



# HEAT PLAN DENMARK 2010 LOW CARBON URBAN HEATING

ANDERS DYRELUND, MARKET MANAGER ENERGY



HEAT PLAN DENMARK 2010 BY ANDERS DYRELUND  
LOW CARBON URBAN HEATING 2010

# HEAT PLAN DENMARK 2010 - A SMALL STUDY WITH A SIGNIFICANT IMPACT

- Bottom-up R&D study financed by the district heating consumers
- Prepared by an independent team of experts from
  - Ramboll and
  - Aalborg University
- Heat Plan Denmark 2008 was the first study to combine the supply and the demand side - this study goes more into detail
- An eye-opener for Danish politicians
- Could be a model for other countries

# THE OVERALL ENERGY POLICY OBJECTIVE IN THE EUROPEAN UNION

- To reduce the fossil fuel consumption in a cost effective way
  - security of supply
  - climate awareness
- Important EU directives to implement this objective
  - Strategic environmental assessment
  - Combined Heat and Power (CHP)
  - Energy performance of buildings
  - Renewable energy

# MOST IMPORTANT OBJECTIVES IN THE ENERGY POLICY IN DENMARK SINCE 1976

- Objectives since 1976
  - Develop the most economic heat supply projects for Denmark
  - Reduce the dependency on oil
  - Promote Combined Heat and Power (CHP)
  - Promote renewable energy
- New additional objectives
  - To reduce CO<sub>2</sub> emissions outside the CO<sub>2</sub> emission trading scheme
  - **To be independent of fossil fuels in the long run ! (2050?)**

# IMPORTANT DANISH ENERGY LEGISLATION TO IMPLEMENT THE POLICY

- Electricity supply act from 1976
  - all new power capacity since 1976 has been CHP
- Heat supply act from 1979
  - Municipalities are responsible for urban heat supply planning
  - Optimal zoning of district heating and natural gas networks based on overall economic evaluation for the society of Denmark
  - District heating companies and block boilers > 0,25 MW are only allowed to invest in the most cost effective heat supply solution
- This legislation ensures unique least cost integration of power, heat, gas and waste sectors in Denmark in accordance with the EU directives
- The building sector is not yet fully coordinated with other sectors

# IMPORTANT DANISH ENERGY LEGISLATION TO REGULATE INVESTMENT PROJECTS

- Legislation is submitted to the parliament by the Ministry of Energy and Climate ([www.kemin.dk](http://www.kemin.dk))
- The Energy Authority, ([www.ens.dk](http://www.ens.dk)), prepares studies and legislation for the Ministry of Energy and Climate
- The Ministry of Finance elaborates the general methodology for evaluation of infrastructure investments (IRR 6 % etc.)
- The Energy Authority issues guidelines and price forecasts to be used by the municipalities in the least cost evaluation based on this methodology
- Energy companies submit project proposals to municipalities
- Municipal decisions can be appealed to the Energy Appeal Board ([www.ekn.dk](http://www.ekn.dk))

# IMPORTANT DANISH ENERGY LEGISLATION TO REGULATE THE COMPANIES

- Heat Supply Act
  - District heating companies can only include necessary costs in the heat price including a reasonable interest of invested capital
  - Any profit shall be returned to the consumers to lower the heat price
  - Separate accounting and consumer influence in private net company
  - Promote municipal and the consumer ownership
  - DH companies submit tariffs to the Energy Regulatory Authority, ([www.energitilsynet.dk](http://www.energitilsynet.dk)) for notification and spot control
  - The Energy Regulatory Authority can declare tariffs illegal
  - Decisions of the Energy Regulatory Authority can be appealed to the Energy Board of Appeal ([www.ekn.dk](http://www.ekn.dk))

# IMPORTANT DANISH ENERGY LEGISLATION ON PROMOTING ENERGY EFFICIENCY AND SAVINGS

- Energy companies are obliged to identify energy saving projects at their consumers and to ensure they are implemented
- The Danish Energy Saving Trust ([www.elsparefonden.dk](http://www.elsparefonden.dk)) is responsible for promoting the most cost effective energy saving measures for the society of Denmark



# HEAT PLAN DENMARK

## FOCUS ON THE HEATING SECTOR

- The plan shows how the Danish heating sector has reduced CO<sub>2</sub> emissions by a factor 2,5 since 1980
- The plan shows that this progressive development can continue
  - to achieve a further **50%** reduction before 2020 and
  - to achieve an **almost CO<sub>2</sub> neutral** society before 2030
- The plan is based on an integrated approach, combining
  - optimal end-user heat demand reductions - additional 25% or more?
  - a lower return temperature from building installations – <35°C
  - from 50% up to 65% district heating based on low carbon sources
  - From 0% to 30% individual heat pumps

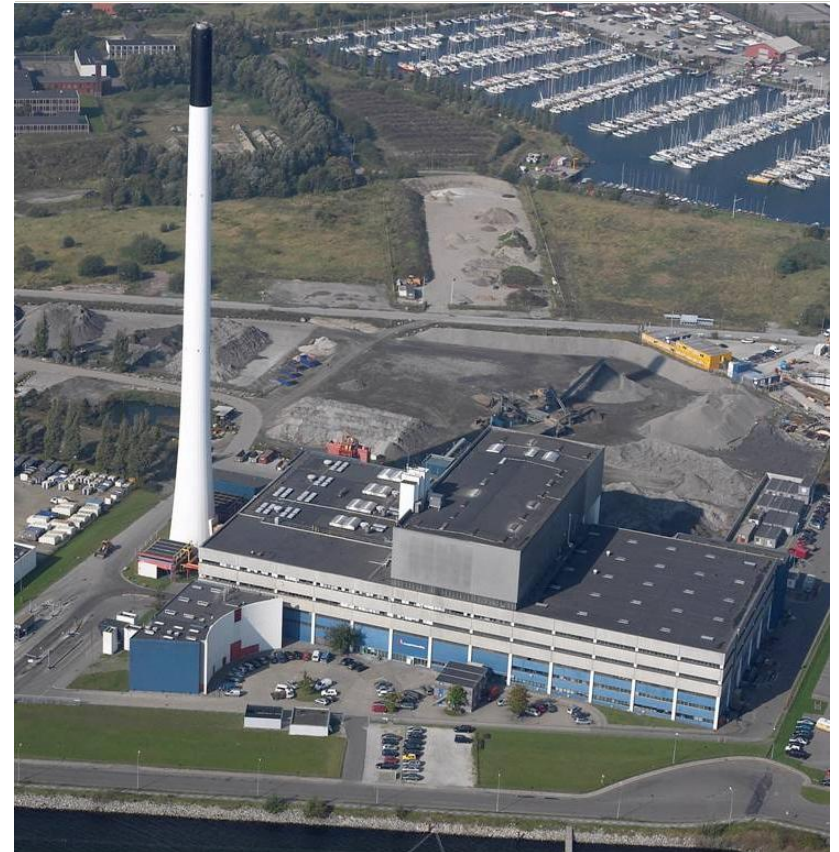
# CHP AND SURPLUS WIND ENERGY VIA HEAT PUMPS COMBINED WITH LARGE HEAT ACC.

- District heating which combines
  - Large and small CHP
  - Electric boilers
  - Heat pumps and
  - Heat accumulators
- Is a precondition for integration of large share of wind energy in Europe
- In Denmark the share of wind is growing from 20% towards 70%



# WASTE TO ENERGY CHP

- Case: Amagerforbrænding
  - the first 100% utilization of waste
  - tunnel to Zealand



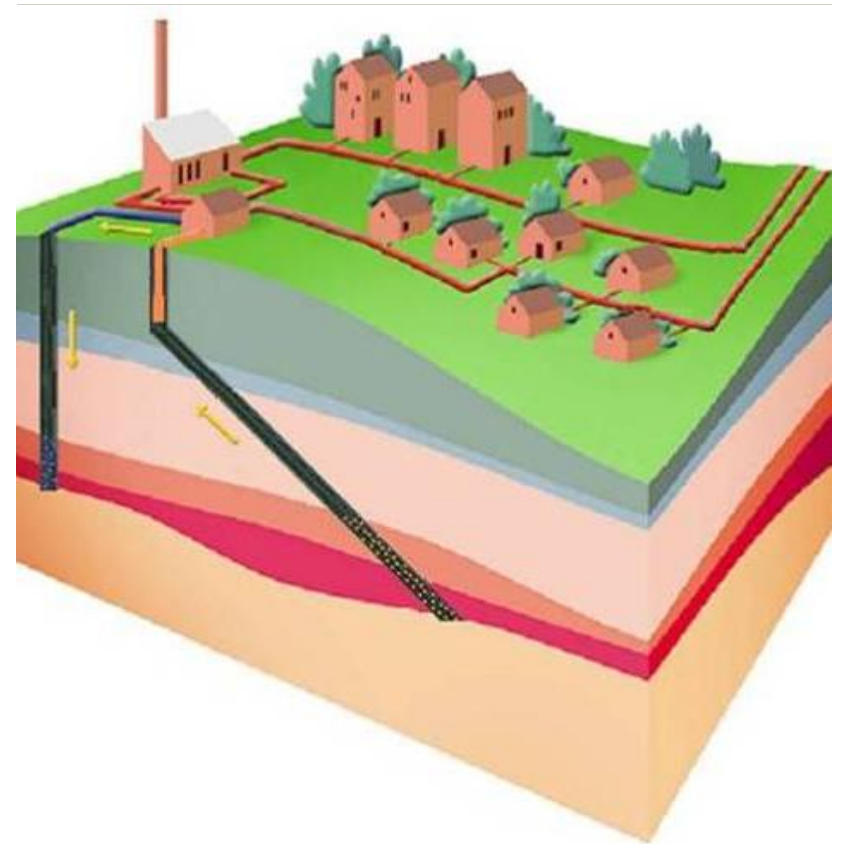
# WASTE TO ENERGY WITH FLUE GAS CONDENSATION

- Case: Vestforbrænding
  - Glass fiber tube
- Efficient use of all the surplus heat from waste
  - only in large district heating systems
  - 23% electrical efficiency in CHP
  - 100% total efficiency with flue gas condensation



# GEOHERMAL ENERGY BOOSTED BY BIOMASS

- 70 dgr.C is sufficient for heating and hot tap water -but only via large district heating systems



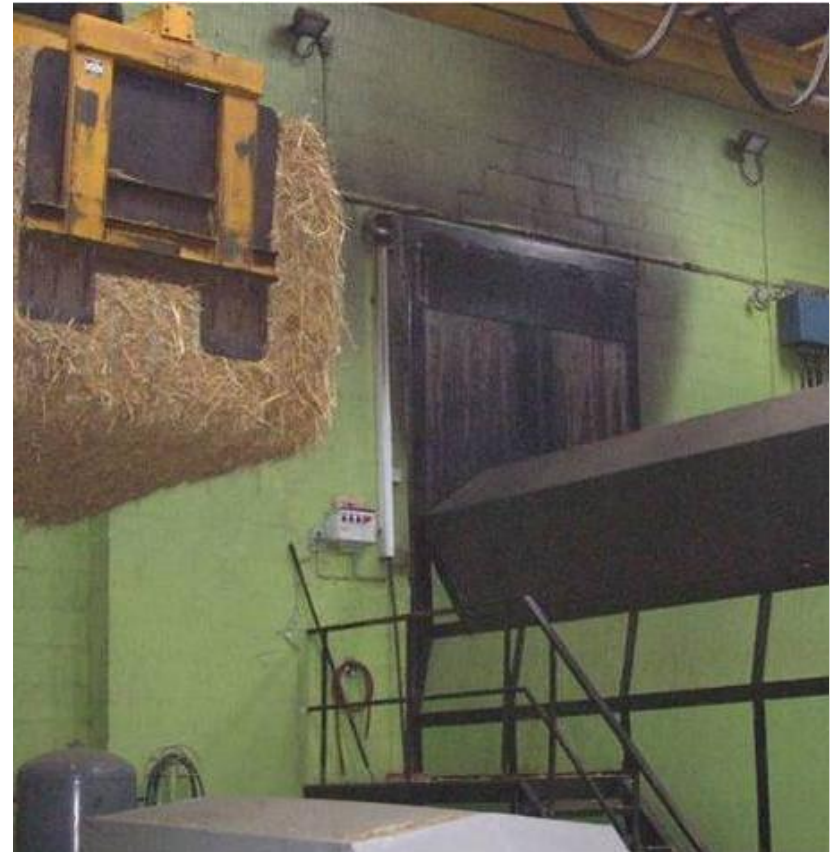
# LARGE-SCALE SOLAR THERMAL 8 MIO.M<sup>2</sup> IN 2030

- Individual solar heating is 6 times more expensive than large-scale solar heating



# STRAW

- Difficult fuels can only be utilized in an environmental acceptable way in large boilers



# SURPLUS WOOD CHIP WITH FLUE GAS CONDENSATION

- 1.000 times more environmental friendly than wood stoves – and twice as efficient





# Integrated district heating systems

01

Vestforbrænding:

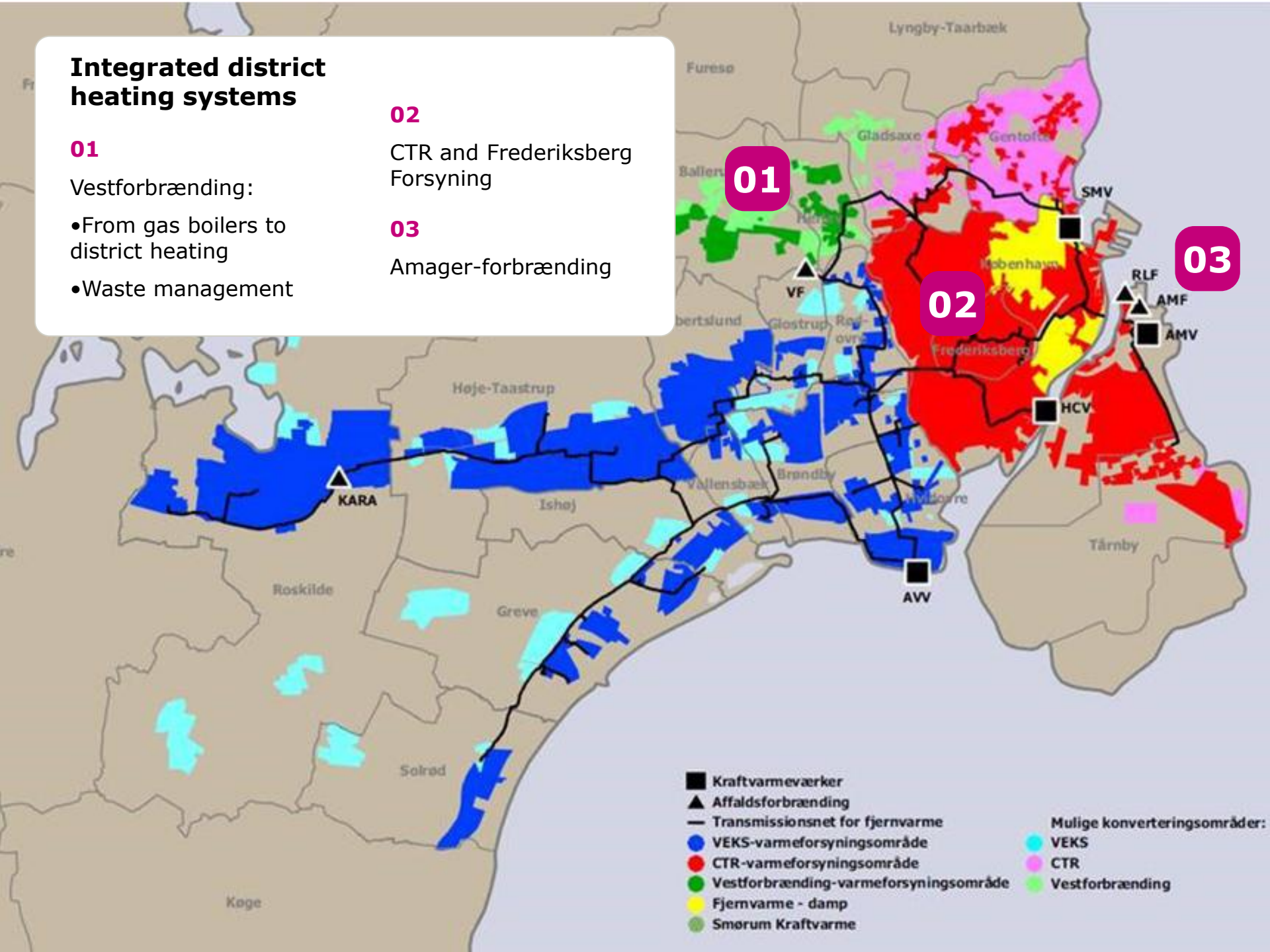
- From gas boilers to district heating
- Waste management

02

CTR and Frederiksberg Forsyning

03

Amager-forbrænding



- Kraftvarmeværker
- ▲ Affaldsforbrænding
- Transmissionsnet for fjernvarme
- VEKS-varmeforsyningsområde
- CTR-varmeforsyningsområde
- Vestforbrænding-varmeforsyningsområde
- Fjernvarme - damp
- Smørum Kraftvarme
- Mulige konverteringsområder:
  - VEKS
  - CTR
  - Vestforbrænding

# NEW SUSTAINABLE BUILDINGS INTERACT WITH THE ENERGY INFRASTRUCTURE

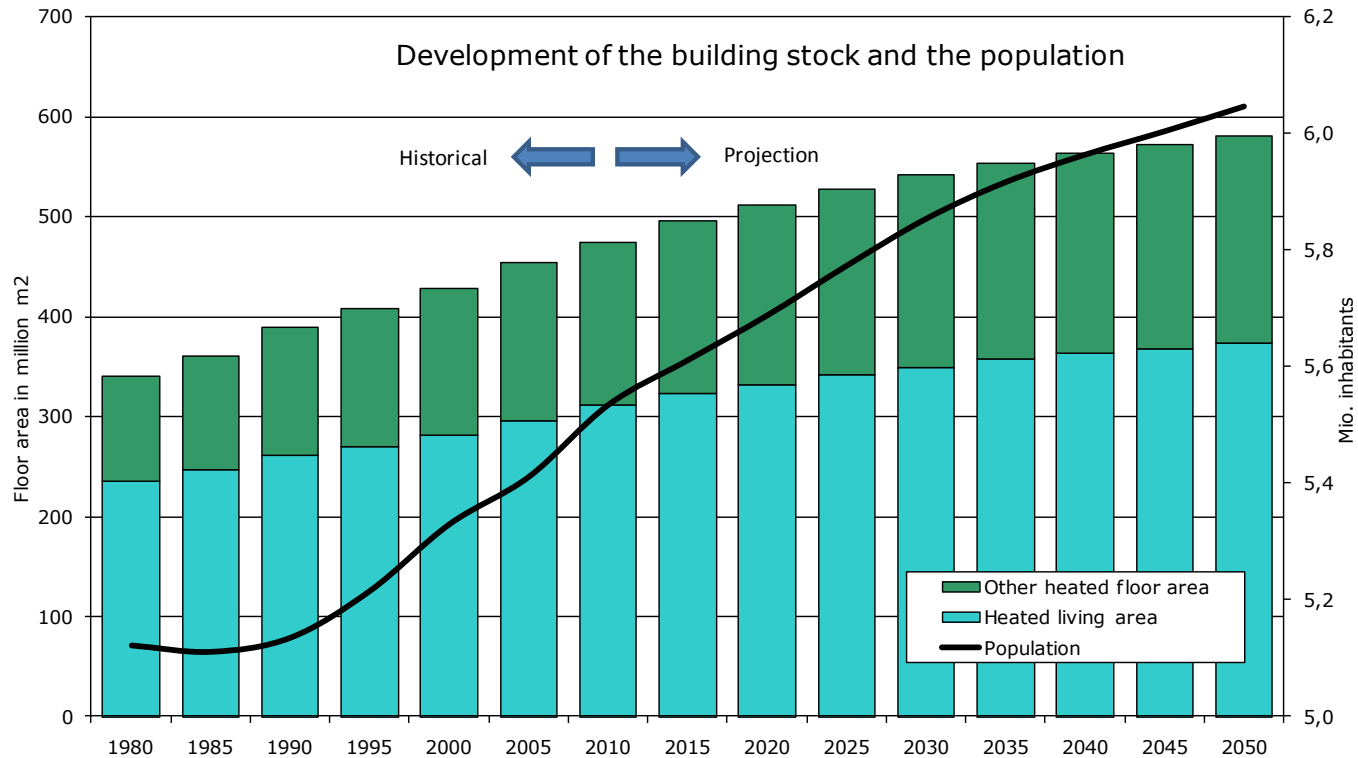
- Case: New Ramboll office in Kolding
  - Close to public transport
  - District heating with waste to energy CHP with flue gas condensation
  - "District Cooling" from nearby water
  - Low temperature floor heating down to 25 dgr. C
  - High temperature free cooling through the same floor tube system



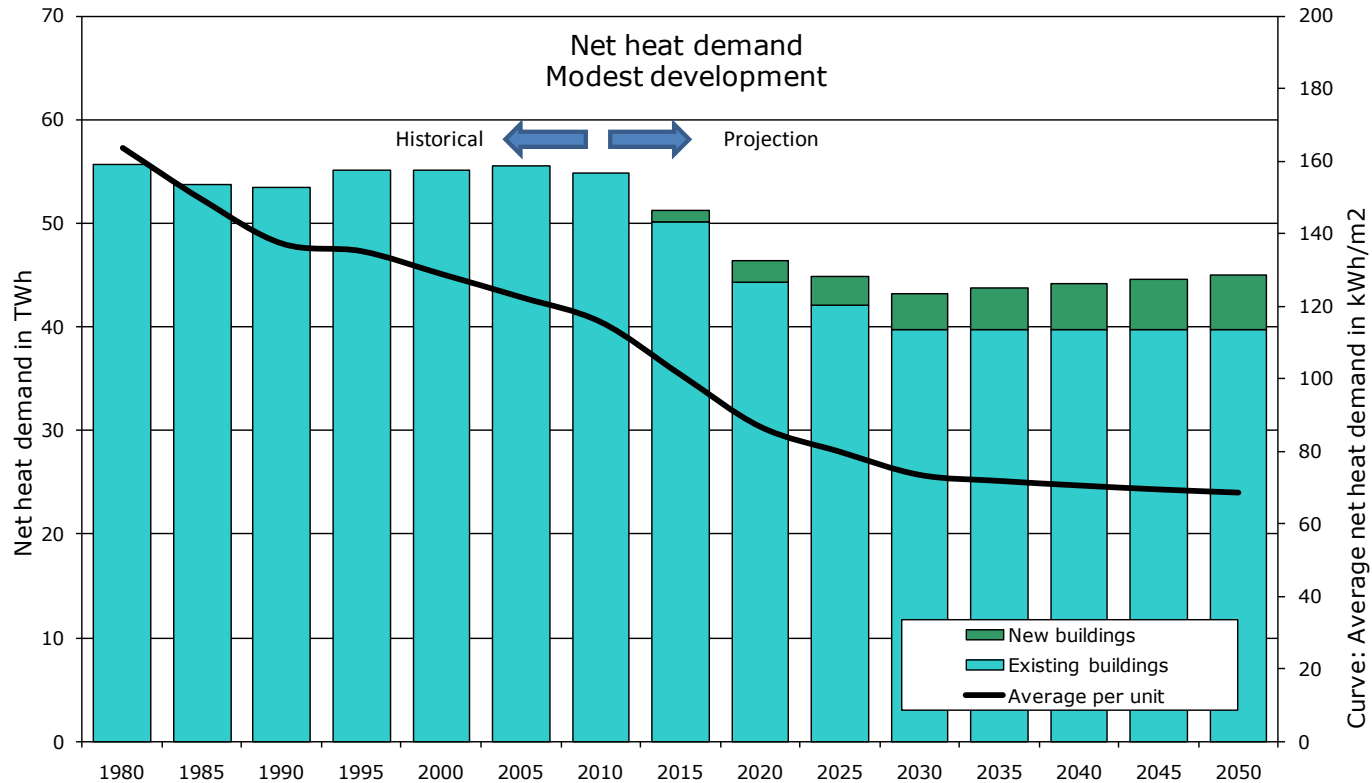
# HEAT PLAN DENMARK 2010: HISTORICAL FROM 1980–PROJECTION TO 2050

- Statistics from 1980–2010
  - Danish Energy Authority
  - More specific information from 430 district heating companies
- Forecast 2010-2050 based on bottom-up analysis for all 420 DH companies grouped in 10 clusters, which reflects the average
- State of the art of today's technologies

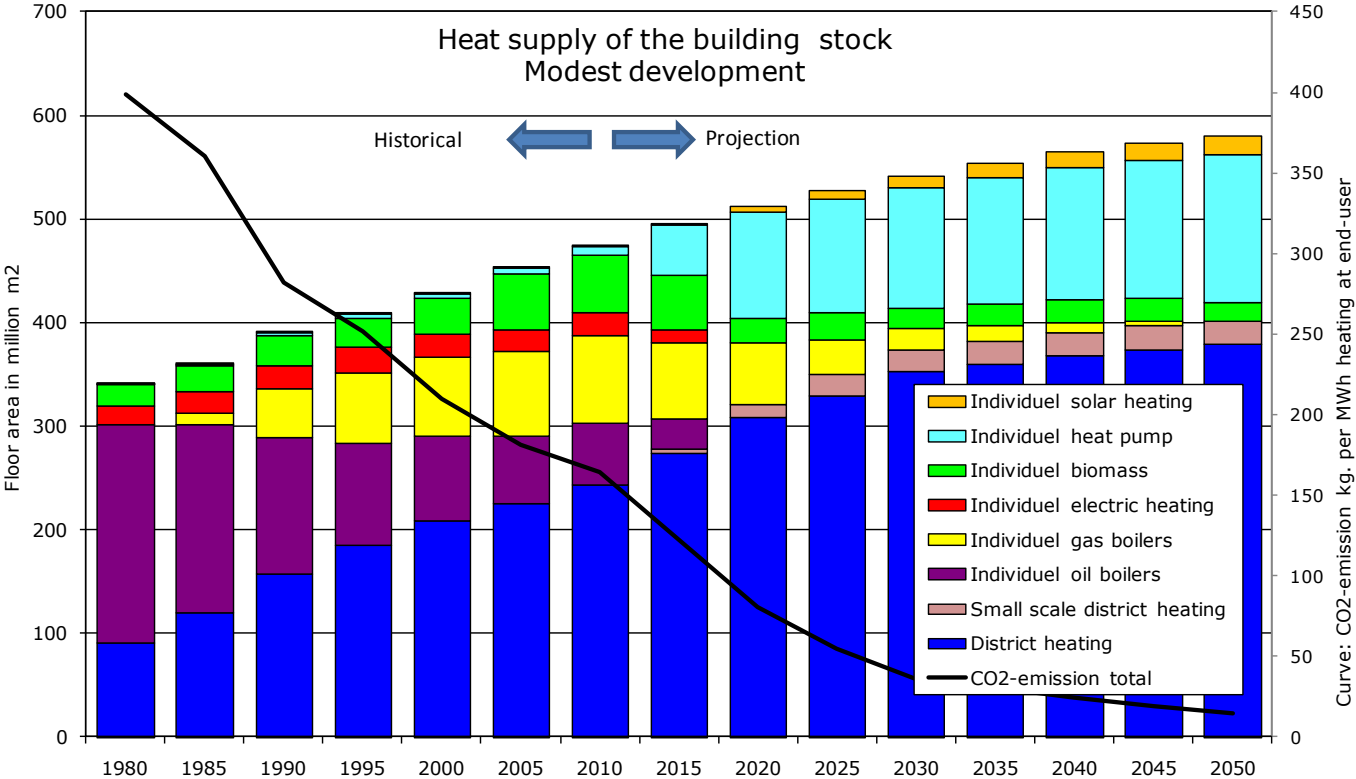
# HEATED FLOOR AREA AND POPULATION GROWTH



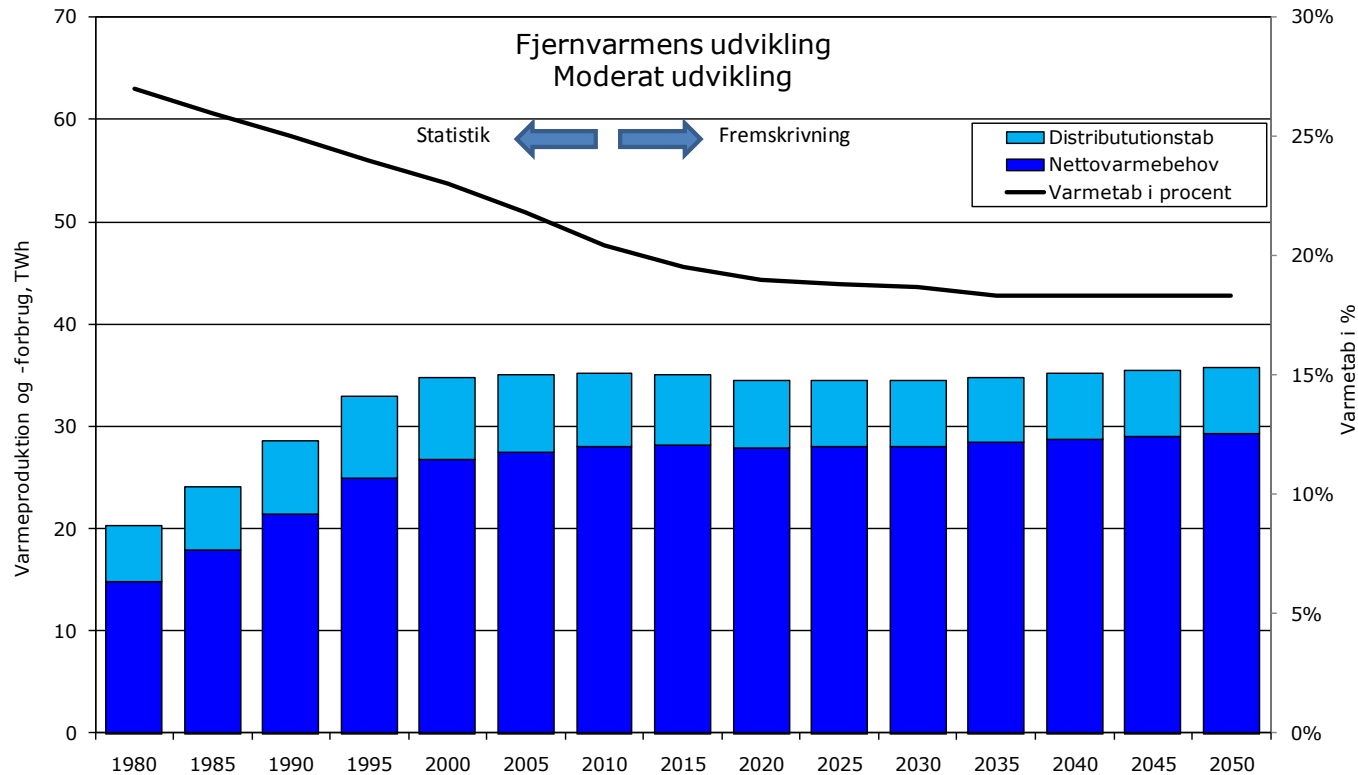
# HEAT DEMAND IN TOTAL AND HEAT DEMAND IN KWH/M<sup>2</sup>



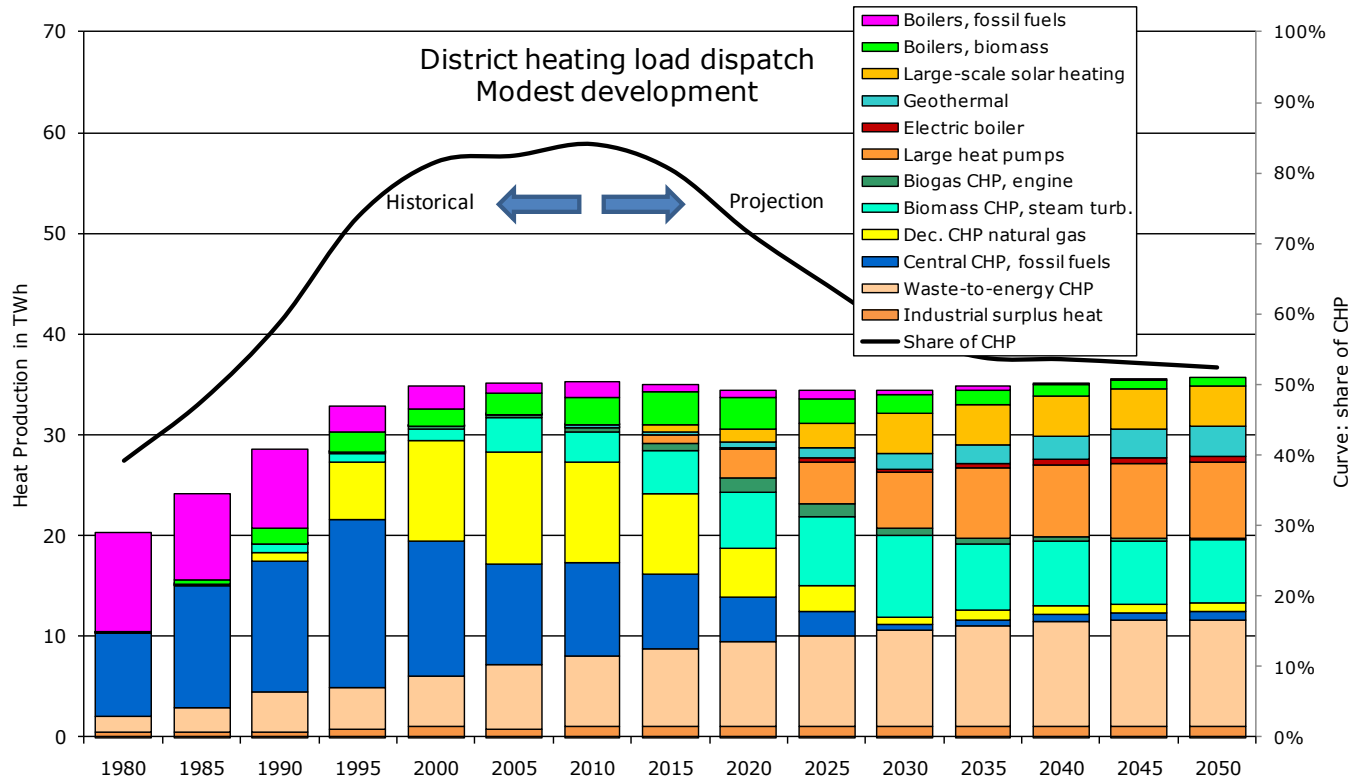
# HEAT DEMAND DIVIDED ON HEAT SOURCES



# DISTRICT HEATING DEMAND AND MARKET SHARE

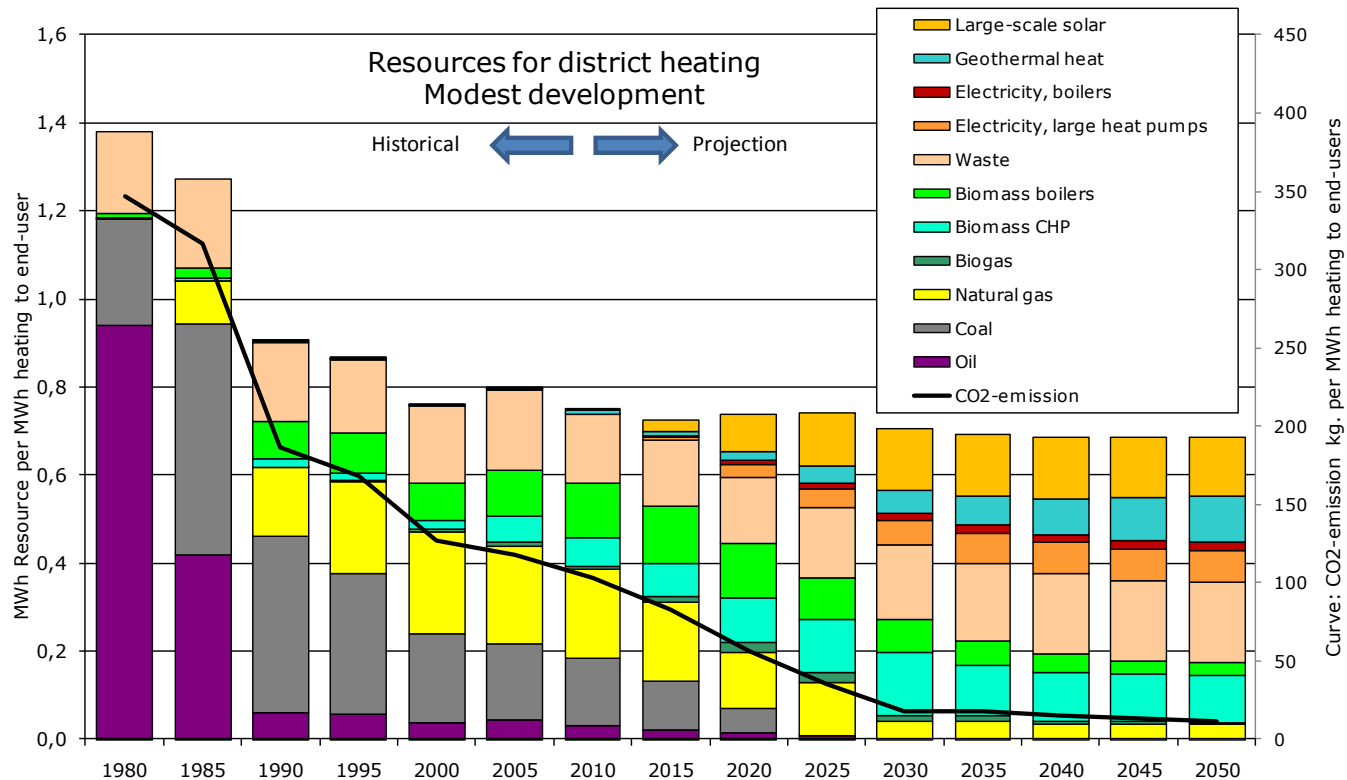


# DISTRICT HEATING HEAT SOURCES AND SHARE OF CHP

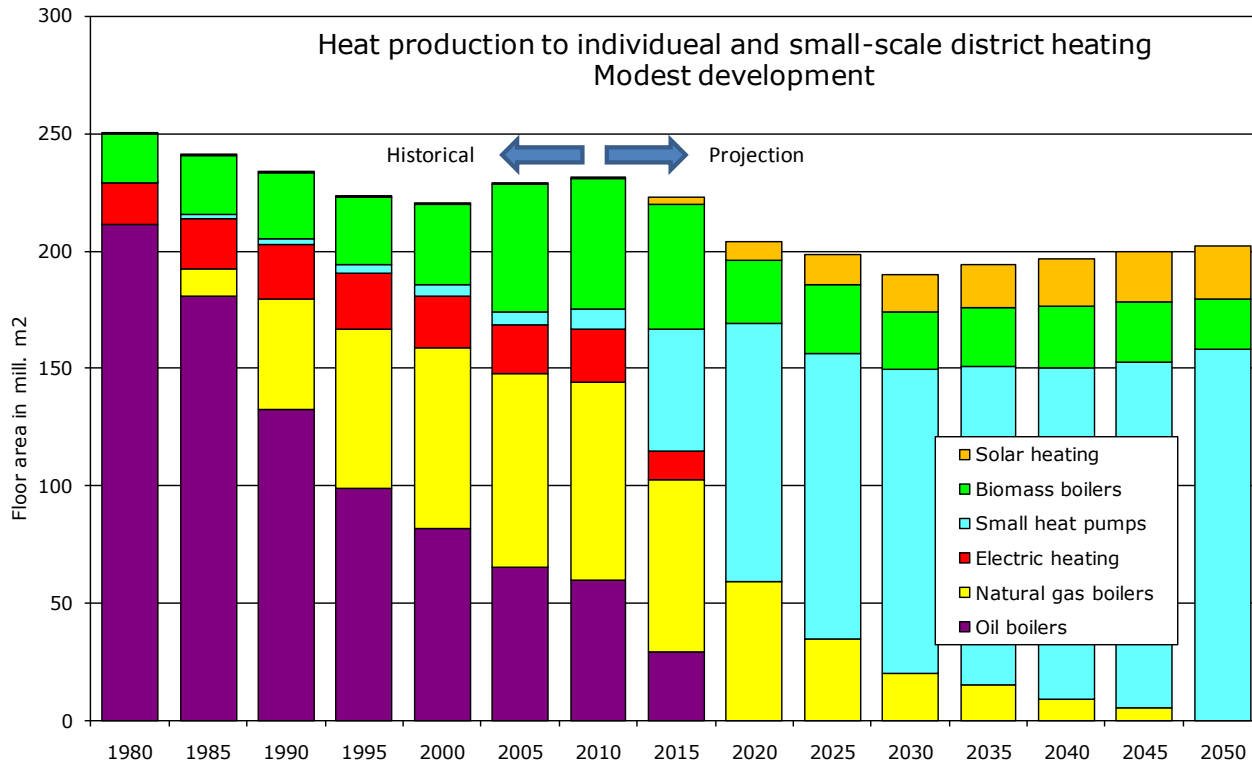




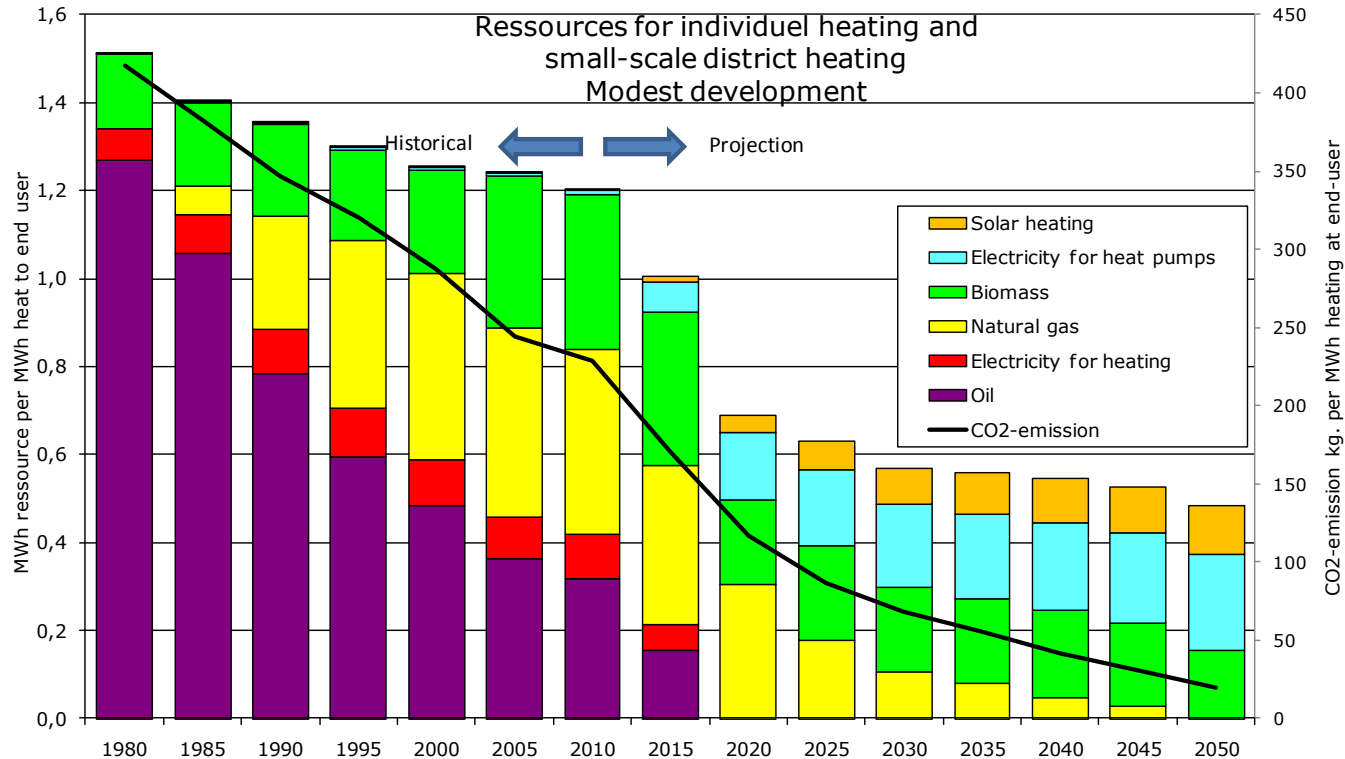
# FUEL CONSUMPTION PER UNIT OF DISTRICT HEATING DELIVERED TO END-USER



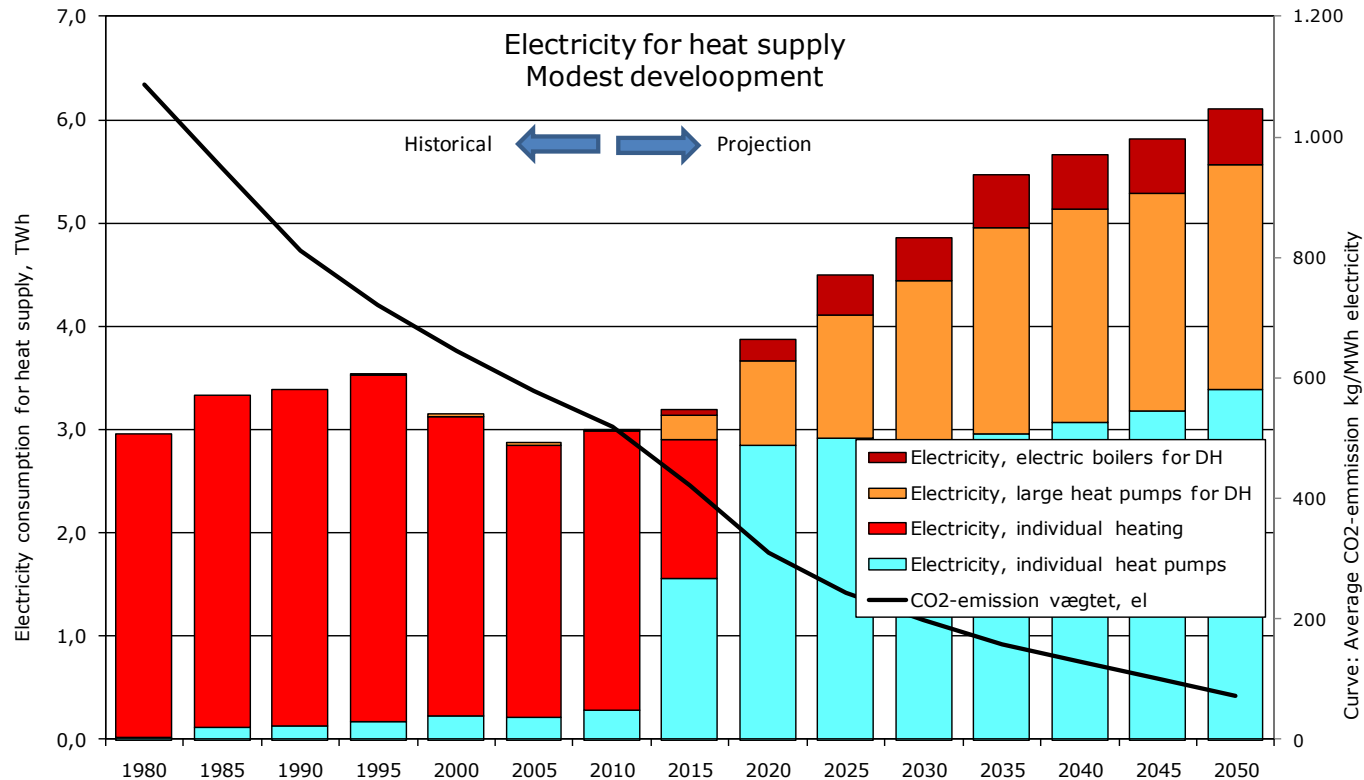
# INDIVIDUAL HEAT SOURCES



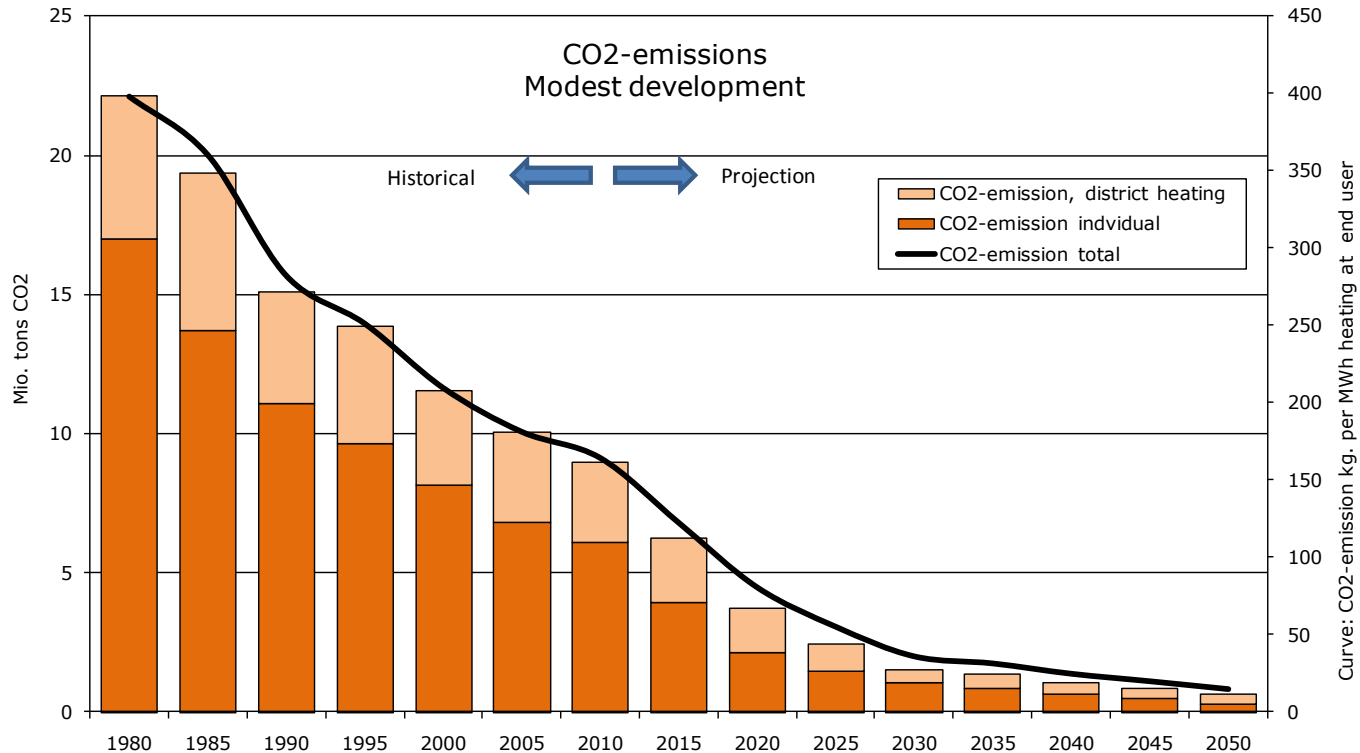
# FUEL CONSUMPTION PER UNIT OF INDIVIDUAL SUPPLY DELIVERED TO END-USERS



# CONSUMPTION OF ELECTRICITY



# CO<sub>2</sub> EMISSION IN MILLION TONNES FOR ALL HEATING AND IN KG PER MWH AT END-USER



# HEAT PLAN DENMARK - STATEMENTS

- It is important to focus on **integrated solutions**, including building envelope, building installations, district heating and power system
- **District heating** is a natural part of the urban infrastructure in modern cities
- District heating is a **precondition** for efficient, flexible and cost-effective use of renewable energy and CHP for urban heating, not least waste-to-energy and wind
- **District cooling** is a natural part of the urban infrastructure in districts with sufficient cooling load
- A stable energy policy since 1976, municipal planning and a tradition for **co-operation in the society** have been important preconditions for CO<sub>2</sub> emission reductions in Denmark

# HEAT PLAN DENMARK

## MESSAGE TO COP 15 IN COPENHAGEN

- Do not worry about signing the Copenhagen Climate Agreement
- It is not a problem to develop a zero carbon heating sector
- You just have to co-operate at all levels in the society
  - a stable and strong national energy policy
  - municipalities take responsibility for the infrastructure
  - well functioning co-operatives in the housing and heating sectors
- Even Danes can do it, have a look your self in Copenhagen
- Have a look at Beijing, who replaced thousands of inefficient and polluting coal fuelled boilers with district heating based on coal fuelled combined heat and power plants, which have reduced the fuel consumption and pollution from the heating significantly

# THANK YOU FOR YOUR ATTENTION!

[ad@ramboll.dk](mailto:ad@ramboll.dk)

[www.ramboll.com/energy](http://www.ramboll.com/energy)

[www.auc.dk](http://www.auc.dk)

[www.danskfjernvarme.dk](http://www.danskfjernvarme.dk)

See our climate solutions at

[www.energymap.dk](http://www.energymap.dk)

