

# THE DANISH JOURNEY OF INTEGRATING HEAT AND ELECTRICITY SYSTEMS

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# ENERGINET

Energinet is the transmission system operator for electricity and gas – owned by the Danish state.

We have a workforce of around 2,500 people split between 7 locations.

Our head office is in Erritsø.



OPERATES AND  
EXPANDS THE  
TRANSMISSION  
NETWORK

WORKING FOR  
WELL-  
FUNCTIONING  
MARKETS

ENSURES BALANCE  
DURING THE  
OPERATING DAY



# The transition from central planning to distributed generation

- THE ELECTRICITY MARKET WAS INTRODUCED IN 1999



1990



1999

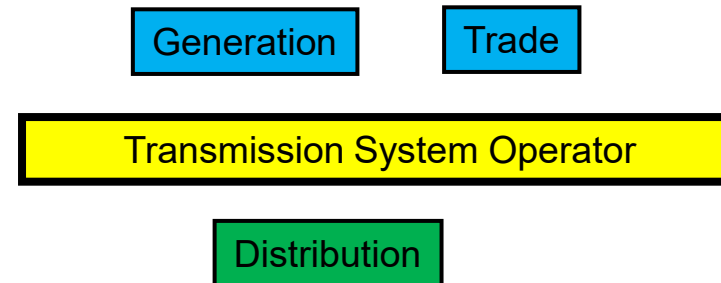
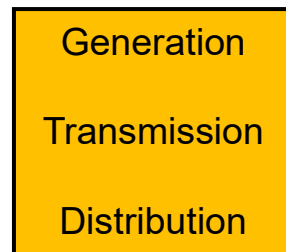


2015

**From primary coal fired to local CHP, wind power and PV**

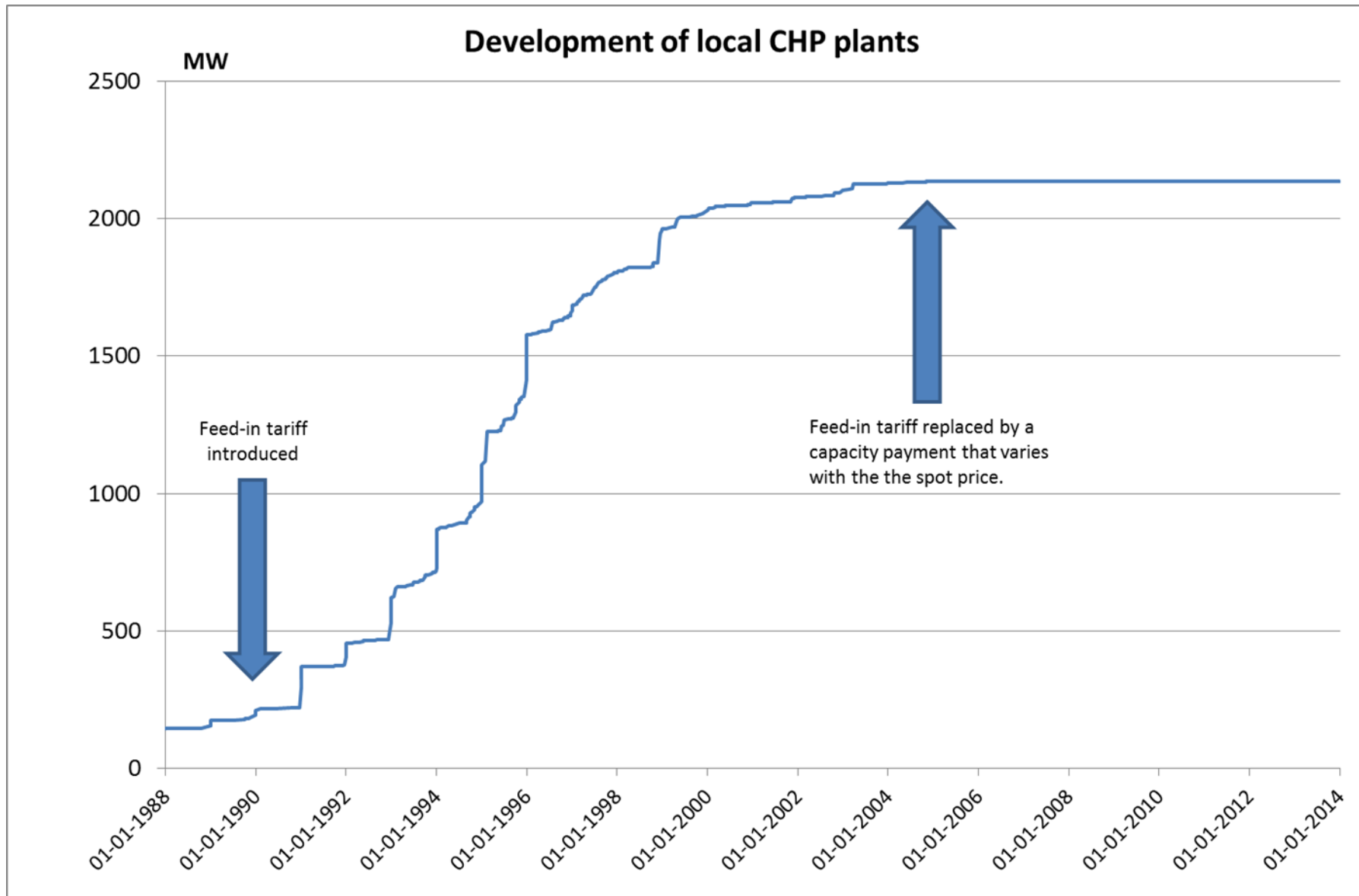


From vertically integrated monopoly to competitive electricity market



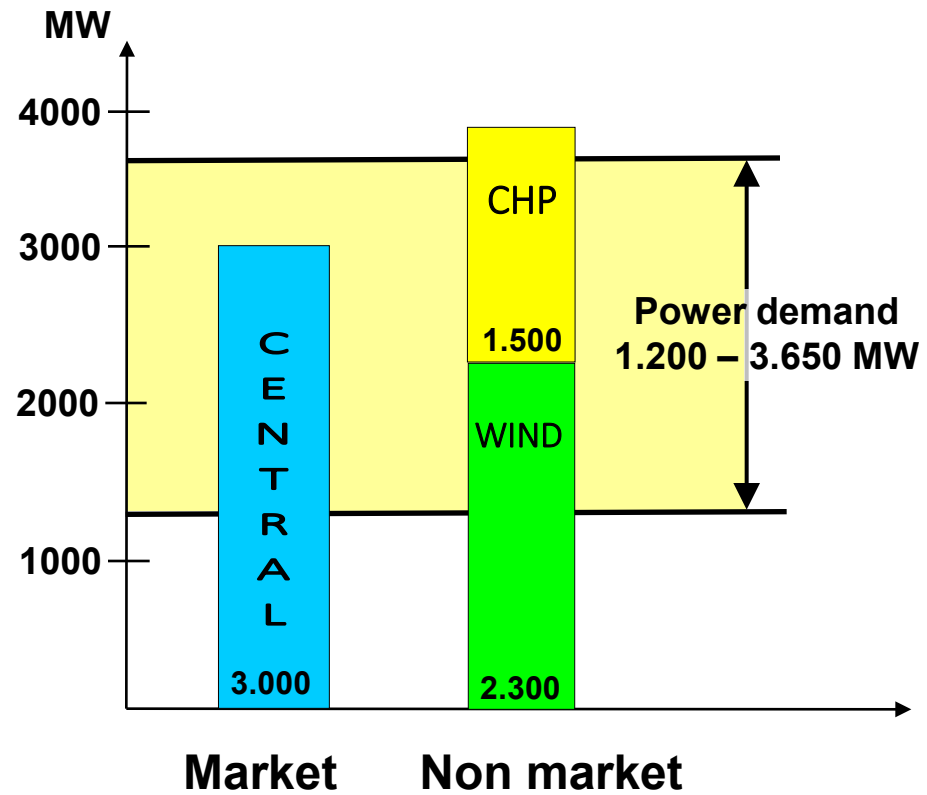
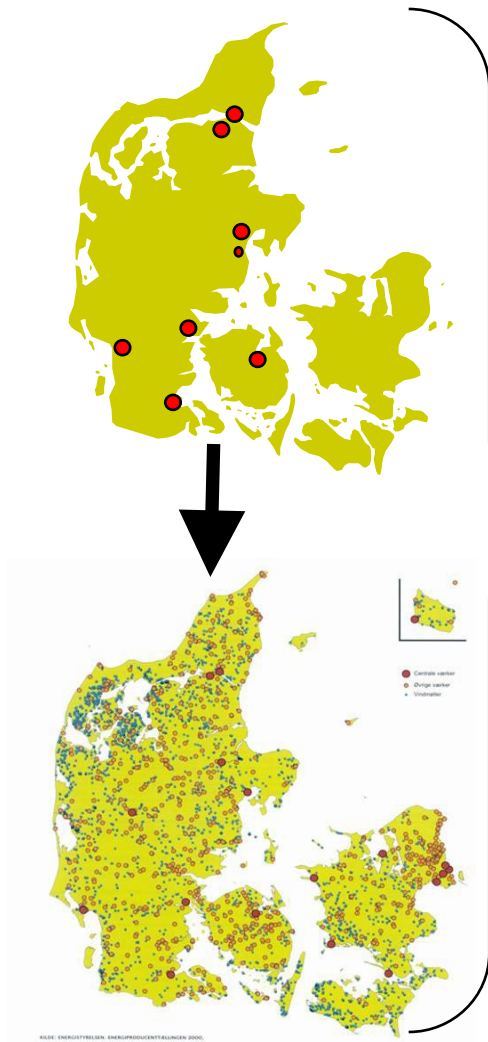
# THE DEVELOPMENT OF LOCAL CHPs IN DENMARK

- The political discussions began in the mid-1980s in the wake of the oil crises.
- Keywords: co-production of electricity and heat, energy efficiency.
- A feed-in tariff was approved by the Danish government in 1990
  - A time-of-day tariff ~ The long term marginal costs of a coal fired unit
  - The tariff was maintained when the electricity market was introduced in 1999
- The feed-in tariff was replaced by a capacity payment in 2005 to better suit the electricity market environment. At the same time it was decided not to incentivise new plants.
- The cost of the incentive was socialized – i.e. financed through a Public Service Obligation tariff paid by the final customers.
- The incentive was put to an end in 2018.



# The starting conditions in year 2000

Local CHPs were operated outside the electricity market



# The lack of market integration created problems

## CHP production did not follow market price signals

- Waste of fuel to maintain production when the electricity market price was close to 0.
- The handling of CHP (and wind power) outside the market created major imbalances.
- Large expenses for regulating power from central units within the market to be able to regulate imbalances from CHP and wind power.

## Governmental proposal: Market orientation of CHP production (2002)

- Production-independent support in stead of a feed-in tariff to ensure that the plants could participate in the spot and regulating power market on a level playing field.
- Forced transition to production on market conditions for large CHP plants (> 10 MW) from 2005.

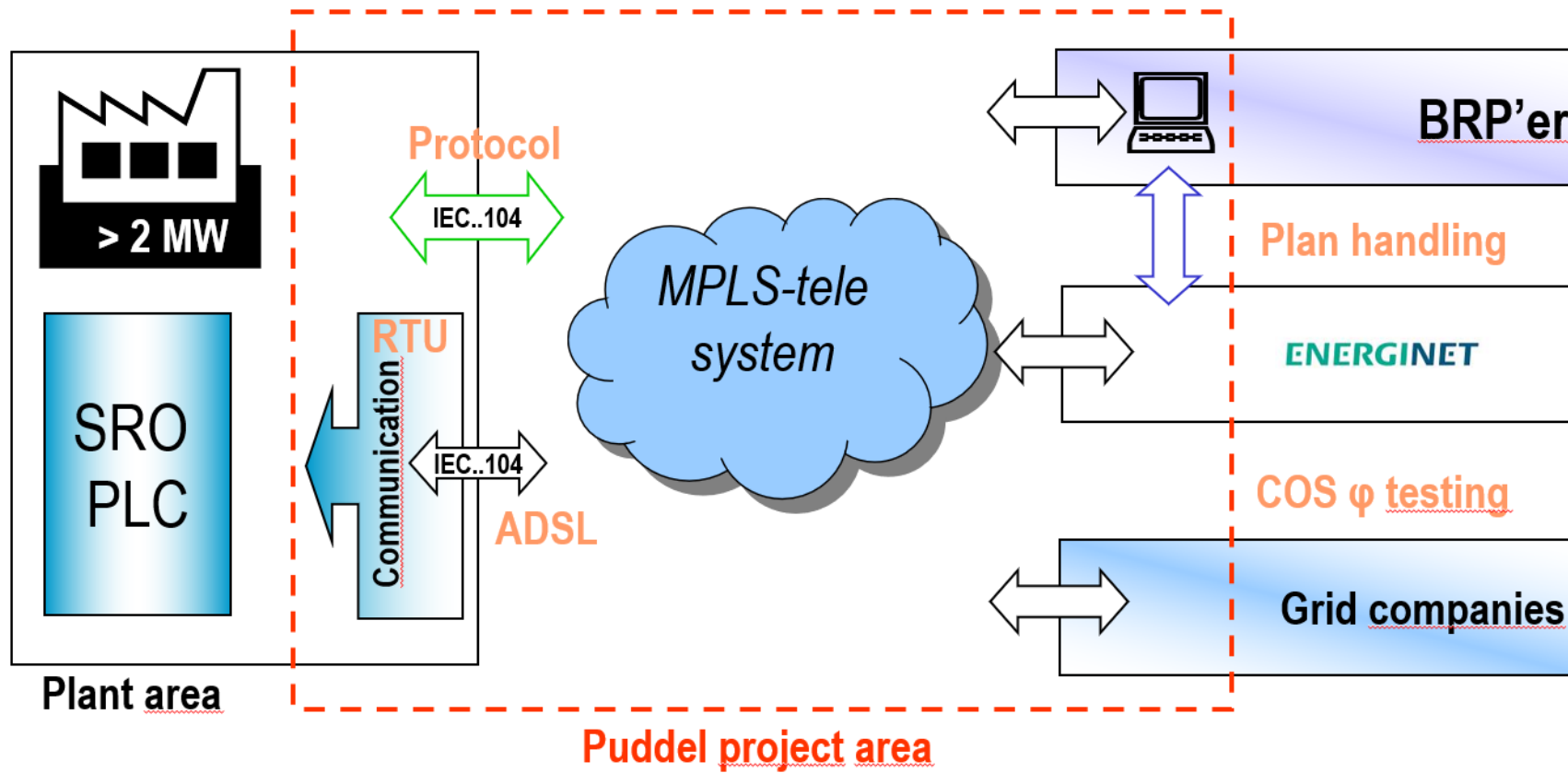
# Energinet supported the government's initiative regarding market orientation from the start

A number of collaborative projects were started to prepare CHP owners for the conditions of the electricity market and to gain better understanding of the plant's cost structure:

- **Optimal operation of CHP plants** (November 2002 – January 2004)
  - ✓ Study of cost structure. Development of theoretical models that can determine bids for the spot market and the regulating power market based on the characteristics of the individual plant.
  
- **Demonstration project regarding sales to the spot market** (July 2023 – February 2024)
  - ✓ Testing of methods and routines regarding the sale of electricity to the spot market by CHP plants.
  
- **PUDEL Project** (May 2004 – May 2005)
  - ✓ Development of tools for communication and operational support for decentralized production in a liberalized electricity market

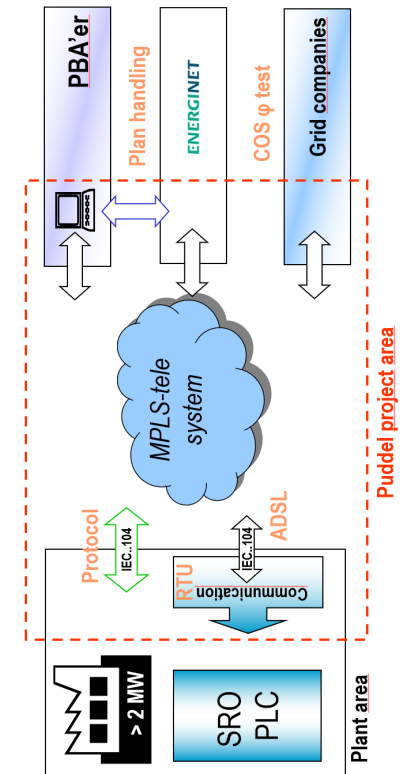
# The PUDDDEL project

Participation from 30 CHP plant owners and 5 BRPs (aggregators)



# The PUDDDEL project, continued..

- **Project goals:**
  - ✓ Discuss information scope and develop tools for communication and operational support.
  - ✓ To carry out a simulated testing of systems and run a period with actual participation in both the spot and regulating power markets.
  - ✓ To assess the possibility of CHP units participating in the regulating power market.
- **Project results:**
  - ✓ Communication standards were developed that can be further refined.
  - ✓ Participation in the regulating power market requires extensive communication and automated operation to meet the tight time requirements.
  - ✓ It is profitable for decentralized CHP plants to participate in the spot and regulating power markets by rationally managing their production.
- In total 26 out of 30 CHP plants continued on market terms after project ending!



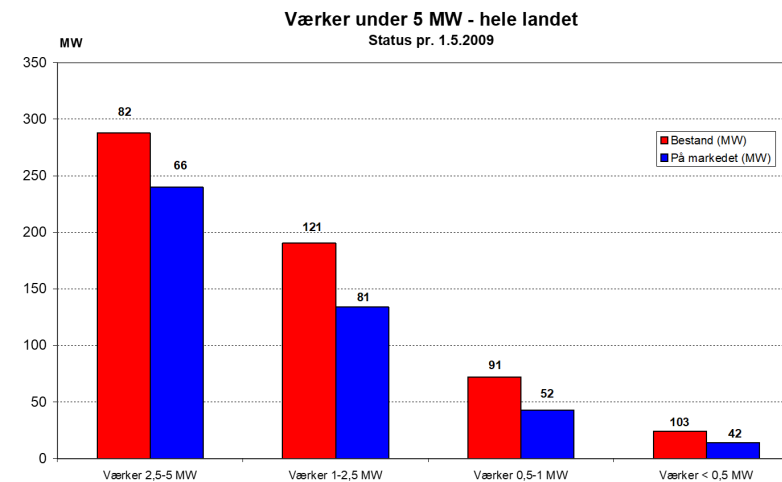
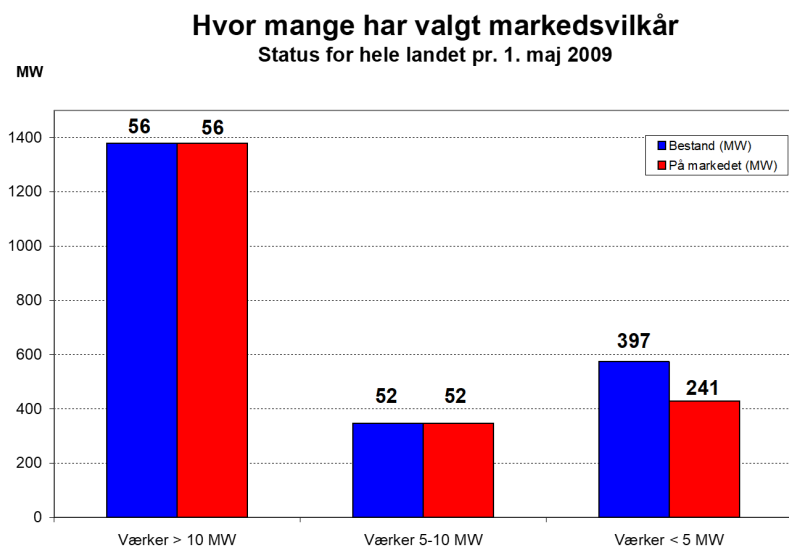
# Market participation development

Danish framework conditions:

- Mandatory for large CHP units (> 10 MW) to participate on market terms from 2005, voluntary for all others

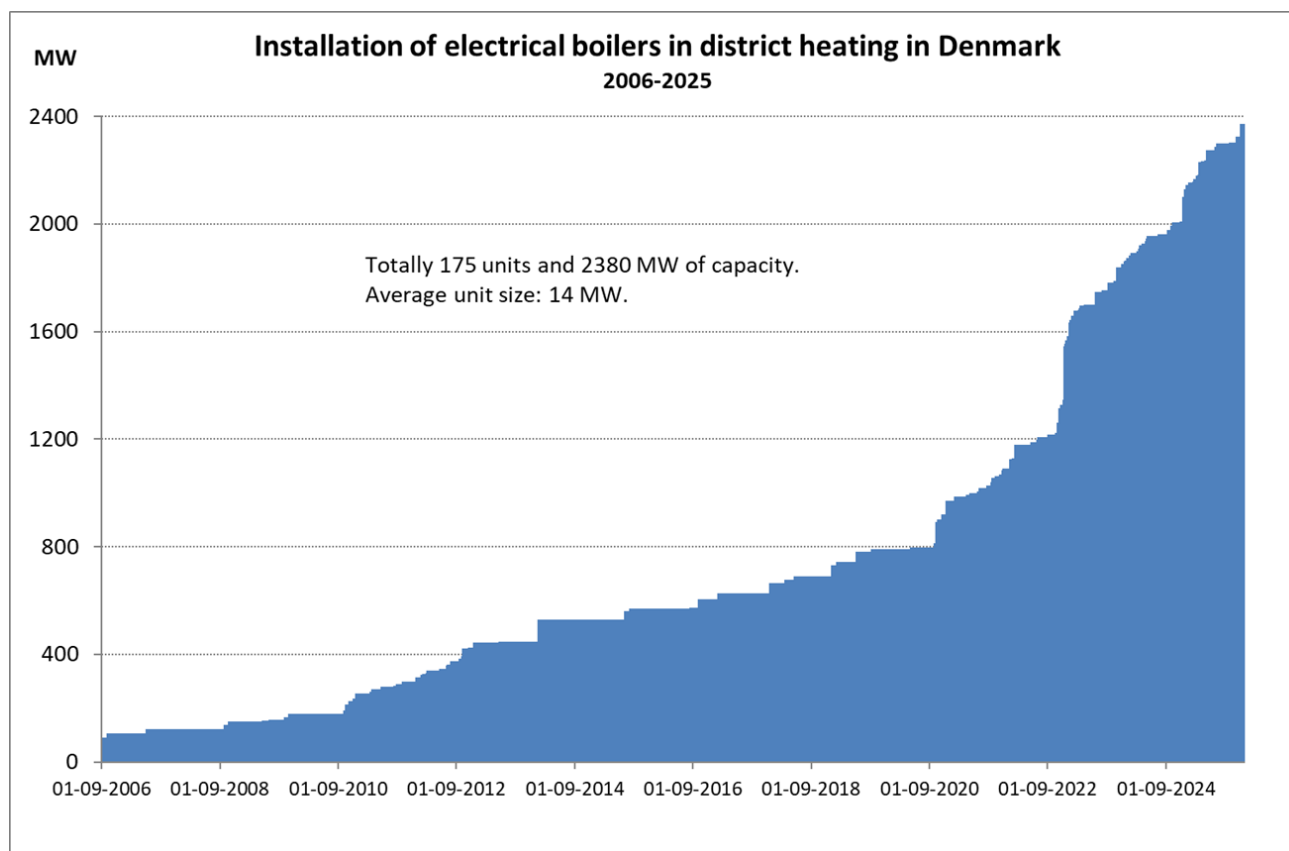
Actual participation on market terms:

51 CHP plants (856 MW) in 2005, 101 CHP plants (1176 MW) in 2007 and 349 CHP plants (2160 MW) in 2009.



## The market integration continues...

Today, the CHP industry provides essential flexibility to the electricity system and further supports the green transition through a number of investments in the 2010s – including investments in electrical boilers.



Besides being fairly cheap and easy to install and operate, electrical boilers can take over heat production when the spot price is sufficiently low.

In addition, electrical boilers are capable of delivering all kinds of ancillary services due to their flexible use.

Questions?

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