

NSON_DK scenario building:
Scenario for the onshore energy
system

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Agenda

1. NETP Flex scenario (2020-2050)
2. NSON-DK wind scenario vs. NETP Flex
3. Focus on Denmark (NSON-DK vs. NETP Flex)

The basis: Nordic Energy Perspectives

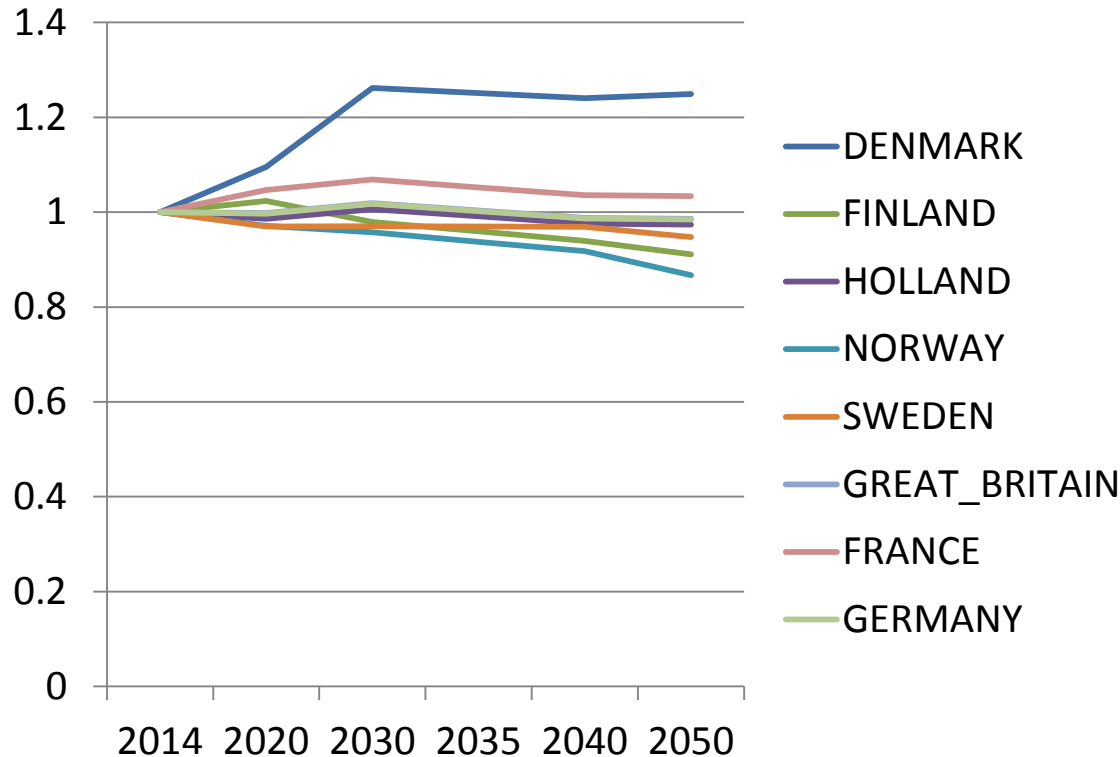
NETP Flex 2016

- Stemming from simulations for a carbon neutral Nordic energy system in 2050
- Closely related to IEA ETP 2016 sharing assumptions (prices)
- For NSON_DK onshore system structure power plants, generation, transmission system and consumption

Electricity consumption through 2050



NETP 2016 Flex



- General:
Stagnation of consumption
- Denmark increase towards 2030:
(32 TWh to 40 TWh)
i.e. just in between scenarios
from Energinet and Energistyrelsen
2014

Transmission system North Sea 2050

(the radial case NETP 2016 Flex)

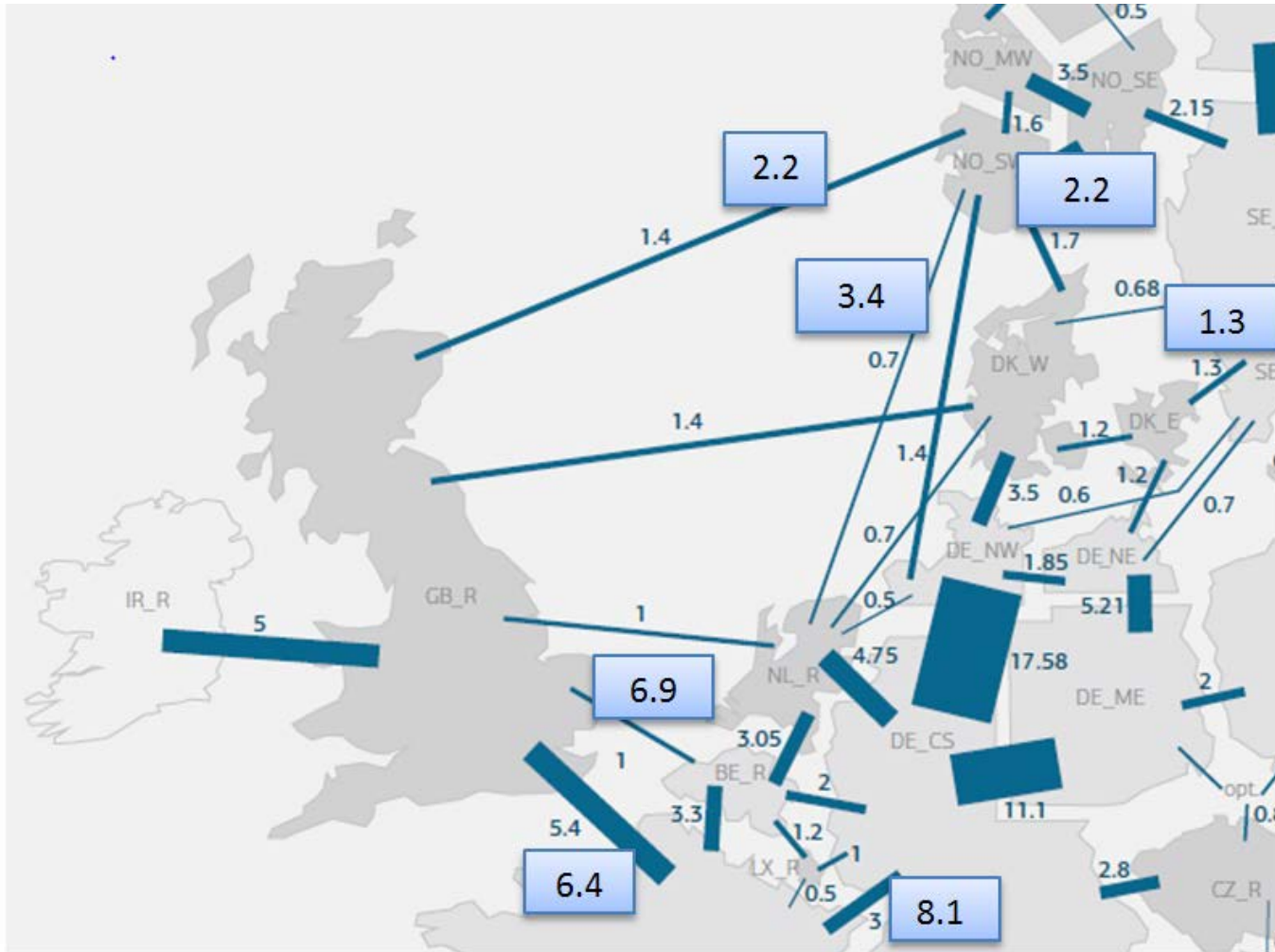
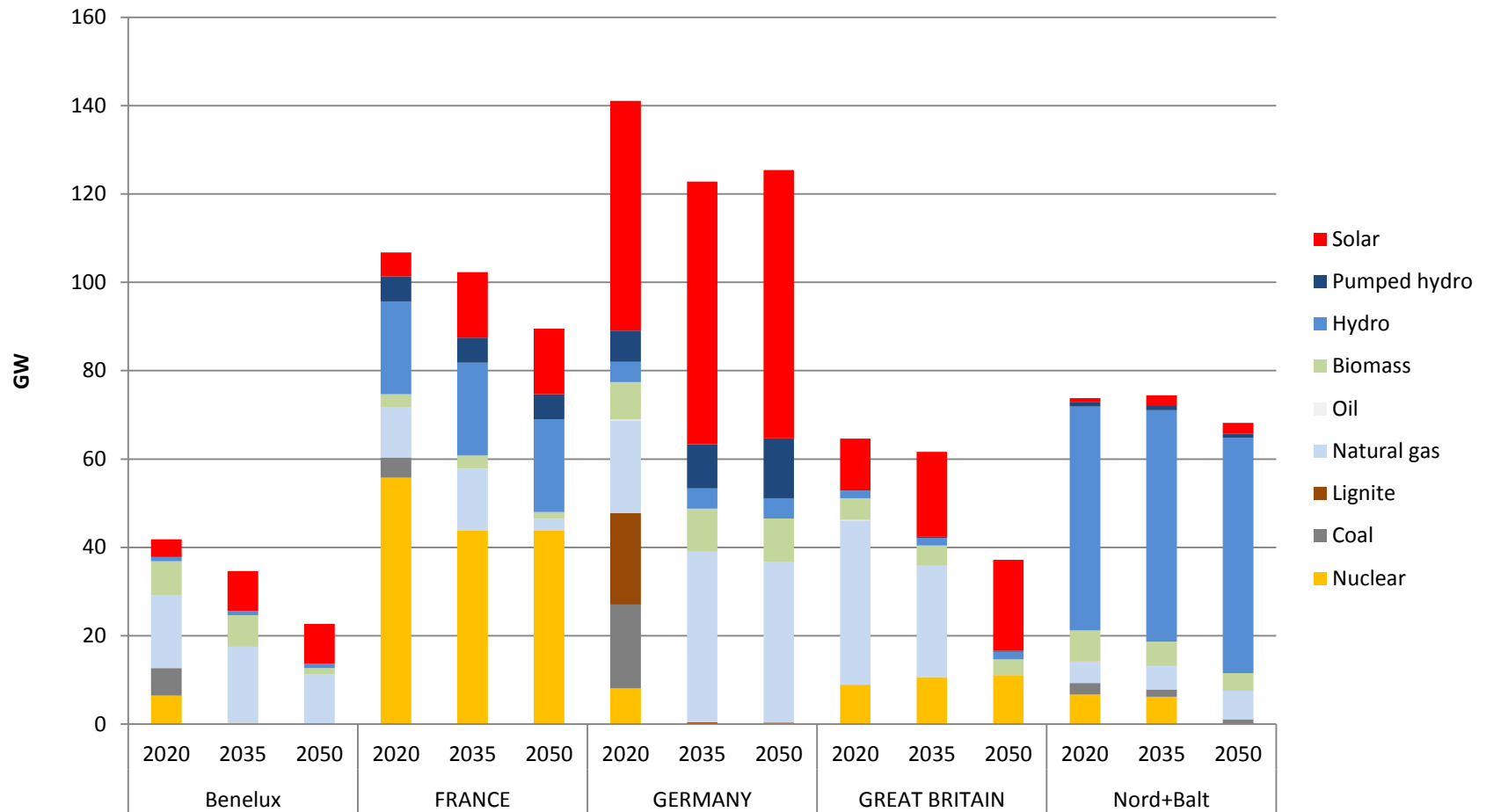


Figure 6: Transmission capacity according to TYNDP 2014 and capacity additions (GW; blue fields) by 2050.

Power plant capacity development



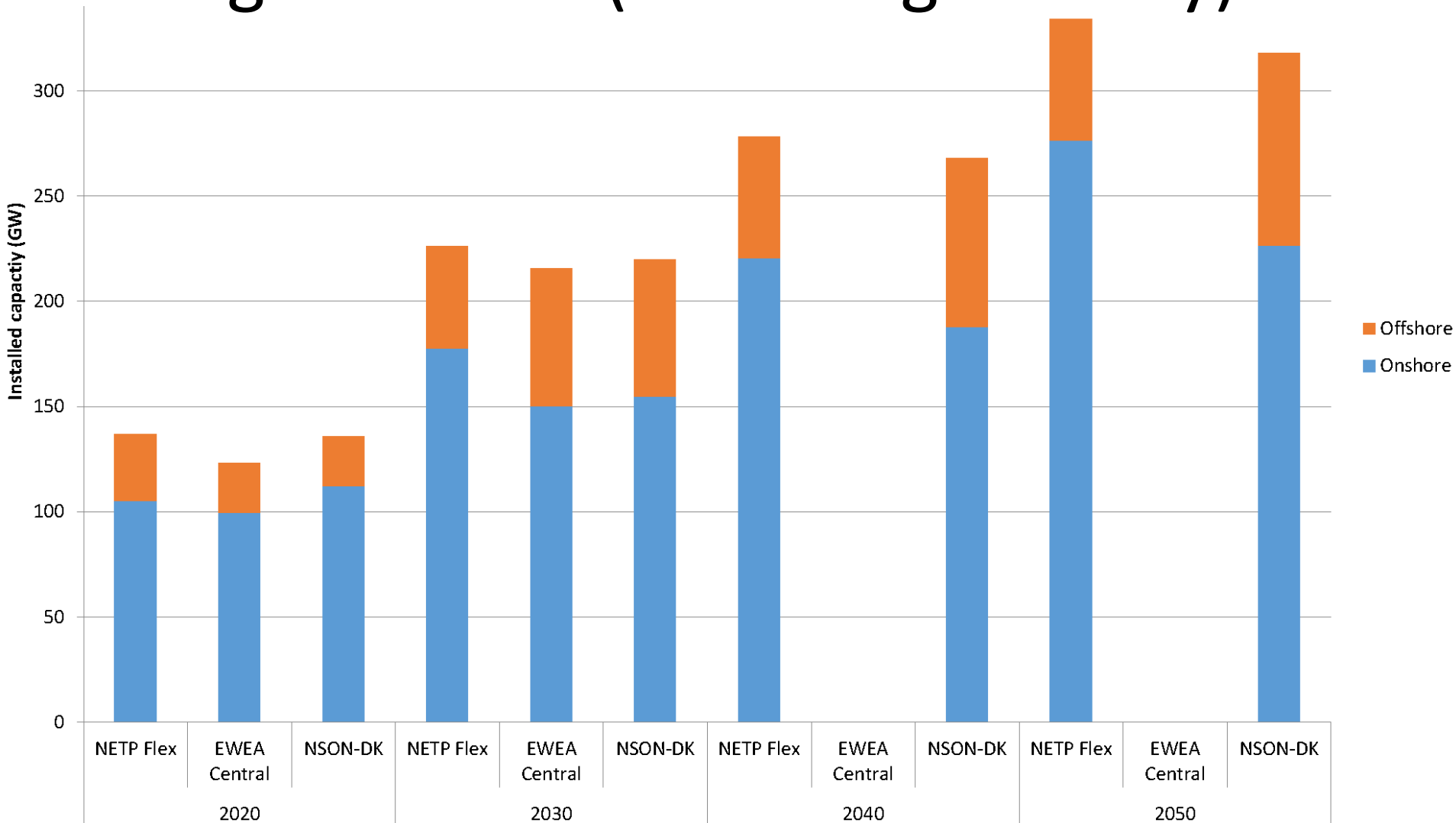
NETP 2016 Flex: Dispatchable and Solar power



NSON-DK wind scenario

- For **2020** and **2030**
 - Offshore installations from EWEA (August 2015)
 - Overall wind installations match NETP Flex (considering expected annual energy generation)
 - Onshore installations are adjusted to achieve this
 - Assumes that offshore generates **60 %** more energy than onshore
- For **2040** and **2050**
 - Overall wind installations match NETP Flex
 - The onshore/offshore share stays on the 2030 level (for expected annual generation)

North Sea region installed wind generation (excluding Norway)



Includes: Baltic and Nordic countries (not Norway), Benelux, France, Germany, UK and Ireland

NSON-DK wind scenario

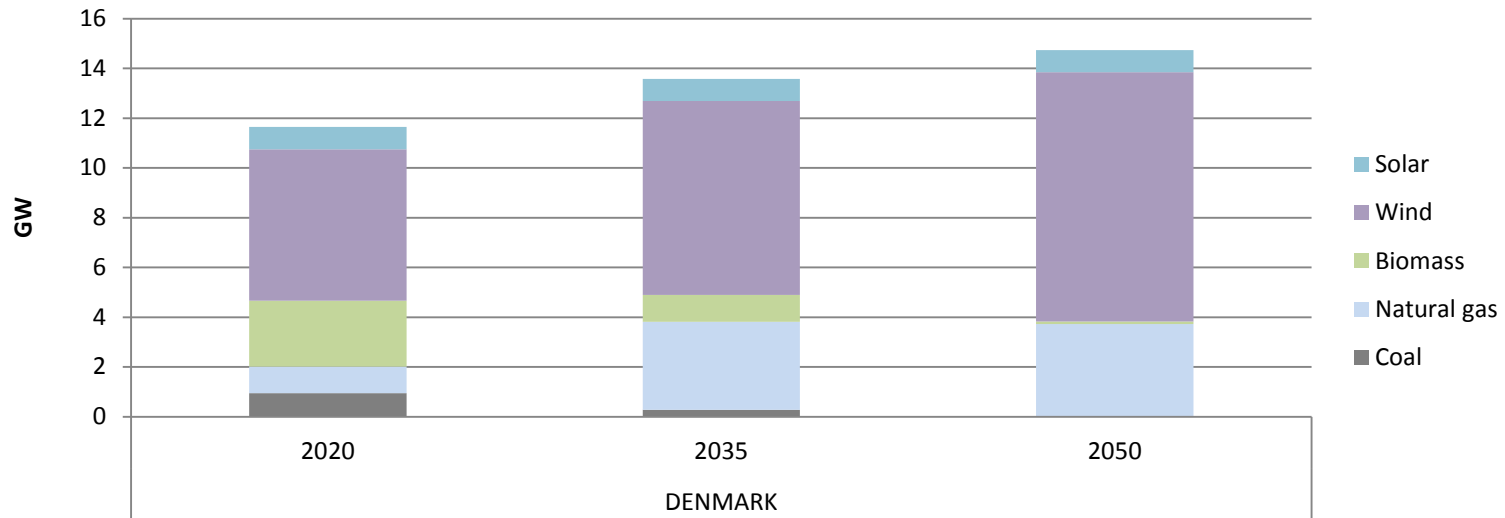
- Considering **Norway**
 - Data not available from EWEA
 - NETP Flex assumes **no offshore wind** for Norway for any year -> assumed also in NSON-DK
- Considering **Denmark**
 - For 2020 and 2030 both onshore and offshore wind installations taken from EWEA
 - Offshore wind based on DTU Wind Energy's data base
 - Expected annual wind generation higher than in NETP Flex

Danish wind installations

Year	Offshore wind (MW)			Onshore wind (MW)		
	NETP Flex	EWEA Central	NSON-DK	NETP Flex	EWEA Central	NSON-DK
2014	1216	1271	1271	3529	3603	3603
2020	2016	2800	2800	4069	3700	3700
2030	2016	3530	3530	5209	4600	4600
2040	2016		4500	6344		4760
2050	2016		6000	8000		4920

In 2050 for Denmark, the NSON-DK scenario gives **8TWhs** higher expected annual wind generation than NETP Flex

Electricity plants in Denmark



- Natural gas development in NETP 2016 questionable: about 10 TWh conflicting with 100% fossil independence
- > Assumption **N SON_DK**: increased wind compensates for gas capacity reduction to about 0.8 GW, yielding
 - 100% renewable (net of exports)

Points for discussion

- DK political target: 100 % fossil independent Denmark by 2050/What does it mean?
- Demand stagnating after 2040 at 40 TWh
- Danish wind development after 2030: expansion/mix between on- and offshore
- Norwegian offshore wind development zero