

A wide-angle photograph of an industrial facility, likely a power plant or refinery, situated along a body of water. The facility features several tall, dark smokestacks emitting white plumes of smoke. In the foreground, two large white wind turbines stand on a grassy area. To the left, a small white lighthouse is visible on a small island. The sky is filled with soft, white clouds, and the water in the foreground is calm.

Heat Plan Denmark

Low Carbon Urban Heating

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Heat Plan Denmark

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
 - Rambøll Denmark and
 - Aalborg University
- The first study in Denmark, really to integrate the energy and building sectors – to combine the supply and the demand side
- An eye-opener for the Danish politicians
- Could be a model for other countries

We focus on the overall energy policy objective in the European Union

- The main objective is to reduce the fossil fuel consumption and the CO₂ emission in a cost effective way



- 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 the society of Denmark
 - Reduce the dependency on oil
 - Promote Combined Heat and Power (CHP)
 - Promote renewable energy



- New additional objectives
 - National obligation to reduce CO₂ emissions outside the CO₂ emission trading scheme
 - Reduce CO₂ emissions for the whole society
 - **To be independent of fossil fuels in the long run ! (2050?)**

Important Danish legislation to implement the policy

- Electricity supply act from 1976
 - all new power capacity since 1976 has been CHP
- Heat supply act from 1979
 - municipal heat supply planning, a new natural gas infrastructure and a substantial increase of district heating
 - optimal zoning of district heating and natural gas networks based on overall economic evaluation for the society of Denmark
 - district heating shifts from fossil fuel boilers to CHP and renewable energy
- This legislation ensures unique least cost integration of power, heat, gas and waste sectors in Denmark
- However, the building sector is not yet fully co-ordinated with the other sectors

Heat plan Denmark

focus on the heating sector

- The plan shows how the Danish heating sector has reduced CO₂ emissions from 25 to 10 kg/m² since 1980
- The plan shows that this progressive development can continue
 - to achieve a further **50%** reduction before 2020 and
 - to achieve an **almost CO₂ 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
 - more district heating (DH) - from 46% up to 63-70% of the market
 - energy efficient use of renewable energy in district heating
 - individual heat pumps, solar heating and wood pellets

How to produce the heat?

CHP and surplus wind energy via heat pumps combined with large heat accumulators

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%



How to produce the heat? Waste to energy CHP

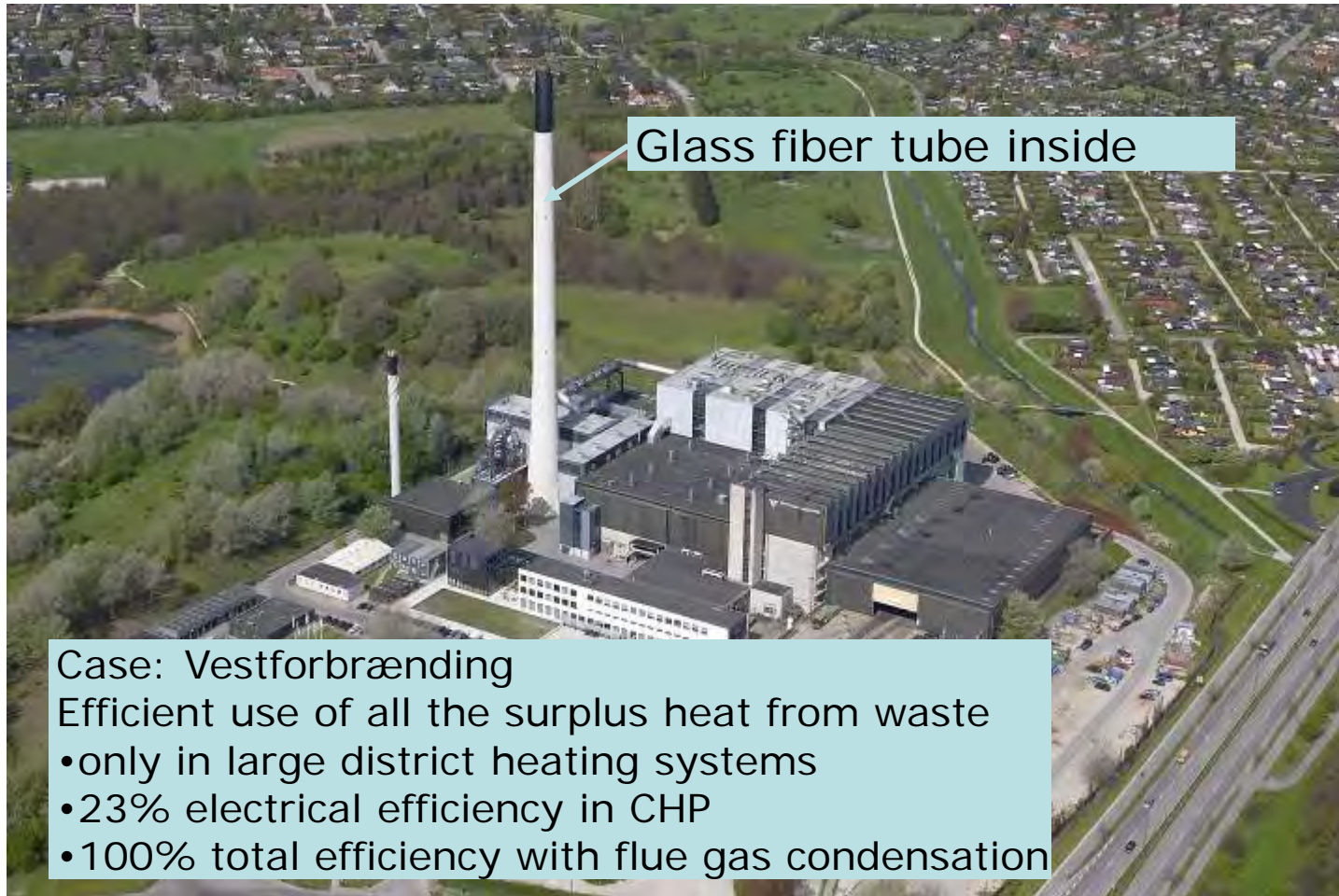


Case: Amagerforbrænding

- the first 100% utilization of waste
- tunnel to Zealand

How to produce the heat?

Waste to energy with flue gas condensation



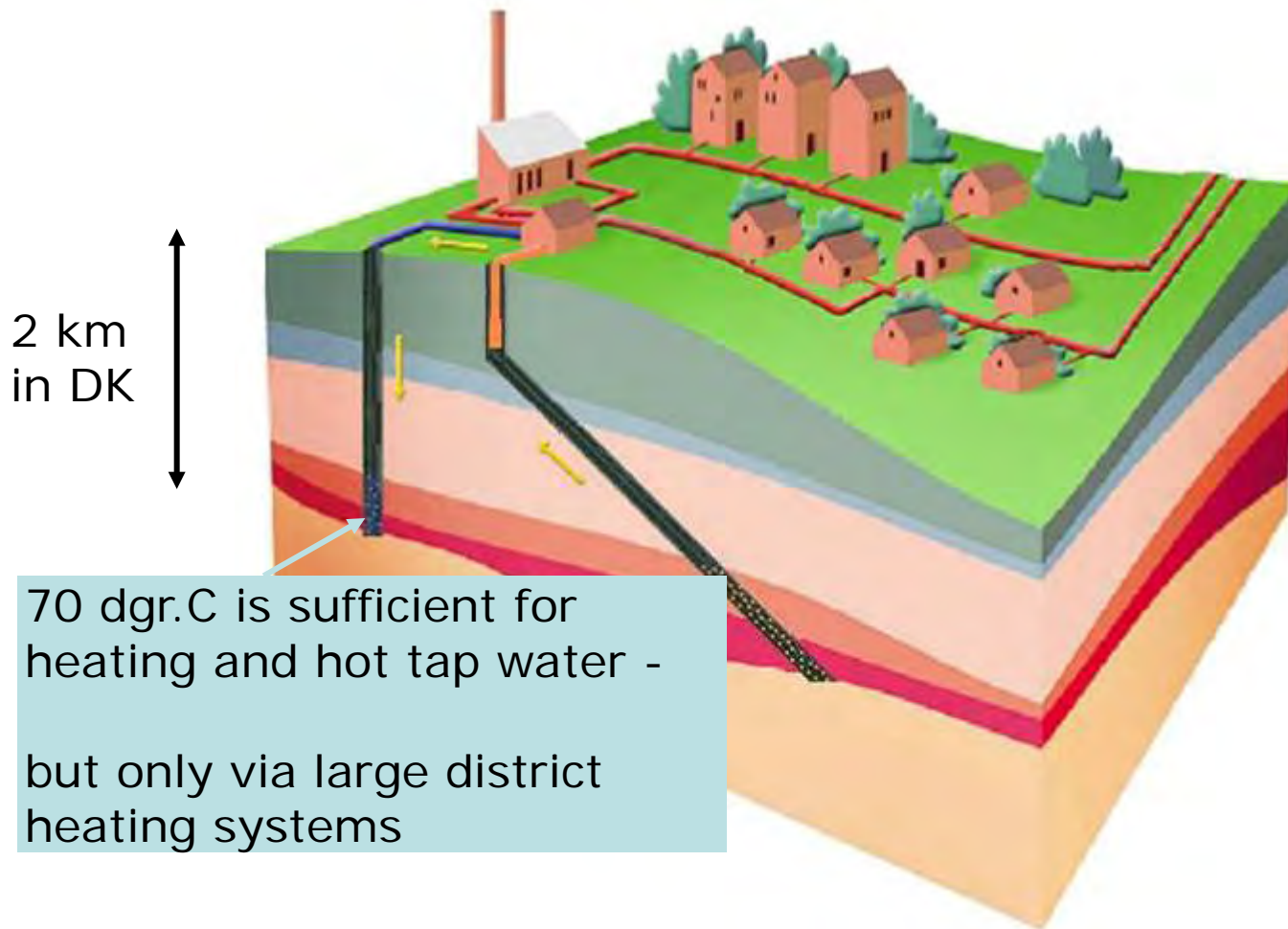
Case: Vestforbrænding
Efficient use of all the surplus heat from waste

- only in large district heating systems
- 23% electrical efficiency in CHP
- 100% total efficiency with flue gas condensation

How to produce the heat? Biogas CHP



How to produce the heat? Geothermal energy boosted by biomass

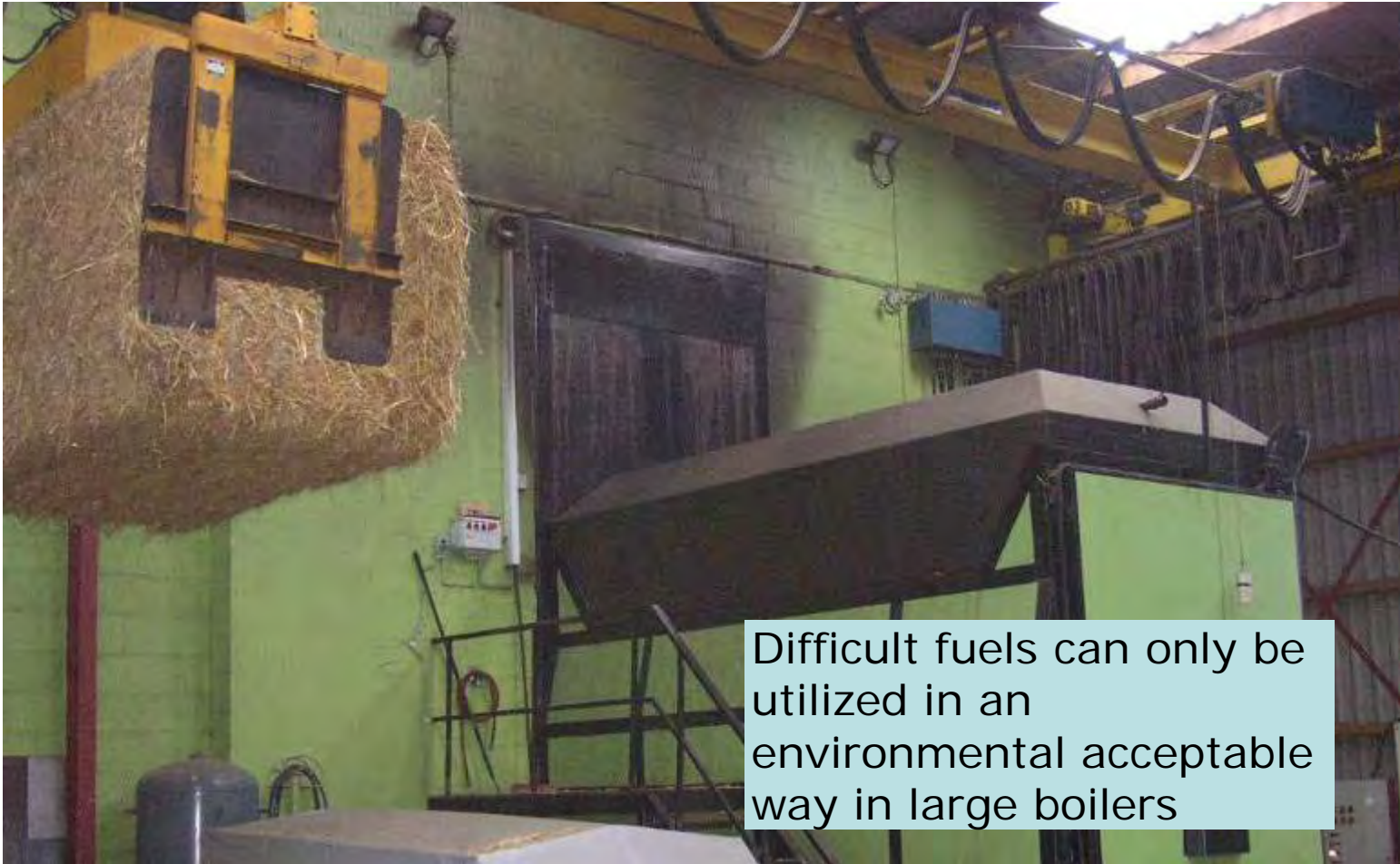


How to produce the heat? Large scale solar thermal plants



6 times more cost effective
than
individual solar heating

How to produce the heat? Straw



How to produce the heat?

Surplus wood chip with flue gas condensation

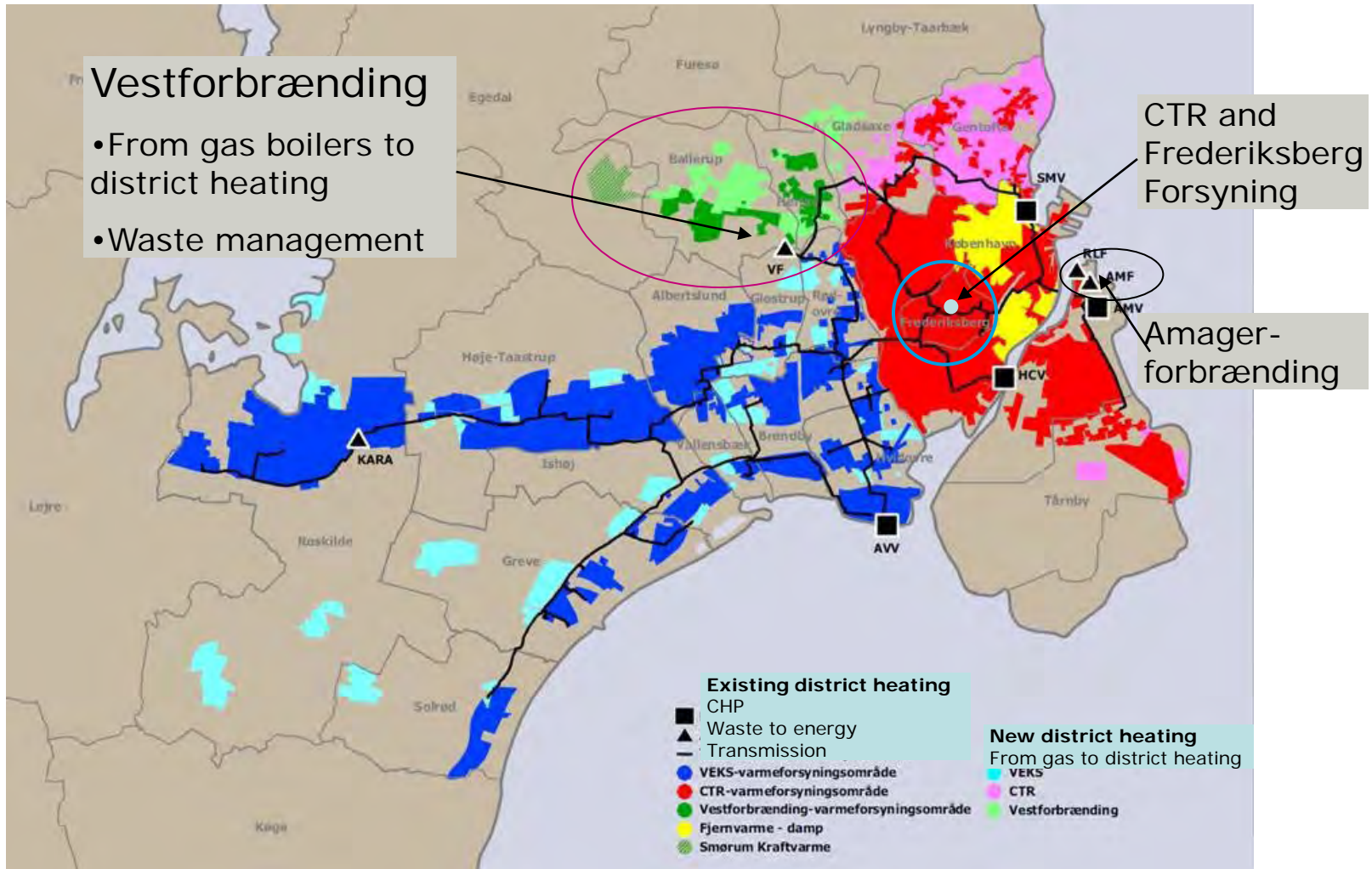


1000 times more environmental friendly than wood stoves – and twice as efficient



Integrated district heating systems

Case: Greater Copenhagen, 2009



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 near by water
- Low temperature floor heating down to 25 dgr. C
- High temperature free cooling through the same floor tupe system

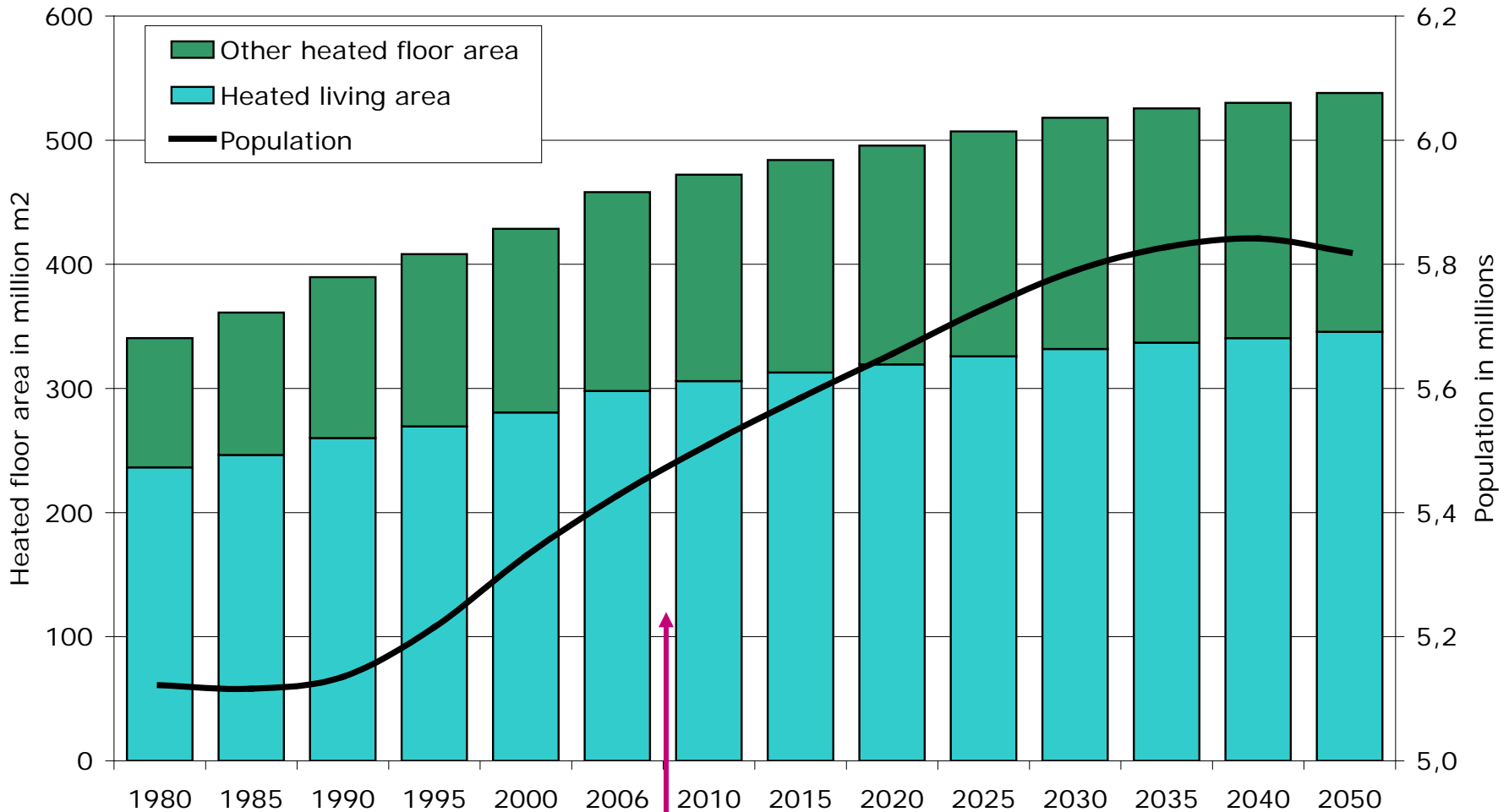


Heat Plan Denmark

statistics from 1980–forecast to 2050

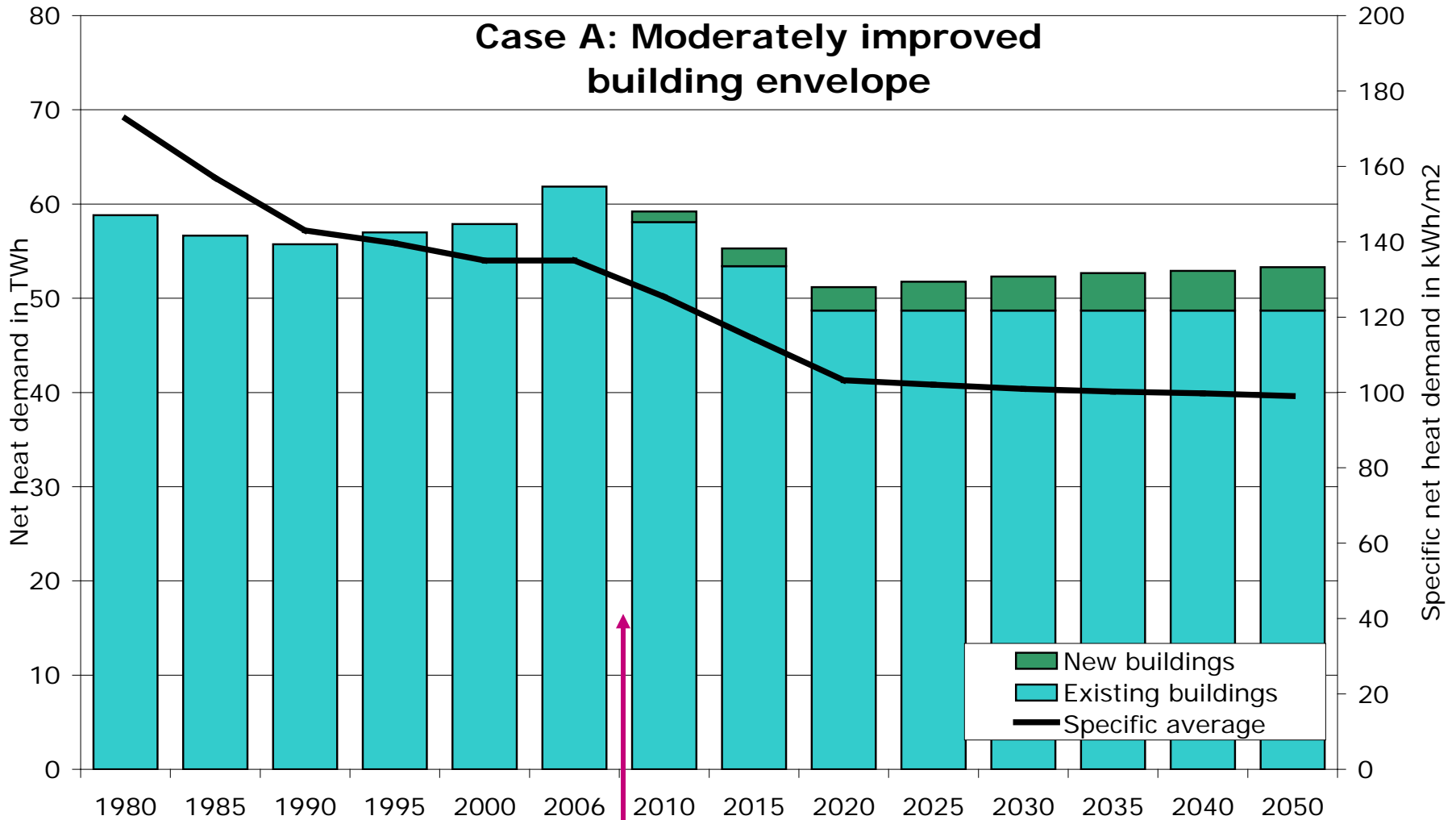
- Statistics from 1980–2006
 - Danish Energy Authority
 - More specific information from 430 district heating companies
- Forecast 2006-2050 based on bottom-up analysis for all 420 DH companies grouped in 10 clusters, which reflects the average
 - DH from 46% to 63% in 2020
 - DH up to 70% before 2050
 - 25% heat demand reduction
 - return temperature down to 35 °C in 2030
- State of the art of to-days technologies

Heated floor area and population grows

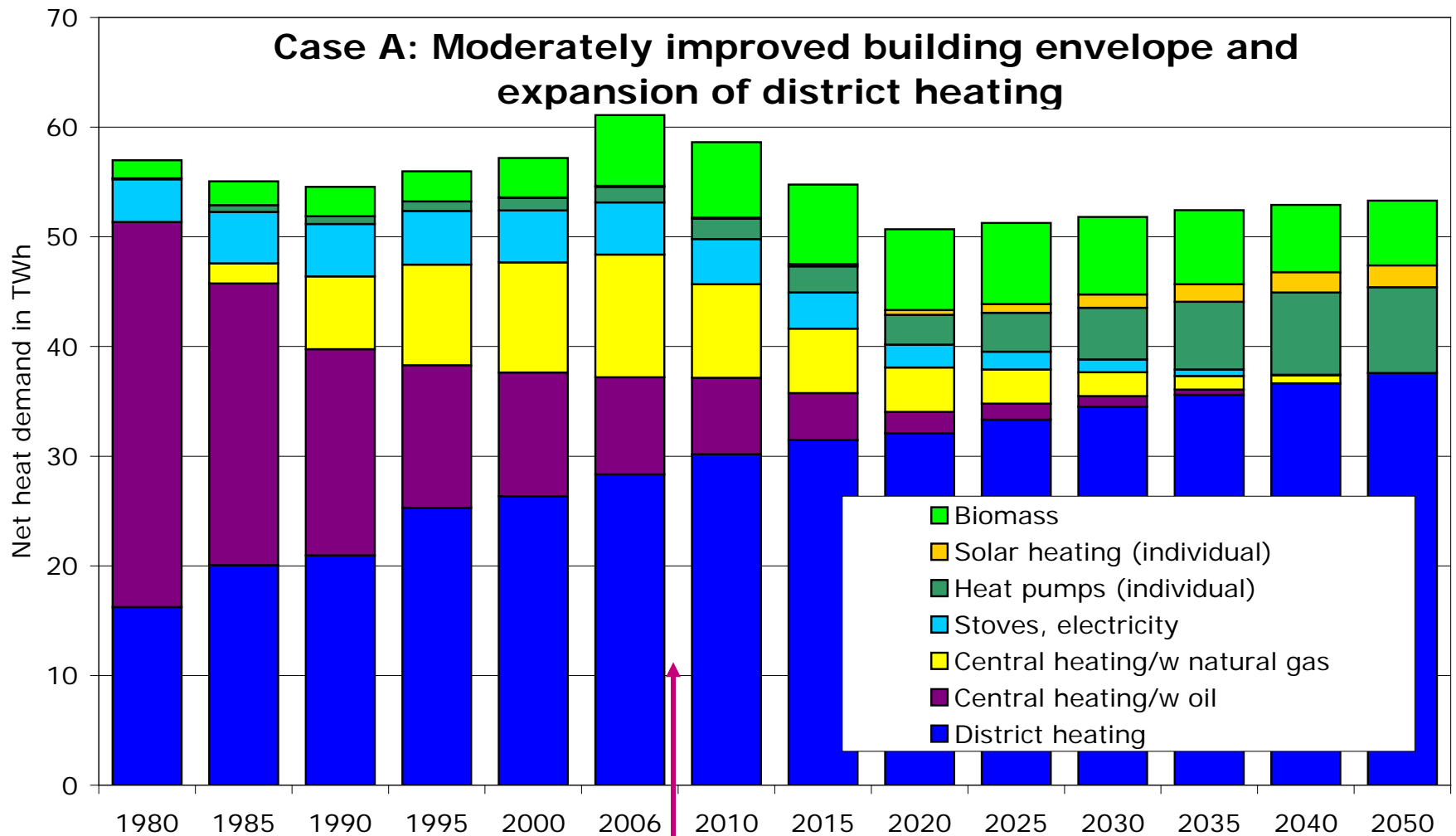


Heat demand in total and heat demand in kWh/m²

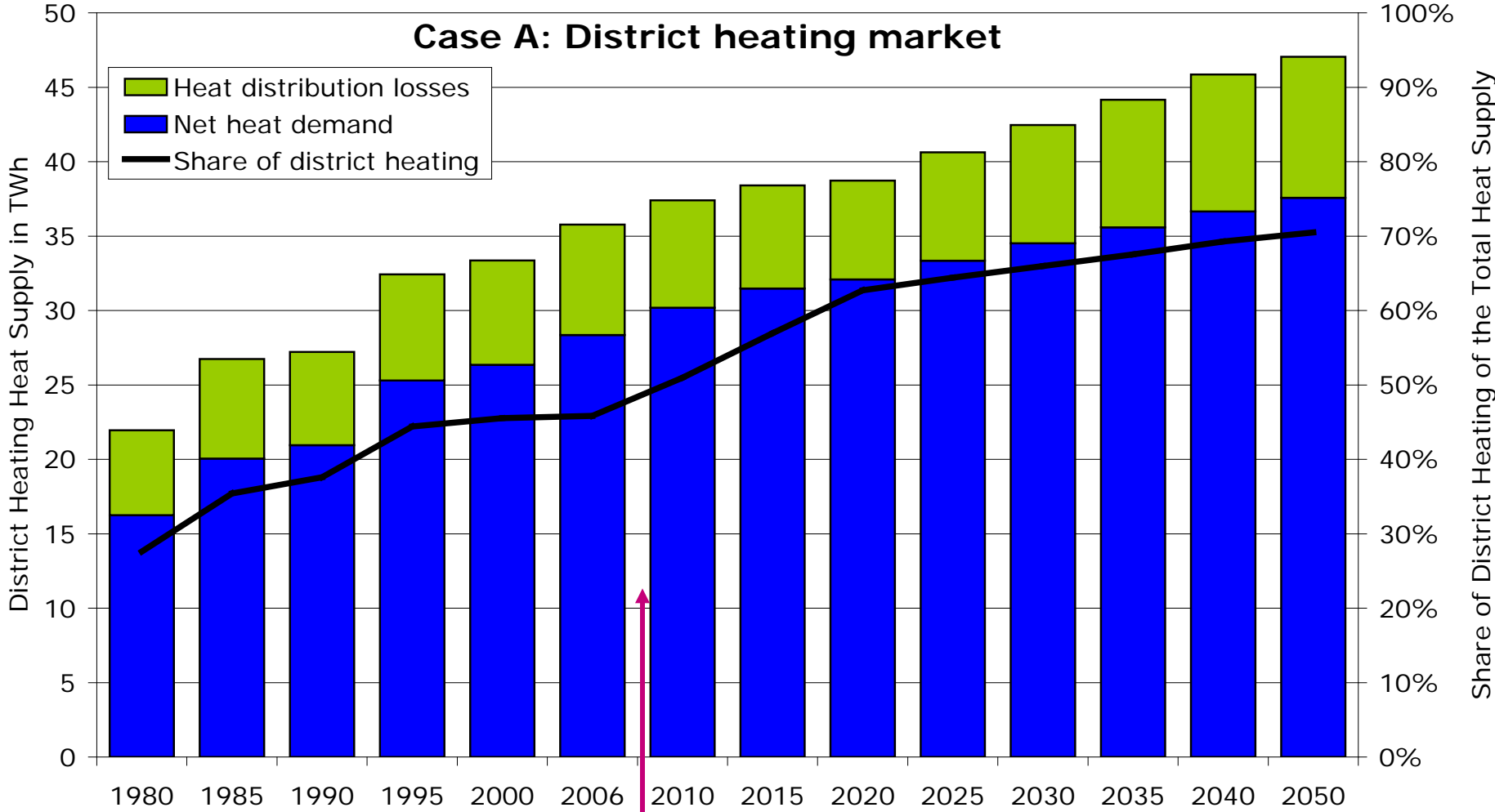
Case A: Moderately improved building envelope



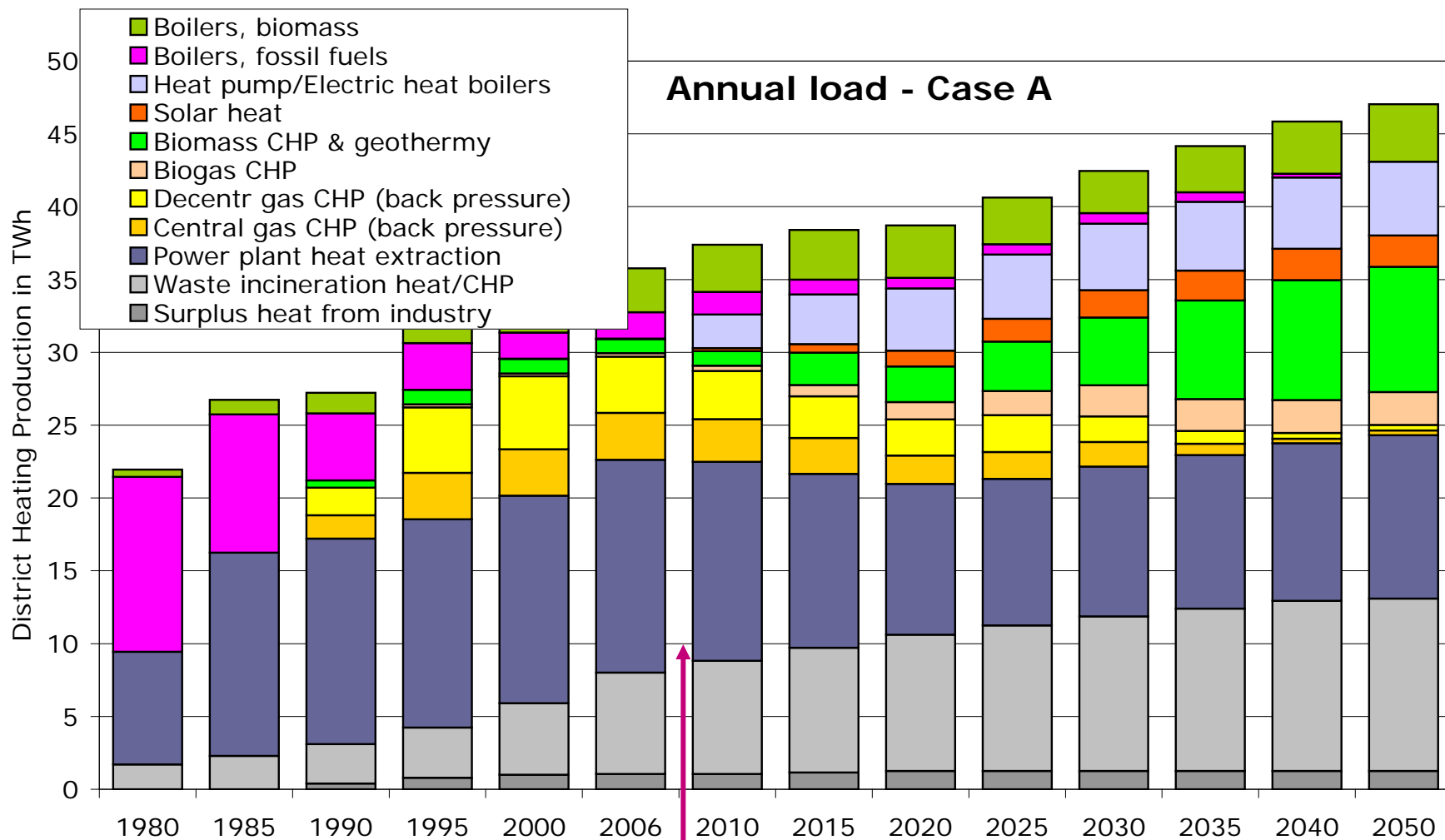
Heat demand divided on heat sources



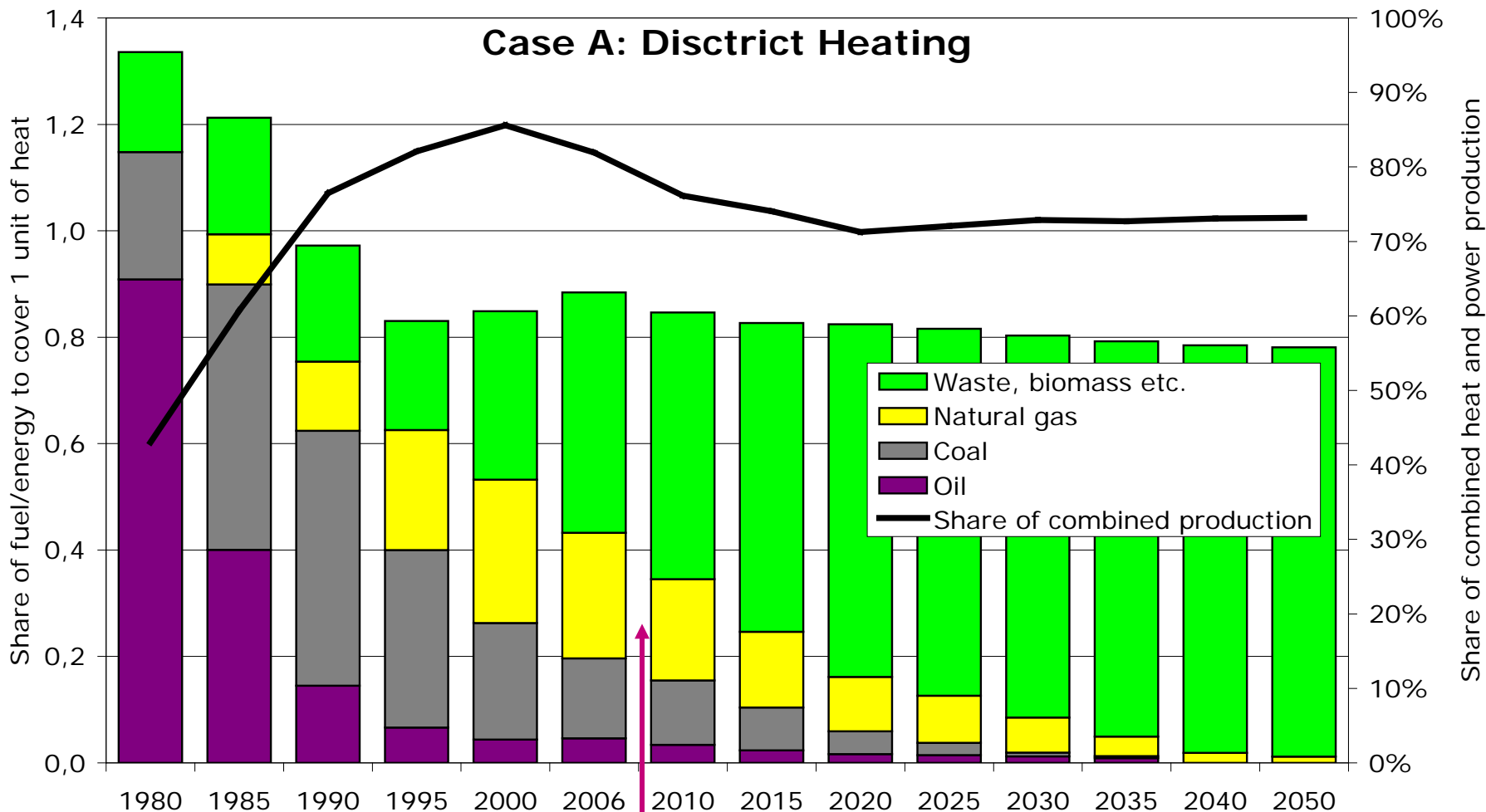
District heating demand and market share



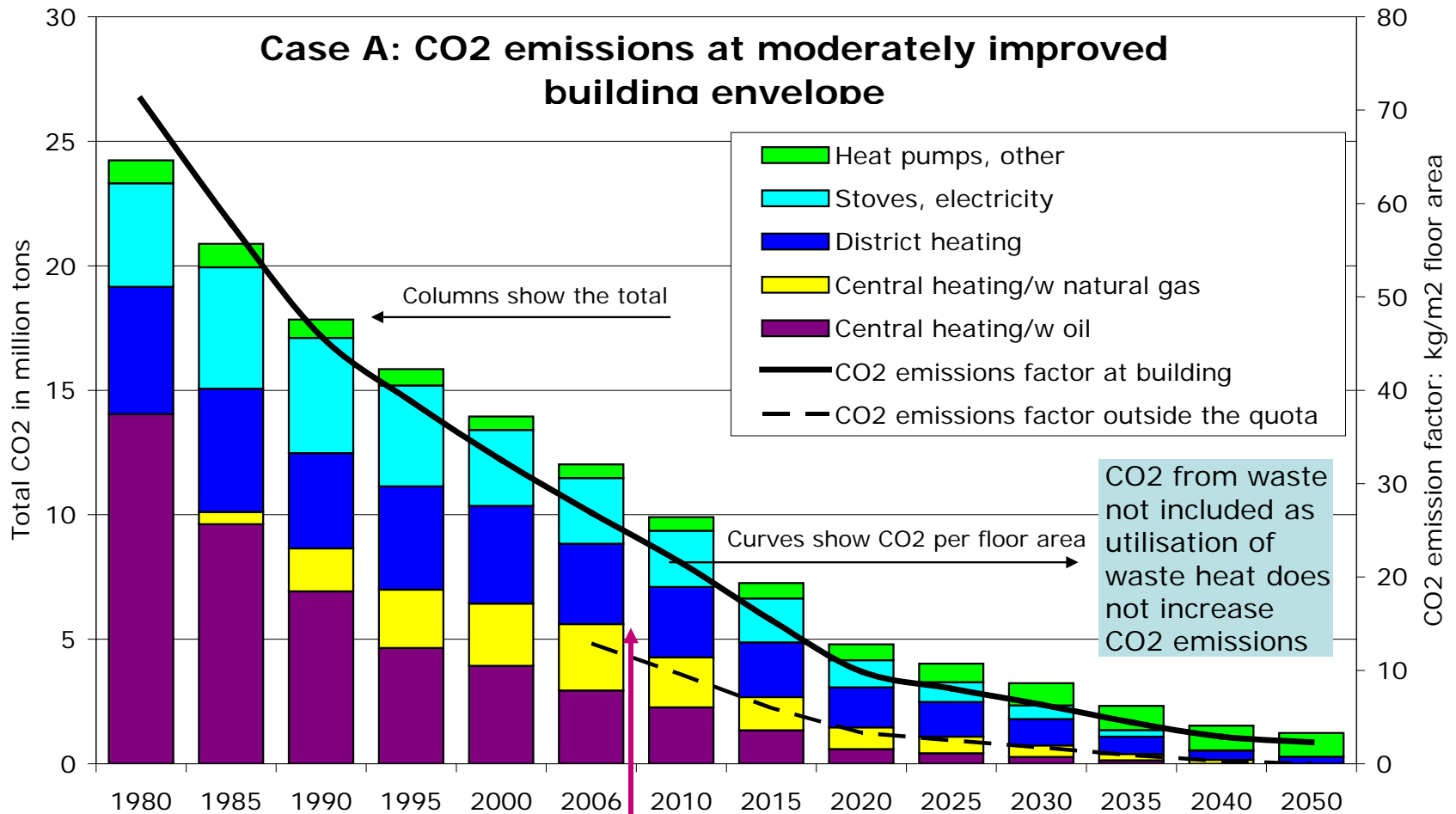
District heating heat sources



Fuel consumption per unit of district heating delivered to end-user and share of CHP



CO₂ emission in million tonnes for all heating and in kg/m² floor area



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 CO₂ 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

Thank you for your attention!

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