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A Snapshot of the Danish EnergyTransition in the Power Sector – An Overview

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Agora‘s “Lessons Learned from Denmark“ Series

Event 1: ”Renewable Energy Integration and Flexibility” (24.09.2015)

→ Wind power integration and the Danish flexibility experience - Report by Ea Energy Analysis

→ Role of the heat sector

→ System integration of wind energy

→ Interconnection and cross-border market integration

Event 2: “Future Paths of Renewables – Scenarios, the Grid and Support Schemes”

12th of November in Berlin - Policy Paper by Agora & DTU Management Engineering

→ Scenarios for the future energy system and the integrated Danish approach

→ Grid expansion and system reliability

→ Support schemes and tendering of offshore wind

Deep Dives

Lessons Learned a

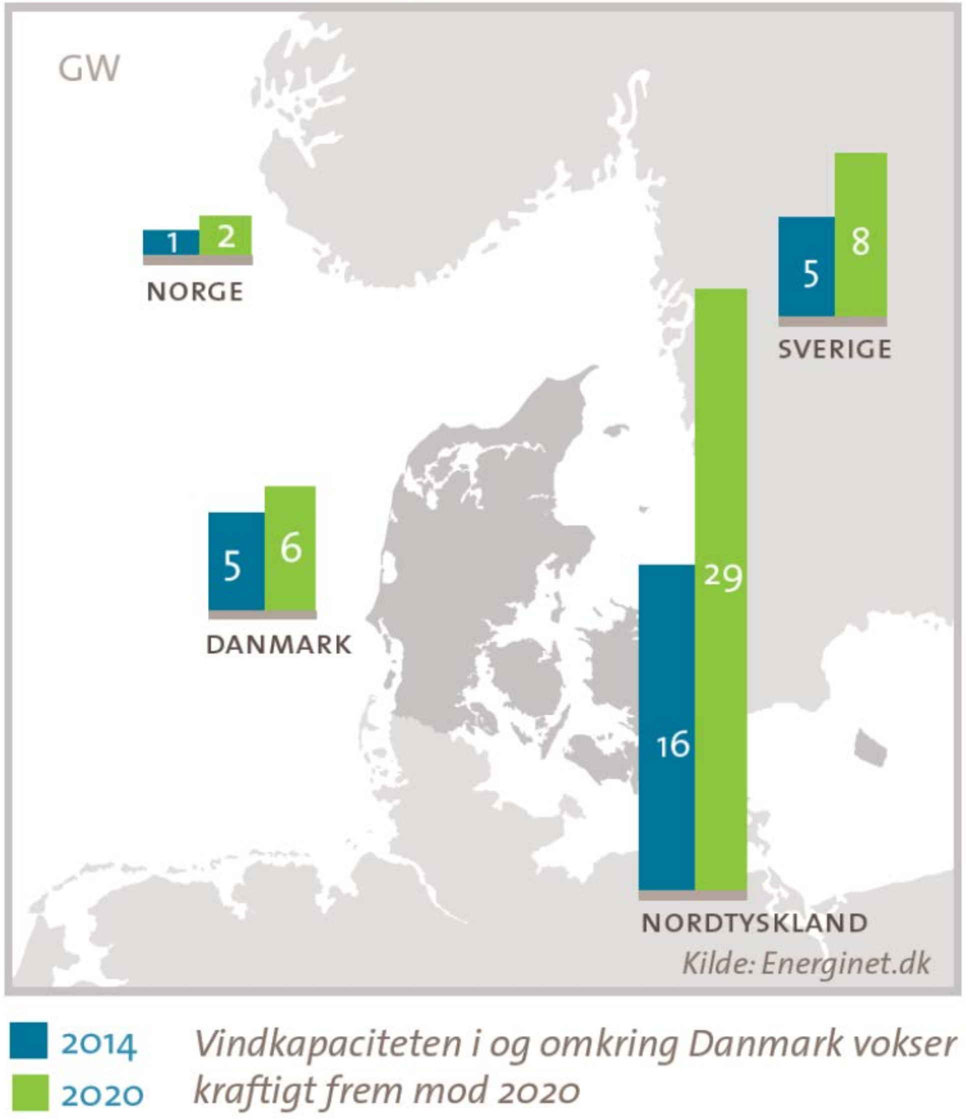
Denmark – *den grønne* … *ewende*

- Objective: 100% rene… 80% renewables in sectors in 2050 (fossil … n by 2050.
- 50% wind share in ele… are in electricity 2020 (already in 2014 … .

> Transition from a fossi… il fuel-based towards a renewable energy bas… sed system with increasing shares of variable ren… ewable generation.

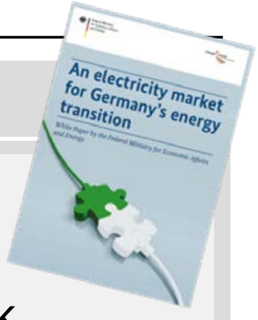
- Strong integration wit… main pillars. (CHP), role of wind &

Installeret vindkapacitet



Vindkapaciteten i og omkring Danmark vokser kraftigt frem mod 2020

Common challenges, similar questions – just a few examples...



Denmark	Germany
→ Markedsmodel 2.0: stakeholder process initiated by Energinet.dk.	→ Strommarkt 2.0: decision of cabinet on Electricity Market Law and capacity and climate reserve last week.
→ Support schemes: experience with tendering for offshore wind energy.	→ Support schemes: introduction of tendering scheme as of 2017.
→ Integrated approach to transition across all energy sectors...	→ Heat sector and electrification gain increasingly attention...
→ The grid: DK-Germany, high shares of wind energy in the North, smart grid...	→ The grid: DK-Germany, high shares of wind energy in the North, smart grid...

The Danish Electricity System

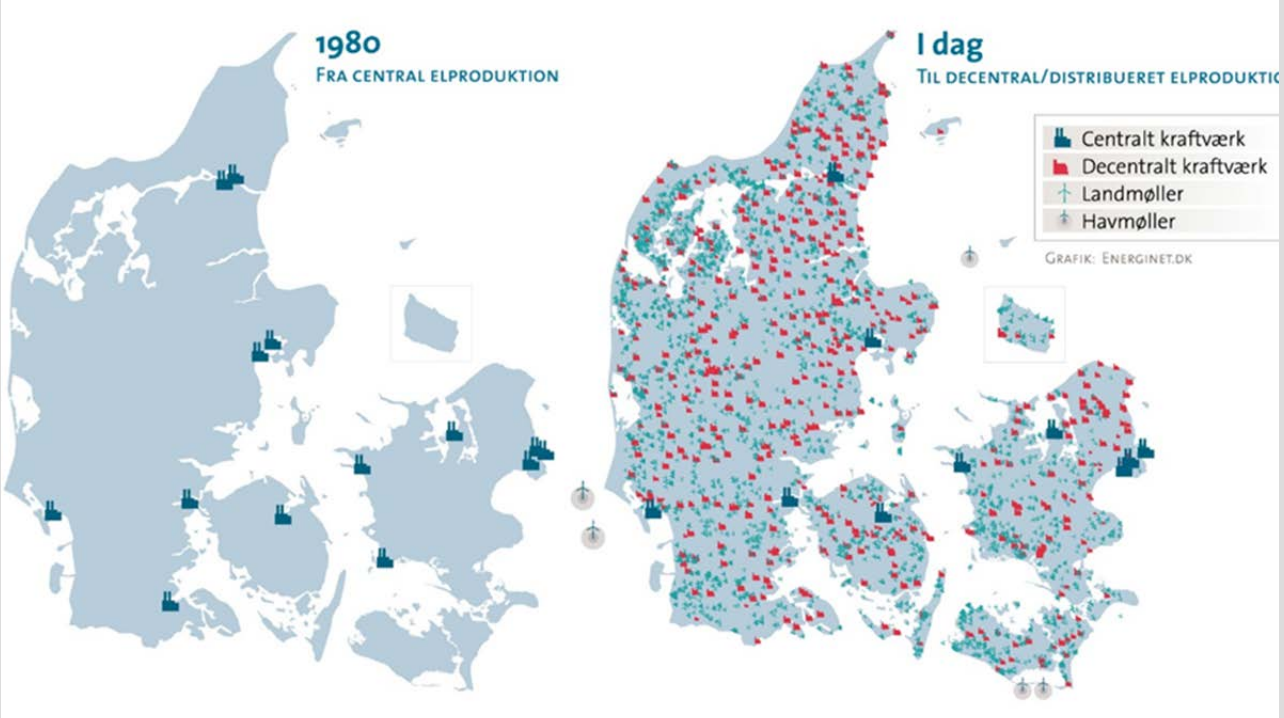
A snapshot of today

Electricity generation in Denmark from 1990 through 2014: Rising shares of wind energy – 39% in 2014.

Energinet.dk (2015)

Structure of the Danish Electricity System: Yesterday (1980s) and today…

From central to distributed generation: 1980 and today



With friendly permission of Energinet.dk for *Agora & DTU (2015).*

Today Denmark has **central power stations** at **16 production sites** – based on coal, natural gas, oil and biomass (4.1 GW in 2014).

Around **1,000 decentralised CHP**, industrial and local plants with generation based on natural gas, waste, biogas and biomass (2.5 GW in 2014). Capacity will be reduced until 2020.

More than 5,200 **wind turbines** are deployed (3.7 GW onshore and 1.3 GW offshore).

… and there are 92,000 solar PV installations. As of 10th Aug. 2015: around 630 MW installed.

(http://energinet.dk/DA/El/Engrosmarked/Udtraek-af-markedsdata/Sider/Statistik.aspx)

A Snapshot: Danish Electricity System Today

Key figures 2014	Western DK	Eastern DK	Denmark
Electricity demand (TWh)	20.1	13.3	33.4
Peak demand (MW)	3,541	2,500	6,033
Wind power (TWh)	10.3	2.7	13.1
Wind share of demand (%)	51	21	39
Wind peak (MW)	3,527	947	4,444
Interconnectors to Norway/Sweden (MW)	2,372	1,700	4,072
Interconnectors to Germany (MW)	1,780	600	2,380

Wind energy supplied **39% of Danish electricity** consumption in 2014.

Wind energy and biomass are expected to play a major role in the future.

CHP plays a major role in electricity production (along with district heating that delivers more than 60% of Danish heat).

Danish electricity supply has evolved from a central to a dispersed structure.

Ea (2015), based on Energinet.dk and ENS data.

A glance at the “wind year“ 2014
- Changes in electricity generation from 2013 to 2014…

Electricity production in Denmark [GWh]	2013	2014	Change
Net electricity production	32,956	30,615	-7 %
Net imports	1,081	2,855	-
Electricity consumption (incl. net losses)	34,037	33,471	-1.7 %
Electricity from central power plants	16,833	13,281	-21 %
Electricity from decentralised plants	4,468	3,643	-18 %
Onshore wind production	6,772	7,913	+17 %
Offshore wind production	4,351	5,165	+19 %
Solar PV production	518	597	+15 %
Hydropower generation	15	16	+6 %

Data: *Energinet.dk (2015)*

Increase in wind energy, decrease in CHP production.

Heading Towards the Future

Danish Energy Objectives and Strategy

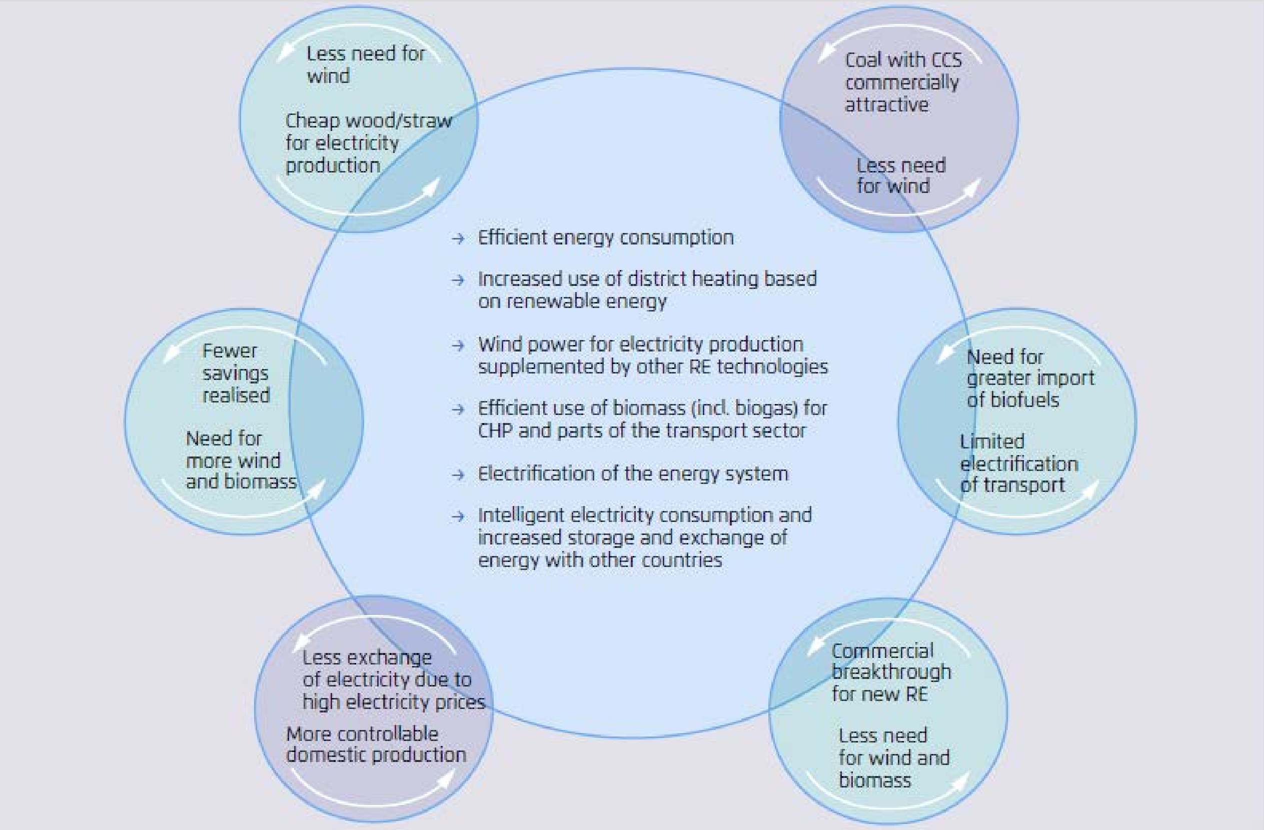
Danish Energy Policy

Energy Strategies and Energy Agreements

- Political instrument of *Energiaftaler* (Energy Agreements) and consensual approach (e.g. elaboration of Market Model 2.0 initiated by TSO Energinet.dk – in cooperation with other stakeholders and interest organizations). History with minority governments, but nevertheless continuity and stability of energy policy.
- **Energy Strategy 2050**, adopted in February 2011 (Venstre-Konservativ): an integrated and comprehensive approach!
- *Regeringsgrundlaget* and *Vores Energi*, autumn 2011 (Socialdemokratiet-Radikale Venstre-Socialistisk Folkeparti): ambitious **2035 / 2030 targets** continue previous policy.
- **Energiaftale 2012**: milestones and concrete initiatives for 2020.

- Now: election in June 2015 (Venstre). Lars Christian Lilleholt is new Energy, Utilities and Climate Minister.
- **Future?** => broad Energy Commission.

What will the future energy system look like?



Energy Strategy 2050

- It is impossible to say what the optimal energy system will look like in 2050.
- **How much wind and biomass?**
- **In-built flexibility** of Danish energy strategy.
- **Energy transition across all energy sectors.**
- Long-term and medium-term objectives.
- Initiatives for the year 2020 are already well underway.

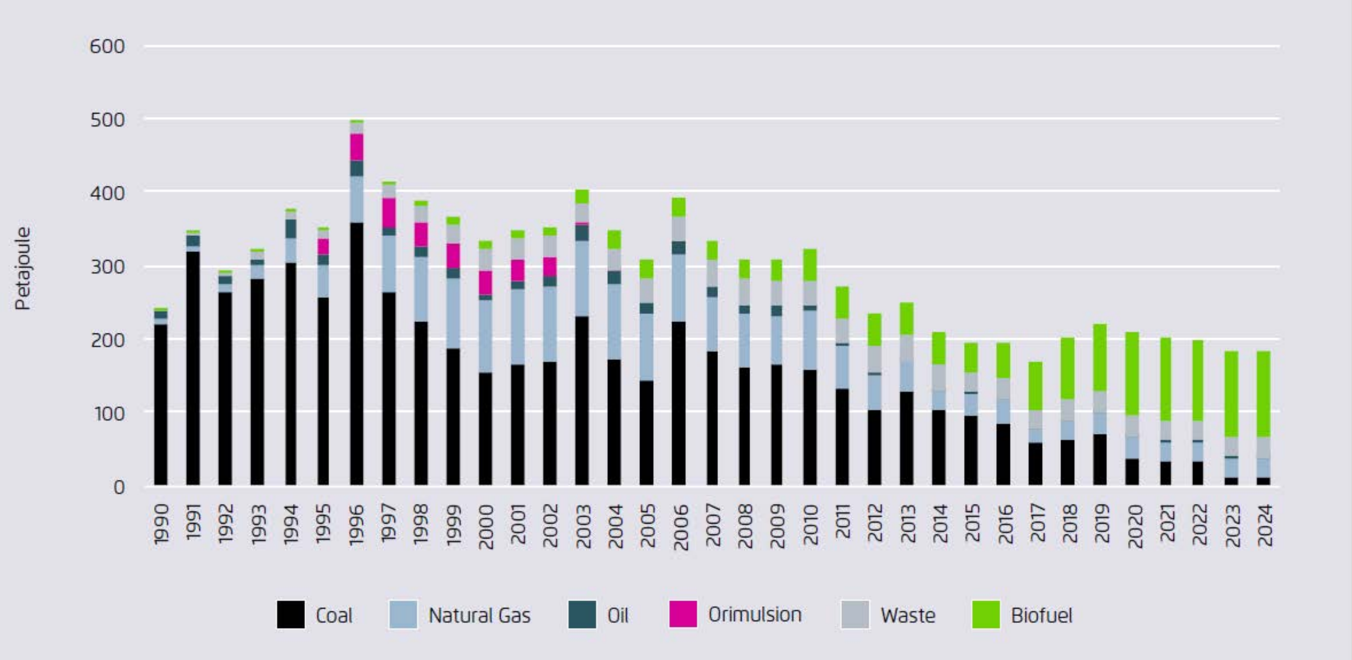
Overview of Danish energy objectives
- A transition across all energy sectors

	2020	2030	2035	2050
General goals	Reduction in greenhouse gas emissions by 40% as compared to 1990.	?		Independence from fossil fuels in all sectors.
Renewable energy sources	35% share of renewable energy sources in total.			100% renewable share as cross-sectoral target.
Electricity sector	50% wind share in electricity consumption.	Phasing out of coal from Danish power plants.	100% renewables in the electricity sector.	100% renewable share as cross-sectoral target.
Heat sector		Phasing out of oil burners.	100% renewables in the heat sector.	100% renewable share as cross-sectoral target.
Energy efficiency	Decrease in gross energy consumption of 4 % as compared to 2006. Decrease in net energy consumption of 12 % as compared to 2006.			
Transport sector	10% share of biofuels.			100% independent from fossil fuels.

Own compilation, *Agora* & DTU *(2015).*

Heading toward the future…

Fuel consumption (*energy* sectors!) in Denmark: historical and forecast 2023



Energinet.dk (2015), in: *Agora & DTU (2015).*

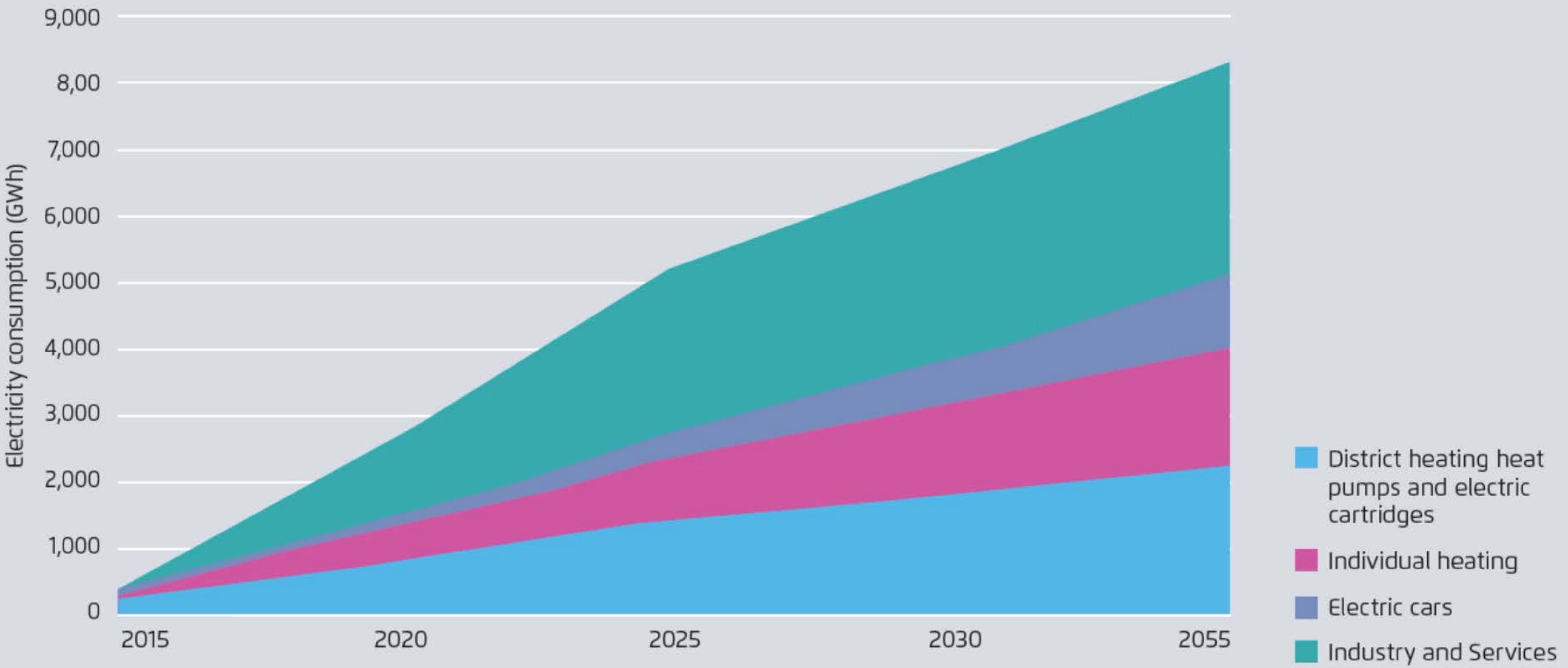
The share of coal is decreasing: rising wind shares and conversion of power plants to biomass.

Still **coal phase-out** until 2030**? Implementation speed??** (discussed in recent election campaign)

The **big future question**: role of wind and biomass. There will be a crossroads in 2020.

The **integrated approach across sectors** is reflected by the Energy Scenarios for 2020, 2035 and 2050.

Danish Ministry of Climate, Energy and Building, Smart Grid Strategy The intelligent energy system of the future (KEBMIN, 2013), p. 11



Major Trends Influencing Future Development

- Already today, **new onshore wind turbines deliver power more cheaply** than natural gas or coal fired CHP plants (**4 ct/kWh**). => *Report on technologies with operation from 2016 until 2035 by ENS.*
- Increasing shares of renewable energy create a need for **system flexibility**. This comprises both the demand and the supply side. Simultaneously, power plants with controllable generation face decreased profitability on the market. A **new market model** is required to cope with these challenges.
- The **flexibility challenge** does not only encompass the electricity sector, but equally the **heating, transport and gas sectors**. The different energy sectors come to play new roles in their interplay for the energy transition.
- The Danish energy system is influenced by **developments in its neighbouring countries**. This includes interconnectors, policy decisions and market design.
- There is increasing integration of national electricity markets on the way to implementing a single **European electricity market**. European network codes lay down common connection, operational and market rules.

Support Schemes

Deep Dive on wind energy

Support schemes
– Onshore wind energy and offshore wind outside tenders

	Fixed premium case	Cap on premium + market	Feed-in tariff case	Expiration of support
	c€/kWh	c€/kWh	c€/kWh	
New onshore wind turbines grid connected as of 1 January 2014 and offshore without tender that have applied for feasibility study after 15 June 2013	0.3 (bal.)	Premium: 3.4 Total cap: 7.8		Eligible for the sum of 6,600 full load hours and an electricity production of 5.6 MWh per m^2 rotor area, corresponding in total to around 25,000 full load hours depending on the type of wind turbine
Onshore turbines connected 21 February 2008 through 31 December 2013	3.4 + 0.3 (bal.)			Eligible for 22,000 full load hours
Offshore wind turbines not covered by tenders connected as of 21 February 2008, with application for preliminary assessment prior to 15 June 2013	3.4 + 0.3 (bal.)			Eligible for 22,000 full load hours
Wind turbines outside tenders connected 1 January 2005 through 20 February 2008	1.3 + 0.3 (bal.)			For 20 years
Wind turbines outside tenders connected before 2000 and 2003-2004	0.3 (bal.)	Premium: 1.3 Total cap: 4.8		For 20 years
Wind turbines connected 2000-2002...				
...Up to 22,000 full load hours	0.3 (bal.)		5.8	Eligible for 22,000 full load hours
...After 22,000 full load hours	0.3 (bal.)	Premium: 1.3 Total cap: 4.8		Price + cap applies after expiration of support for 22,000 full load hours

→ Different variants of price premium.

→ Compensation for balancing cost.

→ Eligible for number of full load hours.

Based on ENS (2015).

Support schemes – support for offshore wind energy I

ENS (2015).

Offshore

→ For offshore wind energy, there are two procedures:

- the **tendering procedure** and
- the **"open door" procedure** in areas not designated for tendering.

→ There are three crucial support scheme design elements for the participation of investors in the tendering procedure:

- Contracts for Difference as financial support,
- Guaranteed grid connection,
- and a one-stop-shop authority (Danish Energy Agency).

Near-shore

→ **Multi-site tendering** is applied in six designated areas for awarding contracts to nearshore wind farms (350 MW). The less stringent conditions of nearshore projects facilitate the entry for newcomers to the Danish offshore segment.

→ **50 MW** of nearshore wind turbines are dedicated to **offshore demonstration projects** (prototypes).

Support schemes – support for offshore wind energy II

→ The outcome of previous tenders for offshore wind reveals large differences in the tendered price level and resulting costs.

Offshore wind farms	Size (nameplate capacity)	Commissioning year	Support feed-in tariff (ct/kWh)	Duration of support
Horns Rev 2	209 MW	2009	7.0	Max of 10 TWh and max 20 years
Rødsand 2	207 MW	2010	8.4	Max of 10 TWh and max 20 years
Anholt	400 MW	2013	14.1	Max of 20 TWh and max 20 years (only support for positive market prices)
Horns Rev 3 (tender closed Feb 2015)	400 MW	2020	10.3	Max of 20 TWh and max 20 years (only support for positive market prices)
Kriegers Flak (expected)	600 MW	2022		
Nearshore wind farms (expected)	Total 400 MW	2018-2020		

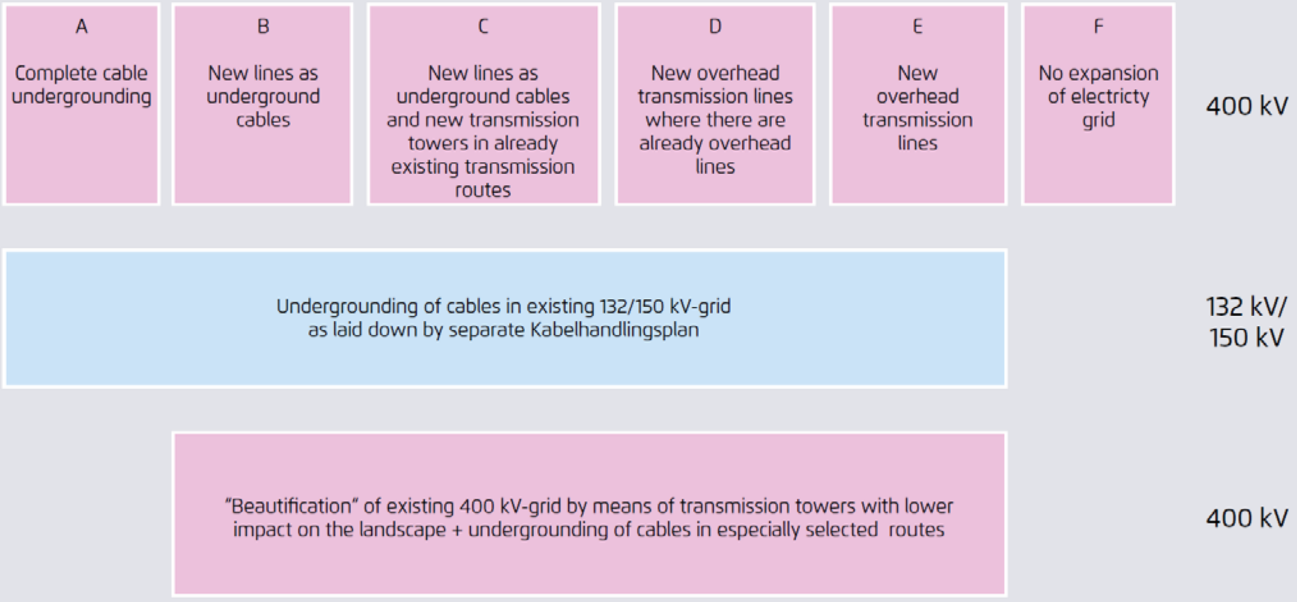
ENS and compilation from offshore wind projects‘ websites.

Grid and Market Integration

The Grid…

The internal Danish grid is no bottleneck so far for the transition.

Principle C has been applied since 2008 (before that: Principle E).



Own translation based on Elinfrastrukturudvalget (2008).

Accommodation of wind worked well so far: utilisation of interconnectors, but also flexibility options in Denmark. There is hardly any curtailment of onshore wind.

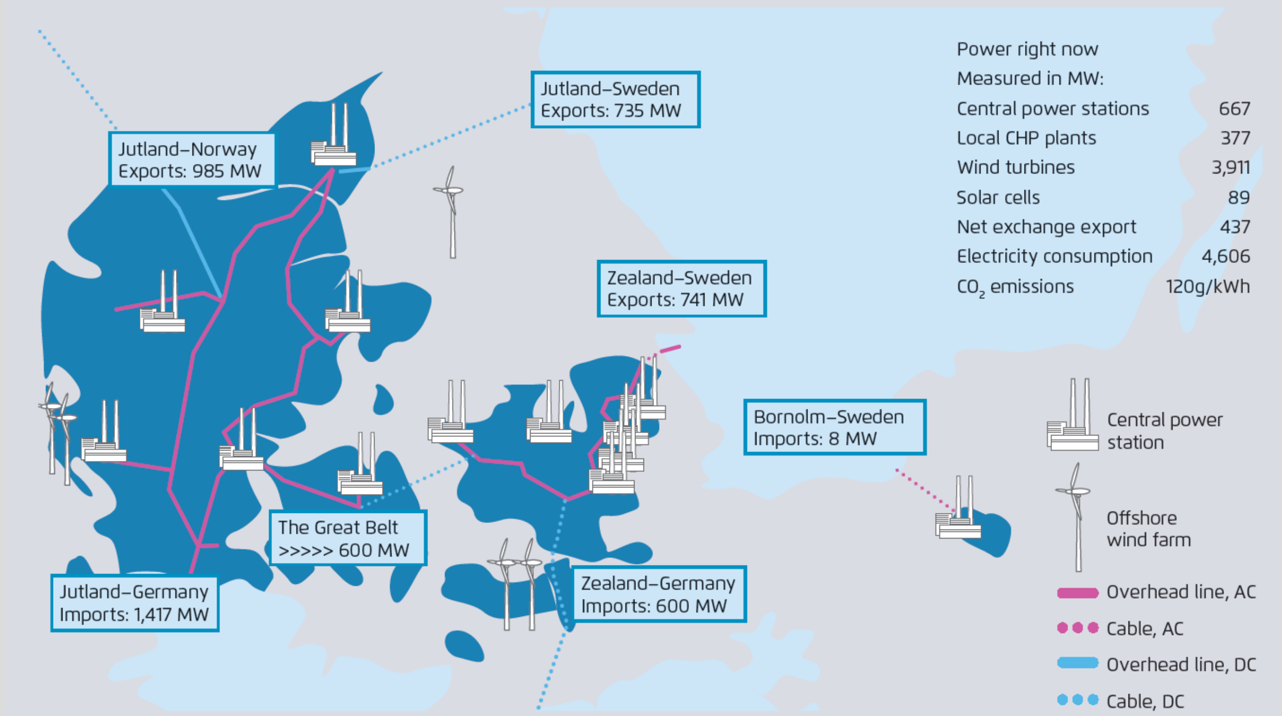
Internal Danish grid expansion:

Undergrounding of 132/150 kV grid cables by 2030, new 400 kV as cables, and **"beautification measures"**.

Coherent planning approach: bi-annuel Grid Development Plan, Kabelhandlingsplan and cross-sectoral System Plan. Smart Grids Strategy and proactive regarding ancillary services.

Interconnectors to neighboring countries have worked as a flexibility option: grid and market integration.

Example: Snapshot of Danish power system on 2 June 2015 at 13:17



Energinet.dk

- **Denmark has 6.4 GW of net transfer capacity to neighboring countries** (and peak load of 6 GW)**.** Capacity to Norway & Sweden: 4 GW and to Germany: 2.4 GW.
- **Early Nordic market integration:** hydropower as “green battery“ and export during hours with high wind energy feed-in.
- Challenge of high wind energy feed-in in Denmark and Northern Germany.
- **The future** also depends on energy mixes and transmission capacities available to neighboring countries (e.g. Skagerrak 4 and DK1-TenneT interconnector and internal German grid expansion).

Grid and Market Integration

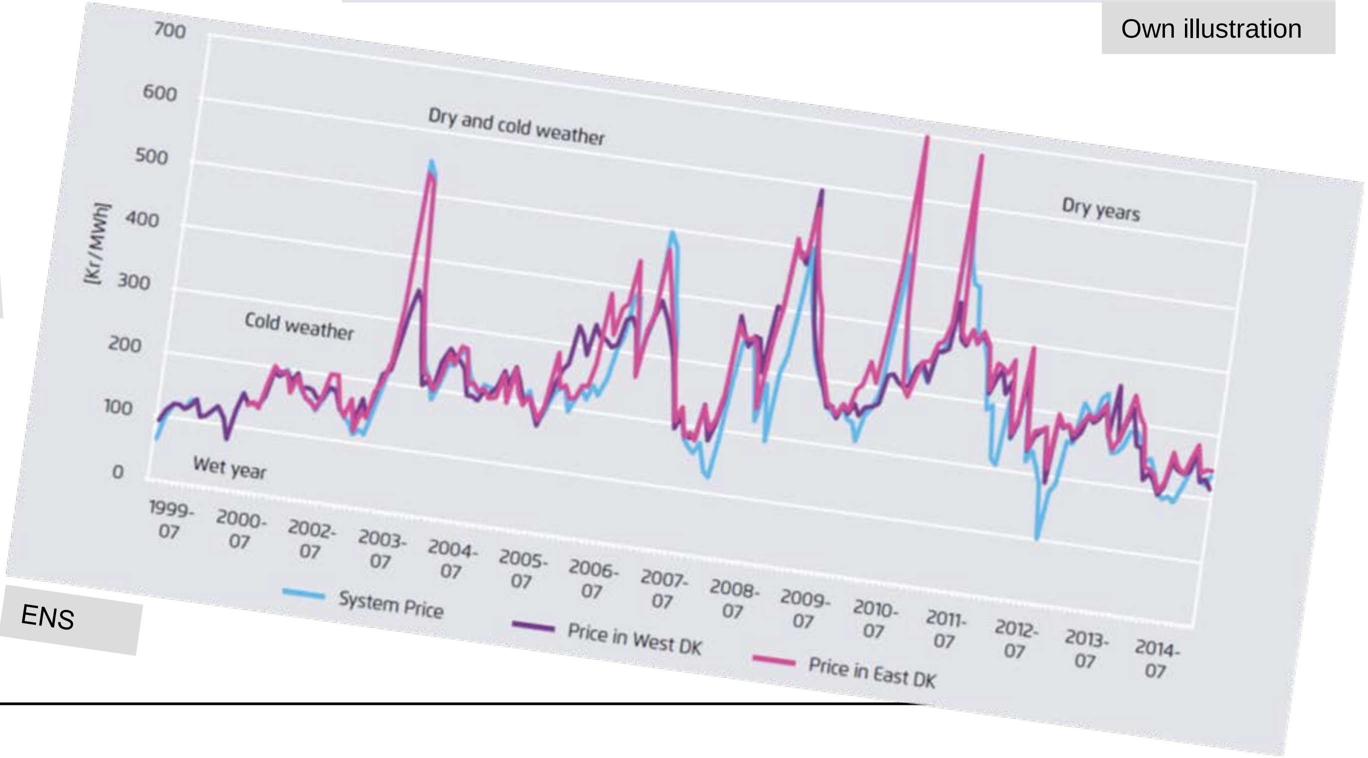
… and the market.

Denmark as part of the Nordic power market...

Electricity imports and exports in 2014: export from DK to neighbors => negative values.

Based on data from Energinet.dk

Own illustration



ENS

Initiated by Energinet.dk - in cooperation with other stakeholders in the energy sector & Quartz+Co and Copenhagen Economics

Markedsmodel 2.0 – Market based solutions for an effective green transition

Capacity	Flexibility

+ ”kritiske egenskaber”

Analysis of ancillary services needed in the future – including products where there can be new actors, e.g. wind power producers...

Acceptance & Participation

Acceptance and consumer participation

→ In general, there is **broad public support** for the Danish energy transition. As areas for new wind projects become scarcer and more renewables are deployed, the **question of acceptance** and the **cost debate for industry** have become more pronounced.

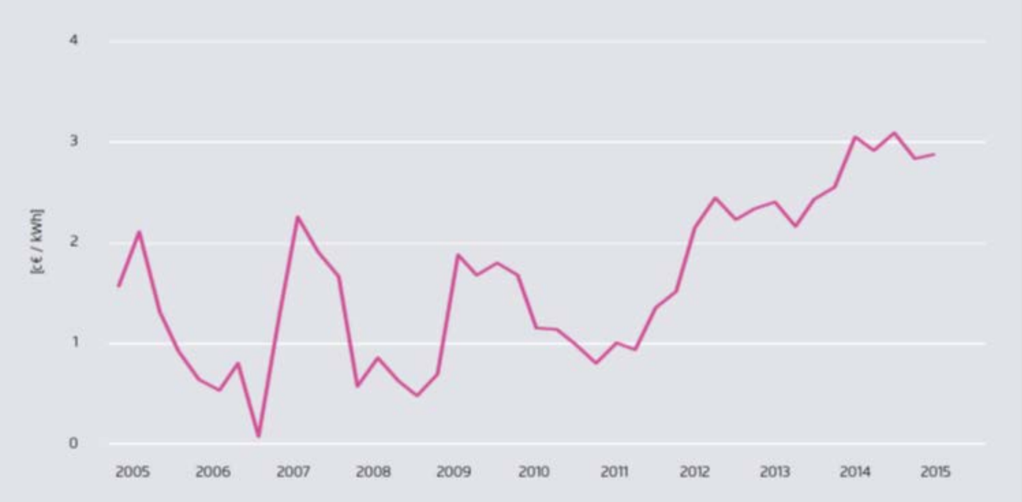
→ Denmark has had a long tradition of consumer ownership. **Consumer participation** and **support for measures to increase acceptance of new local wind projects** are also reflected by different types of regulations contained in the Renewable Energy Act:

- *Den grønne ordning*: municipalities 0.4 øre/kWh for 22,000 full load hours.
- *Garantifonden*: local initiative groups.
- *Køberetsordningen*: local ownership => 20% of project's value.
- *Værditabsordningen*: real estate => compensation for loss in value (>1%, then full coverage).

Consumers – and the cost issue of financing the transition…

Quarterly PSO tariff for customers in West DK (2005-2015)

→ The **cost debate** on financing renewables (by means of the so-called PSO-tariff as part of the final electricity price) has gained increasingly attention in Denmark during the last years – especially, for industry.



Final electricity retail price for households in August 2015

→ In 2014 **a reduction of the PSO component** was introduced by shifting some of the funding to the federal budget.

Own elaboration, based on Dansk Energi (2015) and PSO from Energinet.dk (2015), both in *Agora & DTU* (2015).

Key Findings at a Glance…

1. **Denmark is one of the first movers in implementing a green energy transition across all sectors, and aims to become independent from fossil fuels by 2050.** The Danish power system has been undergoing a transformation, moving from a highly centralised to a more decentralised structure in electricity generation. There has been a significant increase not only in wind power but also in distributed generation from combined heat and power plants since the 1980s. Broad-based political agreements on energy policy have provided security for investors while enabling a smooth and continuous transition to a sustainable power sector.

2. **The Danish energy transition follows an integrated approach that encompasses the electricity, heat and transport sectors.** The interdependencies among these different sectors are reflected in Danish energy policy goals, in scenario analyses as well as in concrete initiatives for implementing the transition to a renewables based energy system.

3. **As an early mover, Denmark has already gained substantial experience in the application of tendering schemes for offshore wind energy.** The Danish tendering scheme is characterised by Contracts for Difference with guaranteed support payments, a guaranteed grid connection and a one-stop-shop authority for preliminary site assessments when new offshore wind energy projects are developed.

4. **Denmark currently covers nearly 40 percent of its electricity needs with wind power, demonstrating that a grid can be well-equipped to accommodate high renewable energy feed-in.** Internal grid expansion in neighbouring countries such as Germany and Norway will play a significant role in the future utilisation of interconnectors.

The following Deep Dives of today's event invite you to take a closer look at lessons learned – and exchange of knowledge and experience...

Structure

1.	*Deep Dive*: The Future Energy System and Energy Transition Across Sectors
2.	*Deep Dive*: The Grid – Expansion and System Reliability
3.	*Deep Dive*: Lessons Learned from Offshore Wind Tendering

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Thank you for your attention!

Questions or Comments? Feel free to contact me:

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Agora Energiewende is a joint initiative of the Mercator Foundation and the European Climate Foundation.

Back Up Slides

5 Scenarios for the Future Energy Mix… Wind or Bio?

Electric capacity [MW] in 2050 for scenarios. Annual utilisation hours are indicated in parantheses.

Scenario	Wind	Biomass	Bio+	Hydrogen	Fossil
Offshore Wind	14,000 (4,116)	5,000 (4,141)	2,500 (4,132)	17,500 (4,073)	5,000 (4,135)
Onshore wind	3,500 (3,076)	3,500 (3,076)	3,500 (3,069)	3,500 (3,076)	3,500 (3,076)
Solar PV	2,000 (849)	2,000 (849)	1,000 (849)	2,000 (849)	800 (849)
Gas turbines	4,600 (300)	1,000 (492)	400 (677)	4,600 (299)	1,400 (200)
CHP biomass	0	2,040 (4,306)	2,400 (4,526)	0	0
CHP coal	0	0	0	0	1,575 (3,980)
Fuel cells	0	0	0	500	0
Electricity imports	3,740 (3,467)	3,740 (1,147)	3,740 (402)	3,740 (3,380)	3,740 (511)
Electricity exports	-4,140 (3,483)	-4,140 (2,863)	-4,140 (3,112)	-4,140 (3,734)	-4,140 (4,169)

ENS (2014). Energiscenarier frem mod 2020, 2035 og 2050.

Way Ahead – Common Challenges and Lessons for Reflection

- ***Energiewende* and *den grønne omstilling*: Transition** from coal (and lignite) based system to renewables – and both countries are located for transit.
- **Common challenges** in market design 2.0, system integration and acceptance.
- Difference: 1) Danish role of biomass 2) special role of DK with high interconnector capacity as compared to load 3) district heating 4) smaller country (*dare I say it ☺*).

Interesting points:

- Danish approach to policy: **integrated/holistic in planning** across energy sectors and actors with ambitious targets: electricity, heating, and transport. => **Cross-sectoral thinking** becomes increasingly important, also in Germany.
- Experience with **tendering scheme for offshore wind** and early introduction of price premium scheme.
- Experience with **wind and regulating power**.
- Experience with initiation of smart meter roll-out, consumer participation.

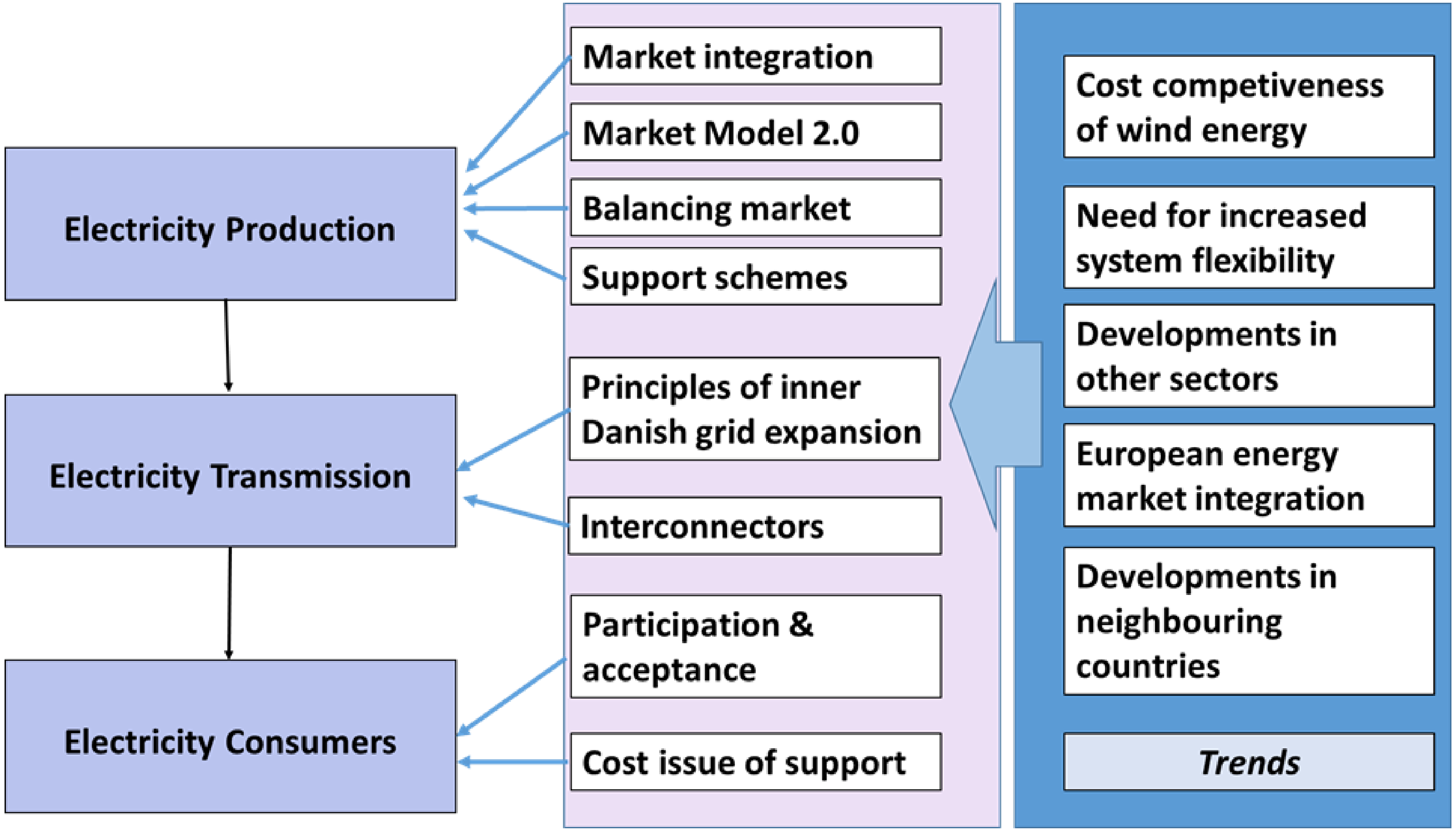
Also: need for dialogue on German grid expansion and DK 1.

Interconnectors to neighboring countries

Interconnections from East Denmark (DK 2) to	
Sweden	• 4 AC connections (two at 400 kV and two at 132 kV) • Export capacity of up to 1,700 MW • Import capacity of up to 1,300 MW
Germany	• Kontek interconnector (400 kV DC) • Capacity: 600 MW
Interconnections from West Denmark (DK 1) to	
Sweden (Konti-Skan)	• Konti-Skan (two 285 kV DC connections) • Export capacity from Jutland (DK): 740 MW • Import capacity: 680 MW
Sweden (from Bornholm)	• AC connection (60 kV seacable) • Capacity: 60 MW
Norway	• Skaggerak (4 DC connections with 2 at 250 kV, one at 350 kV) • Capacity: 1,700 MW (see also explanation in text)
Germany	• 4 AC connections from the Danish town Kassø (two at 400 kV and one at 220 kV) and Ensted Power Station (220 kV) + one 150 kV connection from Ensted Power Station to Flensburg • Import capacity: 1,500 MW • Export capacity: 1,780 MW (depending on congestions in surrounding grids)
Interconnector from Western Denmark to Eastern Denmark	
From Jutland-Funen to Zealand	• Great Belt Power Link (400 kV DC connection) • Capacity: 600 MW

Energinet.dk

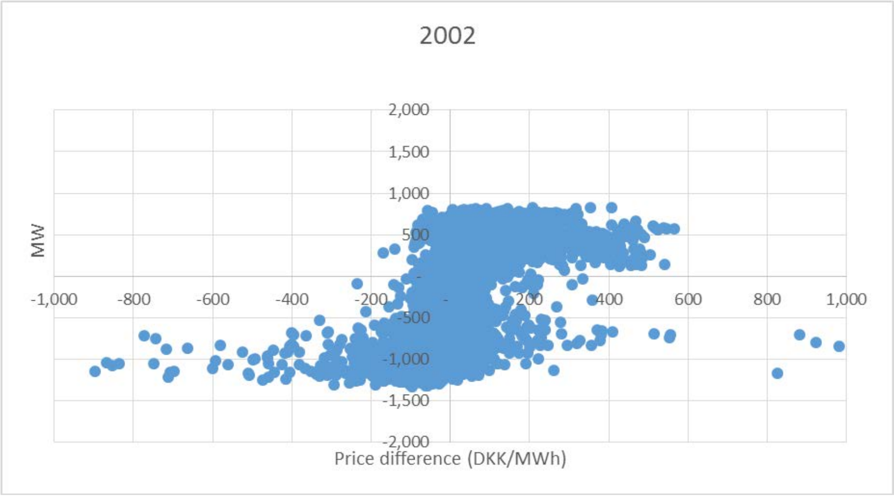
Overview of Topics in Denmark Policy Paper #2

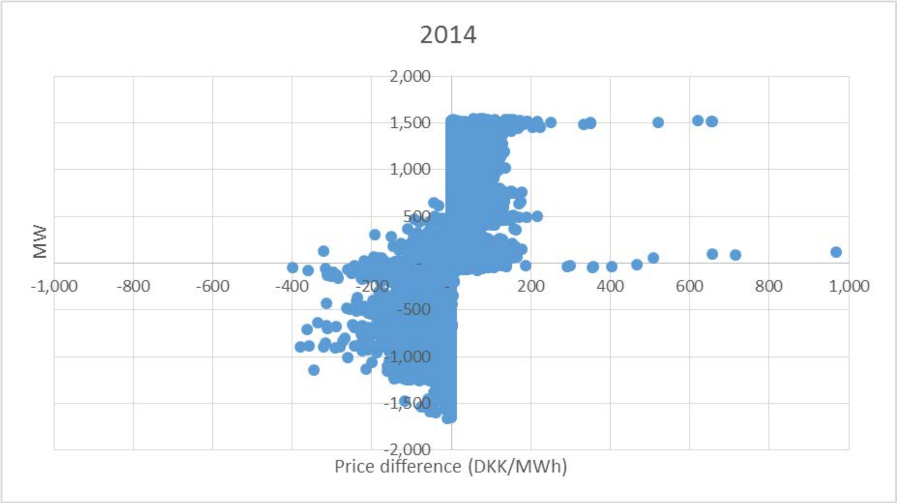


Own elaboration (Paper #2).

Excurses: Physical flow and price difference on the interconnection between Western Denmark and Germany

- Price difference: Price in Western Denmark minus price in Germany.
- Positive flow: Import to Western Denmark. Negative flow: Export to Germany.
- It is notable that even in 2014 and with implicit market coupling, there were situations with the flow direction being contrary to the direction incentivised by price differences. This is likely due to subsequent arrangements in the markets for ancillary services.





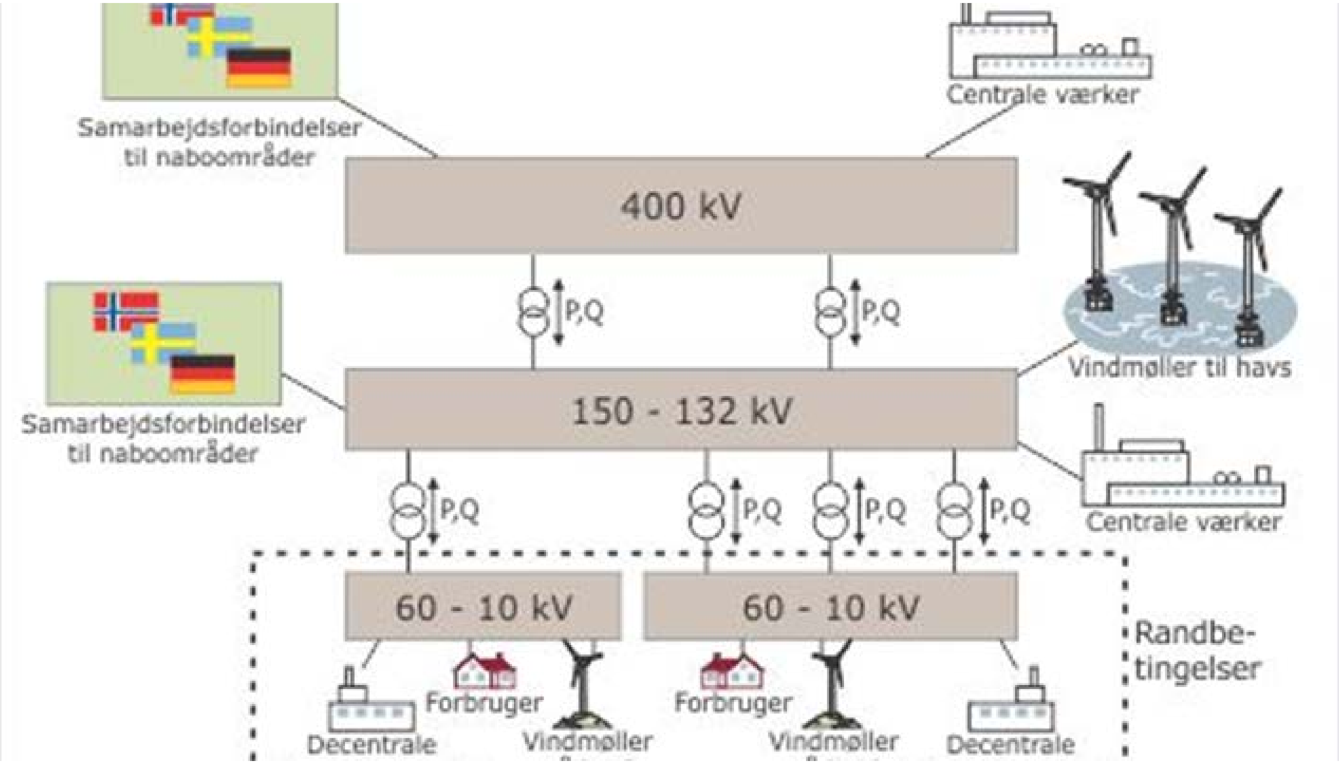
Source:
Ea DK Paper #1 (2015).

Lessons Learned from the Power Market II

- Influx into Nordic hydropower has traditionally influenced Danish power prices. Now wind energy exerts **downward pressure on prices**. This does not only pose a challenge for conventional power stations, but in the future also for renewable generators, such as wind power producers.
- There is need for a **new market model** in order to ensure adequate flexibility and capacity in the future. During the **Market Model 2.0** process, initiated by Energinet.dk, stakeholders work together to find a **consensual approach.**
- The **Danish regulating power market** provides favourable conditions for the participation of **wind energy**: asymmetric bids, short gate closure times, and a market split up into an availability market and an activation market (energy only bids).
- Electricity based on renewables has priority access. Despite high wind shares, there is hardly any curtailment of onshore wind energy. For offshore wind farms, a special rule for **downward regulation** applies.

Lessons Learned – The Danish grid is no bottleneck so far for the transition.

Structure of Danish transmission and distribution grid.



Energinet.dk (2014).

Accommodation of wind worked well so far: utilisation of interconnectors, but also flexibility options in Denmark. There is hardly any curtailment of onshore wind.

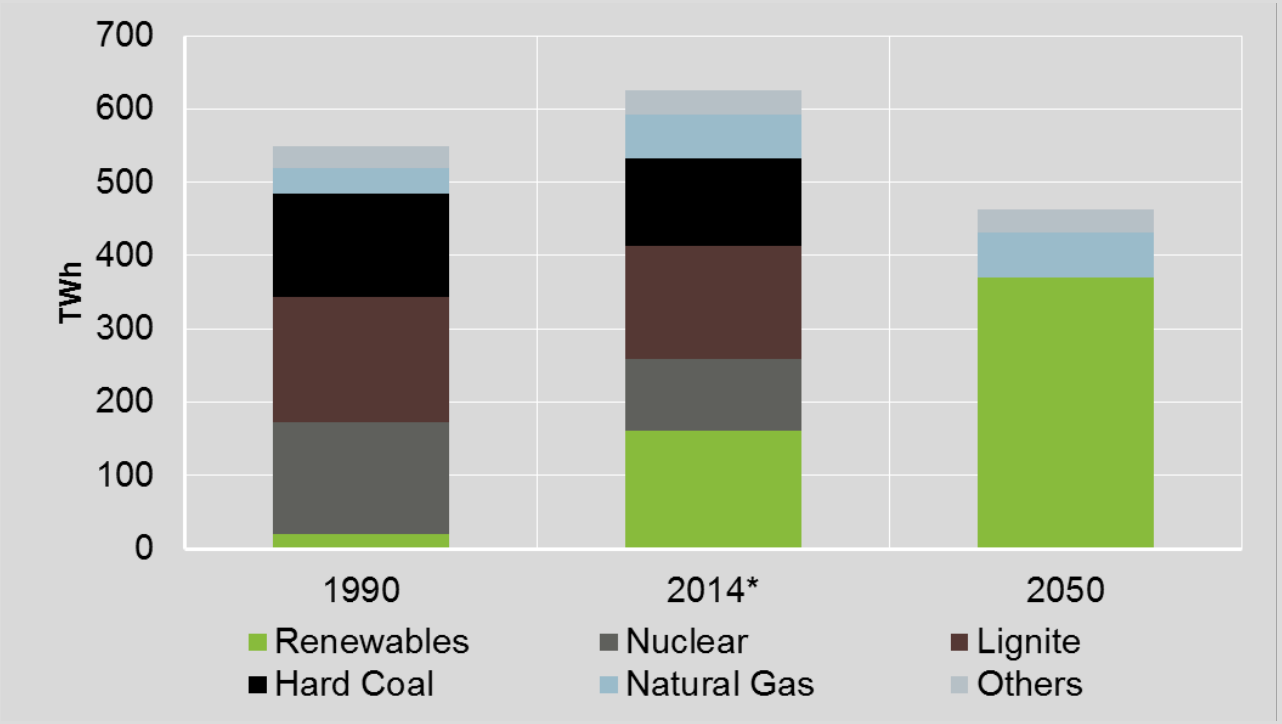
Coherent planning approach: bi-annuel Grid Development Plan, Kabelhandlingsplan and cross-sectoral System Plan. Smart Grids Strategy and proactive regarding ancillary services.

Undergrounding of 132/150 kV grid cables by 2030, new 400 kV as cables, and **"beautification measures"**.

Future question: neighbouring countries (e.g. Skagerrak 4 and – especially – DK1-TenneT interconnector and inner German grid expansion.

The Energiewende means fundamentally changing the power system

Gross electricity generation 1990, 2014 und 2050



AGEB (2015a), BReg (2010), EEG (2014), own calculations * preliminary

Phase out of Nuclear Power
Gradual shut down of all nuclear power plants until 2022

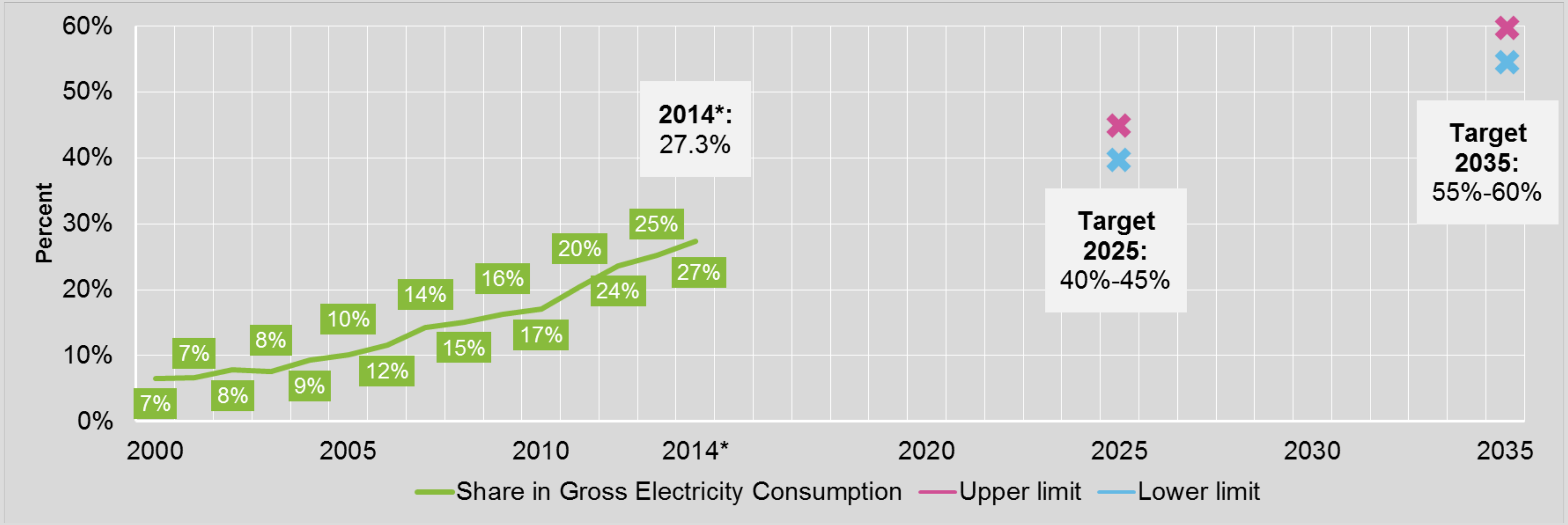
Reduction of Greenhouse Gas Emissions
Reduction targets below 1990 levels:
- 40% by 2020; -55% by 2030; - 70% by 2040;
- 80% to -95% by 2050

Development of renewable energies
Share in power consumption to increase to:
40-45% in 2025; 55-60% in 2035; ≥ 80% in 2050

Increase in efficiency
Reduction of power consumption compared to 2008 levels: -10% in 2020; -25% in 2050

The Renewable Energy Act aims at increasing the share of renewables to 40-45% by 2025 and 55-60% by 2035

Share of renewable energies in gross electricity consumption 2000 – 2014 and targets 2025 - 2035

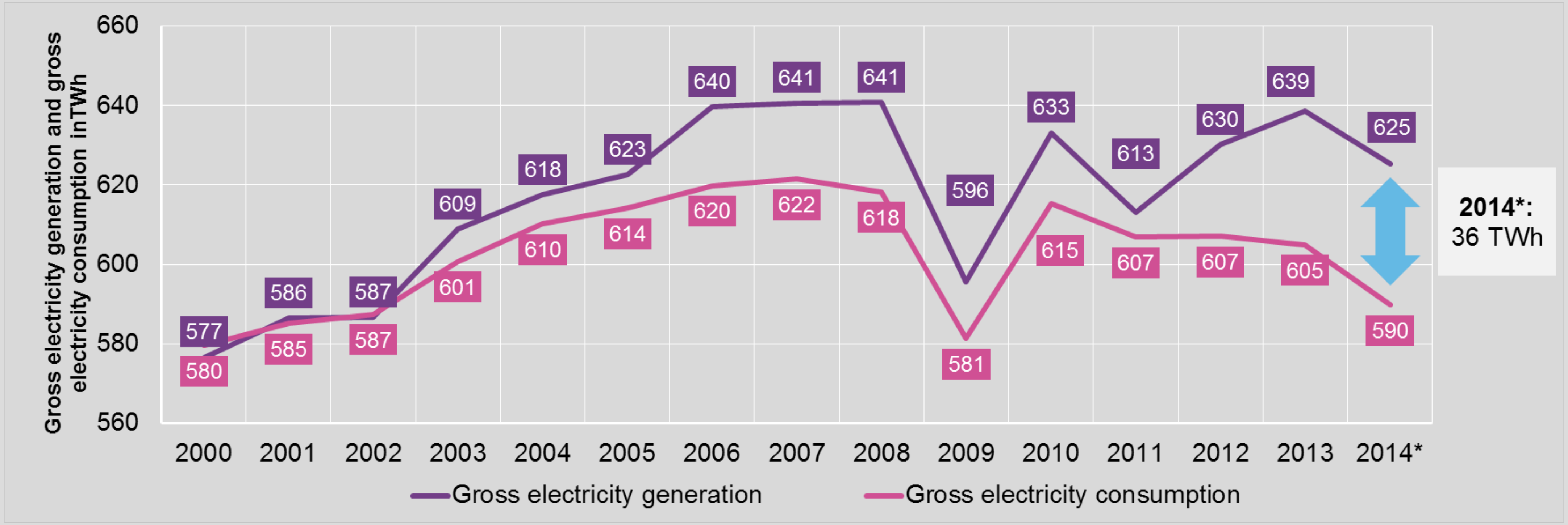


AGEB (2015a), EEG (2014)

* preliminary

Since 2001, Germany has produced more electricity than it consumes – 2014 marked a new record with 6% of power production being exported to neighbouring countries

Gross electricity generation and gross electricity consumption 2000 – 2014



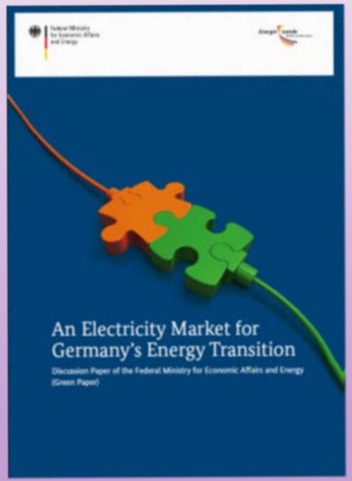
AGEB (2015a)

* preliminary

On the way to a new Electricity Market Law (*Strommarktgesetz)*

Green Paper

October 2014



White Paper

July 2015

Strommarktgesetz (Electricity Market Law)

Fall 2015 - Summer 2016 (July)

Referentenentwurf

Entwurf eines Gesetzes zur Weiterentwicklung des Strommarktes (Strommarktgesetz)

§

Market Model 2.0: Reliance on Energy Only Market (EOM) + new reserves to secure supply in ”extreme” situations (”belt and braces approach”)

“Netzreserve“ (“Grid Reserve“)

- Security of supply and grid reliability (accounting for congestions in the grid)

INTERPLAY

Climate and capacity reserve

- Security of supply (after market closure)
- Capacity reserve: auction
- Transition period: additional function of climate reserve to contribute to reduction in emissions

New!

Onshore wind – high deployment, question of future development

→ Onshore wind installed...

...in 2014: 4,750 MW gross installation (by comparison: corridor with net deployment of 2,500 MW) => 38 GW in total

...in the first half of 2015: 1,185 MW (gross deployment; net: 1,093 MW). 42 GW onshore wind expected by industry at the end of 2015.

→ Support: Classical feed-in tariff. *EEG revision last year*: Direct marketing & Contract for Difference.

→ Offshore wind:

...initially, there were some obstacles due to new technology and challenges specific to offshore wind in Germany (deep sea, high distance to shore) => initial 10 GW target by 2020 reduced to 6.5 GW.

...in the first half of 2015: 422 offshore wind turbines (1,765 MW) got grid connected. In total there are 668 offshore wind turbines with a total capacity of 2,778 MW.

→ Change to tendering scheme as of 2017.

Challenge: Power Market Design
The government is planning to propose in 2016 both a new power market law and a new renewable energy law

Schematic diagram of the governments' envisaged power market design

Coordinate supply and demand	**Power Market 2.0** (complemented by flexible markets for balancing energy)	
Guarantee security of supply and build up of renewables	**Resource Adequacy** Capacity reserve (partly consisting of old lignite power plants)	**Renewables** Auctions for large wind- and solar power plants, feed-in tariffs for small scale RES
Reaching climate targets	**EU Emissions Trading**	

Own illustration

Power Market 2.0
Power market is to become highly flexible, so as to continuously let fossil power plants, renewables, demand and storage interact with each other

Resource Adequacy
Peak prices in times of scarcity are to refinance fossil backup power plants; for emergency situations, a capacity reserve is installed

Renewables
Renewables receive 20year-market premium, support level for large wind and solar power farms is to be determined by auctions as of 2017

EU Emissions Trading
CO_2 price is to be restored through ambitious EU ETS reform including enhanced market stability reserve and higher emission reduction factor