Heat pumps on Smart district heating in Denmark

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Agenda

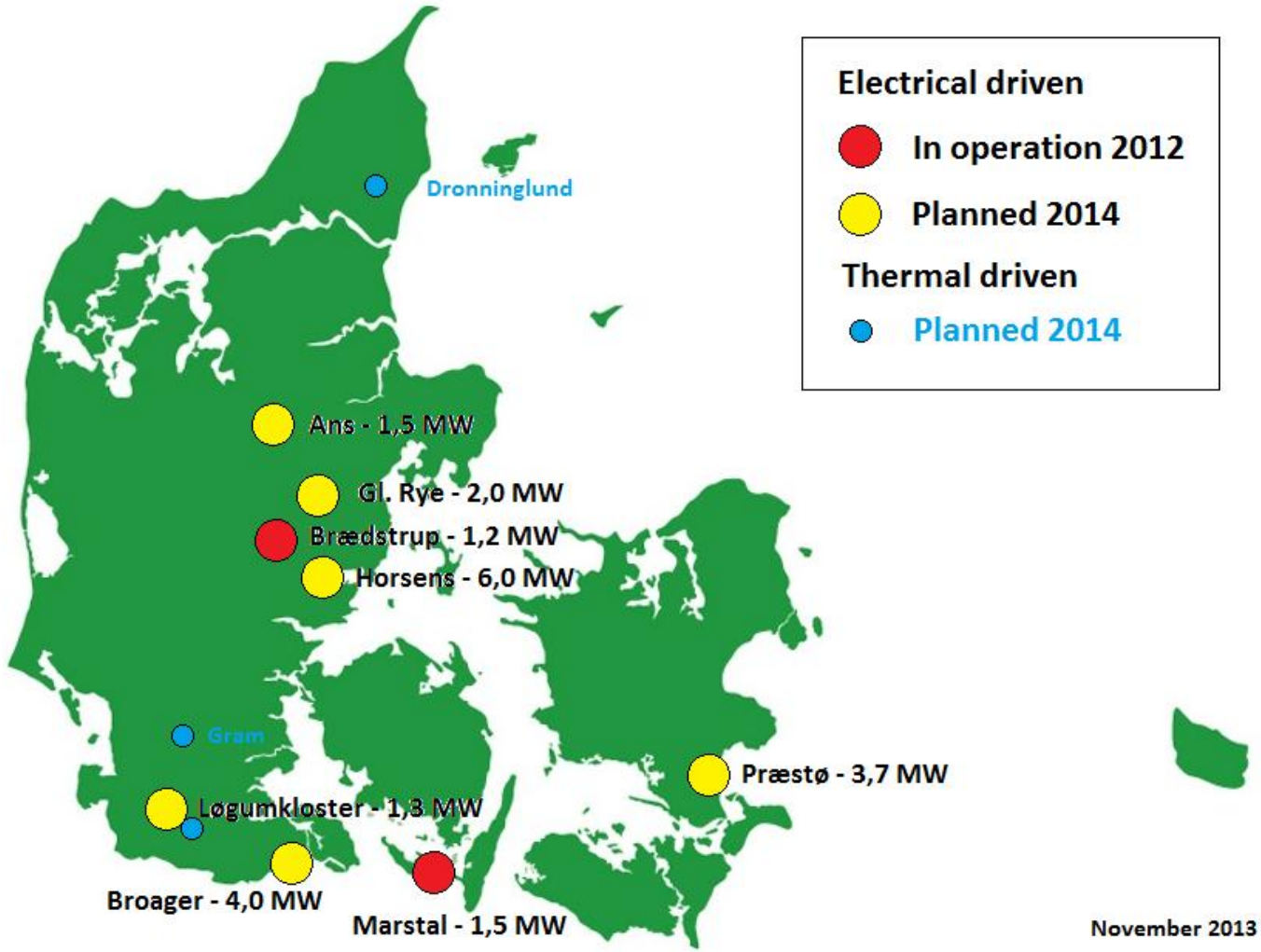
- Who is PlanEnergi?
- What is ”Smart district heating”?
- What’s so special about Denmark?
- What is the SUNSTORE^{TM} concept?
- Where can I read more?

PlanEnergi

- Consultants
- 30 years with RE
- 29 employees
- Offices in
  - Skørping
  - Aarhus
  - Copenhagen

- Distict heating
  - Solar thermal
  - Seasonal storages
  - Heat pumps
  - a.m.
- Energy planning
- Biogas
- Wind turbines

PlanEnergi projects with heat pumps for district heating in DK



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Definitions and solutions

- **District heating** (DH) is

  a water based system which distributes heat from production units to consumers of space heating and domestic hot water

- DH is ”**smart**”

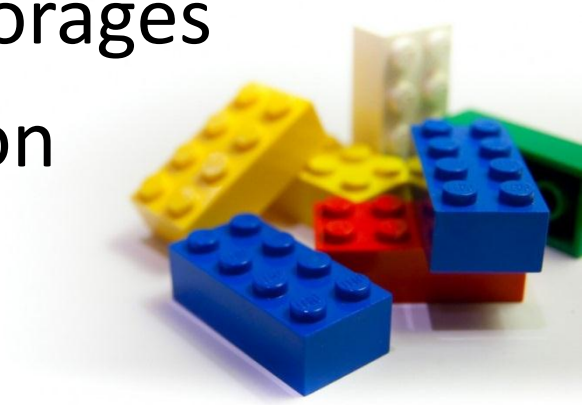
  when it cuts down the use of **fuels** in the energy system (power + heat + transportation)

- DH can cut down the use of fuels

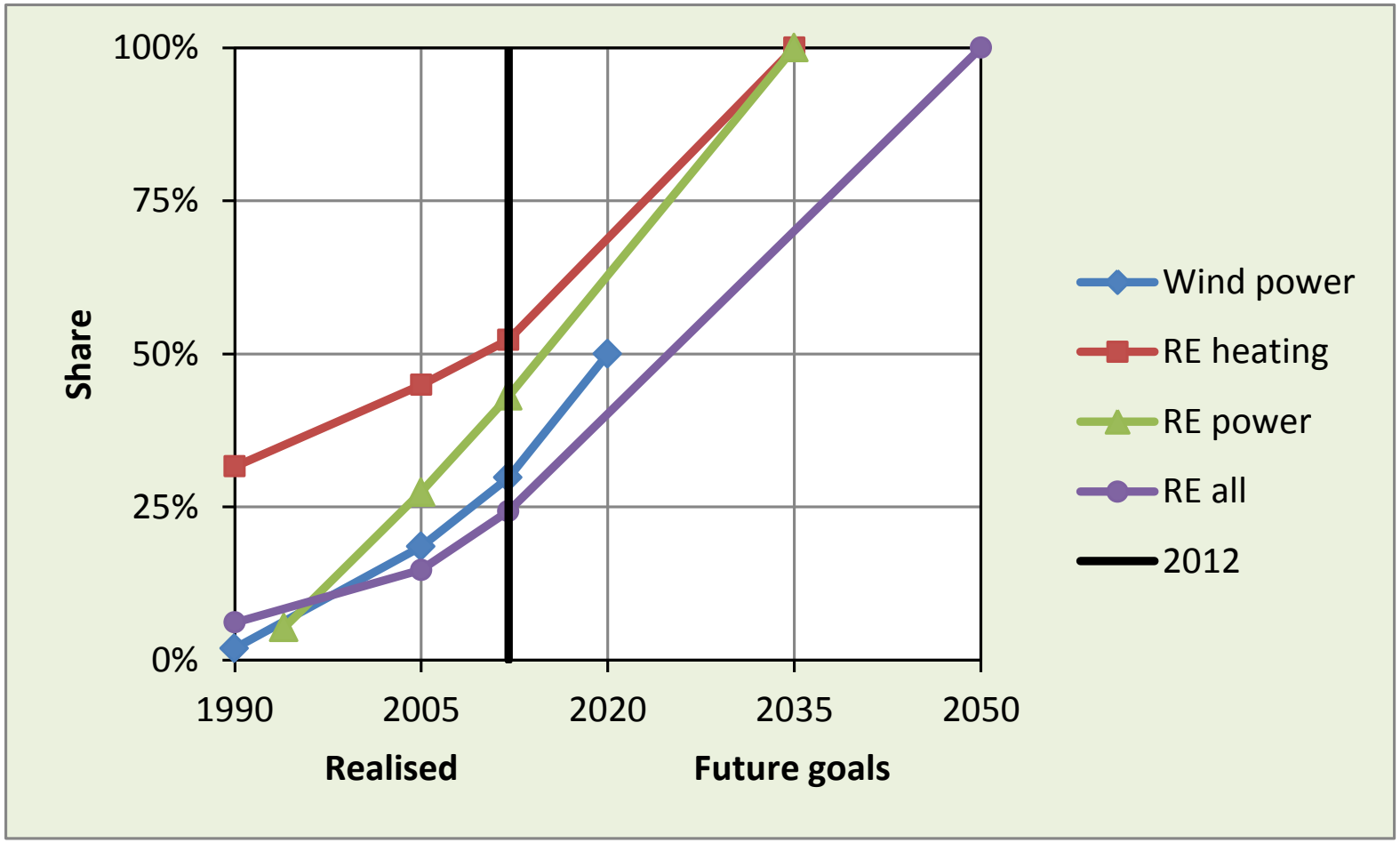
  by using **solar thermal**, **heat storages** and **heat pumps**

What's so special about Denmark?

- National climate goals
- High taxes
- Lot of district heating
- World leader in solar thermal DH
- Development of seasonal heat storages
- Strong traditions with refrigeration



National climate goals



High taxes

- E.g. 0.42 €/Nm^3 on natural gas (for heating)
- or 35 €/MWh on produced heat
- Makes RE more competitive!

Lot of district heating

- 63% of all homes in DK has DH
- Low DH temperatures (typical 80°C / 40°C)
- 460 DH companies
- 250 of these are natural gas fired CHP plants
- Most DH companies owned by the consumers
- DH price is regulated by law

World leader in solar thermal DH

ARCON SOLAR

SUNMARK®

SUSTAINABLE SOLAR SOLUTIONS

Boreholes in Brædstrup:
8,000 + 10,600 m^2

SUNSTORE 4 in Marstal:
18,300 + 15,000 m^2

Development of seasonal heat storages

Dronninglund: 60,000 m^3 pit heat storage (under construction)

Strong traditions with refrigeration

- Sabroe / Johnson Controls
  - Industrial compressors and heat pumps

Brædstrup: 1.2 MW_{th}

- Danfoss
  - Small compressors and refrigeration components

- Advansor
  - CO_2 heat pumps

ADVANSOR™ by Hill PHOENIX

Marstal: 1.5 MW_{th}

Now, let's put the bricks together

LEGO model of Brædstrup DH in LEGOLAND, Billund

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Smart district heating

- **RE** replaces fuels
- Adds **heat storages** to even out timeshifts between heat supply and heat demand
- Uses **heat pumps** as flexible power consumption that utilizes low temperature heat sources
- This makes it possible to integrate more **fluctuating RE** in the energy system

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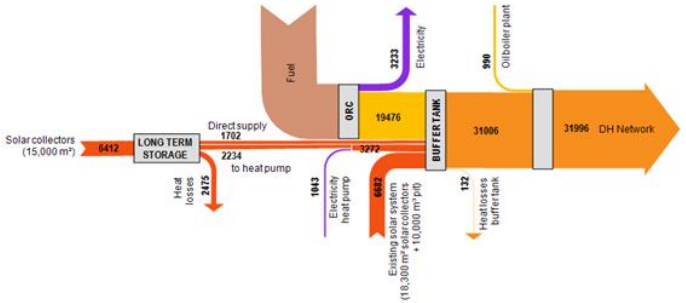
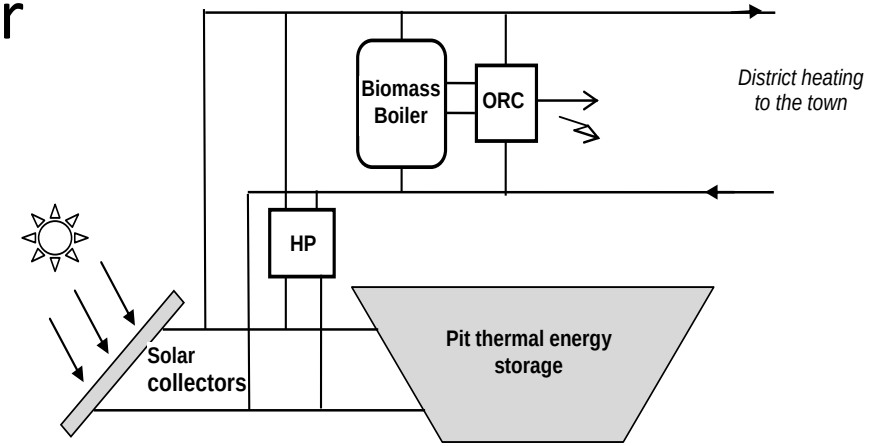
The SUNSTORE™ concept

- A district heating system with
  - 100% RE
  - > 50% solar thermal
  - A seasonal heat storage
  - A heat pump
- The SUNSTORE 4 project
  - Supported by EC 7th framework programme
  - Demonstration plant in Marstal, 2012

SUNSTORE 4 demonstration plant in Marstal

- District heating system consisting of
  - 33,300 m^2 solar plant
  - 75,000 m^3 pit heat storage
  - 1.5 MW_{th} heat pump
  - 4 MW wood chip bioler
  - 750 kW_e ORC





Heat storages and heat pumps in DK

- Report made for the Danish Energy Agency

- Report made by
  - PlanEnergi
  - Teknologisk Institut
  - GEO
  - Grøn Energi

- http://www.ens.dk/undergrund-forsyning/el-naturgas-varmeforsyning/forsyning-varme/fjernvarme/analyse-fremtidens

Thank you for your attention

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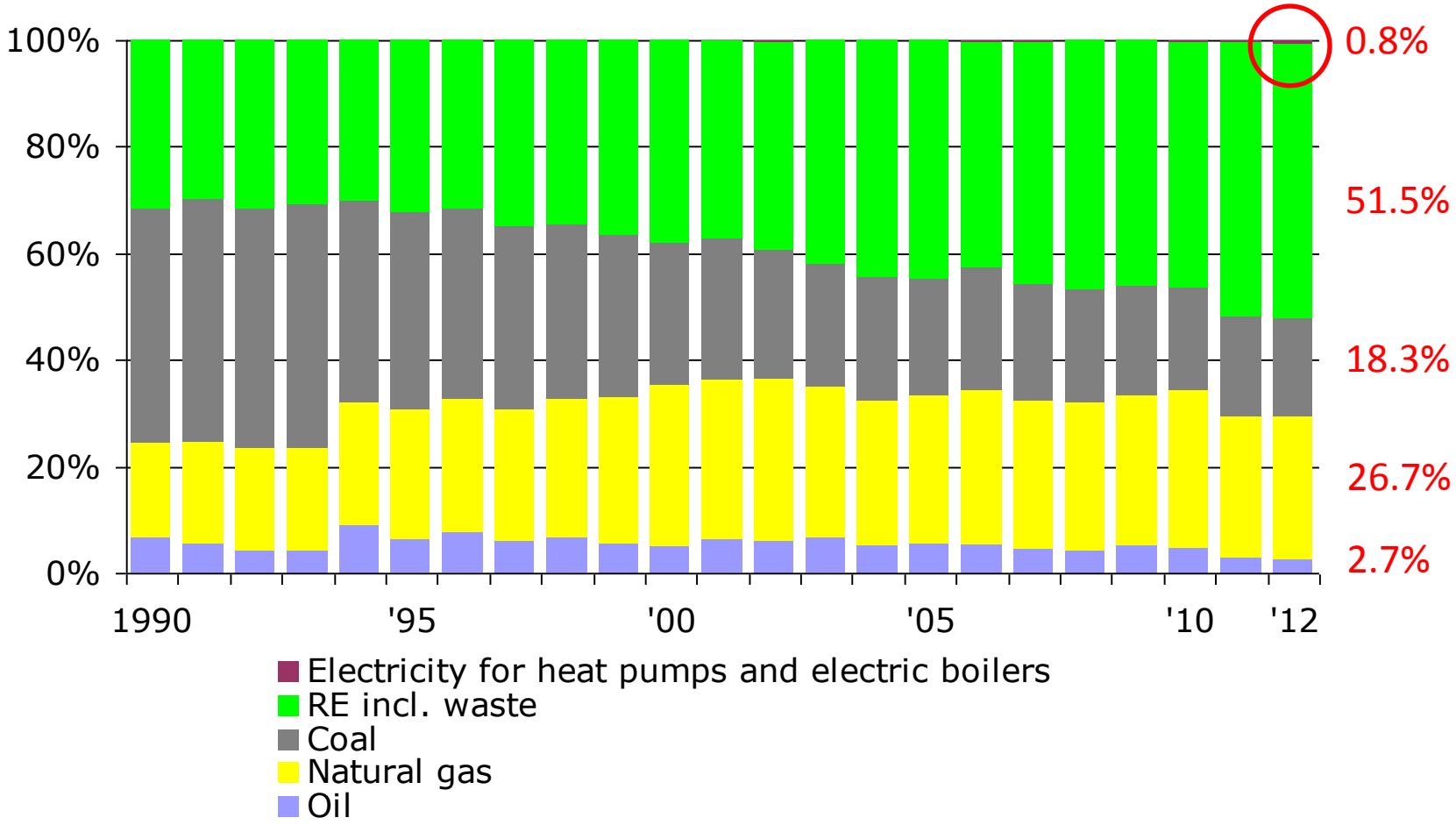
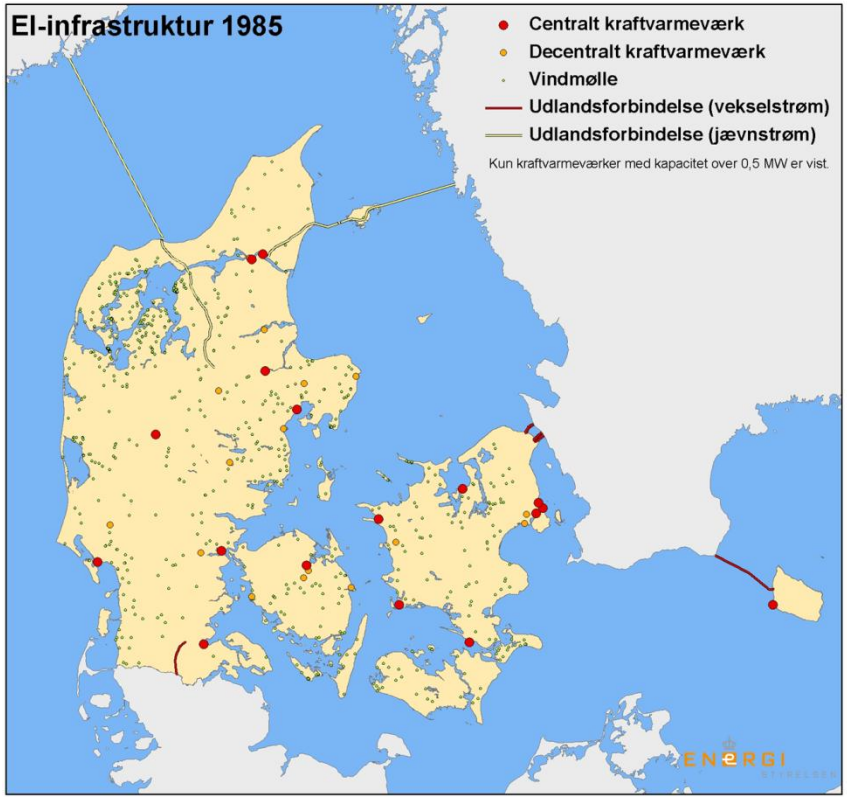
Bonus material

Fuel consumption for DH

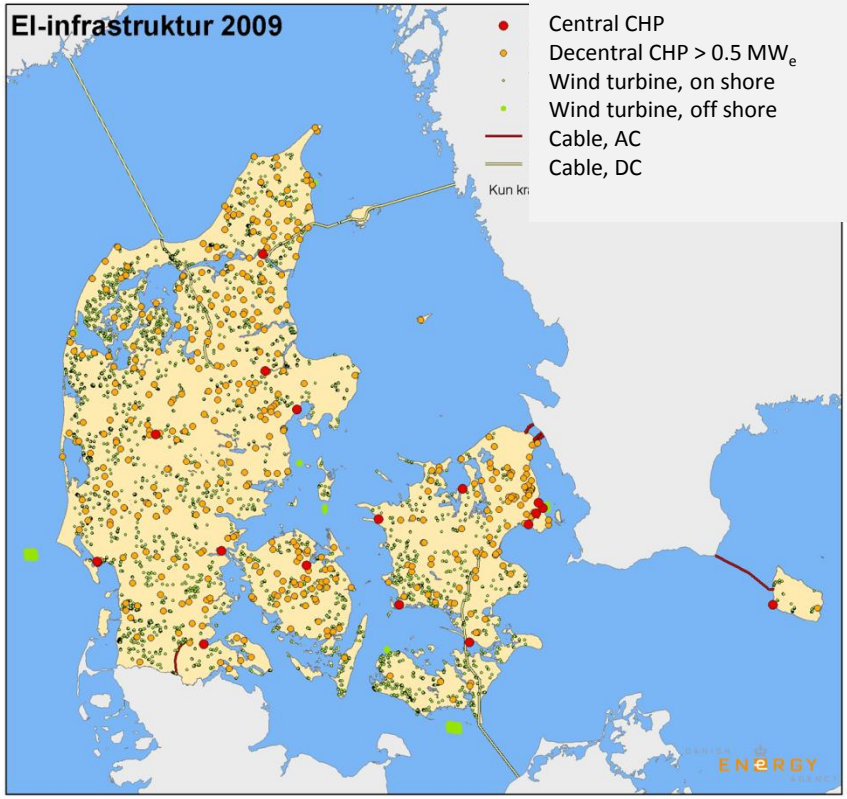


Power infrastructure

1985



2009



Installed power capacity, 2012