Velkommen til…

Welcome to…

Willkommen zu…

Lessons Learned from Denmark – Event 1

“Renewable Integration and Flexibility”

24TH SEPTEMBER 2015 IN BERLIN

Agora‘s “Lessons Learned from Denmark“ Series

Event 1: ”Renewable Energy Integration and Flexibility”

24th September 2015 in Berlin

- 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

Deep Dives

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

12th of November in Berlin *Save the Date*

- Scenarios for the future energy system and the integrated Danish approach
- Grid expansion and system reliability
- Support schemes and tendering of offshore wind

Lessons Learned and Energy Transitions…

Denmark – *den grønne omstilling*

- Objective: 100% renewables across *all* energy sectors in 2050 (fossil fuel-free system).
- 50% wind share in electricity consumption by 2020 (already in 2014: 39%).

- Transition from a fossil fuel-based towards a renewable energy based system with increasing shares of variable renewable generation.

- Strong integration with the heating sector (CHP), role of wind & biomass.

Germany – *die Energiewende*

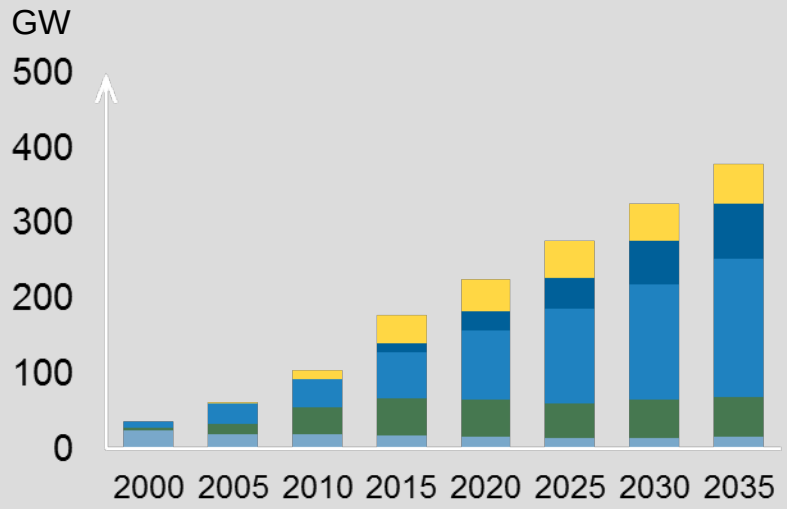
- Objective: More than 80% renewables in electricity consumption by 2050.
- 40-45% renewable share in electricity consumption by 2025.

- Transition from a fossil fuel-based towards a renewable energy based system with increasing shares of variable renewable generation.

- Wind and solar PV as main pillars.

Energiewende:
With wind and solar, the new power system will be based on two technologies that completely change the picture.

Gross electricity generation of renewable energies 2000 - 2035

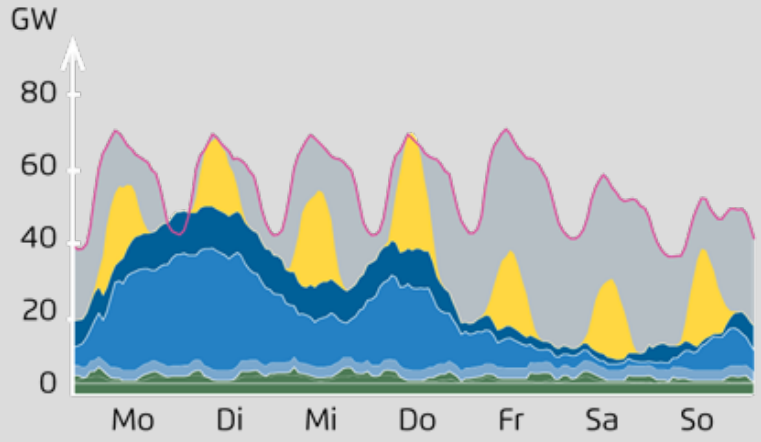


AGEB (2015a), BNetzA (2014), BNetzA (2015b), own calculations

Specific characteristics of Wind and Solar PV

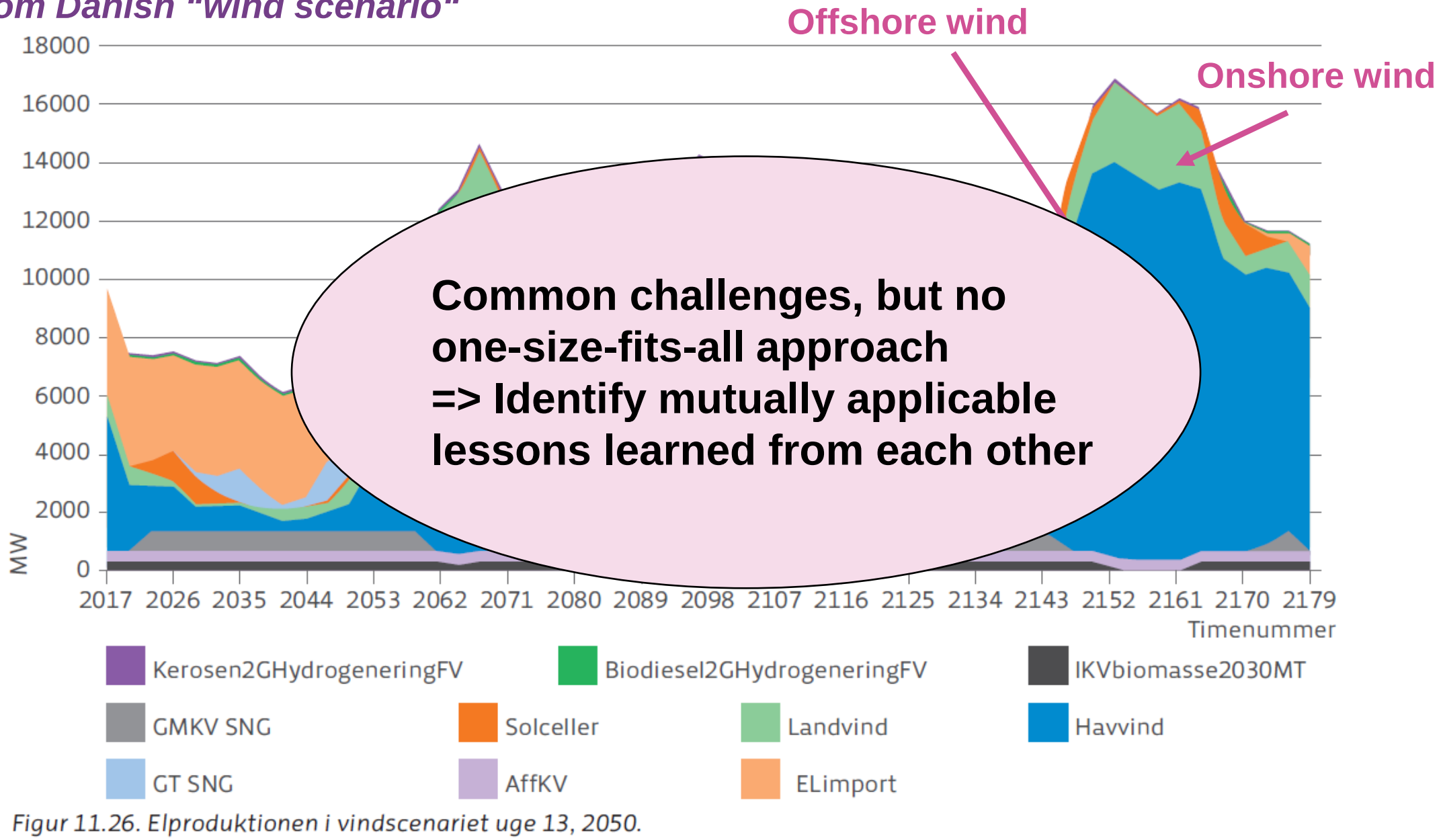
1. Intermittent
2. High capital costs
3. Very low variable cost

Electricity generation and consumption in a sample week 2023



Fraunhofer IWES (2013)

Example from Danish "wind scenario"

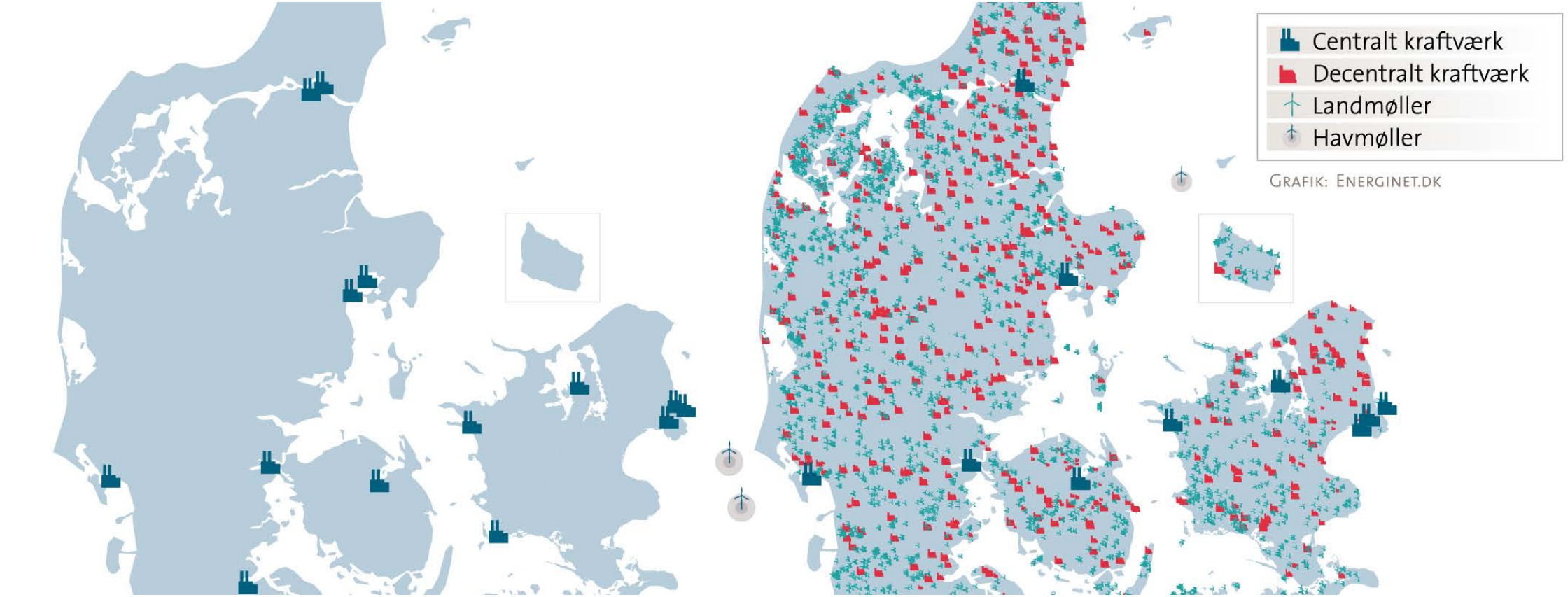


Common challenges, but no one-size-fits-all approach
=> Identify mutually applicable lessons learned from each other

Figur 11.26. Elproduktionen i vindscenariet uge 13, 2050.

ENS (2014), *Energiscenarier frem mod 2020, 2035 og 2050*. p. 81.

From a centralised to a distributed system…



With friendly permission of Energinet.dk (for paper Ropenus and Jacobsen (2015), to be presented at Event 2).

In brief

Key Findings

1	Denmark is the world's leader in the deployment of **wind power**, with **39%** of electricity consumption supplied by wind. The challenge of integrating a high share of wind power led Danish institutions and market participants to develop **several flexibility options** early on.
2	Flexibility options include the use of **interconnectors**, increasing the **flexibility of thermal power plants**, making **district heating** more flexible, encouraging **system friendly wind power**, **demand side** flexibility and introducing alternative options for procuring **ancillary services**.
3	With 6.4 GW of **net transfer capacity** to Norway, Sweden and Germany (Danish peak demand: 6 GW), Denmark is able to sell electricity during times of high wind production, and to import electricity in times of low wind production.
4	Regulation has been reshaped to **reduce heat bound electricity generation** in situations with **high wind energy feed-in**. In the future district heating systems are envisioned to become electricity consumers rather than producers in times of high wind power production.

Report will be available on website

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Tusind tak for jeres opmærksomhed!

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.