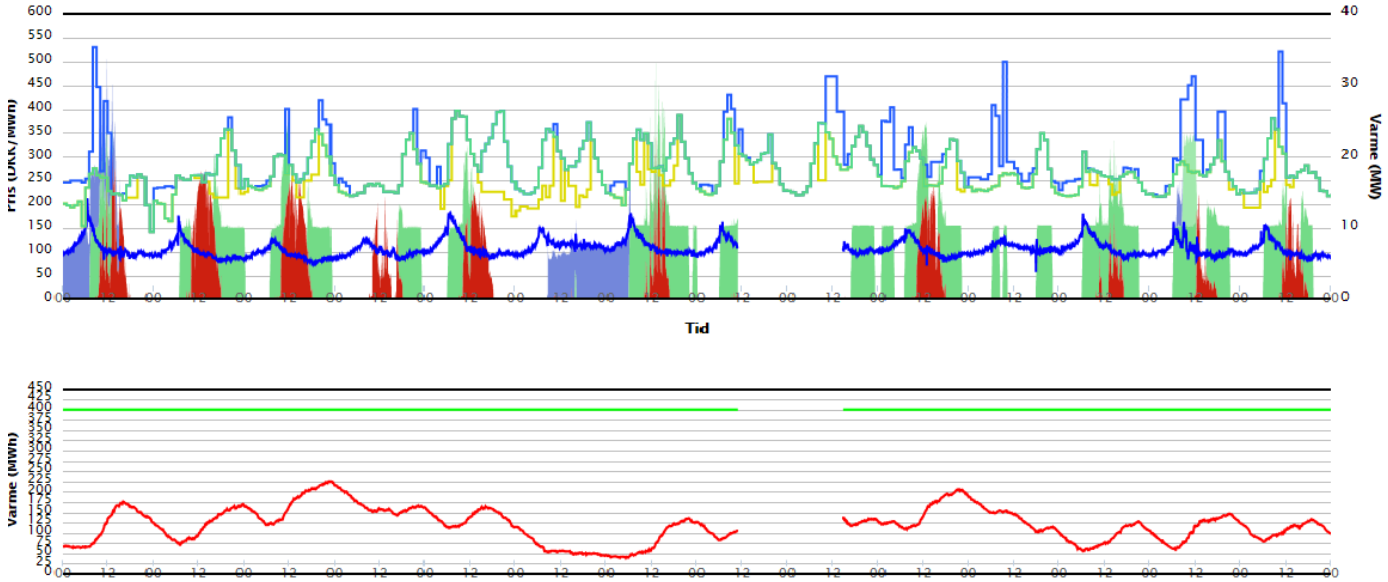
Cogeneration



Supporting the energy system continued

- Gives flexibility to the power system with both CHP, heat storage and electricity based production
- Indirect financial support to power production through de-risking investments and lowering need for ramping production up and down
- Securing revenue streams for industry with waste heat like PtX production.

District heating supports the energy system real world example



- Spot price electricity
- Regulation price UP
- Regulation price DOWN
- Heat consumption
- Solar heat
- Natural gas engine
- Natural gas turbine
- Electric boiler
- Natural gas boilers
- Heat storage
- Storage capacity

Data from Ringkøbing Fjernvarmeværk between Thursday 14 Sep. 2017 and Wednesday 27 Sep. 2017

Security of supply

- District heating is fuel “agnostic” therefore local sources can be used e.g. biomass, industrial excess heat or heatpumps
- Few individual production units can switch fuel. Establishing new central units is cheaper and way easier than having all buildings retrofitted
- Much less reliance on partly monopolised fuels gives more independence in security politics
- Less dependence of specific fuel imports is important for the trade balance and lowers the risk from fluctuations in exchange rates

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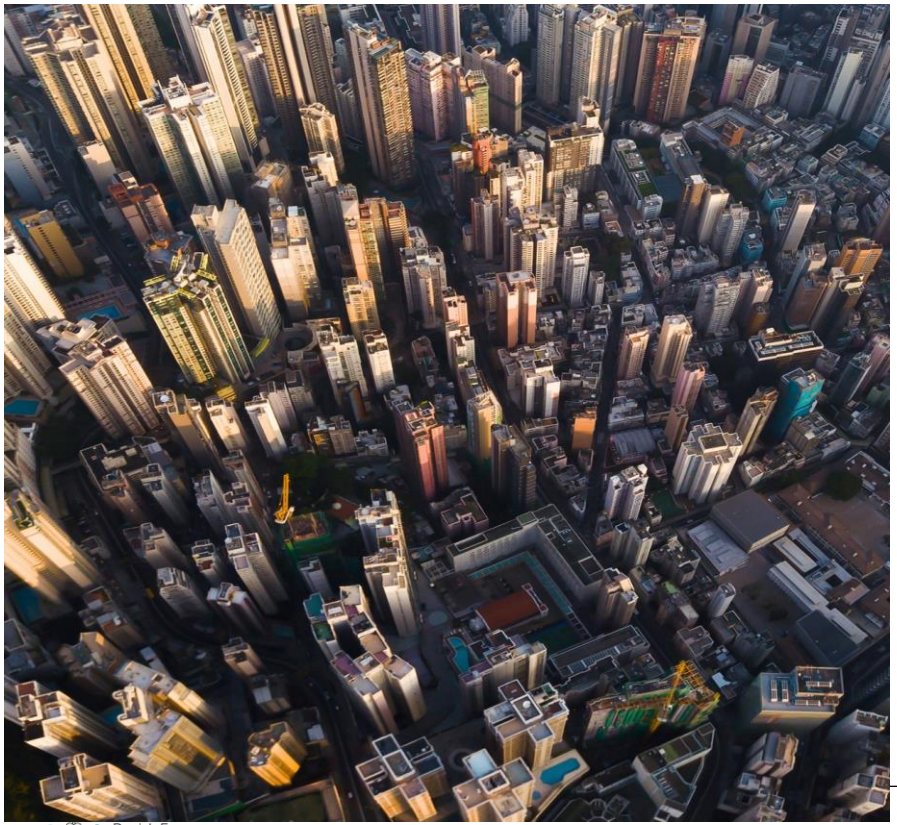
Considerations and requirements
– Why the Danish experience is needed

Considerations

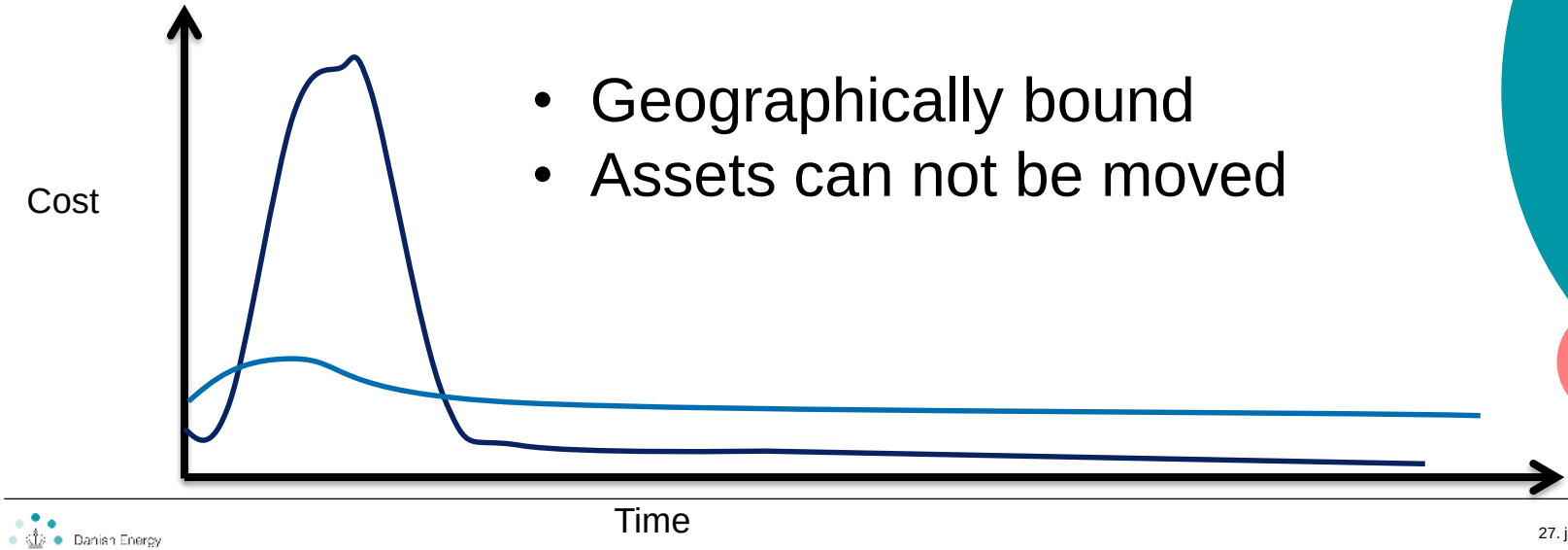
Why District heating does not build itself



- Investments are high and not distributed. De-risking projects and low interest rates are crucial
- Heat prices are political
- Few options for individual service levels
- Natural monopoly
- Important economics of scale. Not least for externalities.
- Like all other infrastructure!

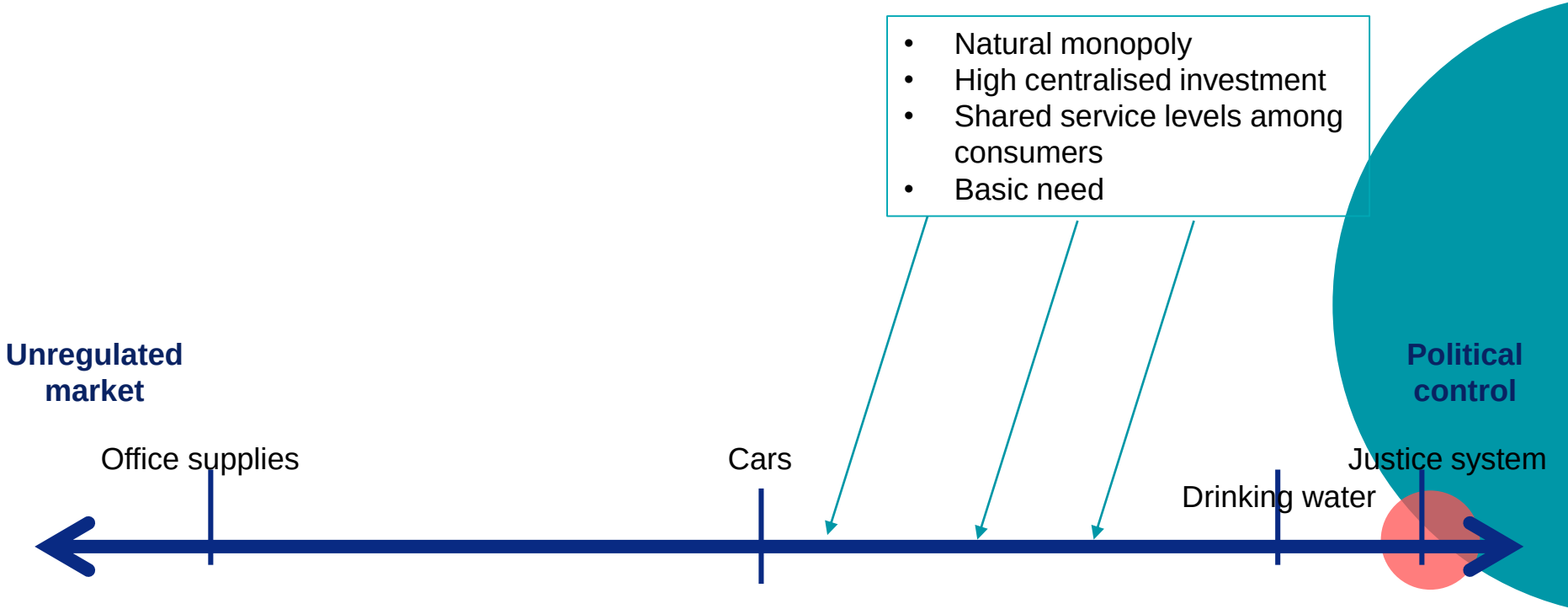
Capex and Opex in individual heating and DH

- High cost of entry and exit barriers for suppliers and consumers



- Geographically bound
- Assets can not be moved

Heat prices are political and will be regulated



Political dilemma

How to establish district heating

Governments favour private investments and initiative

But at the same time:

- Heat is a basic need: must be offered and at reasonable prices
- District heating is infrastructure: High investment and a natural monopoly
- Governments want control of:
    - Fuel used (green transition)
    - Supplied areas
    - Prices

→ Governmental and political control is therefore needed

Other challenges
Political control and local conditions

- Need for national political control over general direction of the energy sector to avoid local sub-optimisation

- But heat is local and local conditions have to be considered
  - Production alternatives vary depending on local infrastructure, geography, heat density, resources and more
  - Local stakeholders will seize possibilities and erect or overcome barriers

- Asymmetrical information and knowledge between authorities and companies

A few universal requirements

- Strong governmental framework
- Local flexibility and planning options
- Low investment risk
- Low consumer risk
- But, keep consumers and companies accountable

The Danish solution

District Heating and the institutional set up

- District heating is defined as a municipal task and thus qualifies for municipal guarantee, which in turn means the State of Denmark
- Other institutions are also part of it.

Institution	Roles
Ministry and Danish Energy Agency	Primary & secondary legislation and guidelines
Municipalities	Approval of DH/NG – projects; municipal heat planning; administrative means
Danish Energy Regulatory Authority (Energitilsynet)	Supervision of ”non profit” - price regulation
Energy Supplies Complaint Board (Ankenævnet på Energiområdet)	Handles complaints regarding prices and delivery conditions (Voluntary sector board)
DH-companies (production, transmission, distribution) and NG-distribution companies	Preparation of heat supply projects for approval by the municipalities. Implementation and operation (DH/NG networks, DH-production)
The Energy Board of Appeal (Energiklagenævnet)	Handles complaints over municipal decisions etc.

§20 nødvendige omkostninger

Economic accountability and security for consumers

- Only necessary costs will be covered by consumers
- But ALL necessary costs will be covered by consumer
- Any surplus goes back to consumers
- Necessary costs means the lowest possible i.e. if cheaper energy is available, it is not necessary to pay extra.
- This also indirectly allows for third party access to networks

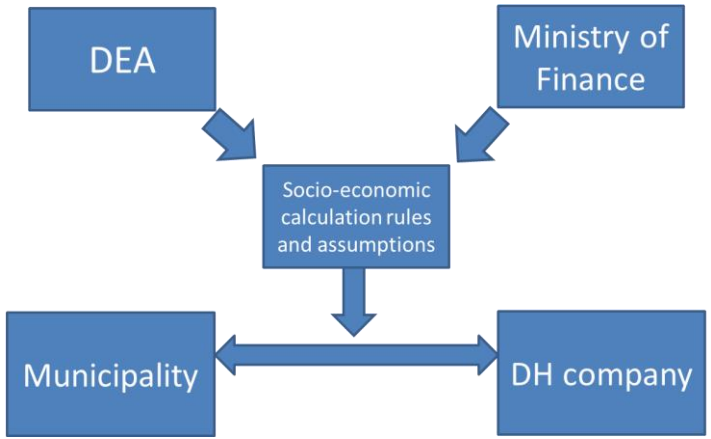
§ 20. Kollektive varmeforsyningsanlæg, industrivirksomheder, kraftvarmeanlæg med en eleffekt over 25 MW samt geotermiske anlæg m.v. kan i priserne for levering til det indenlandske marked af opvarmet vand, damp eller gas bortset fra naturgas med det formål at levere energi til bygningers opvarmning og forsyning med varmt vand indregne nødvendige udgifter til energi, lønninger og andre driftsomkostninger, efterforskning, administration og salg, omkostninger som følge af pålagte offentlige forpligtelser, herunder omkostninger til energispareaktiviteter efter §§ 28 a, 28 b og 29, samt finansieringsudgifter ved fremmedkapital og underskud fra tidligere perioder opstået i forbindelse med etablering og væsentlig udbygning af forsyningssystemerne, jf. dog stk. 7-17 og §§ 20 a-20 c. 1. pkt. finder tilsvarende anvendelse på levering af opvarmet vand til andre formål fra et centralt kraft-varme-anlæg, jf. § 10, stk. 6, i lov om elforsyning.

Stk. 2. Energi-, forsynings- og klimaministeren kan fastsætte regler om, at andre udgifter og omkostninger end de i stk. 1 nævnte kan indregnes i priserne, jf. dog stk. 7. Energi-, forsynings- og klimaministeren kan endvidere fastsætte regler om indregning i priserne af kompensation ved et projekt til ændring af områdeafgrænsningen og indregning af driftsmæssige afskrivninger, henlæggelser til nyinvesteringer og med Energitilsynets tiltræden forrentning af indskudskapital.

Stk. 3. Energi-, forsynings- og klimaministeren kan fastsætte regler om fordeling af omkostningerne til levering af ydelser omfattet af stk. 1 og andre ydelser.

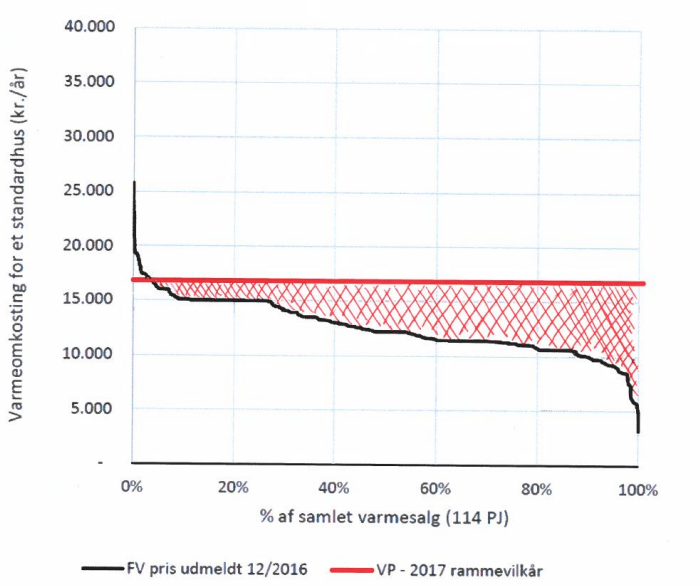
How to approve district heating projects

- DH Companies have to document socio-economic feasibility based on central calculation methodology and assumptions
- Municipalities examines whether proposals are in accordence with methodology



Concluding the Danish case

- We have well established District Heating
- We have lower prices than the alternative
- Could it be more efficient? Forsyningstilsynet/The Danish Utility Regulator estimates that the DH sector can cut costs by 100-200 million € between 2022 and 2030
- Maybe the optimal regulation for established infrastructure differs from the one needed to establish it?



What we offer in our cooperation

What we offer

Access to 100 years of institutional knowledge!

- A broad range of practitioners: Operators, regulators, legislators etc.
- Established and well proven technical solutions
- Academic research and academics
- The international experiences and comparisons from GC work

Green recovery and district heating

Green Recovery

District heating is a as good an economic stimulant as possible

- Support the green transition
- Creates local jobs in across on all levels of education
- Increases resiliency in the energy system
- Diverse global supply chain
- Few highly specialised skills required → no educational bottlenecks
- High investment and low marginal cost

Conclusion

Conclusion and key take aways

- The technology is simple (even the data)
- It's not just about heat! The positive externalities are as important
- Regulation and framework needs to be in place –it is utility infrastructure
- District heating has a lot of characteristics needed in green economic recovery

Agenda

Some of our cooperations on district heating

Case stories
UK

Energy Governance Partnership

Main cooperation with BEIS and Scottish Government on regulation

E.g. Parliamentary Committee in Scotland refers to Denmark and our input in their reports

Important Danish partners: The Danish Embassy and Danish Board of District Heating

The Netherlands

Energy Governance Partnership

Main cooperation with central government and research organisation TNO

Invited to comment on new heat law

Dialogue with many different actors such as heat cooperatives, regional government, private investors and financial institutions.

Important Danish partners: The Danish Embassy and Danish Board of District Heating

Ukraine

EU Neighbourhood programme

Working with Ministry of Energy, SAEE, local authorities and DH companies on saving district heating from collapse

Ukraine has well developed DH, but the service has potential for improvement

Important Danish partners: The Danish Embassy and Danida Sustainable Infrastructure Finance

Other countries

- Germany
- Turkey
- China
- USA (No longer focus on DH)


Thank you for your attention!
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