Energy Use and Efficiency in Denmark

Washington Industrial Symbiosis Tour, September 2025

Fabian Bühler Special Advisor, fbnbh@ens.dk

7. september 2025

Danish Energy Agency

Danish Ministry of Climate, Energy and Utilities

Danish Geodata Agency

Danish Energy Agency

Agency for Data Supply and Infrastructure

Danish Meteorological Institute

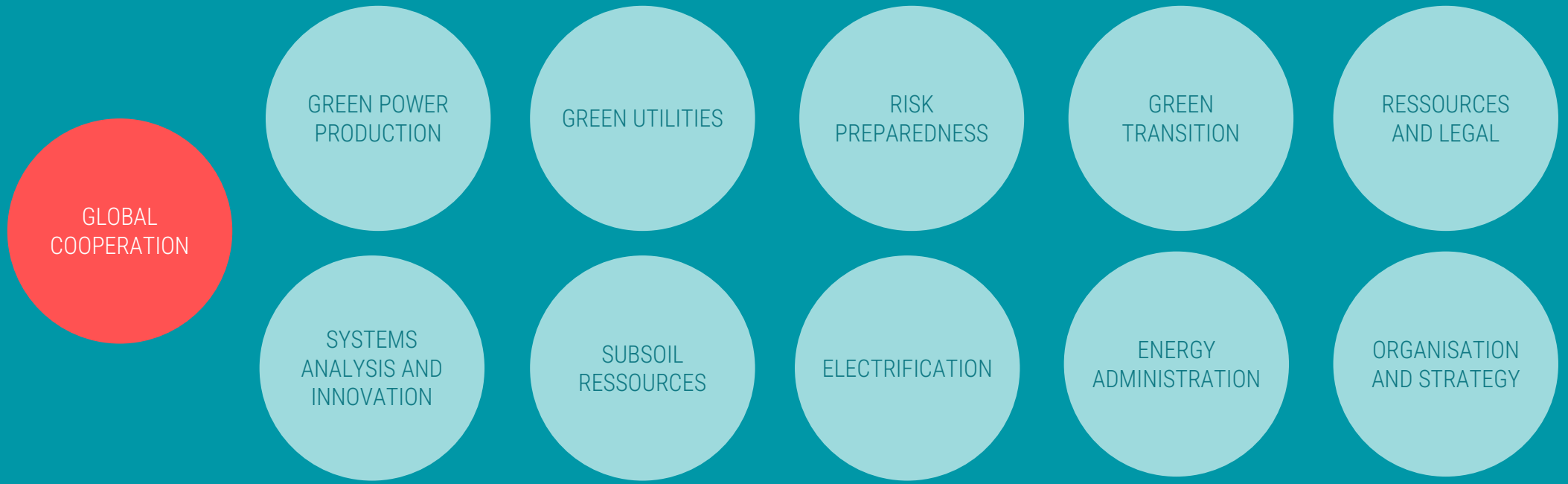
GEUS

Danish Utility Regulator

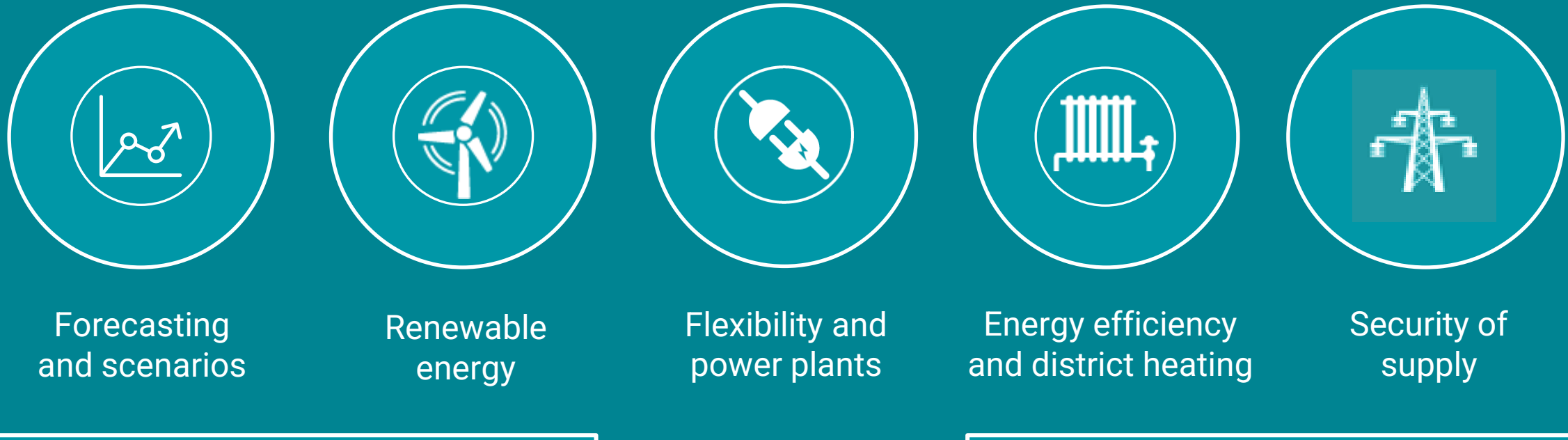
ENERGINET

Klimarådet.

The Danish Energy Agency (DEA)

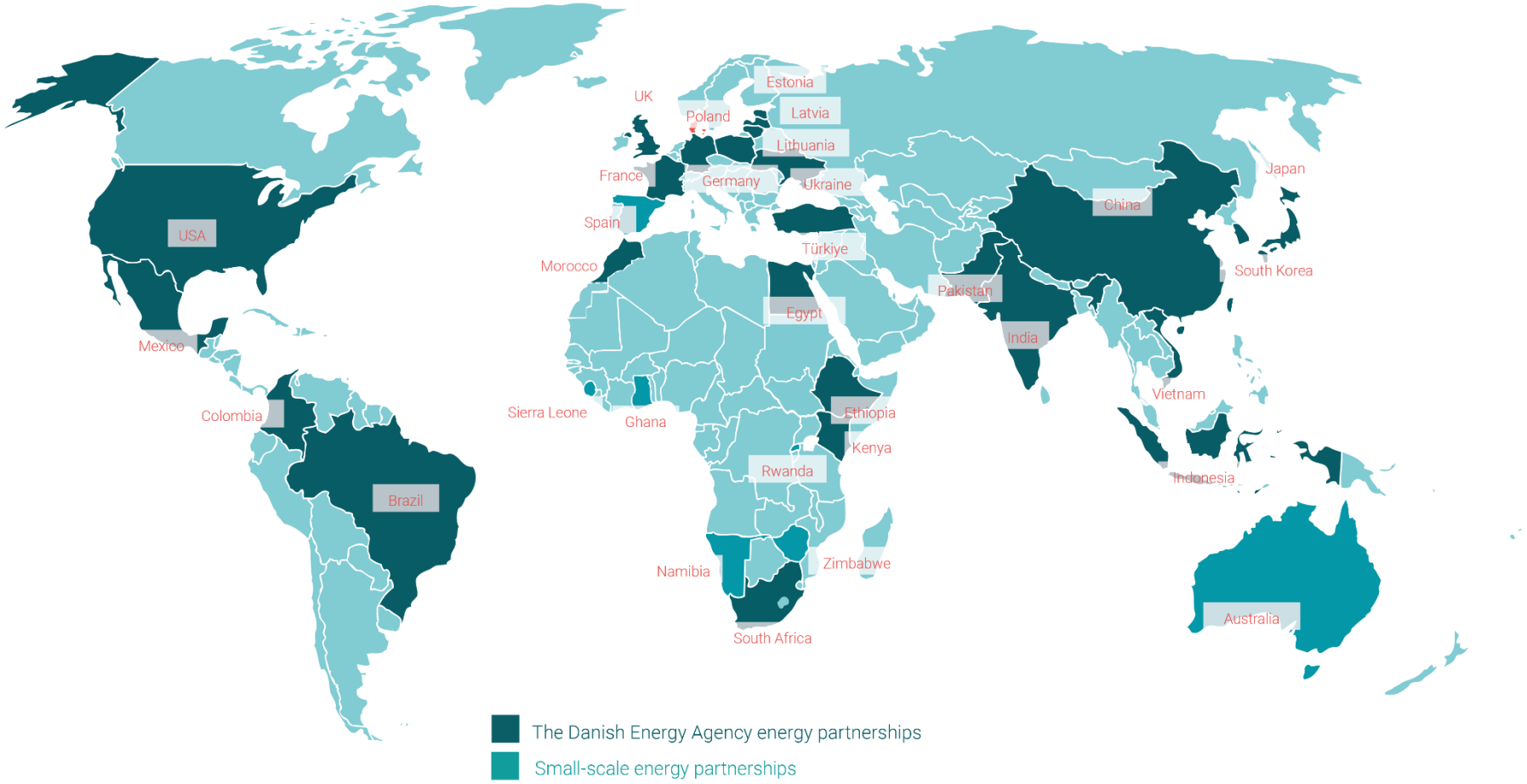


OUR CORE COMPETENCES



Mission: **70 pct. CO_2-reduction** in 2030 and **climate neutrality in 2045**, while maintaining **low energy prices** and a **high security of supply**.

Cooperation with 24 partner countries



In Denmark...

... we represent **0,07 %** of the world's population

... we emit **0,1 %** of the global CO_2 emissions

Our partners...

... represent **~61 %** of the world's population

... emit **70 %** of the global CO_2 emissions

Agenda

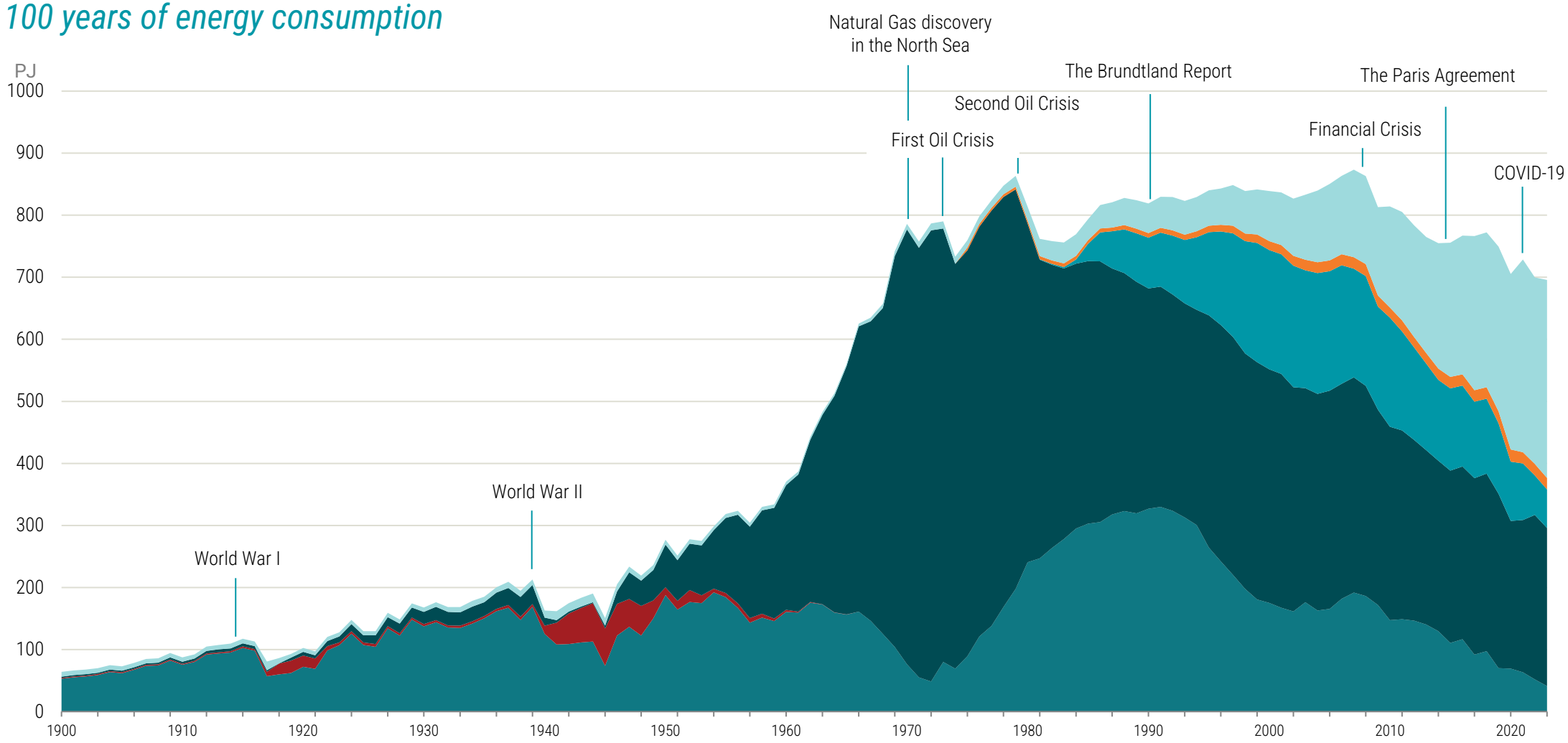
- Energy use and Energy Efficiency Developments in Denmark
- Drivers for (green) transition in the energy sector
- Objectives and Challenges for Denmark
- Main energy efficiency tools and initatives
- District Energy and Heat Planning

Energy Use and Energy Efficiency in Denmark

Danish Energy Agency

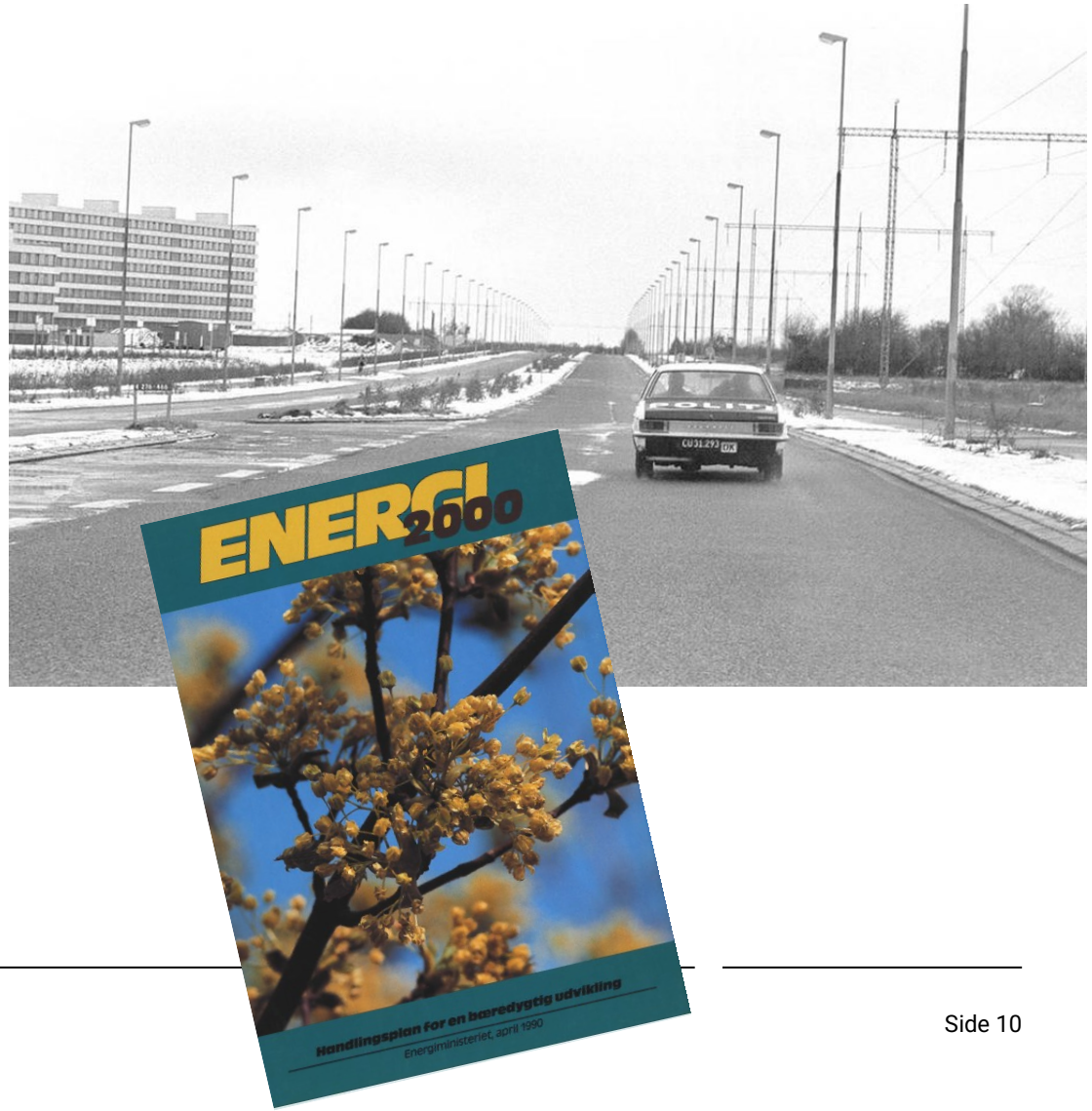
Gross energy demand of Denmark

100 years of energy consumption



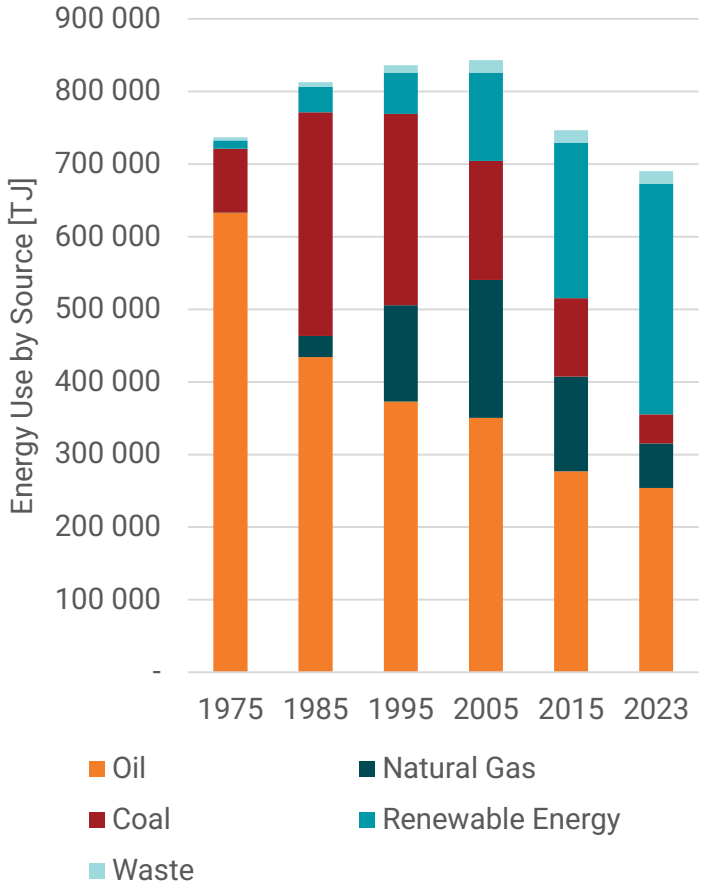
The basis for Energy Efficiency in Denmark

- The first oil crisis in 1973 was the start
  - The main focus was reduction of the dependency on oil
- The second oil crisis made oil very expensive
  - Focus on energy policy was to reduce costs
- Energy 2000 set the first Danish target for reduction of CO_2 in 1990
  - 20 % reduction in 2005 compared to 1990
  - Introduction of the CO_2 tax

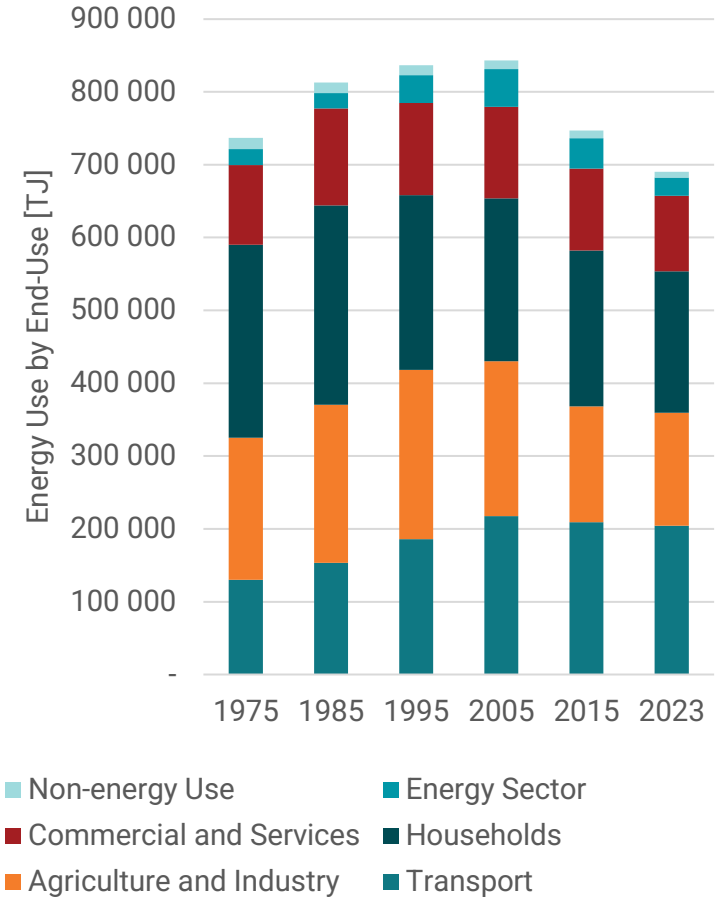


Shift in Energy Use in Denmark

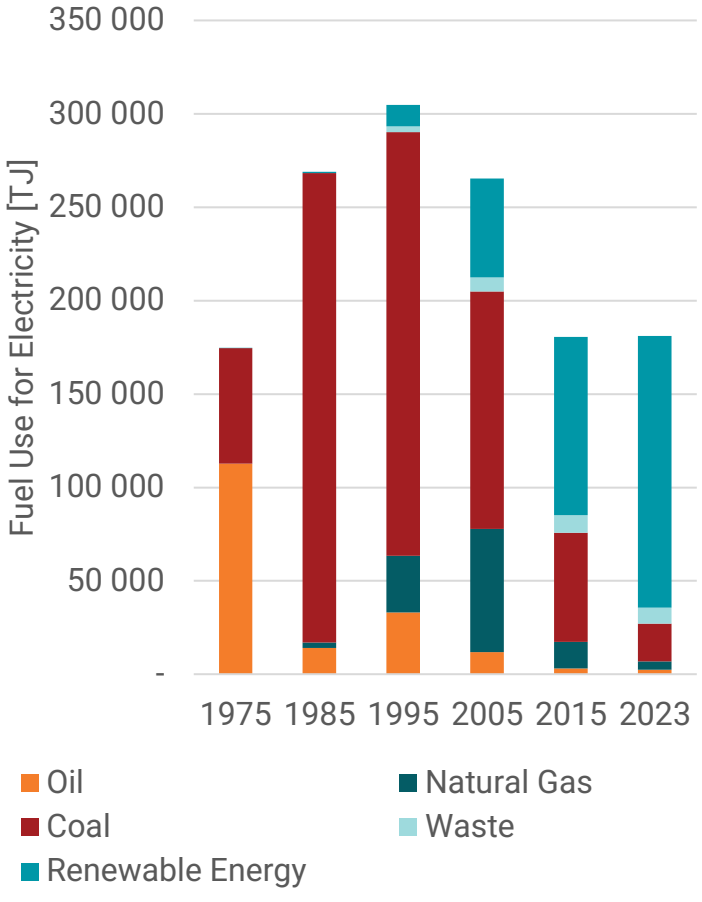
Energy Sources



Energy Use

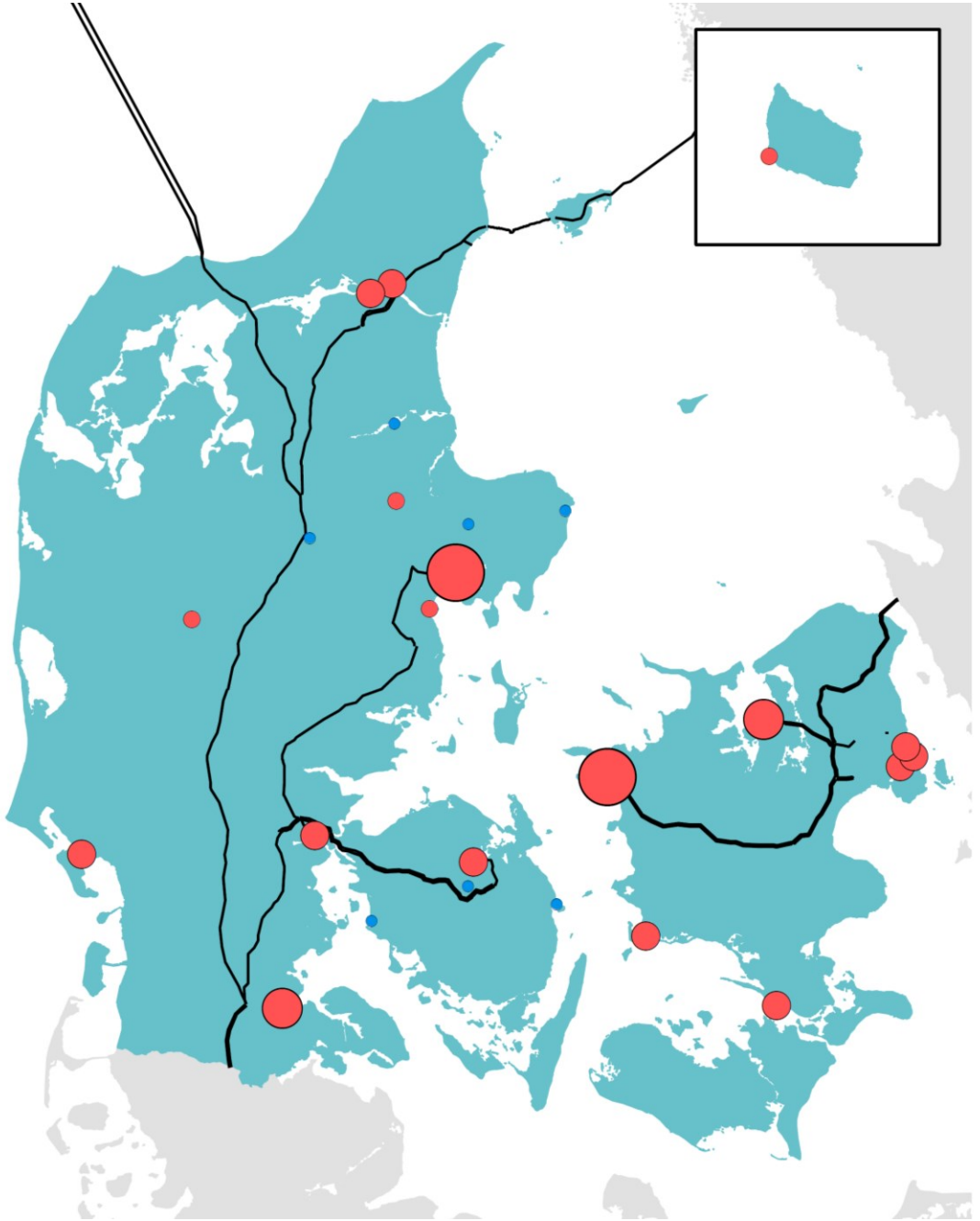


Electricity Sources



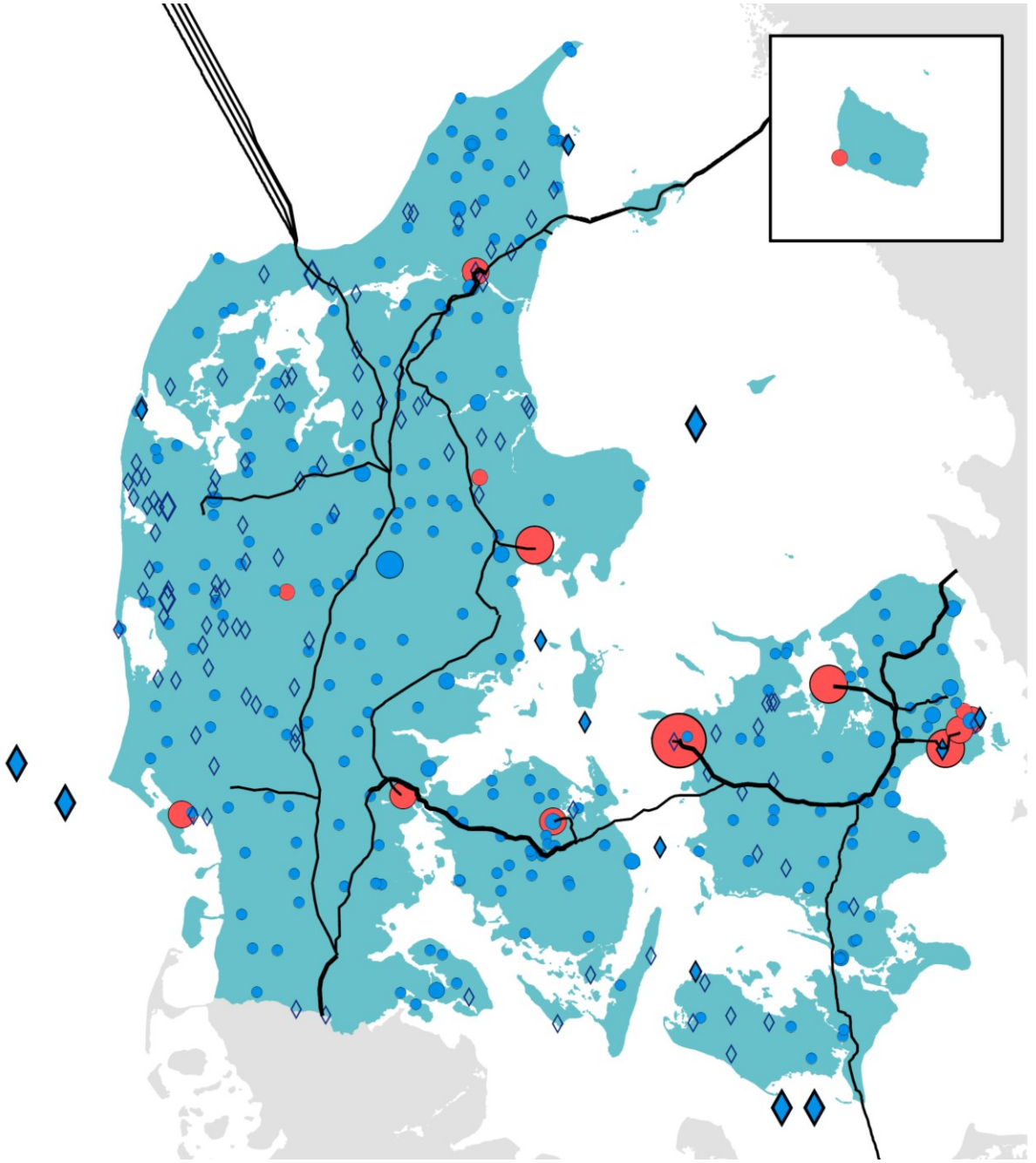
Danish Energy Agency

A least cost energy transition with high security of supply, a high share of renewable energy and an efficient energy consumption.

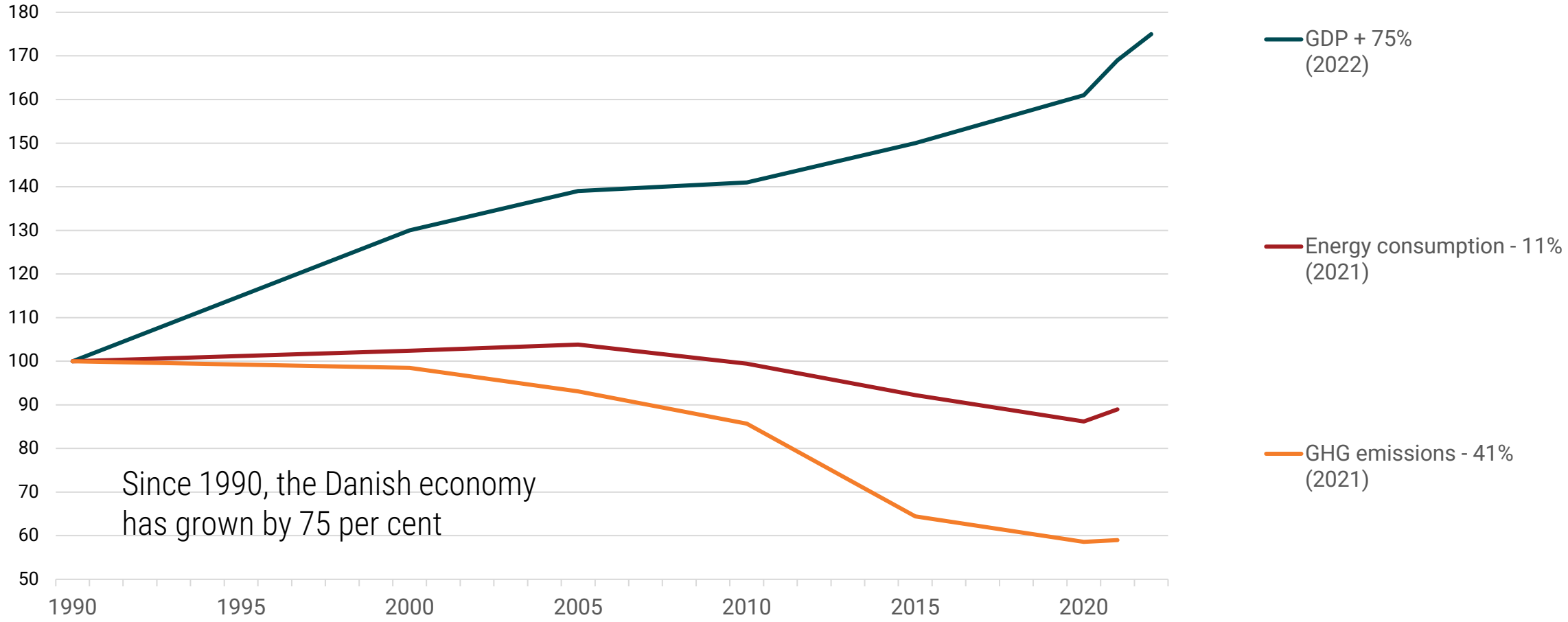


Danish Energy Agency

A least cost energy transition with high security of supply, a high share of renewable energy and an efficient energy consumption.



Since 1990, **the Danish economy** has grown by **75 per cent**

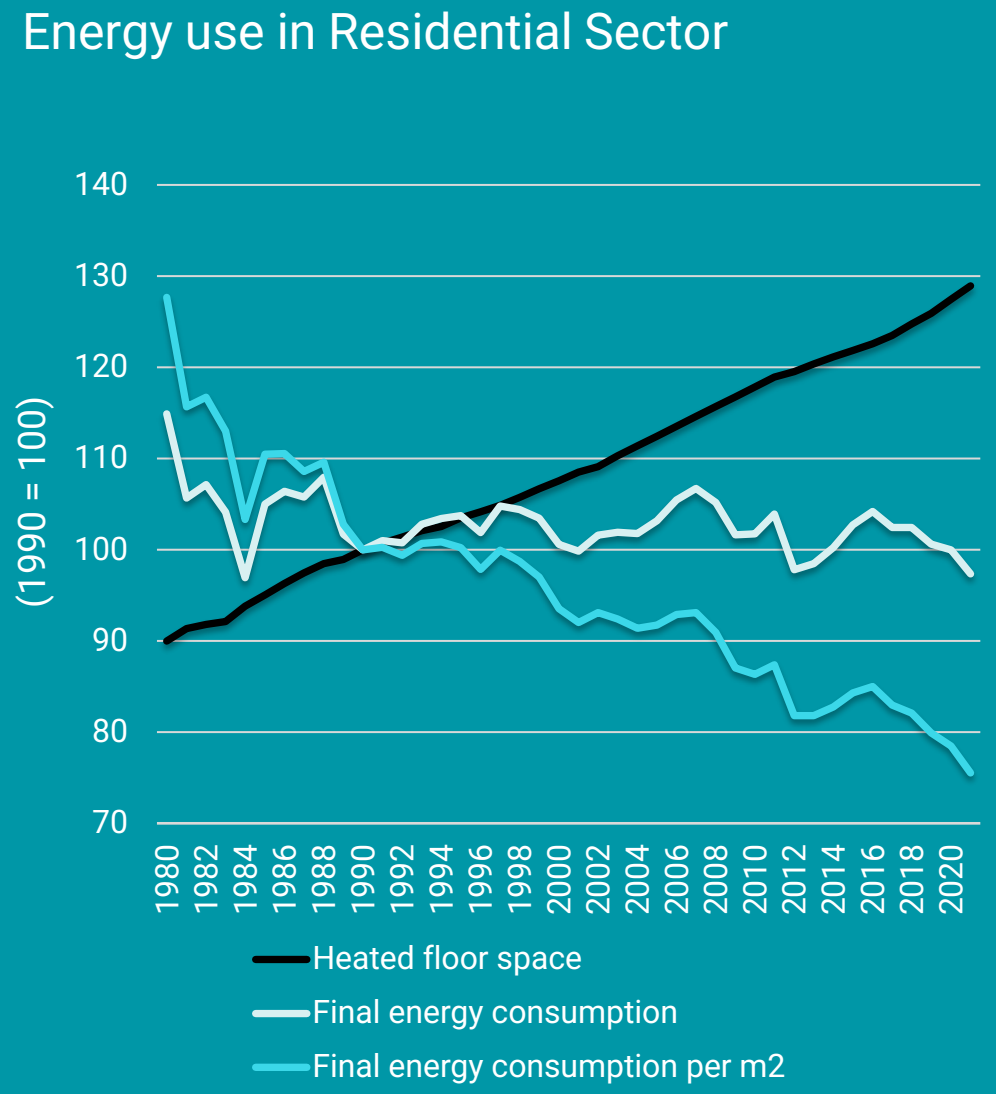


Combined Heat and Power (CHP)

- In thermal power plants, fuel efficiency is often < 40 %
- CHP can increase fuel efficiency to > 90 %
- More than 60 % of Danish homes have district heating from CHP-plants, most of them highly efficient and biomass-fired
- CHP and district heating were the first big steps towards a green economy

Growth in Denmark

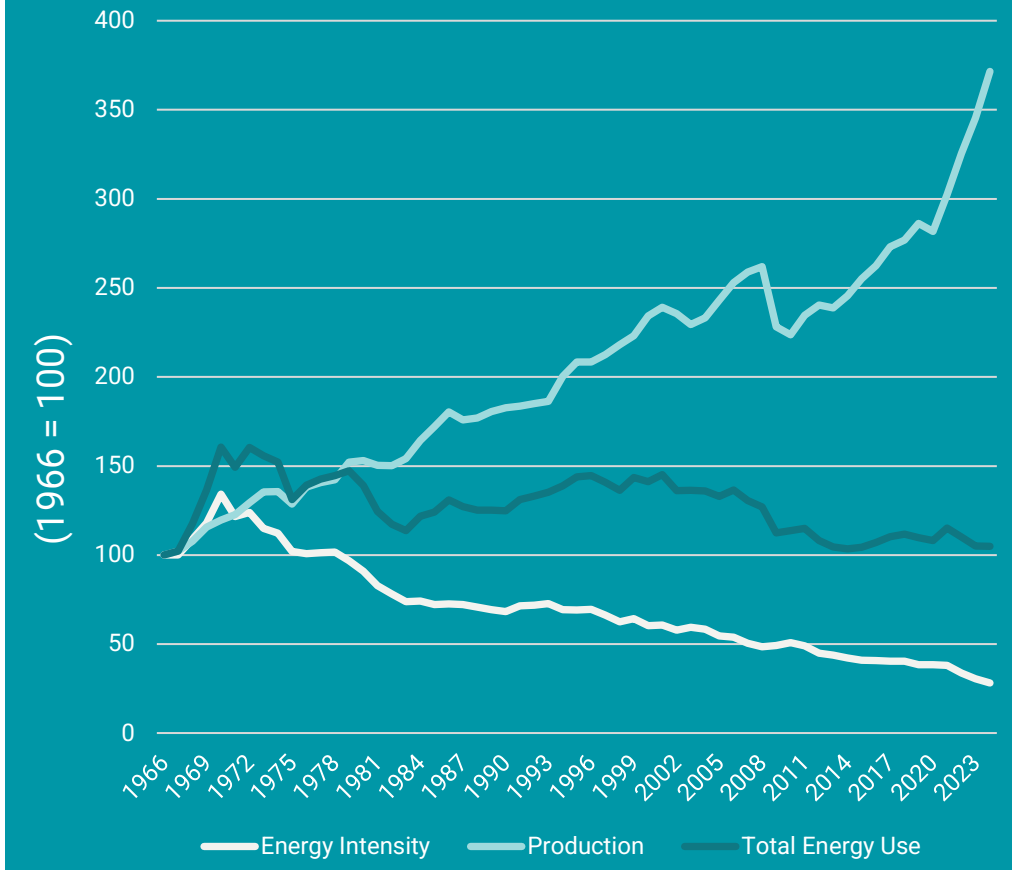
- Denmark has come far in reducing energy consumption in buildings



Growth in Denmark

- Denmark has come far in reducing energy consumption in buildings
- Manufacturing industry experienced significant increase in production, while energy use declined

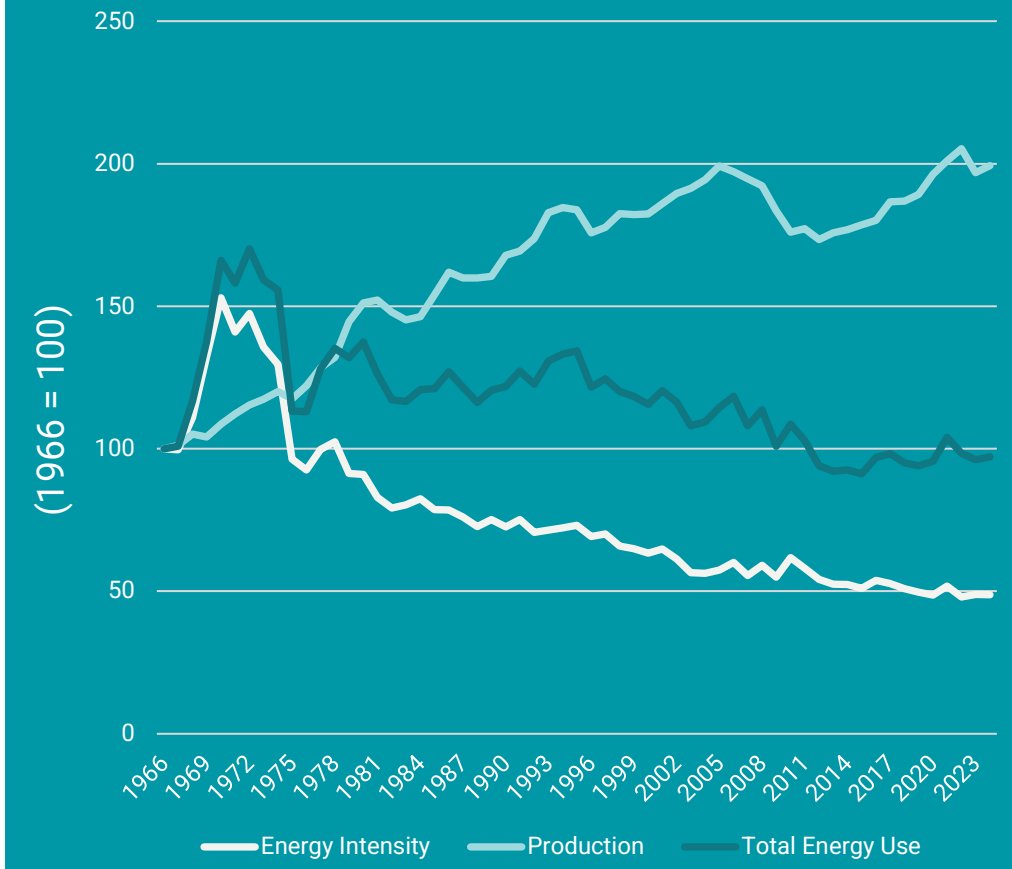
Energy Use and Intensity in the Manufacturing Industry



Growth in Denmark

- Denmark has come far in reducing energy consumption in buildings
- Manufacturing industry experienced significant increase in production, while energy use declined
- Food & Beverage had significant process, now focus on decarbonization

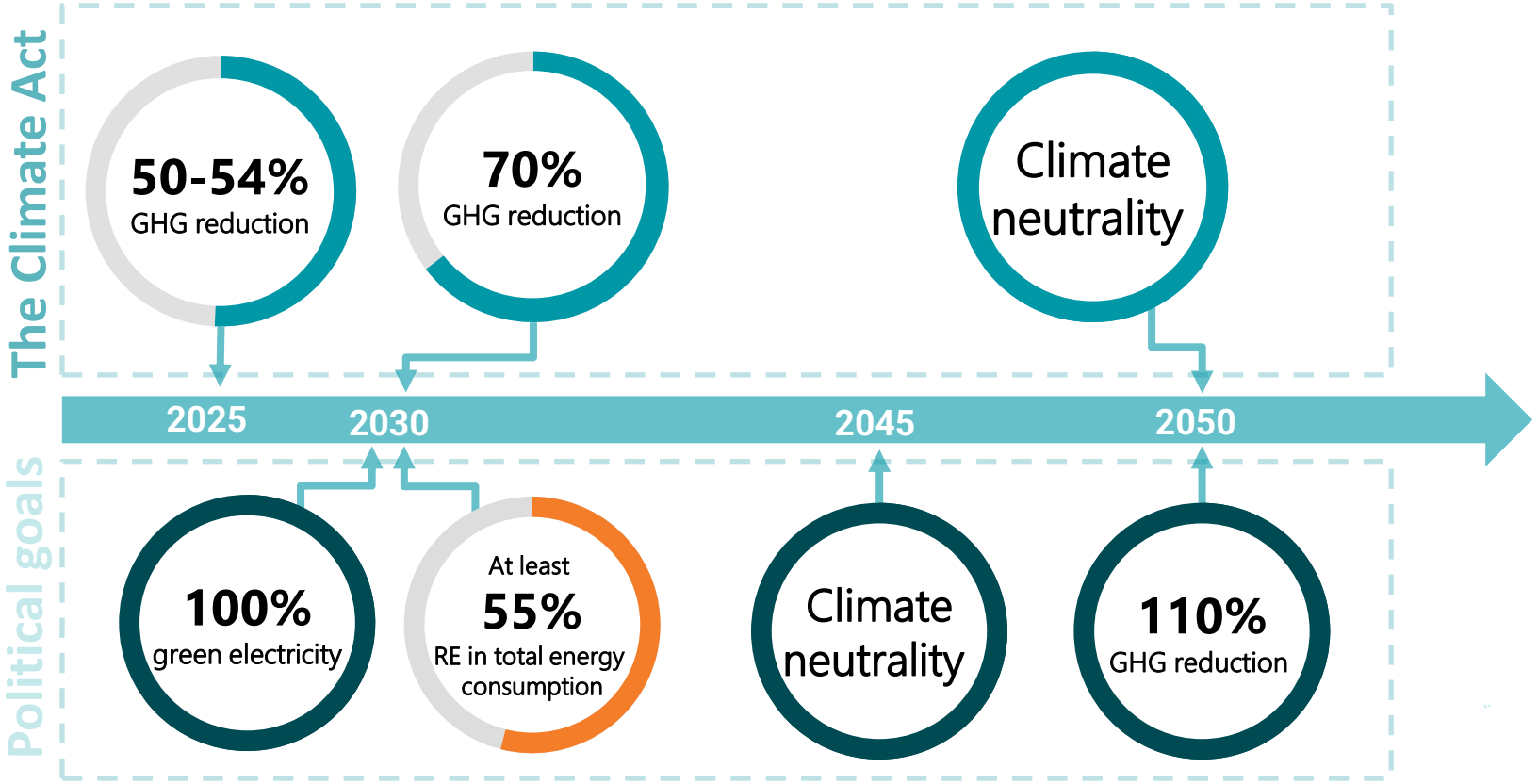
Energy use and Intensity in Food & Beverage Processing



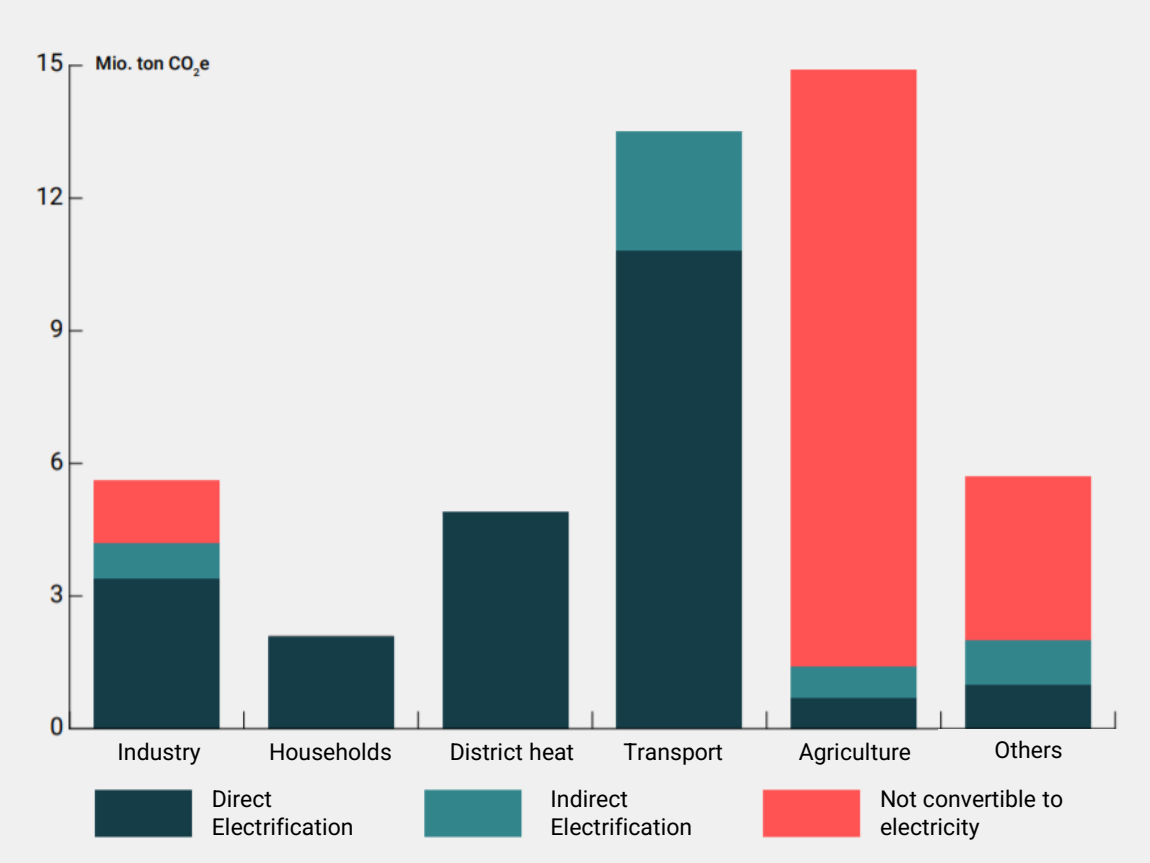
Outlook and Challenges in Denmark

Danish Energy Agency

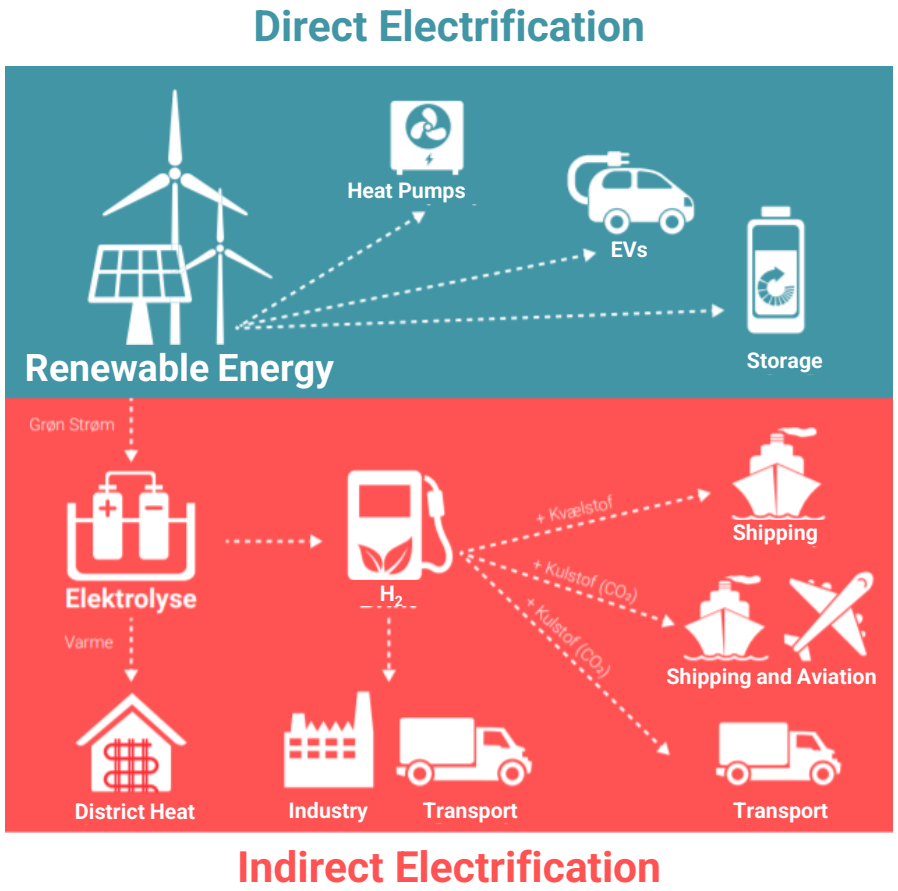
Next step: Reaching our ambitious climate goals



Reaching Net Zero With Electrification

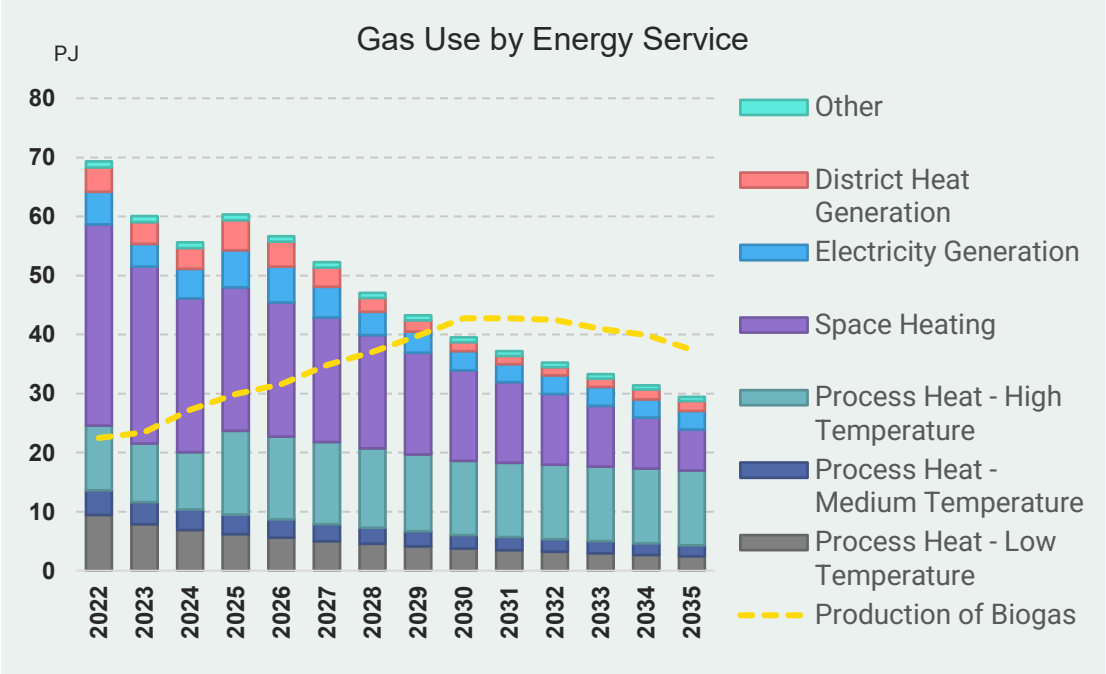


Source: Danish Ministry of Climate, Energy and Utilities (2021)



Gas use in Denmark

Denmark's Climate Status and Outlook

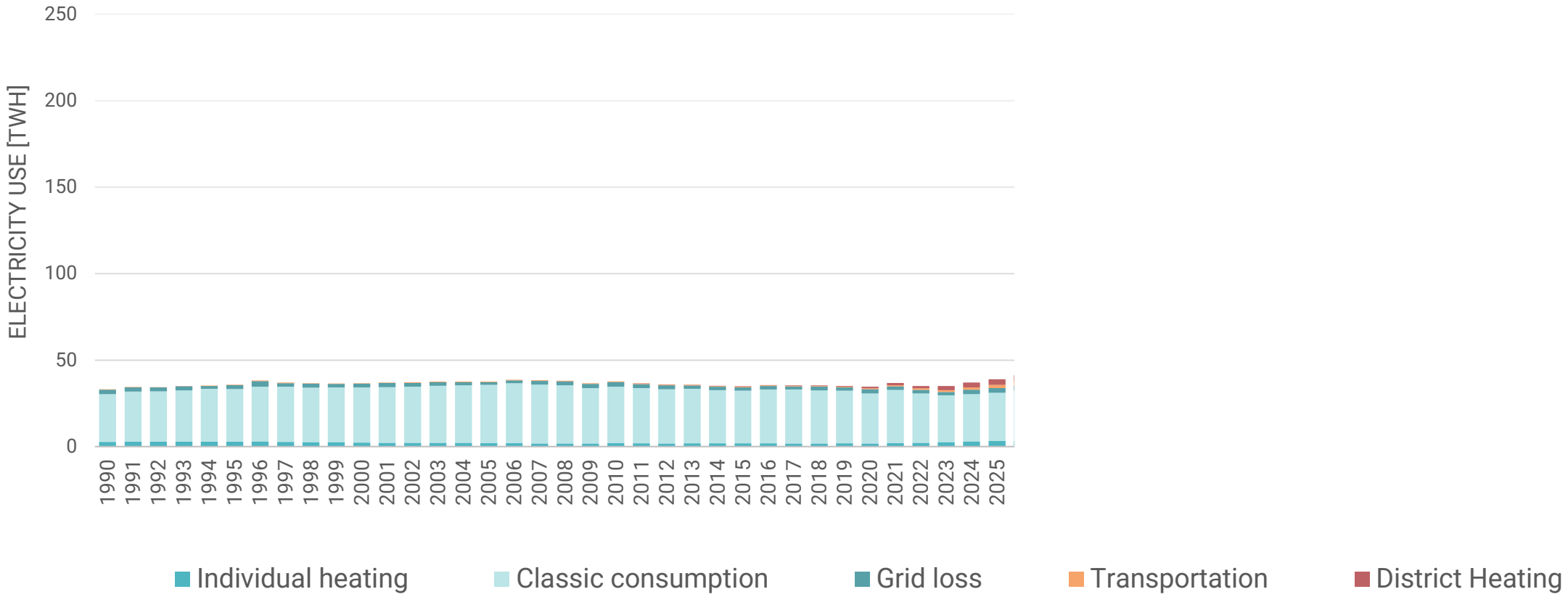


Denmark's Green Gas Strategy

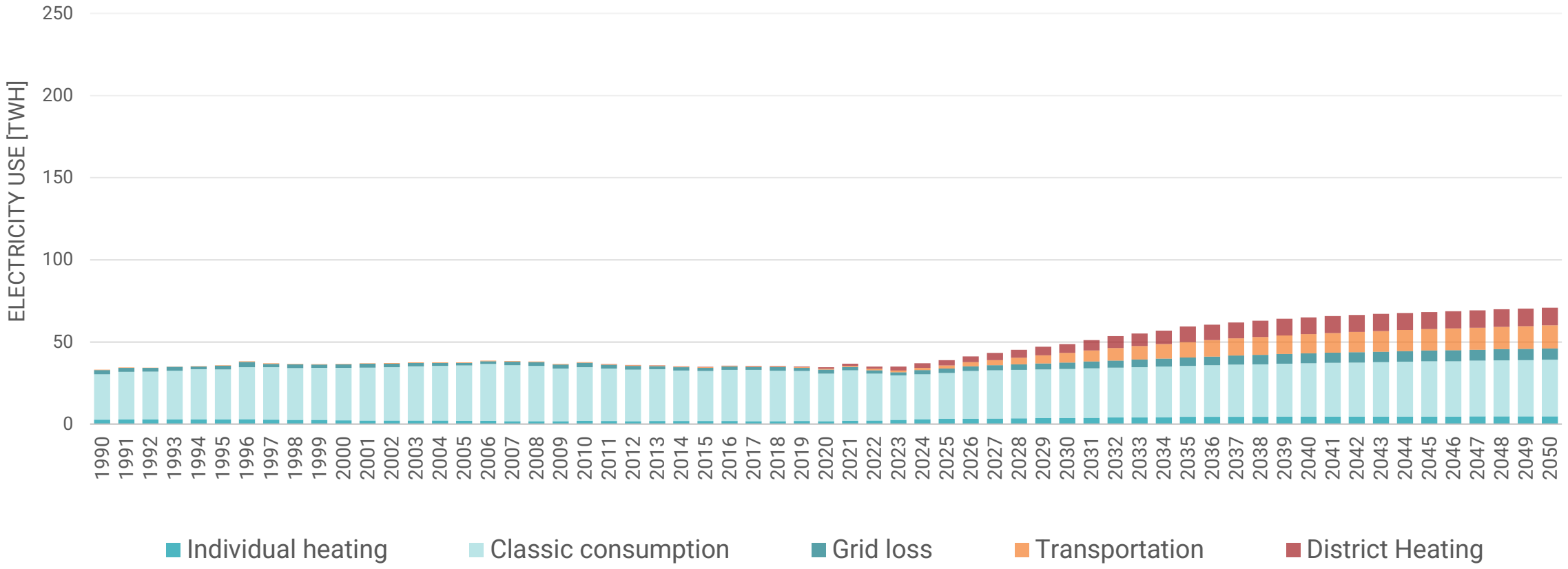
Key Points for Gas Consumption

1. Green gas must supplement the electrification and be used where it has the greatest value.
2. Green gas in industry must support jobs in Denmark for the benefit of development and employment
3. Conversion to green gas must occur with consideration of competitive tariffs and on commercial terms

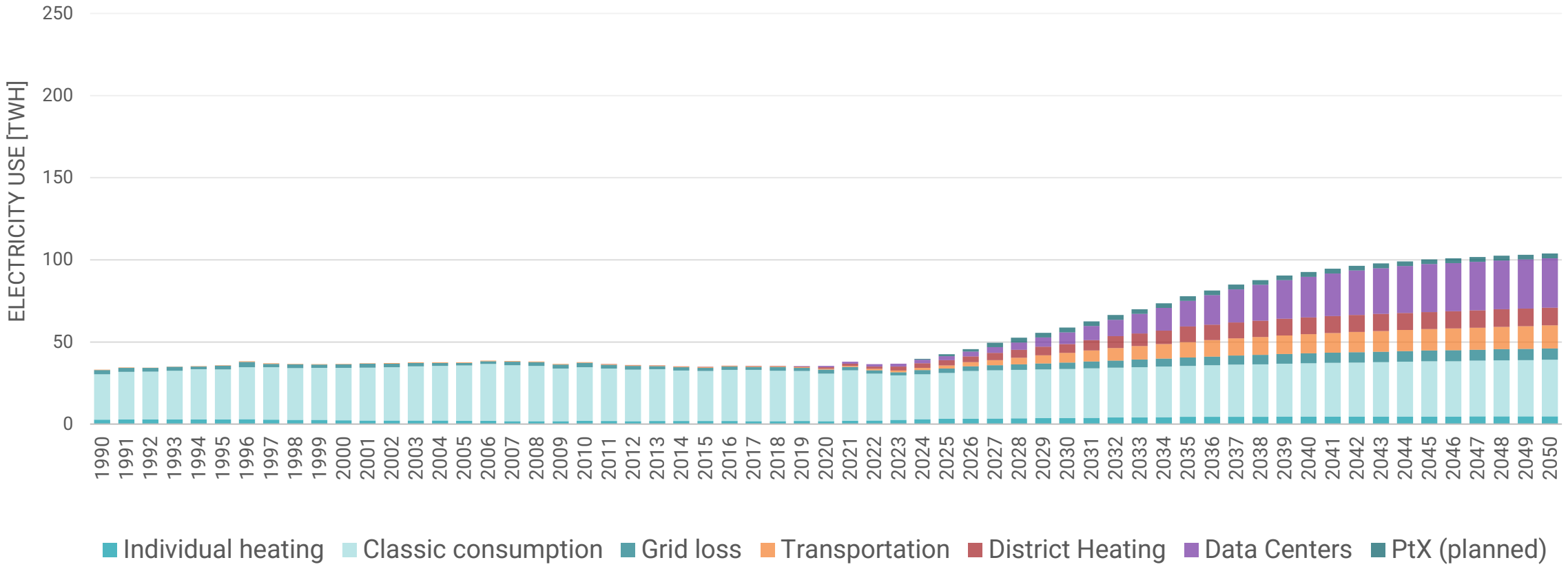
The Load has been Constant



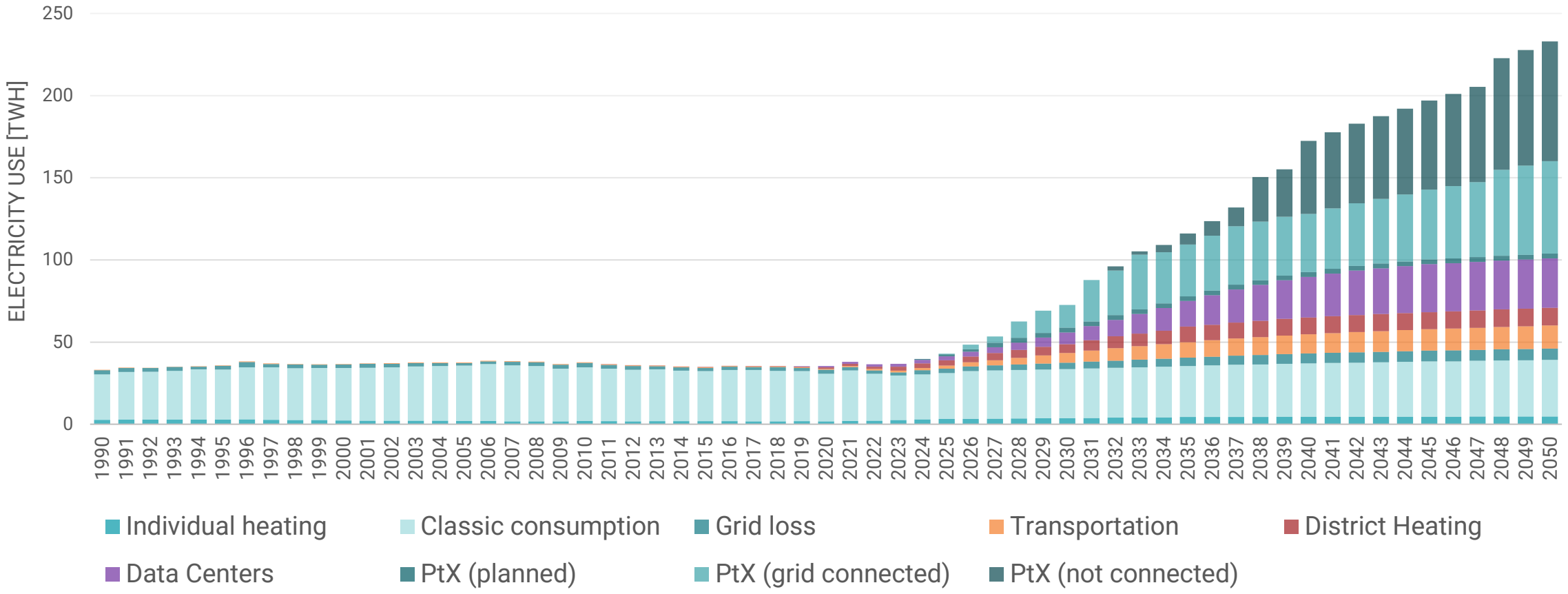
The Load is expected to Grow



The Load is expected to Grow and Grow



The Load is Expected to Grow



Load Growth Challenges in Denmark

Now

- Higher end-user prices
- Higher CO2 emissions from electricity use
- Longer installation times and higher costs for grid connection

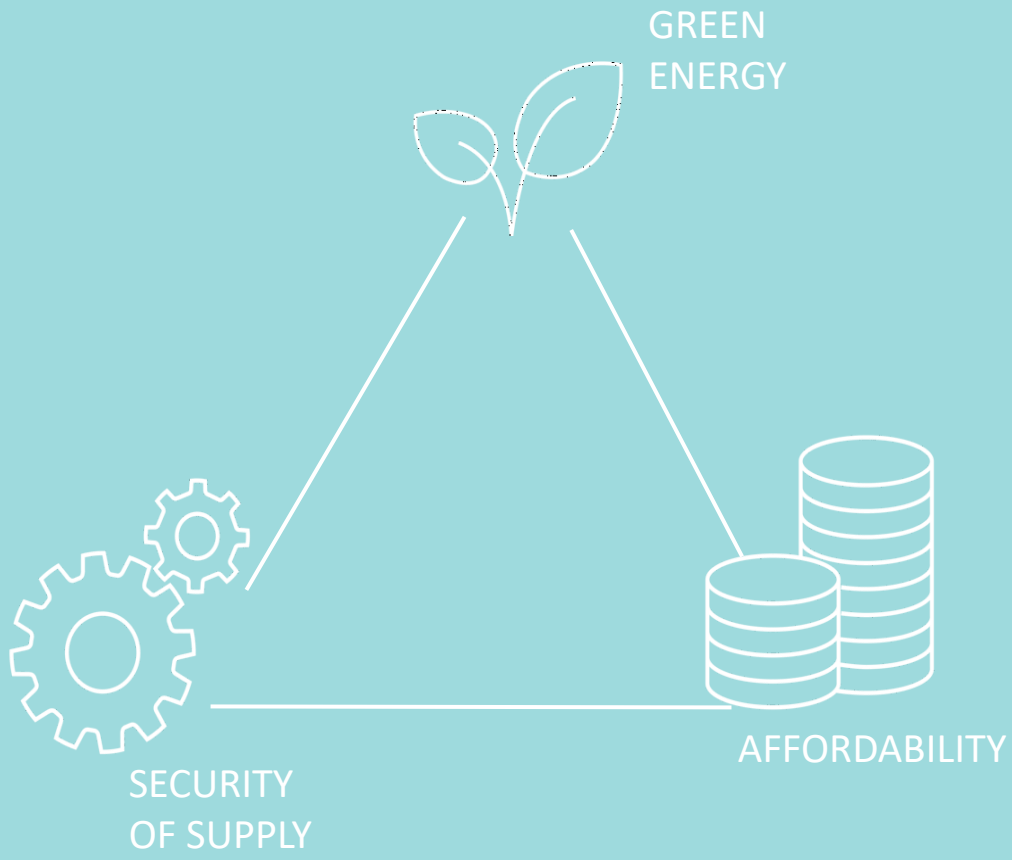
Future

- Uncertainty in electricity price development
- Transmission build dependent on system flexibility and other means to increase utilization of grid
- High security of supply, but new challenges to uphold resilience

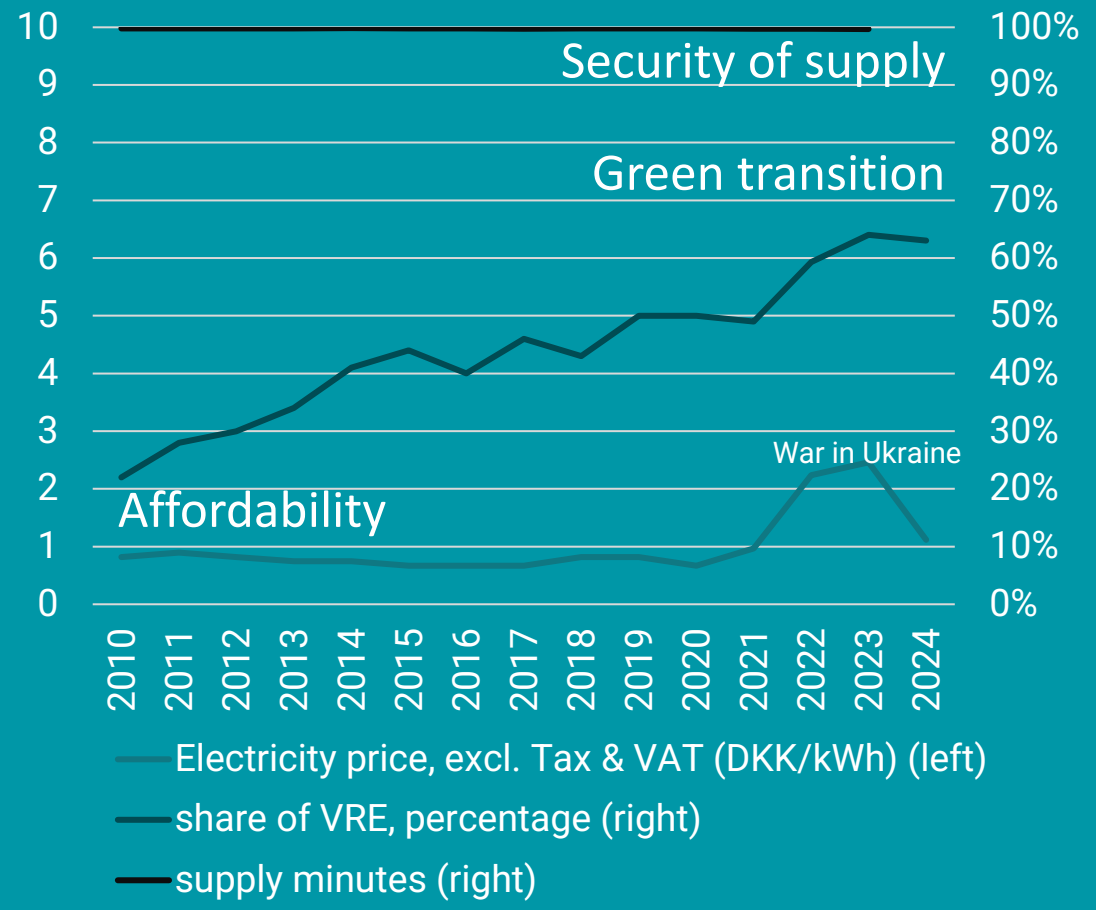
Potential Challenges Resulting from Load Growth

- Lower number of new manufacturing industry
- Reduced international competitiveness
- Energy poverty/ Affordability

Solving the Energy Trilemma



THE BALANCING ACT



Load Growth

Solving the challenges caused by load growth, while having a high security of supply and keeping energy affordable, requires a holistic approach. Initiatives addressing all the energy system, will unlock the best results while creating a robust system.

Supply Side

- Renewable Generation Capacity
- Grid Development
- Planning and Modelling

Market & Cross-Sector

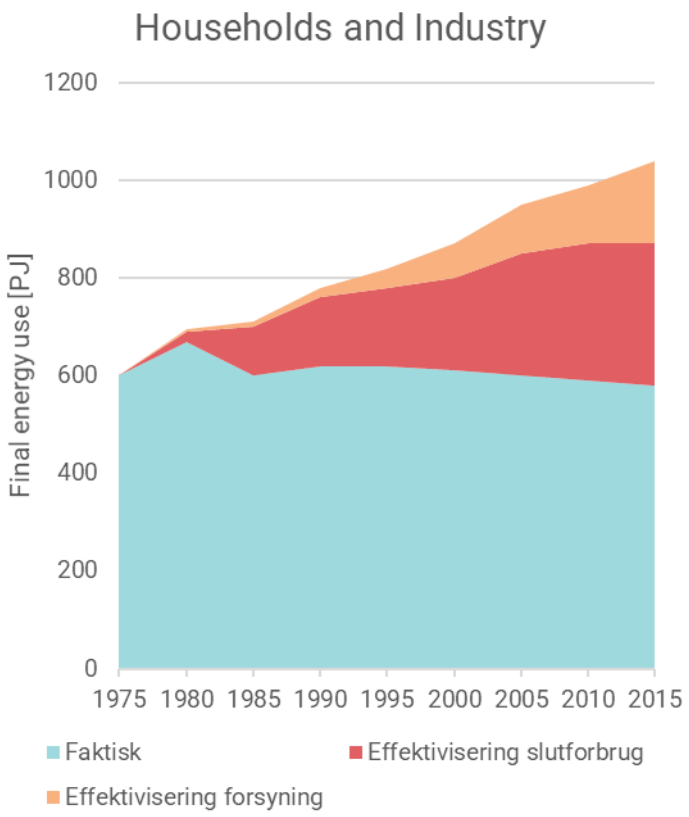
- Datahub & data transparency
- Markets
- Digitalization
- Sector Coupling
- Innovation

Demand Side

- Energy Efficiency
- Energy Storage
- Demand Response for consumers

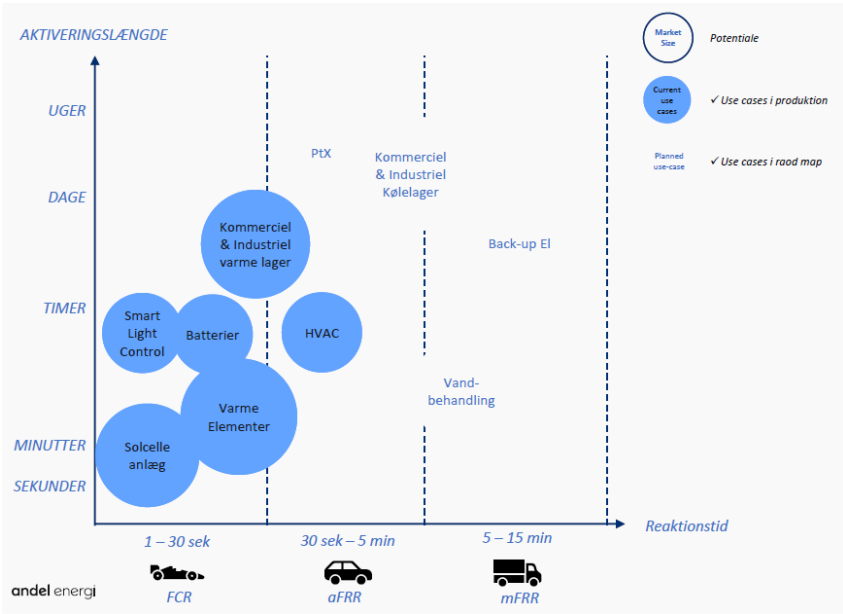
Load Growth Demand Side

Energy Efficiency



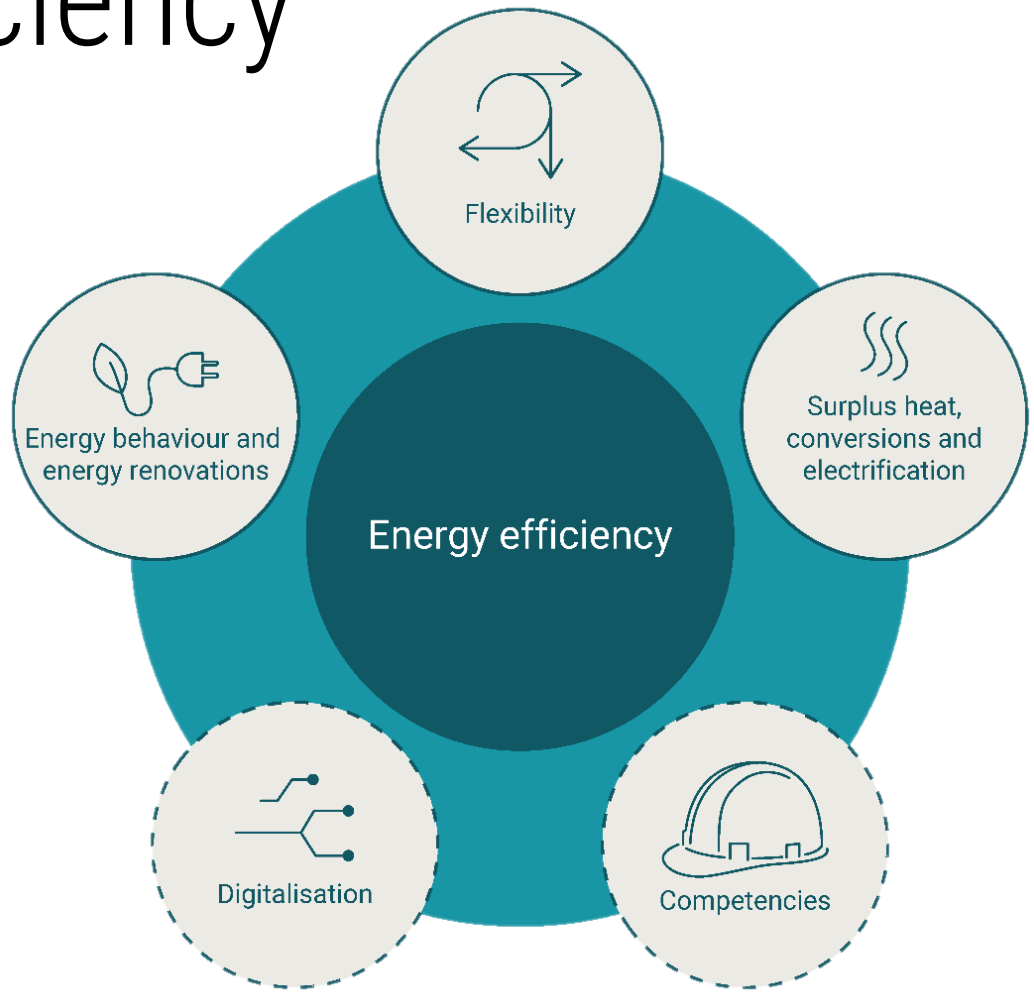
Energy Storage

Demand Response



New Role for Energy Efficiency

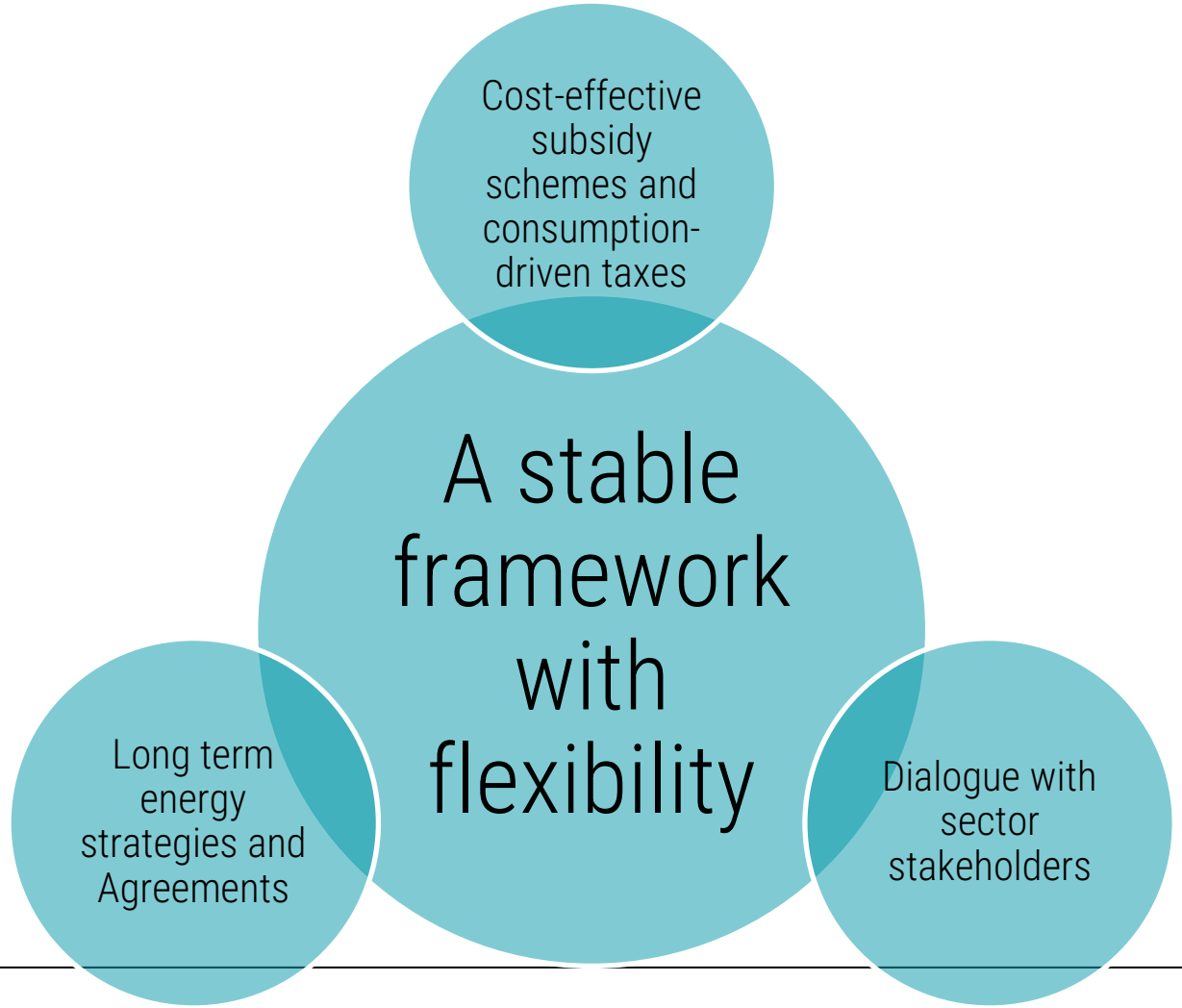
Ensuring a strong focus on improving the energy efficiency of both private homes, enterprises and public sector buildings as well as the government's desire to support the green transition across the whole of the EU and globally.



EU and Danish Regulations for Energy Efficiency

Danish Energy Agency

Key Elements of Danish Energy Policy



Instruments for energy efficiency

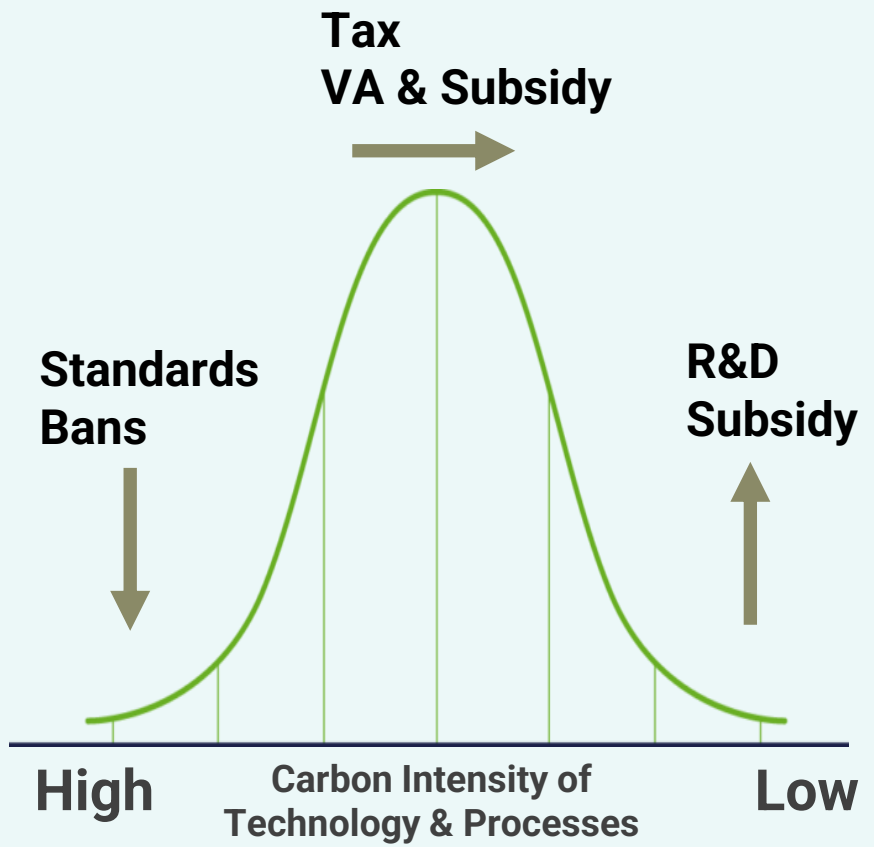
The administrative setup has not one single instrument:

- Energy & CO_2 taxes
- Energy efficiency obligations
- Research & Development
- Voluntary agreements
- Subsidies & Grants
- Mandatory energy audits (EU)
- Qualified energy consultant scheme
- Product regulation
- Access to Information
- Peer to peer groups
- Financing & Disclosure (EU)
- Long-term planning and modelling

Instruments for energy efficiency

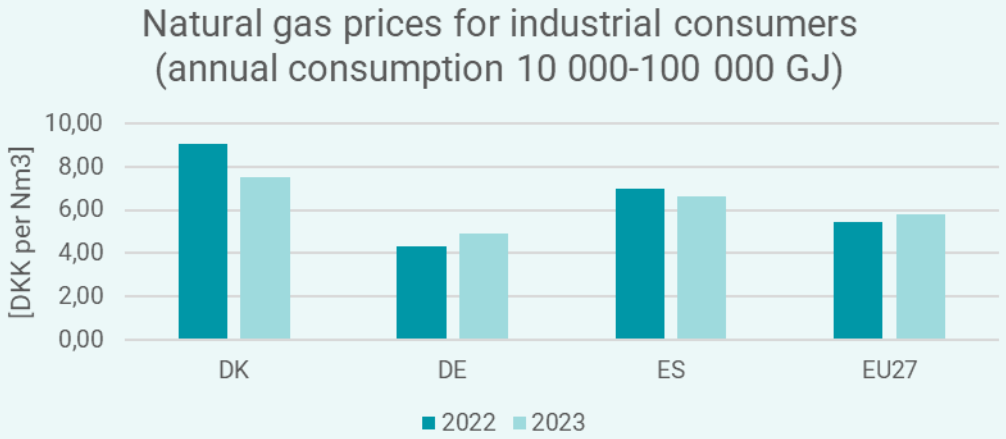
The administrative setup has not one single instrument:

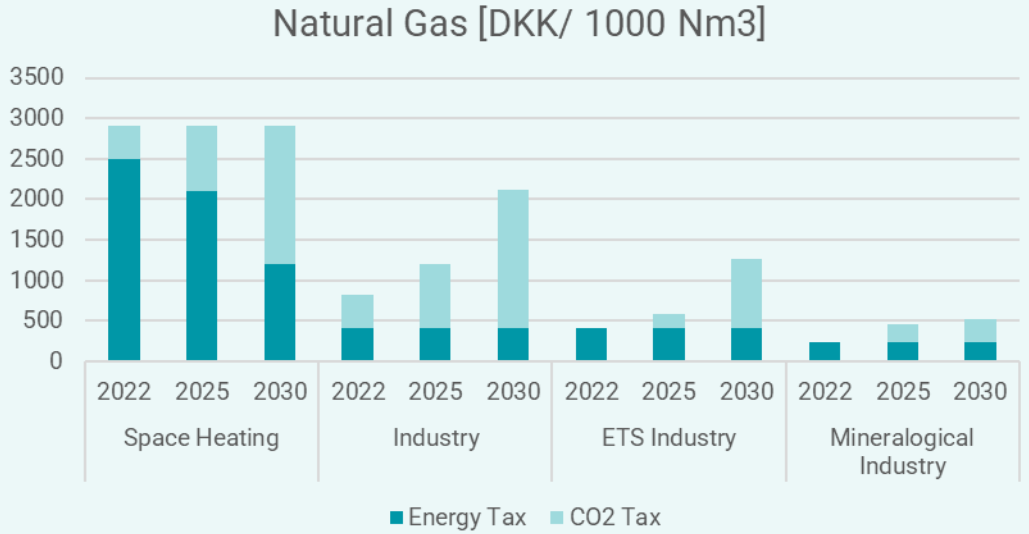
- Energy & CO_2 taxes
- Energy efficiency obligations
- Research & Development
- Voluntary agreements
- Subsidies & Grants
- Mandatory energy audits (EU)
- Qualified energy consultant scheme
- Product regulation
- Access to Information
- Peer to peer groups
- Financing & Disclosure (EU)
- Long-term planning and modelling



Taxes on CO2 Emissions

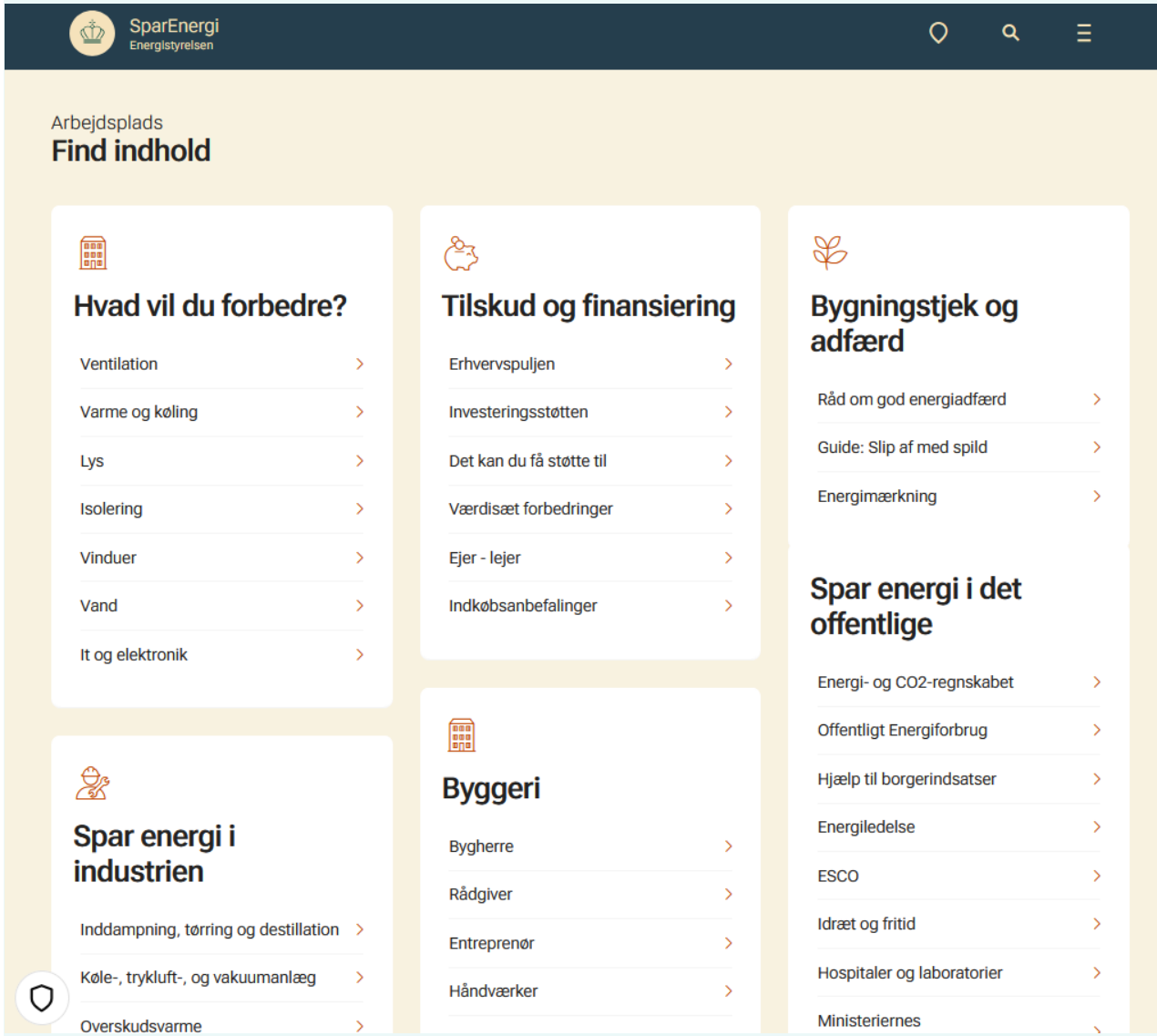
- Green tax reform will reduce Denmark's GHG emissions by 4.3 million tCO_2 – about one-tenth of the Danish GHG emissions recorded in 2019.
- The CO_2 tax will be fully implemented in 2030
- Differentiated to avoid carbon leakage through production decline





SparEnergi
Energistyrelsen

- Sector- and technology-specific information
- Case studies
- Introduction to the technical focus areas
- Step-by-step guides
  - › Energy efficiency
  - › Technology focus
  - › Financing
- Checklists
- References to products and suppliers
- Information on Subsidy Schemes



Voluntary agreement schemes in Denmark

What is the VA-Scheme?

- A state instrument for stimulating industrial energy efficiency and energy savings, introduced in the mid-90's.
- Same overall instrument exists today in Denmark but through several evaluations there has been made changes in scope and target
- The approach from Danish Energy Agency has from the beginning been to interact closely with the participating companies and stakeholders.

How does it work?

- Participating companies get a energy tax refund in return for signing a binding agreement to implement an energy management system and conduct energy saving projects
- It is voluntary for the eligible companies to participate.
- DEA is responsible for administering the Voluntary Agreement Scheme.

Voluntary Agreements in Denmark

Main mechanisms for enterprises

- Company enters into a binding 3 year-agreement with DEA:
    - Implement and maintain a certified energy management system
    - Implement energy efficiency projects with a time of payback under 5 year
    - Carry out special investigations (analysis of savings in difficult areas, test new technologies and solutions etc.)
    - Report to DEA
- Company gets a refund on their electricity* tax
- Sanctions: Claim for repayment if the requirements are not met

Mandatory Energy Audits

Energy Efficiency Directive (EED)

- Established in 2012 and revised multiple times
- EED 2023/955 Article 11 Energy management systems and energy audits

Company with > 85 TJ in average per year

› Independently certified EMS

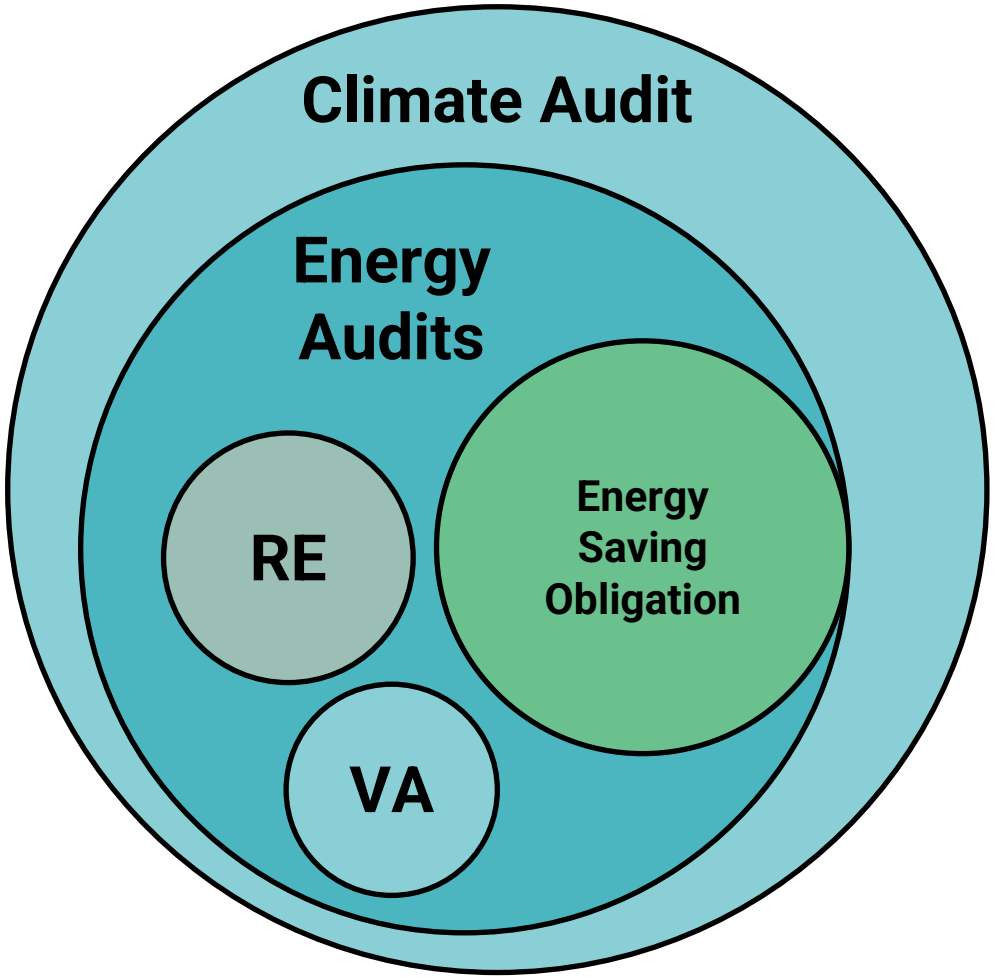
Company with > 10 TJ in average per year

› Energy Audit

› Action plan to be published by company

SME's encouraged and supported to do energy audit

Climate-audits on energy-intensive production (Denmark)



Climate-audits on energy-intensive production

Addon to the established energy audit starting 2025

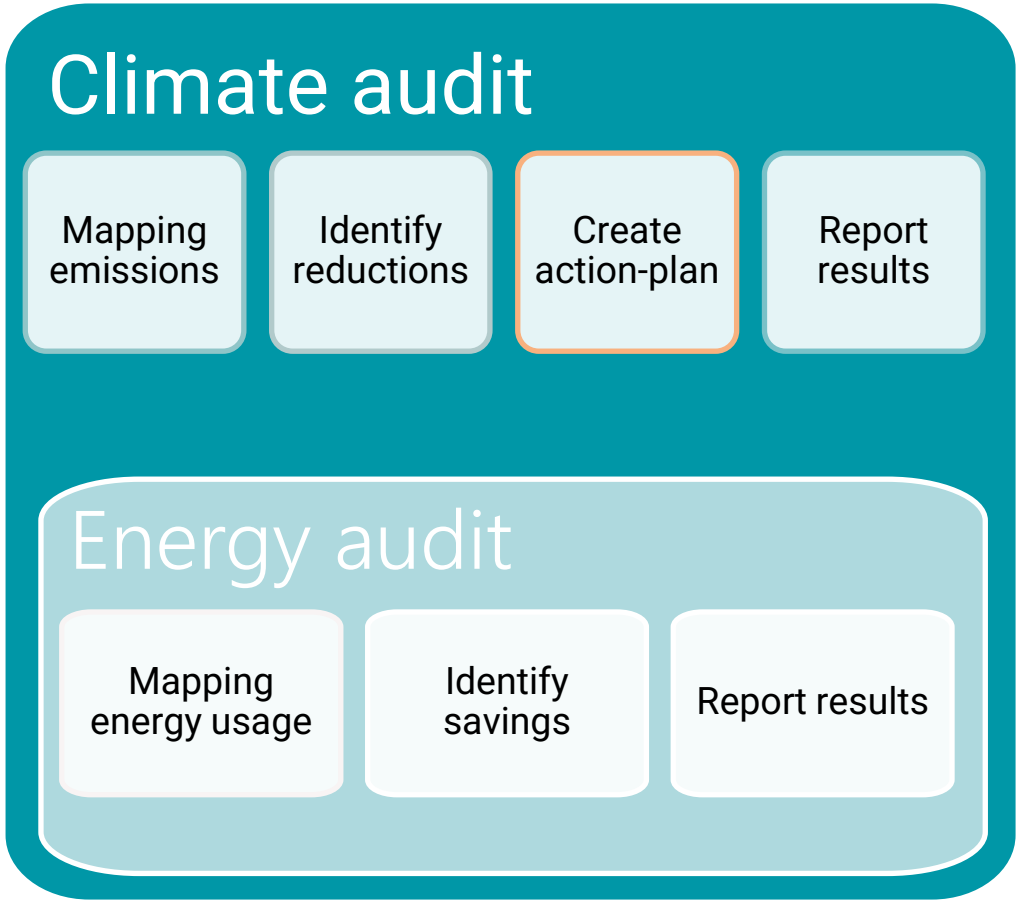
EU's 2030 goal of at least a 55% reduction in greenhouse gas emissions

Two key aspects:

1. Intensifies focus with an action plan
2. Mandatory for receiving funds

Target: Energy intensive production

- More than 10 TJ p.a.
- ~700 Danish firms



The Climate Partnerships

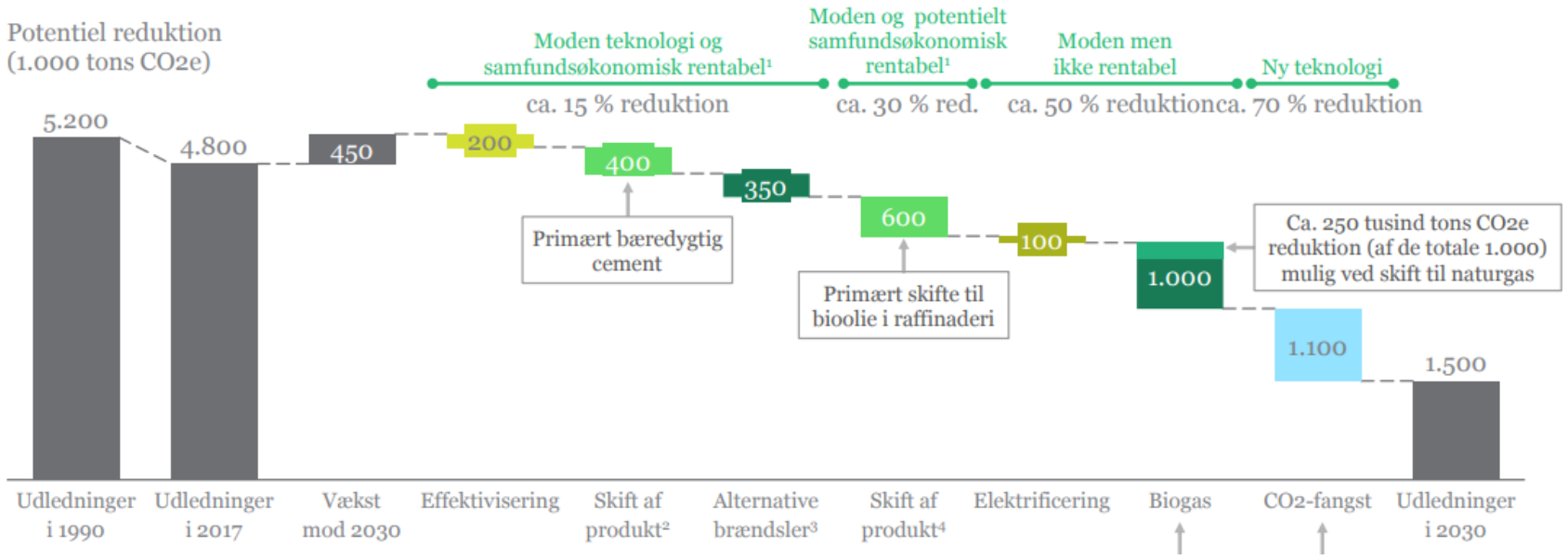
In November 2019 the Danish government established 14 public-private climate partnership.

Partnerships cover amongst others:

- Manufacturing activities
- Energy and utilities sector
- The Blue Denmark
- Energy-intensive industry
- Food and agricultural sector

The Climate Partnerships

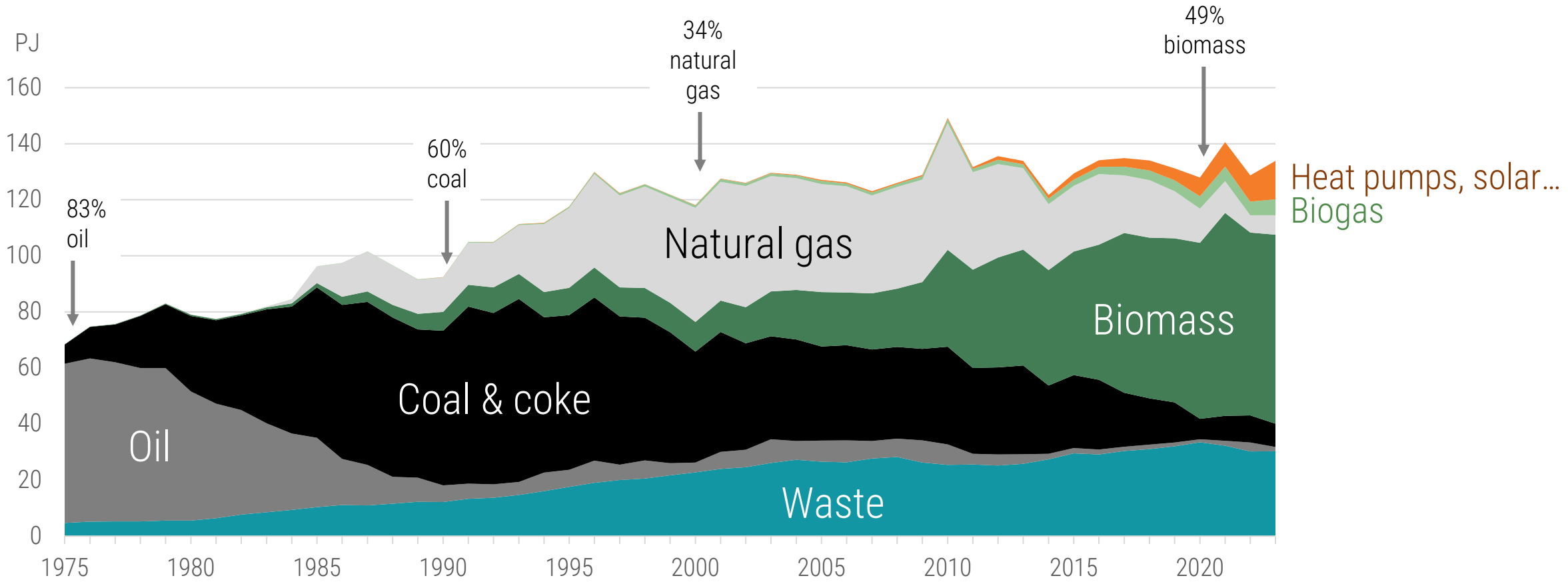
Example of a partnership for energy-intensive industry



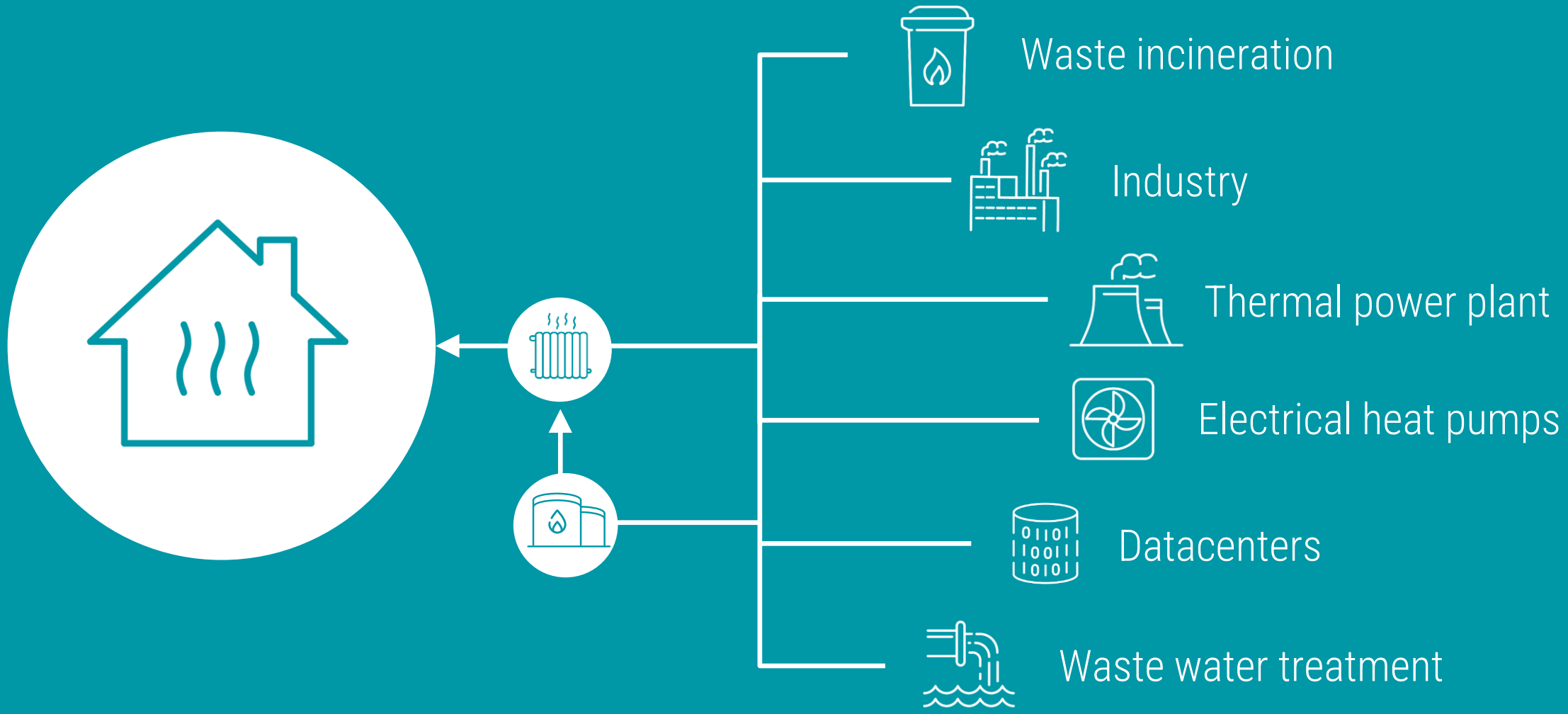
District Heating and Heat Planning

Danish Energy Agency

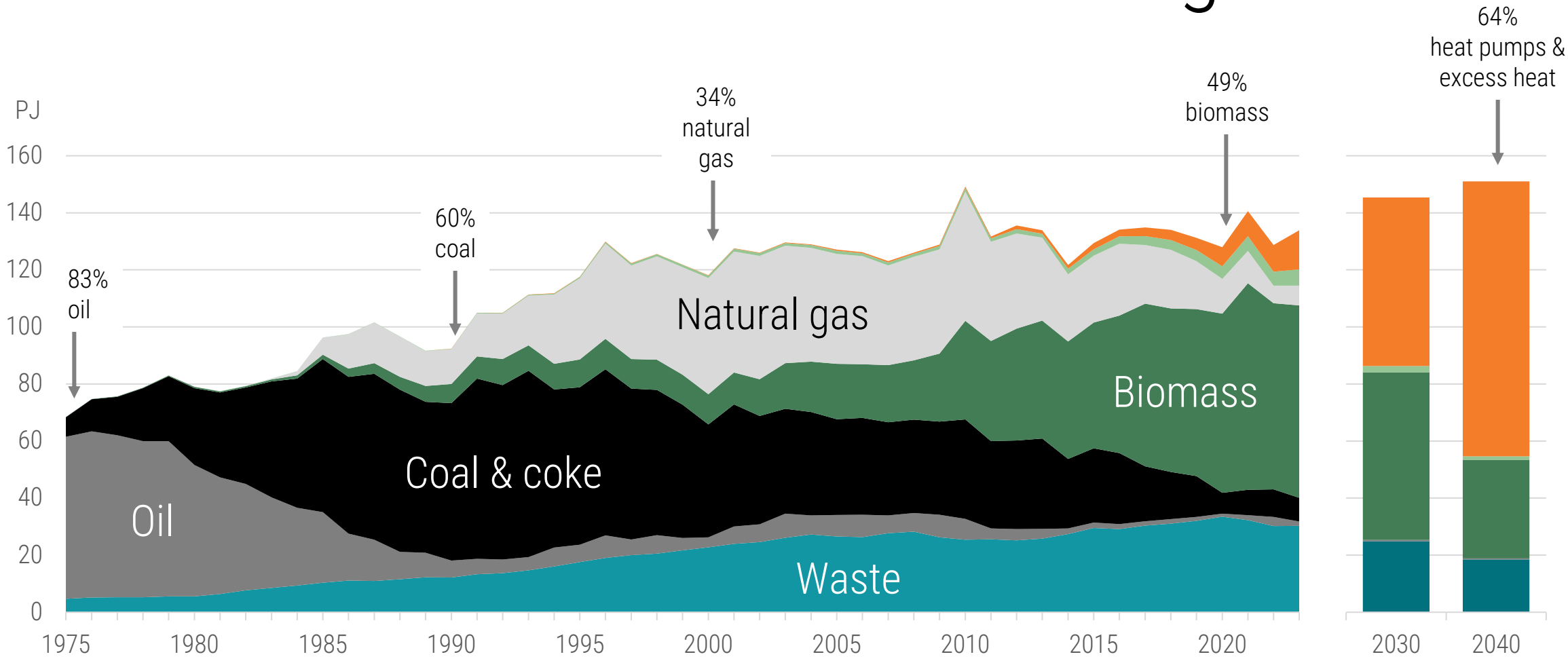
The heat sources for district heating changed



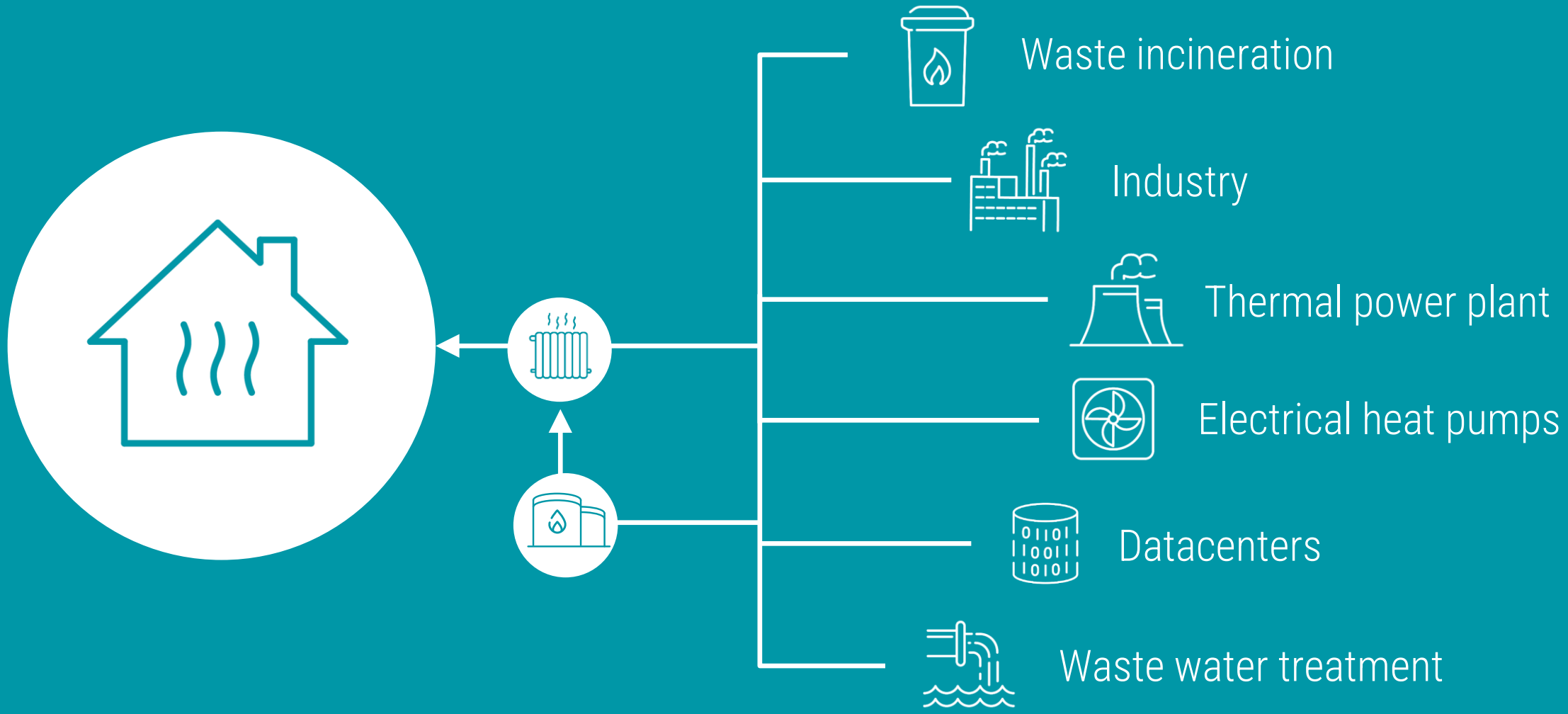
Heat can come from a multitude of sources



The heat sources continue to change



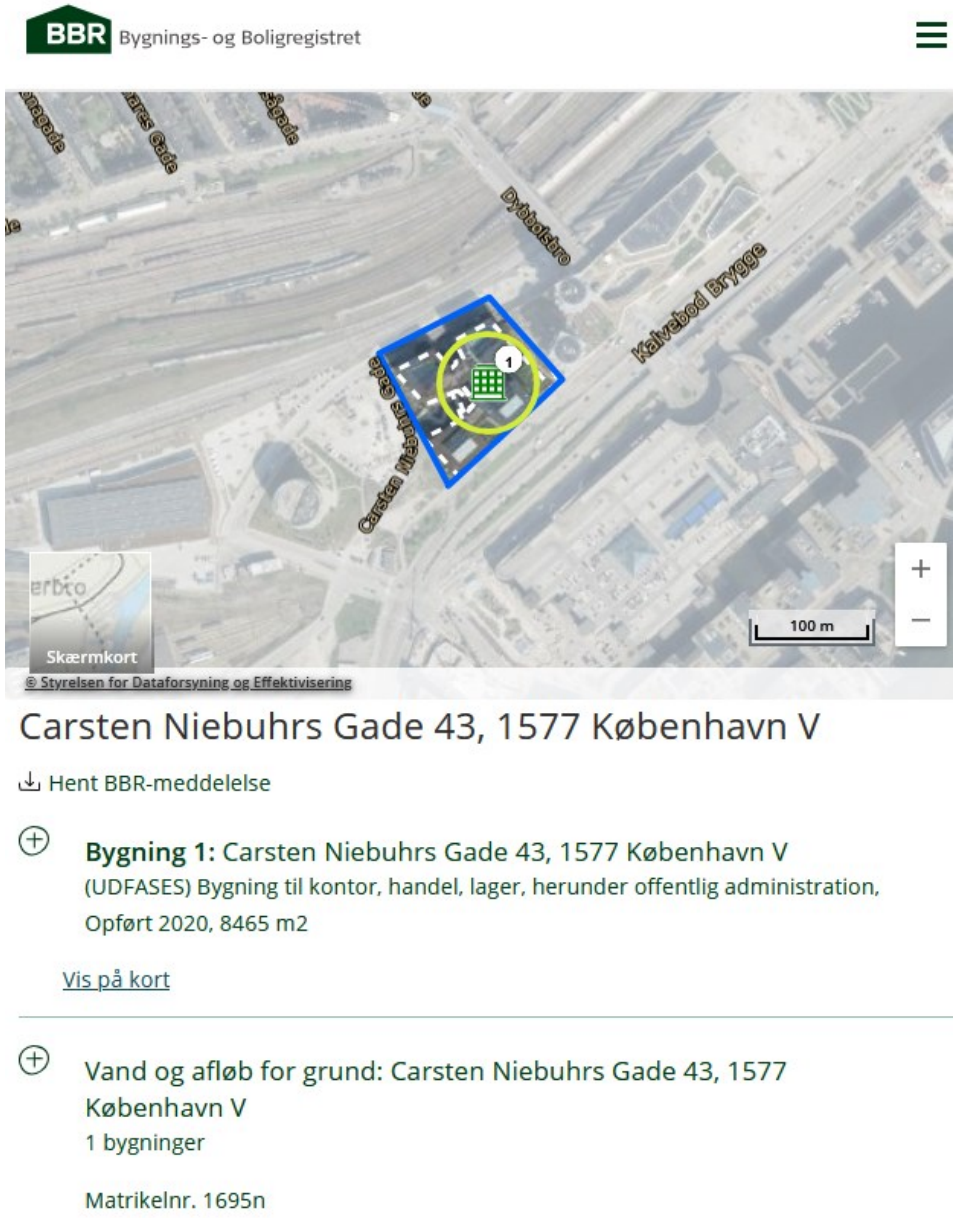
Heat can come from a multitude of sources



Digital databases

Supporting building owners and energy planning with energy efficiency.

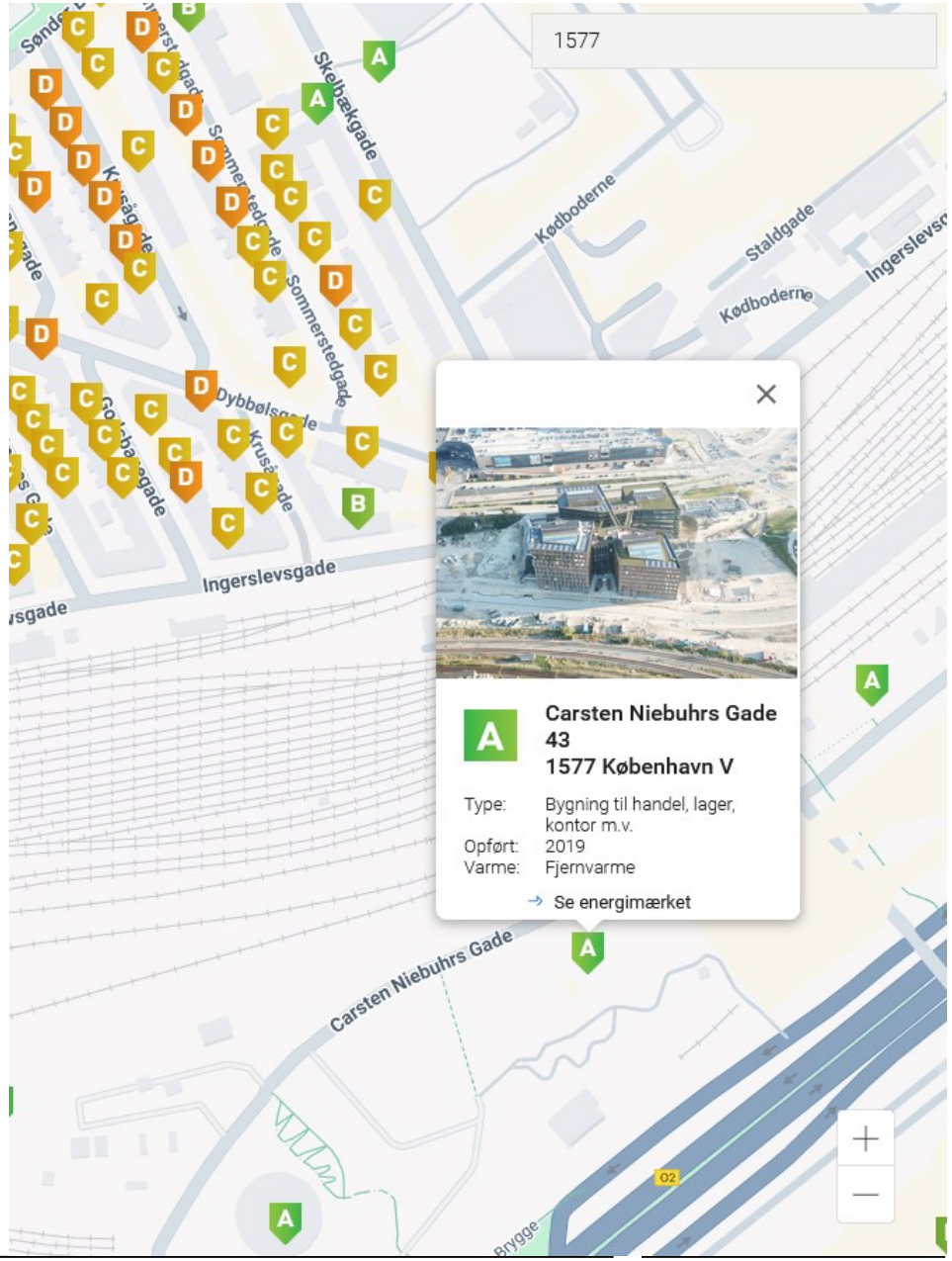
- **Danish building- and housing register (BBR)**
- Register of listed and protected buildings
- EPC mapping tool
- Maps by Agency for Climate Data
- Municipal heat planning maps
- Digital Utility Program



Digital databases

Supporting building owners and energy planning with energy efficiency.

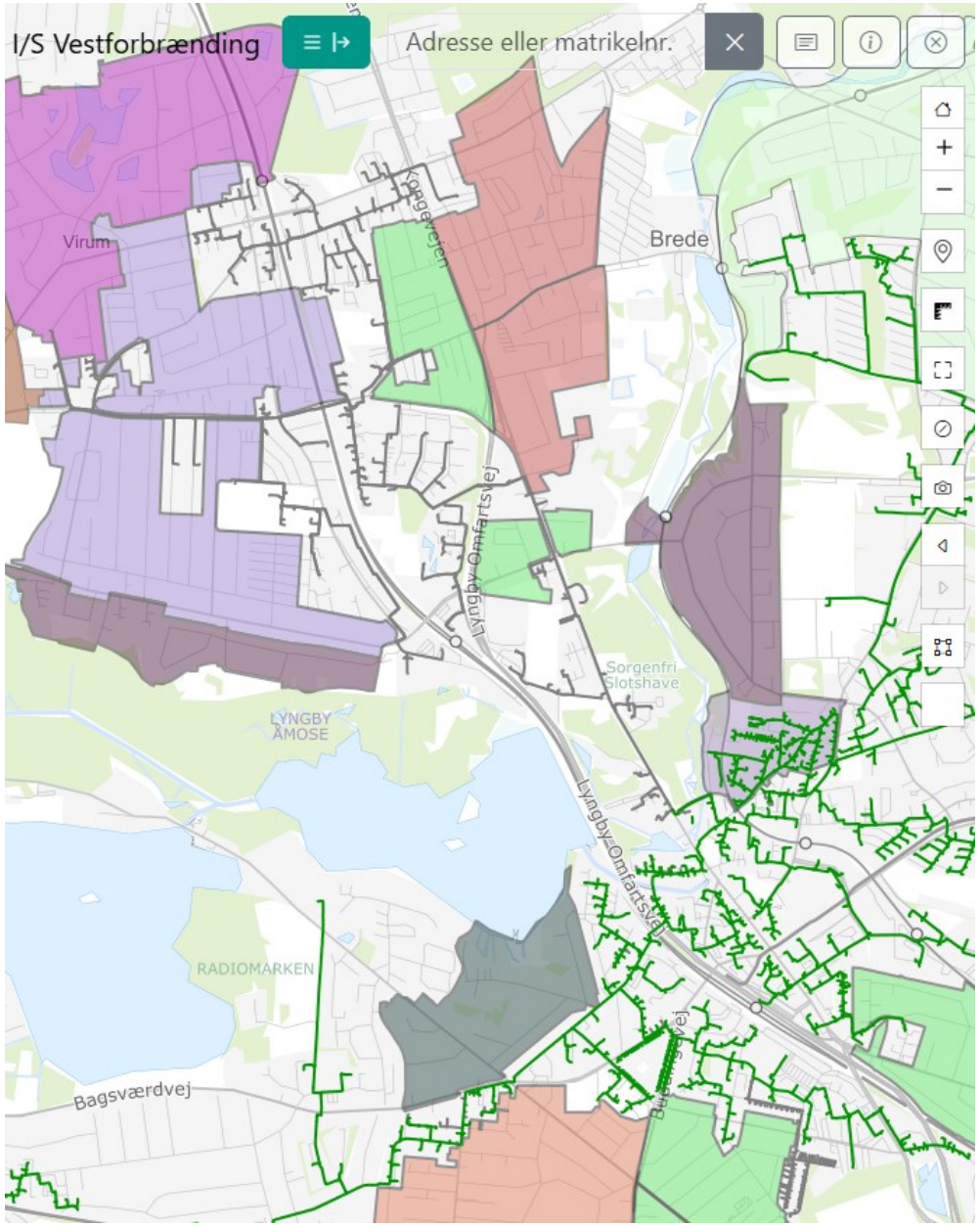
- The Danish building- and housing register (BBR)
- Register of listed and protected buildings
- **EPC mapping tool**
- Maps by Agency for Climate Data
- Municipal heat planning maps
- Digital Utility Program



Digital databases

Supporting building owners and energy planning with energy efficiency.

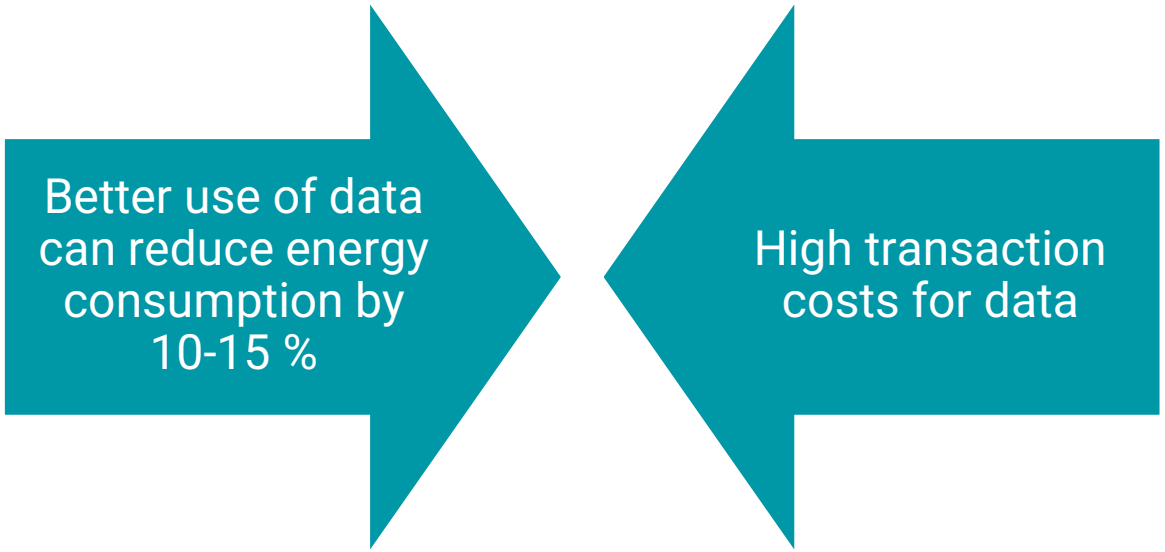
- The Danish building- and housing register (BBR)
- Register of listed and protected buildings
- EPC mapping tool
- Maps by Agency for Climate Data
- **Municipal heat planning maps**
- Digital Utility Program



Digital databases

Supporting building owners and energy planning with energy efficiency.

- The Danish building- and housing register (BBR)
- Register of listed and protected buildings
- EPC mapping tool
- Maps by Agency for Climate Data
- Municipal heat planning maps
- **Digital Utility Program**



- New Danish digitalization strategy (Feb. 2024)
- Private-public partnership program to promote a coherent ecosystem for utility data
- Use case: District heating data

Thank you!
Any questions?

Danish Energy Agency