Distributed Generation Trends and Regulation:

The Danish Experience

Cambridge

June 6, 2014

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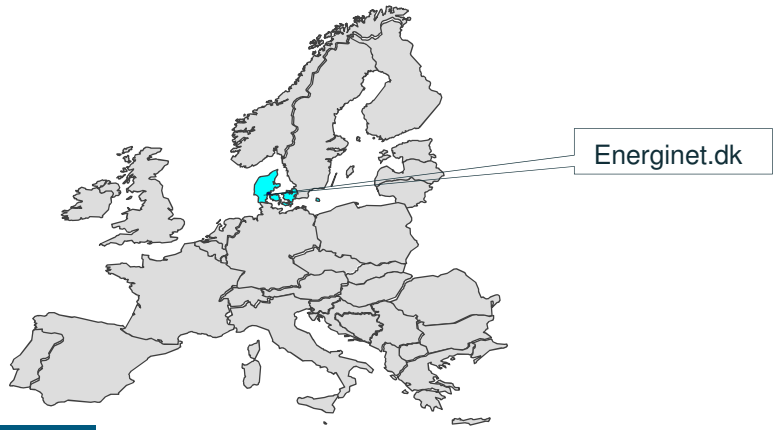
Agenda

- Briefly about Energinet.dk
- The transition from central planning to distributed generation
- Observations regarding incentives
- Challenges with a large share of renewables

Energinet.dk

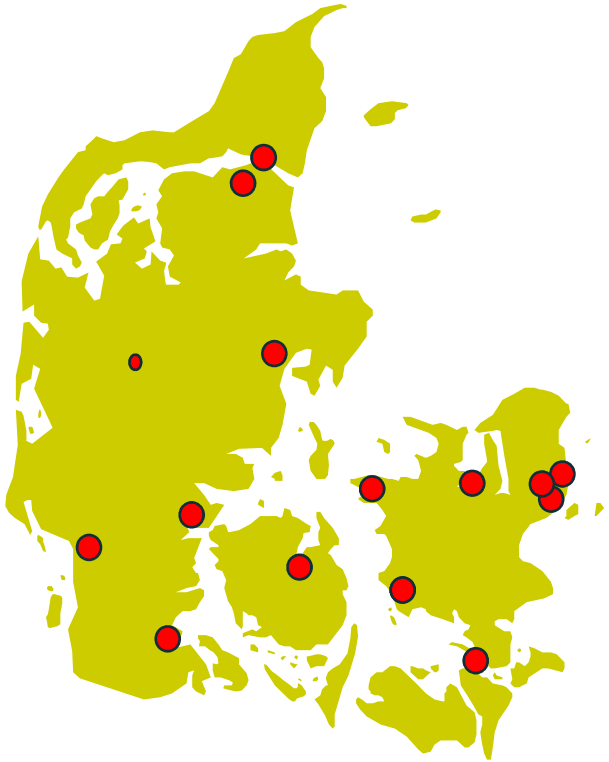
- National Transmission System Operator for Electricity and Gas in Denmark
- Independent public enterprise with approx. 650 employees
- Owns and operates the main electricity and natural gas grids
- Core tasks:
  - Develop a more flexible power system capable of handling considerably larger amounts of renewable energy.
  - Ensure well-functioning electricity and gas markets.



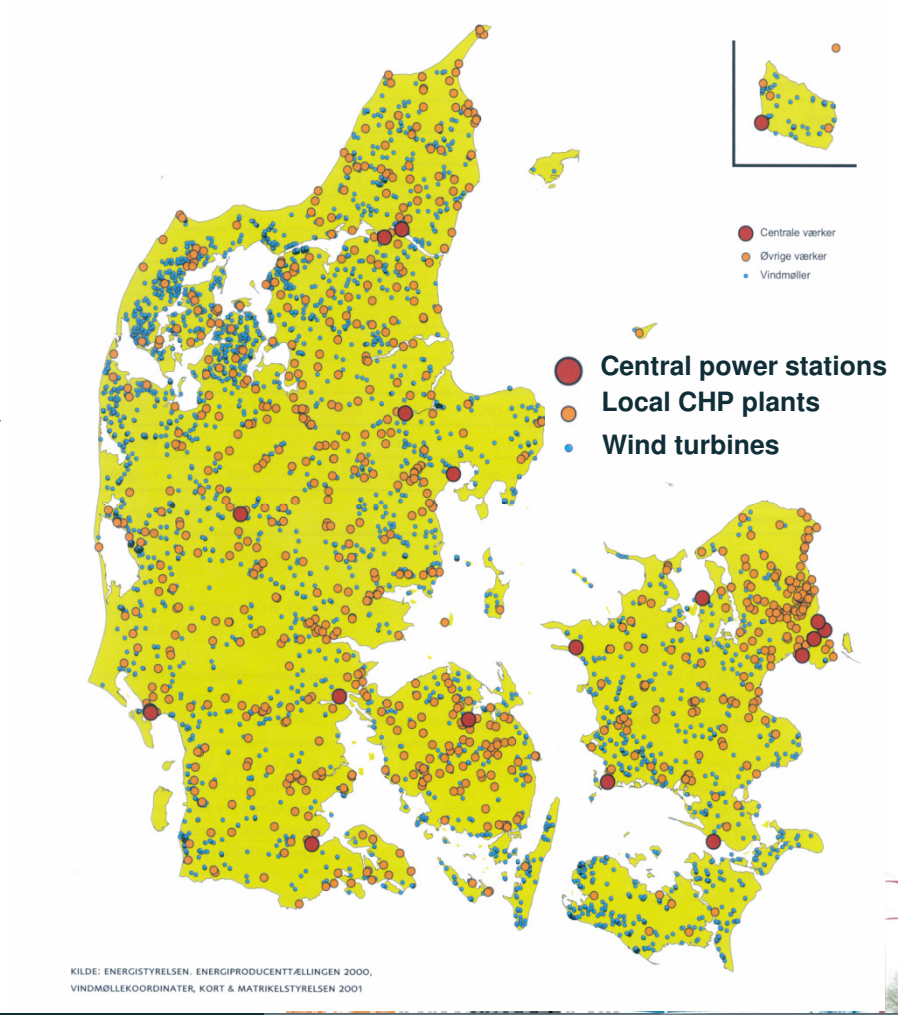
The transition from central planning to distributed generation

- The electricity market was introduced in 1999

1990



2014



The Danish Power System
Installed Capacity, January 1st, 2014

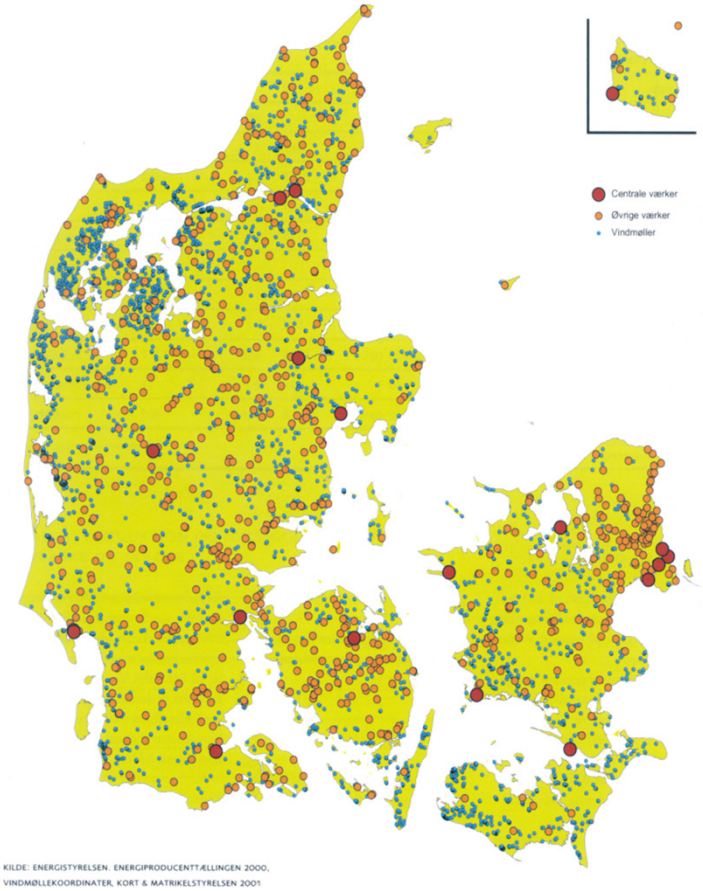
ENERGINET.DK

20 Central Power Stations

4,200 MW

670 Local CHPs

2,300 MW



5,175 Wind Turbines

4,800 MW

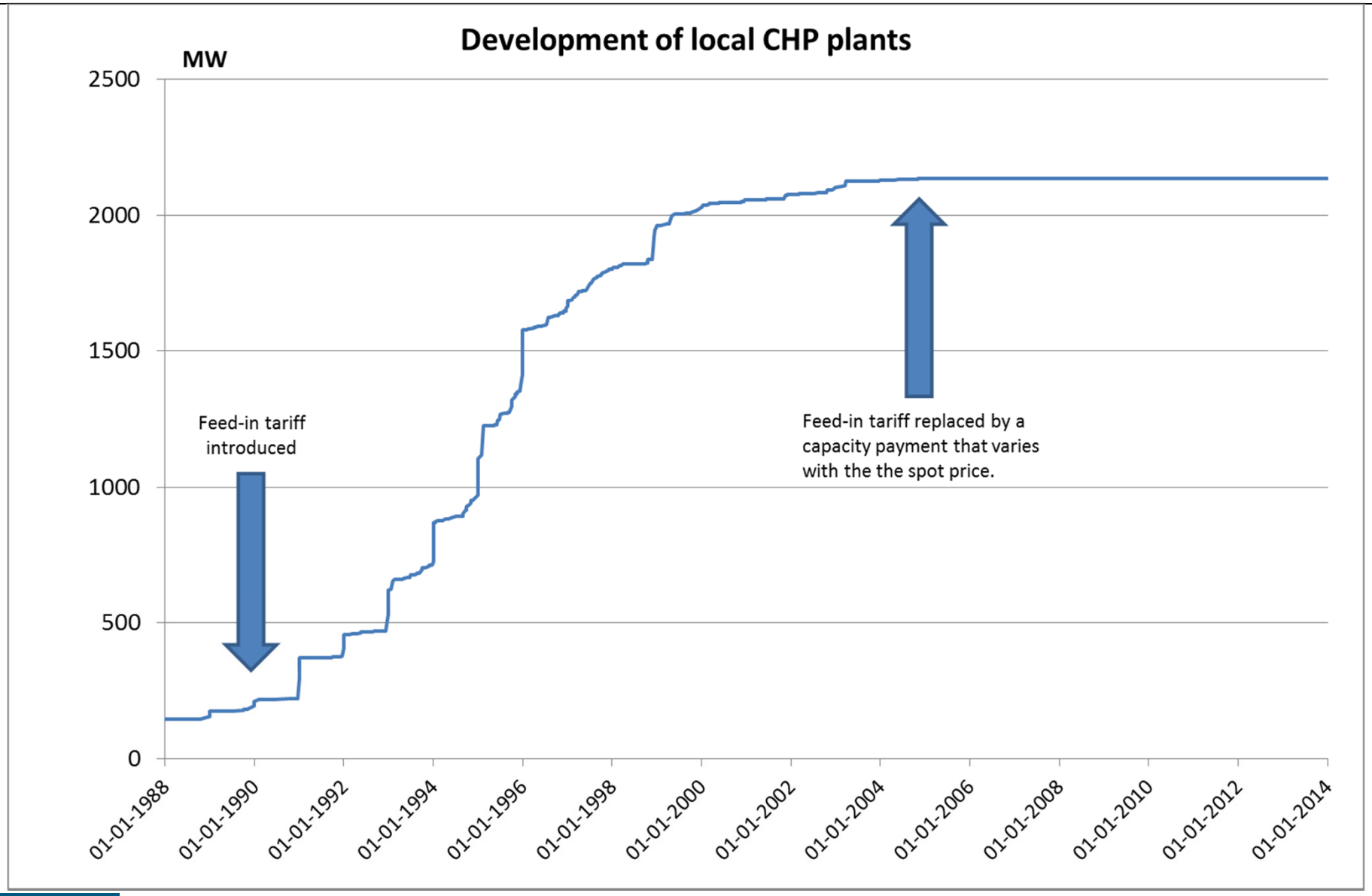
90,000 Solar PV

575 MW

Demand is between 2100 MW and 6300 MW

The development of local CHPs

- The political discussions began in the mid-1980s in the wake of the oil crises.
- Keywords: co-production of electricity and heat, energy effiency.
- A feed-in tariff was approved by the 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
- 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 is socialized – i.e financed through a Public Service Obligation tariff paid by the final customers.
- The incentive is announced to end in 2018.


Development of local CHP plants
MW
2500
2000
1500
1000
500
0
Feed-in tariff introduced
Feed-in tariff replaced by a capacity payment that varies with the the spot price.
01-01-1988
01-01-1990
01-01-1992
01-01-1994
01-01-1996
01-01-1998
01-01-2000
01-01-2002
01-01-2004
01-01-2006
01-01-2008
01-01-2010
01-01-2012
01-01-2014

The development of wind power

- The political discussions began in the late1980s.
- Conditions for wind power have been the most discussed issue in Danish energy policy during the last 20 years.
- Keywords: CO_2-reductions, ensure that the Danish wind power industry remains a frontrunner, fossil-free by 2050.
- Today: Consensus in the Danish parliment about green transition and the role of wind power in that context.
- Specific goal: By 2020, wind power must constitute 50% of the electricity consumption.

Incentives for the development of wind power

- Extensive regulation and financial incentives are in place with regard to the development onshore wind power and to promote public acceptance:
  - More than 20 different subsidy schemes have been applied during the last 15 years, including fixed feed-in tariffs, premiums with and without caps etc.
  - Possible grid expansion costs due to environmental friendly production are socialized – i.e. the owner just pays for the connection to the nearest location with the correct voltage level.
  - The ”loss of value” scheme: If a property loses value due to the erection of new wind turbines, the owner is ensured full compensation for his loss.
  - The ”option to purchase” scheme: Allows the local citizens to purchase a minimum of 20 % of the project at cost price.
- All the above costs are included in the PSO tariff.

Connection charges and handling of DSO grid costs in particular.

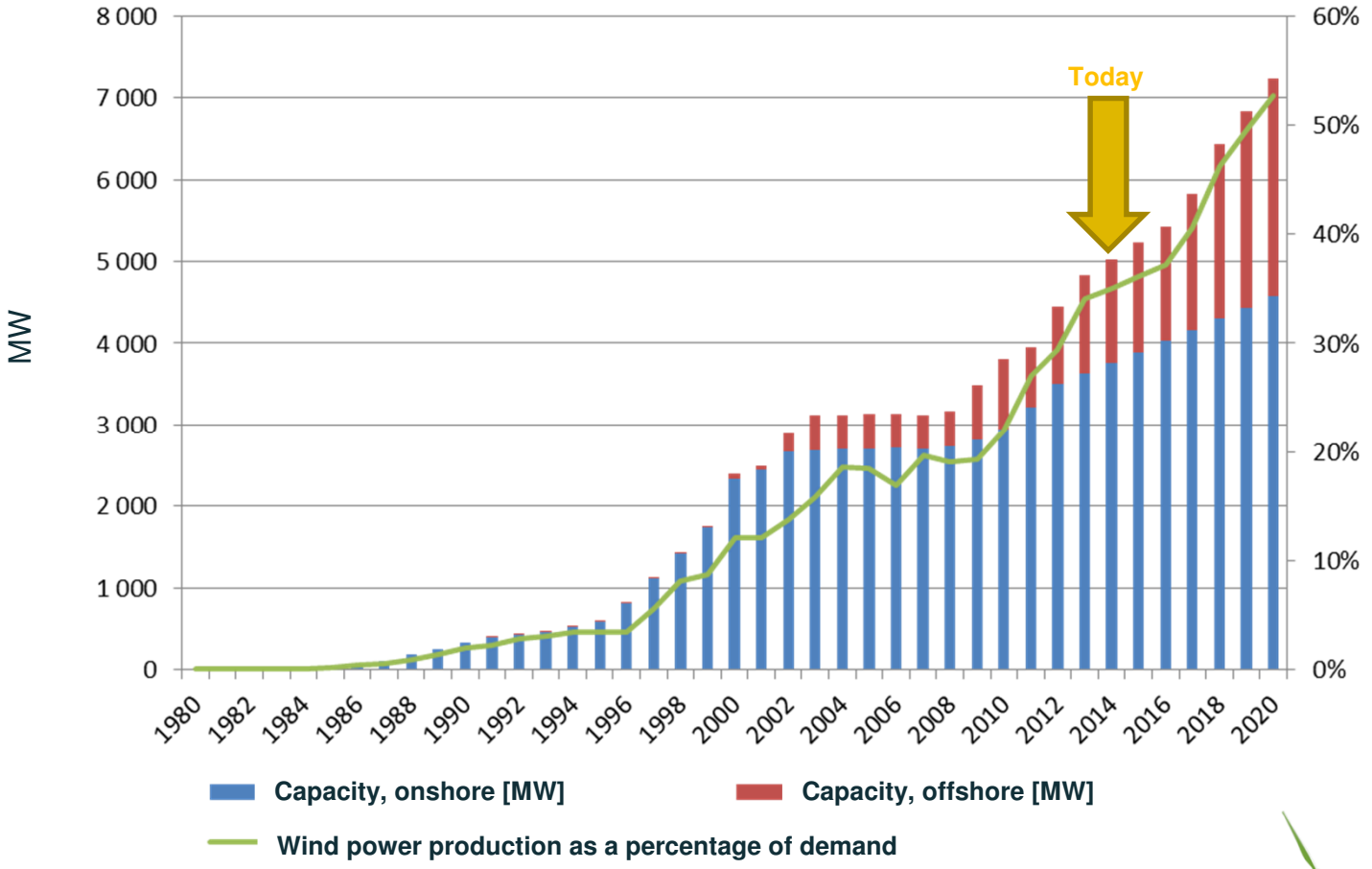
- All new units of environmental friendly production (wind power, biogas, CHP, PV) pay the direct cost to be connected to the nearest location with the right voltage level.
- The DSO pays for possible distribution network upgrade (10 kV and 60 kV). For wind power projects above 1,5 MW the DSO is obliged to add a connection point in the wind farm area.
- The DSO is subsequently compensated by Energinet.dk according to a model calculation of the grid expansion costs.
- Consequently, the reimbursement may overcompensate or undercompensate the DSO[1)].
- A key average figure: The DSO is compensated with 40,000 £ per MW installed capacity.

1) An independent sample analysis showed a difference between model calculation and actual costs of up to 5%.

Connection and system charges, cont'd.

- All generators except for offshore wind farms pay a transmission system charge to Energinet.dk. The charge is currently 0,4 € per MWh.
- The charge is set in accordance with the guidelines from EU, cf. EU Regulation 838/2010, and is not dependent on location.
- There is no distribution system charge at the DSO level.
- The generators pay a monthly fee to the DSOs for metering and administration.
- Regarding use of grid: Renewables have priority access to the grid. However, wind turbine owners are encouraged to participate in the regulating power markets and provide services to the TSO on commercial terms.

Development of wind power in Denmark

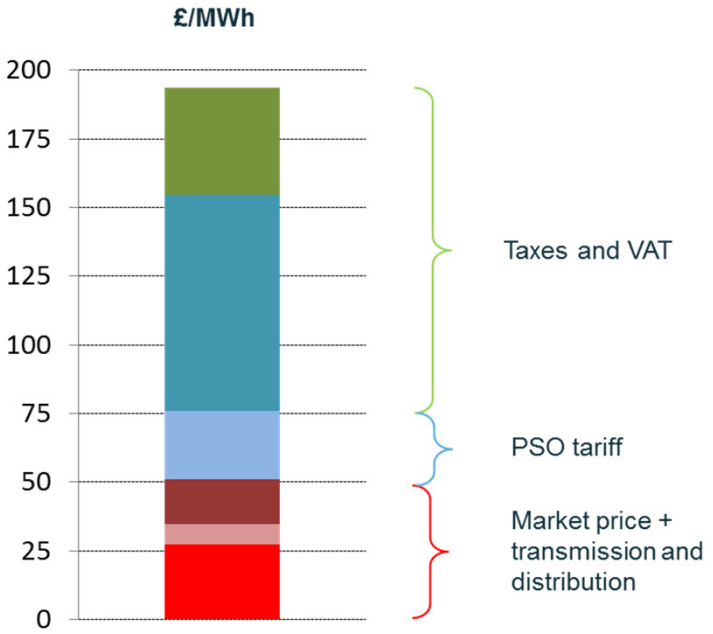


Offshore wind power

- Regulation regarding the development of offshore power:
  - A number of locations have been pointed out
  - Wind farms are built by public tender
  - Fixed feed-in tariff applies (~ the offer price)
    - Latest addition: The subsidy disappears in case the spot price is negative
  - Grid connection costs are socialized
    - Latest addition: This rule does not apply to near-sea wind turbines
- All the above costs are included in the PSO tariff.

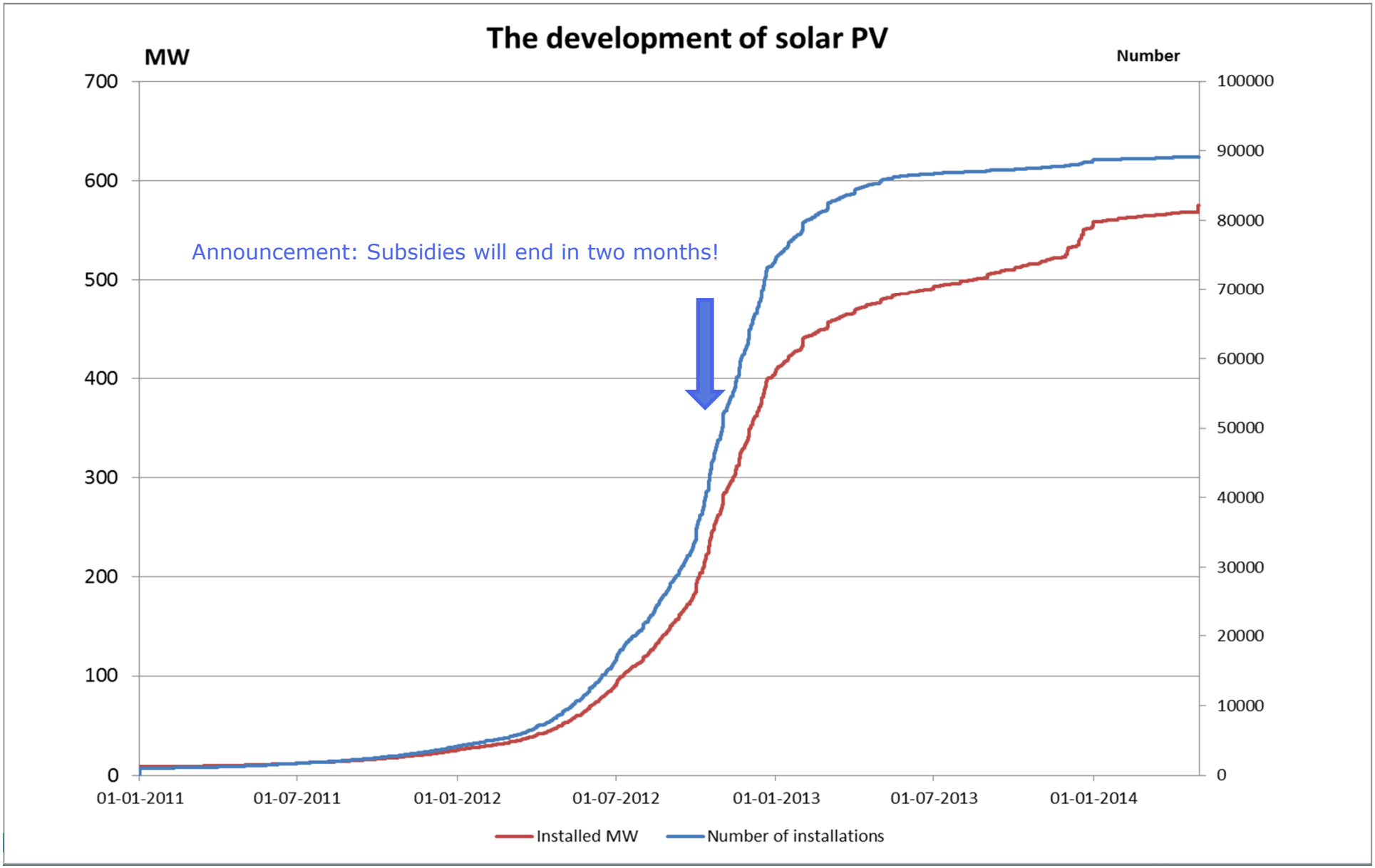
The development of solar PV

- Since 1998 households can set up solar power plants (max 6 kW) and achieve net settlement – i.e. production from the PV system in a calendar year can offset the household own consumption within a calendar year.



A decrease of the costs of solar PV installations started in 2011 – probably due to agressive campaigns in Germany.

This development made the investment in solar more and more attractive and created a boom in Denmark in 2013.


The development of solar PV
MW
Number
700
600
500
400
300
200
100
0
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Announcement: Subsidies will end in two months!
01-01-2011
01-07-2011
01-01-2012
01-07-2012
01-01-2013
01-07-2013
01-01-2014
Installed MW
Number of installations

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Observations regarding incentives

It is important that financial incentives support market operations, cf. EU guidelines:

- Aid should be granted as a premium in addition to the market price.
- Beneficiaries should sell the electricity directly in the market subject to standard balancing responsibilities.
- Generators should have no incentive to generate electricity under negative prices.

These conditons ensures that renwables will react on price signals in the electricity market.

Socializing grid expansion costs means that the owner does not take into account local grid conditions – i.e. there is a risk of inefficient and expensive grid extensions and lack of socioeconomic optimal considerations.


EUROPEAN COMMISSION

Brussels, XXX
C(2014) 2322/3

COMMUNICATION FROM THE COMMISSION

Guidelines on State aid for environmental protection and energy 2014-2020

{SWD(2014) 139}
{SWD(2014) 140}

Important notice: These Guidelines have been adopted in principle on 8 April 2014. The formal adoption will follow. This version is published for information purposes only and without prejudice to the authentic texts that will be published in the Official Journal in all EU official languages.

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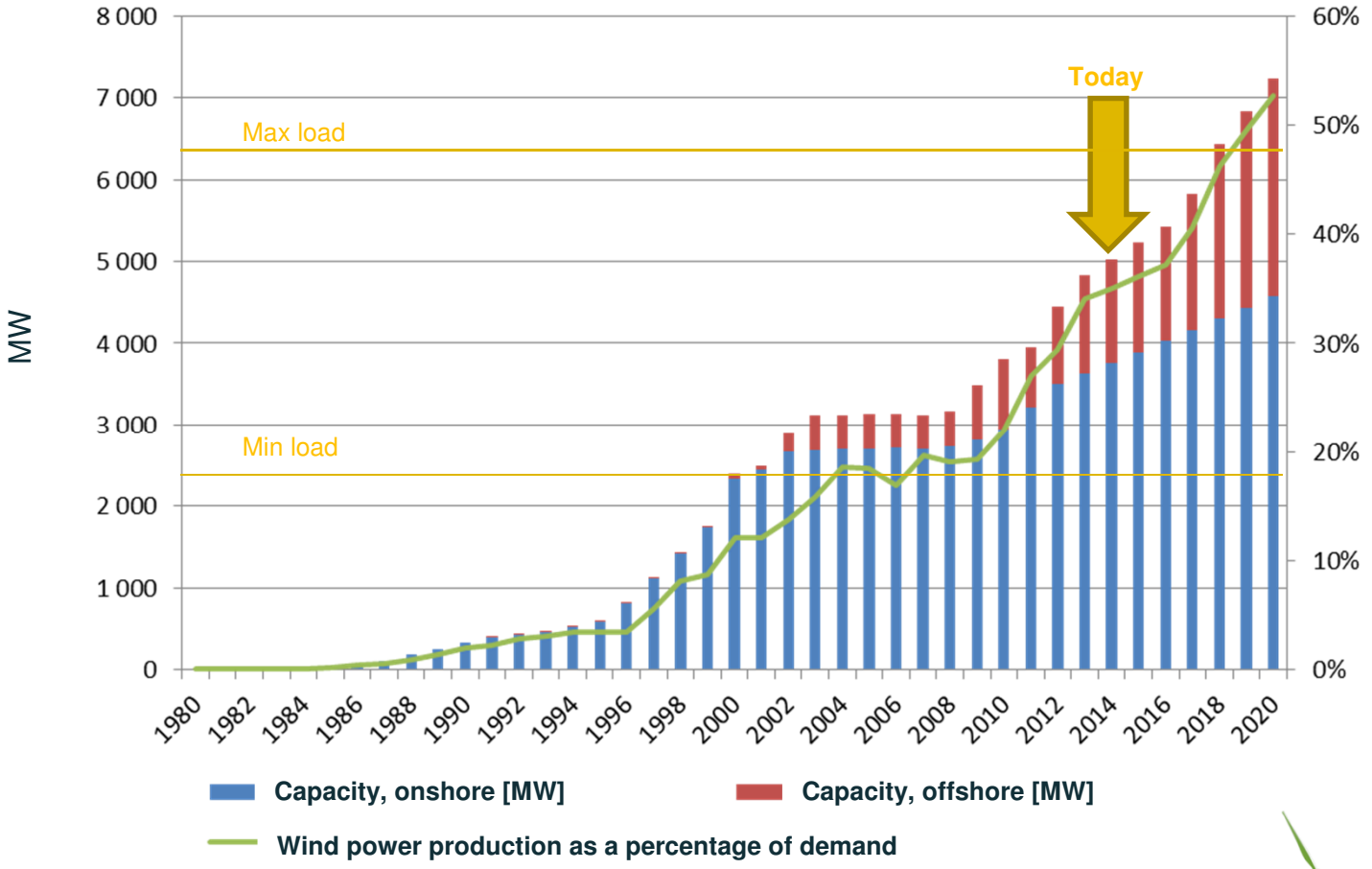
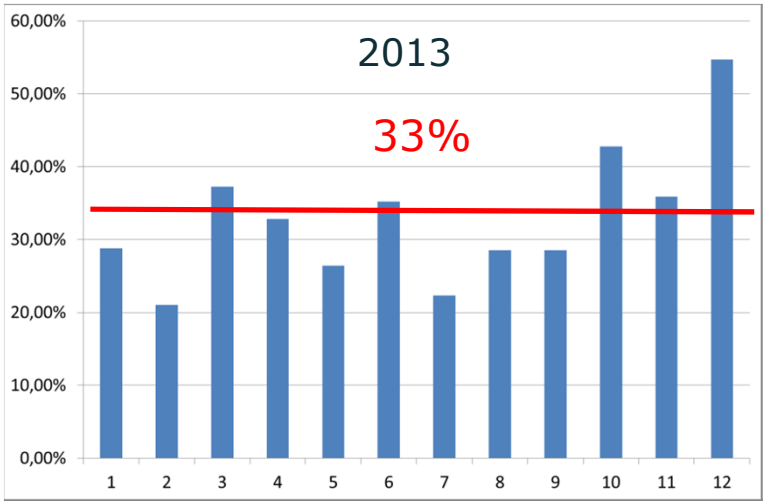
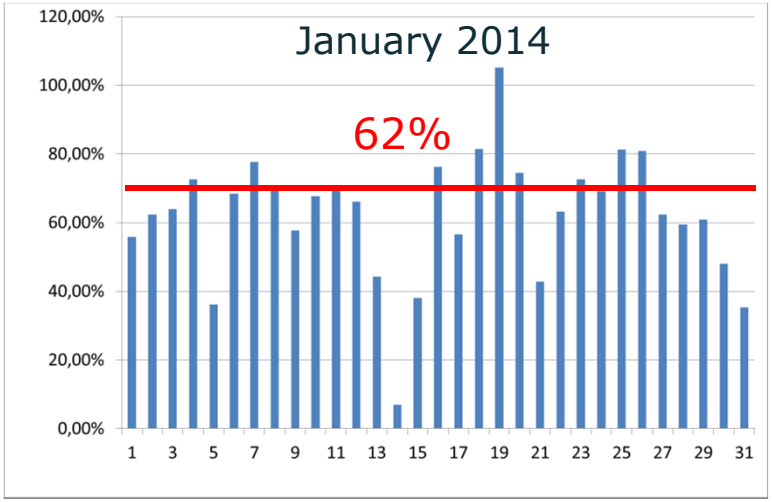
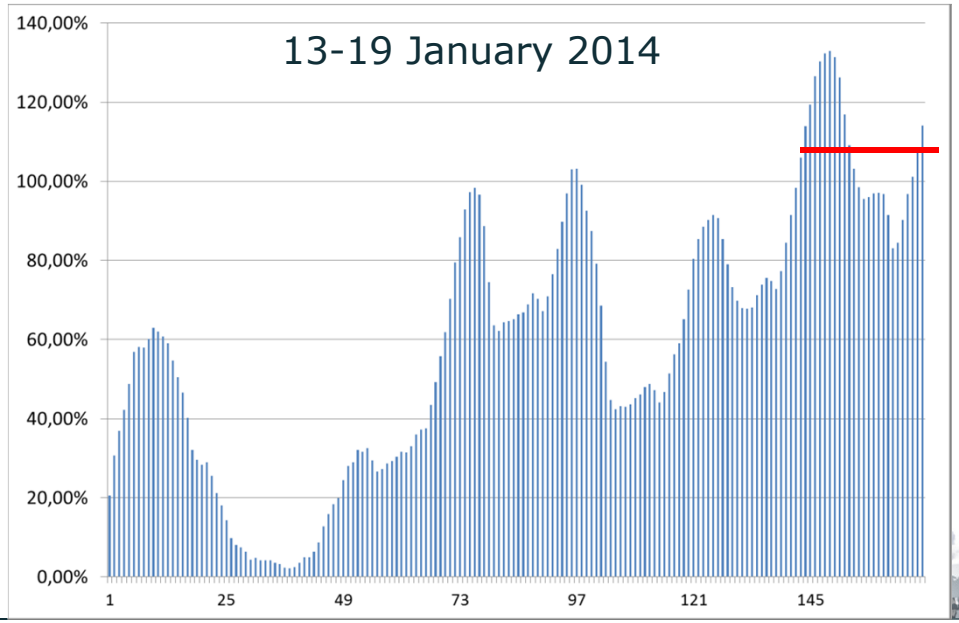
Development of wind power in Denmark



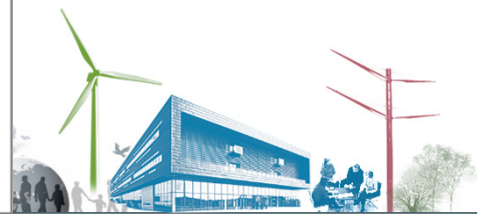
Wind Power Share in Denmark





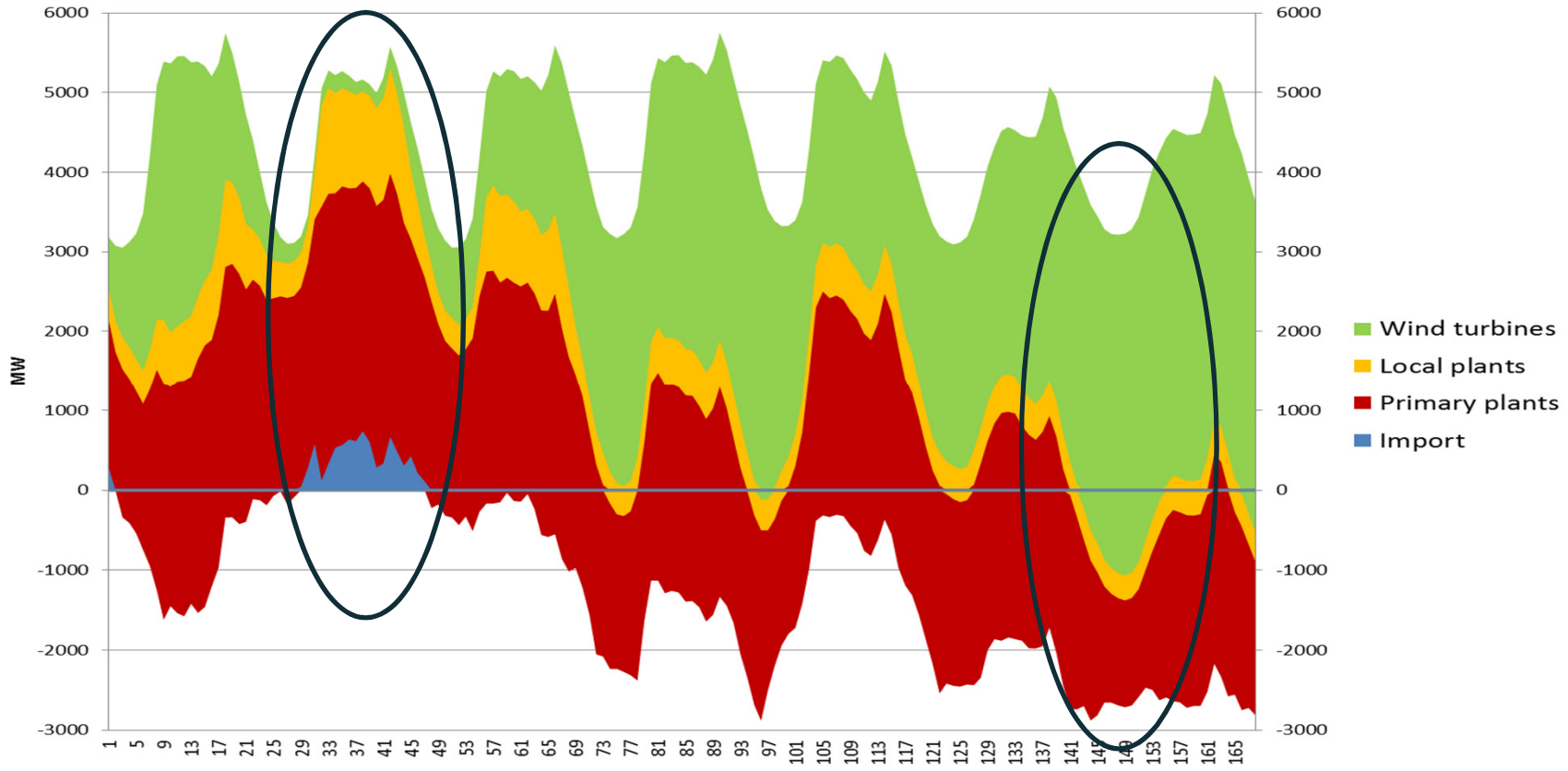


Sunday 19 Jan
105%



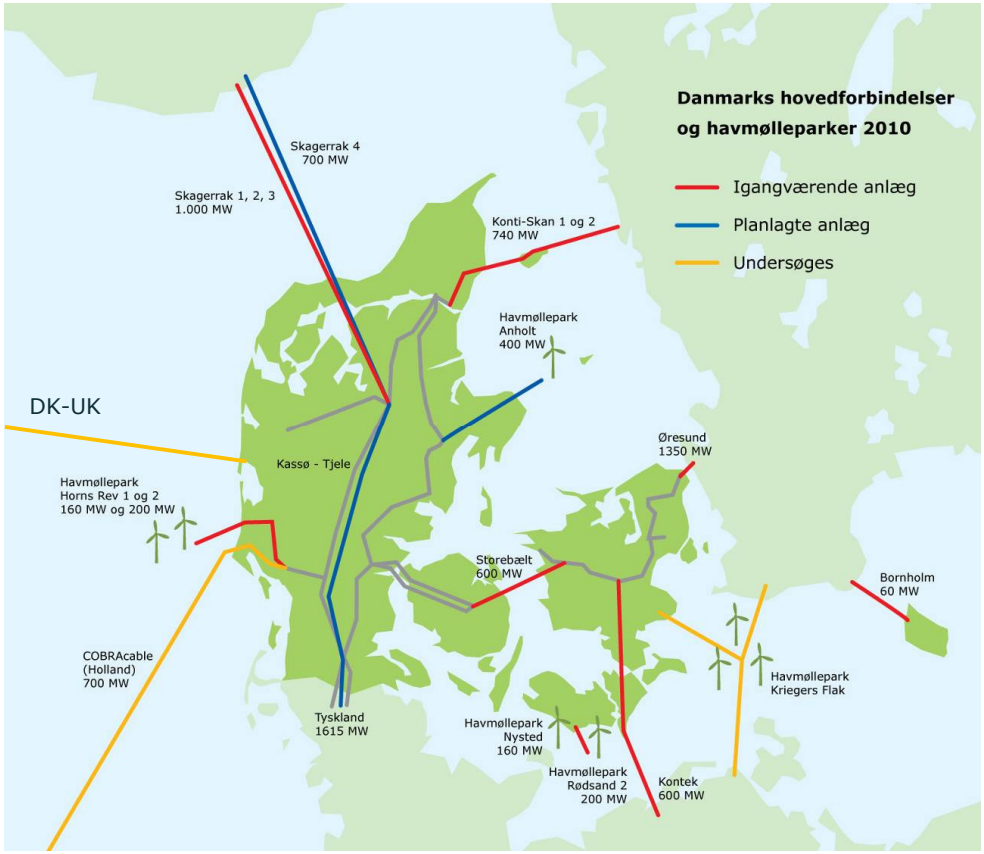
Flexibility in the electricity system

- hourly dispatch 13 – 19 January 2014

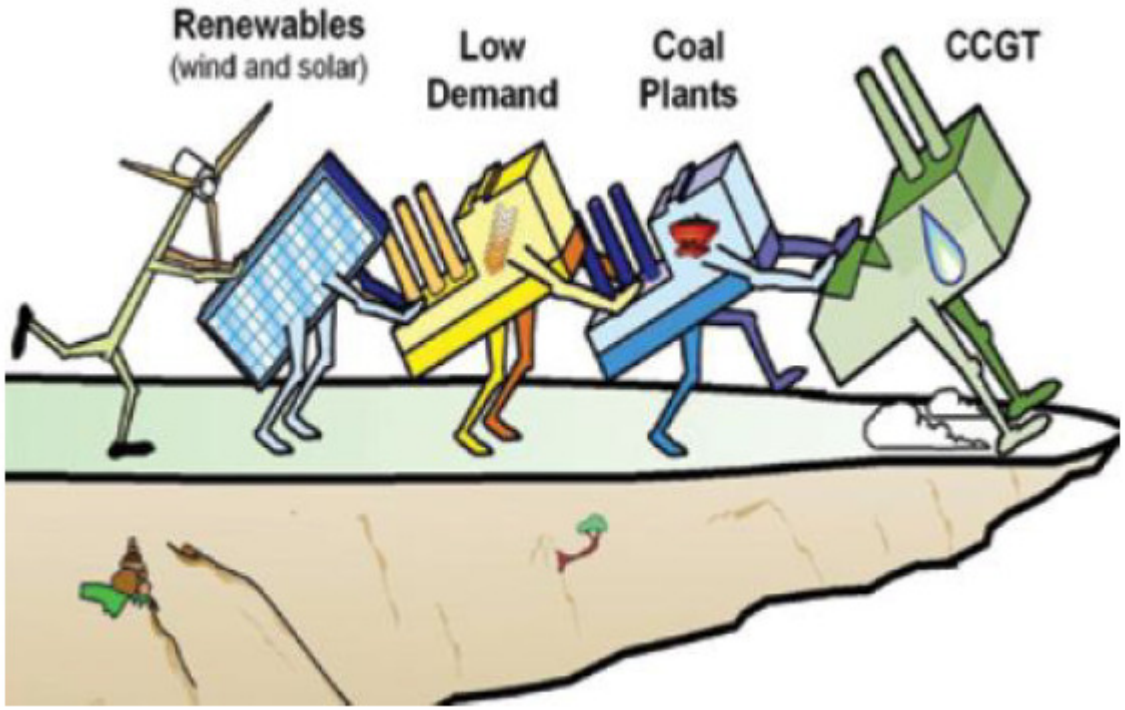


How to cope with the variations?

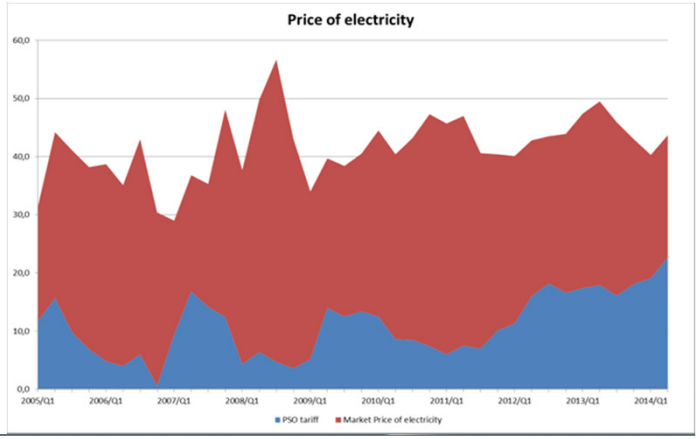
- Strong transmission system to balance variable RES in a large area
- Competitive electricity markets to optimize grid utilization



The challenge



- The continued governmental support around Europe to renewable with zero marginal costs drives conventional units out of the market.
- Role of thermal power plants is changing towards providing flexibility potential / back-up. Possible capacity markets.



Thank you for your attention!

www.energinet.dk

This is how we deal with the challenges

What do we do, when the wind is not blowing and the sun does not shine?

SHORT TERM

International connections

Cross-border markets

MEDIUM TERM

Smart Grid

Integration of electricity, gas, heat and transport

LONG TERM

Storage of wind power

Green gases