Energinet.dk scenarios – towards 2030, 2035 and 2050

NSON-DK scenario Webinar
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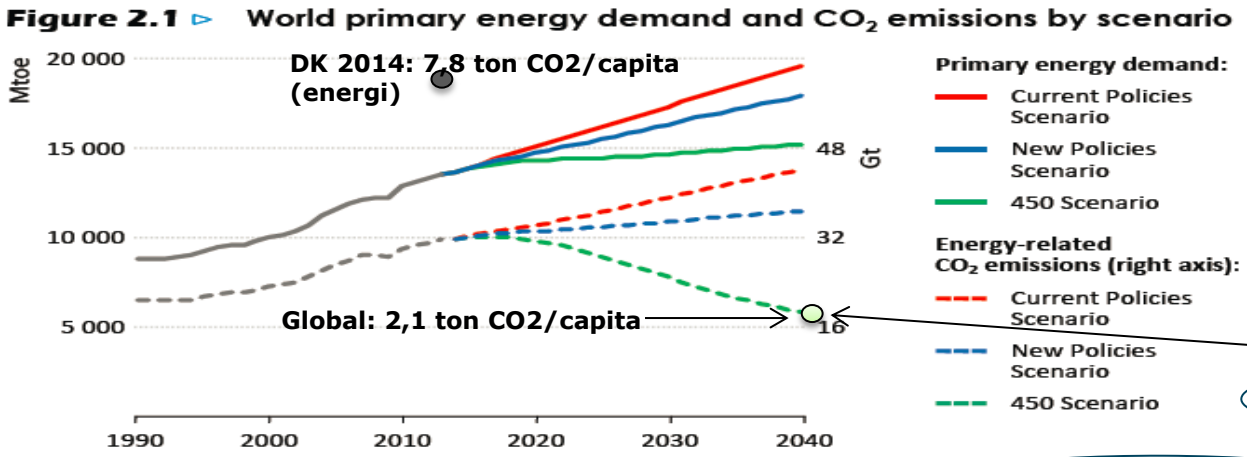
Global contekst – IEA WEO and COP 21



IEA 450 PPM ≈

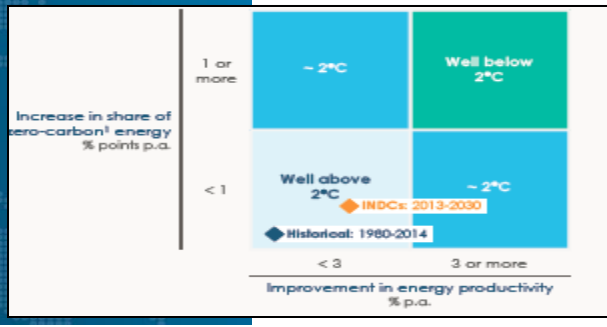
Mission Innovation
More global R&D

Target:
"Well below 2 degr."

INDC's

A tough challenge to realise Paris COP21 targets
– significant CO2-reduction needed

Global plans (INDC's) – significant grow in wind/solar

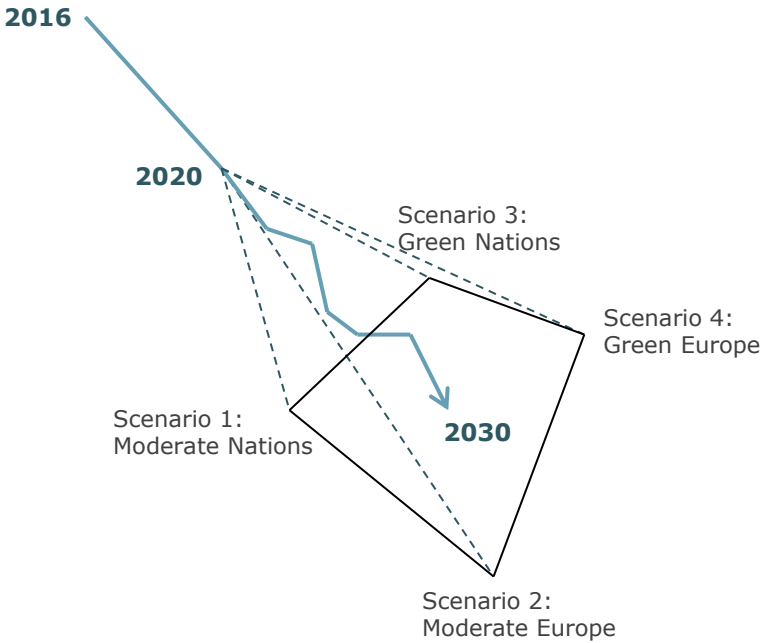


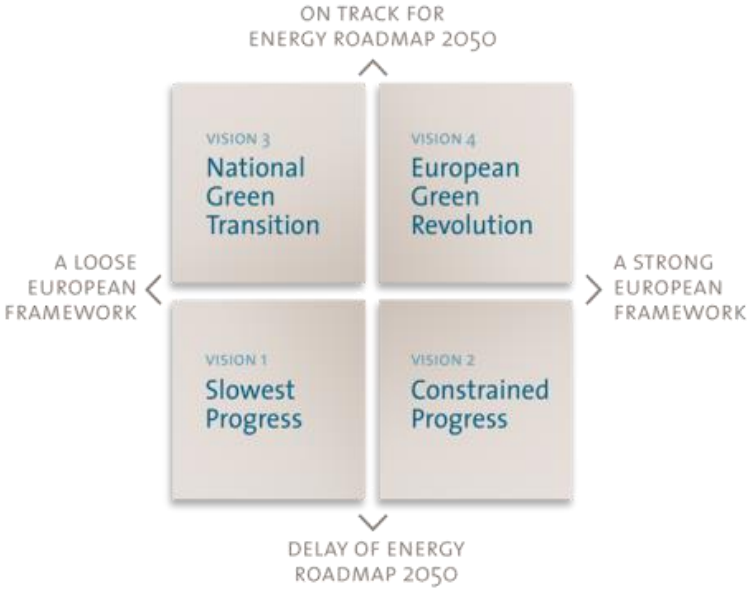
- INDC's does not lead to needed reduction in CO2 if "Well below 2 degr" should be realised
- A need for even more wind, solar, RE-fuels and energy efficiency

Uncertainties in international framework conditions (fuel and CO2-prices, focus on green energy etc.)

- *A need for scenarios to handle uncertainties*

Scenarios – to cope with an uncertain future





Danish scenarios based on ENTSO-E European scenarios

Energinet scenarios towards 2030

Scenario 3 – Green Nations

- Danmark showcase for transition towards ”Well below 2 degr.” target
- Low international cooperation but many countries are ambitios
- IEA 450 PPM price level (low fuel and high CO2 prices)

Scenario 4 – Green Europe

- EU showcase for Green transition (COP21) – Energy Union
- International cooperation in EU – Energy Union with markets for Green gas
- IEA 450 PPM price level (low fuel and high CO2-prices)

High focus RE

National focus

EU
Energy Union

- Denmark low RE-ambition
  - only whats internationally imposed
- Low international cooperation – ”Brexit” tendencies in Europe – no EU carbon market
- Few reforms of tax/regulation in DK and EU
- IEA Current Policies fuel prices
  - High fuel-prices and low CO2-prices

- Moderate ambition RE in EU and DK
- High international cooperation – EU regulation, standards and grid codes
- IEA New Policies price level Medium Fuel and CO2-prices

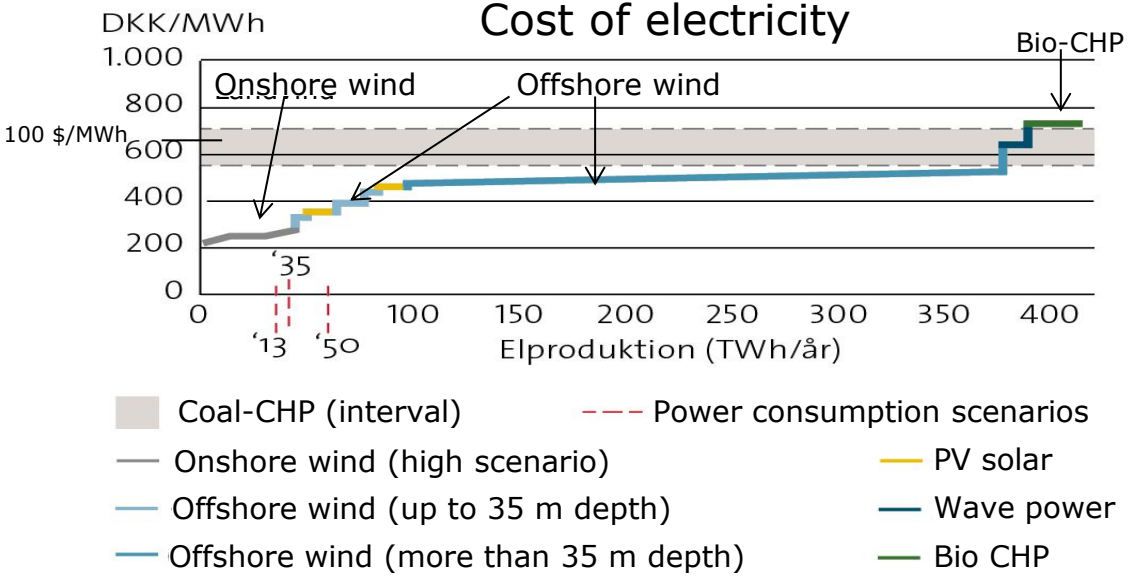
Low focus RE

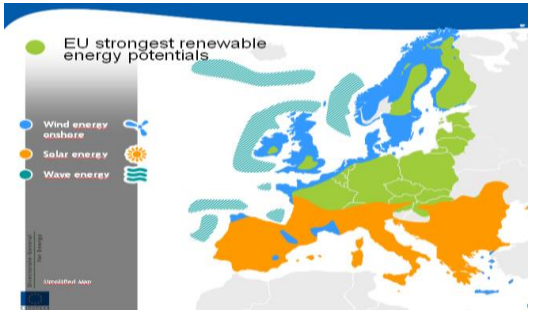
Scenario 1 – Moderate Nations

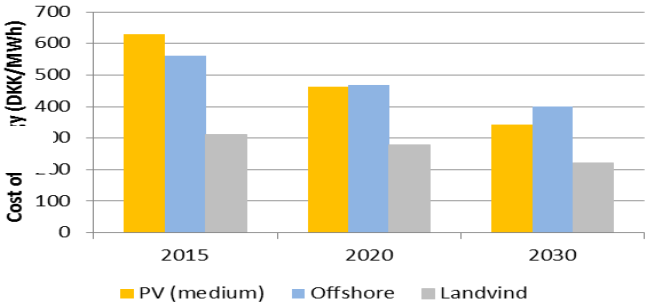
Scenario 2 – Moderate Europe

RE-electricity ressources DK

Socio-economic cost of energy 2030 excl. integration (LCOE)

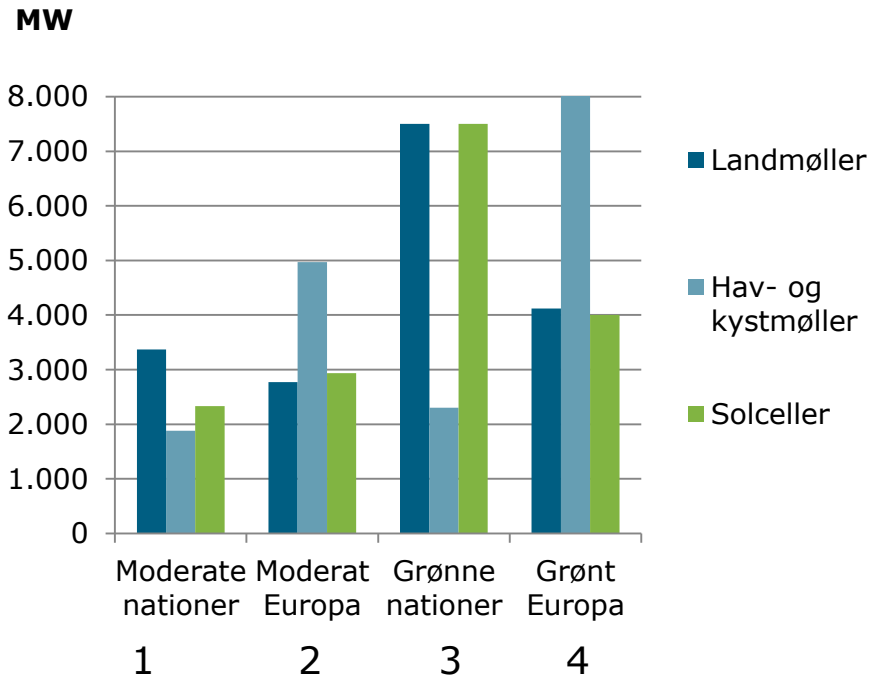






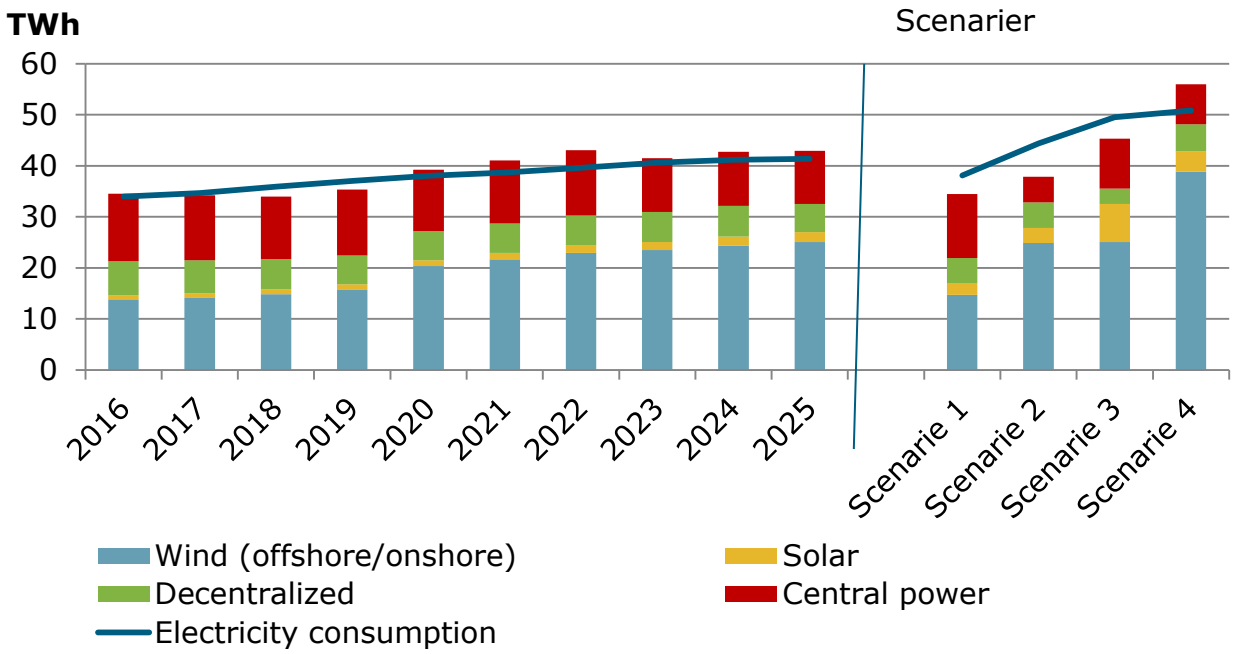
Technology data 2014/2015 and 4% discount
Solar large scale not illustrated

Wind and solar in the scenarios



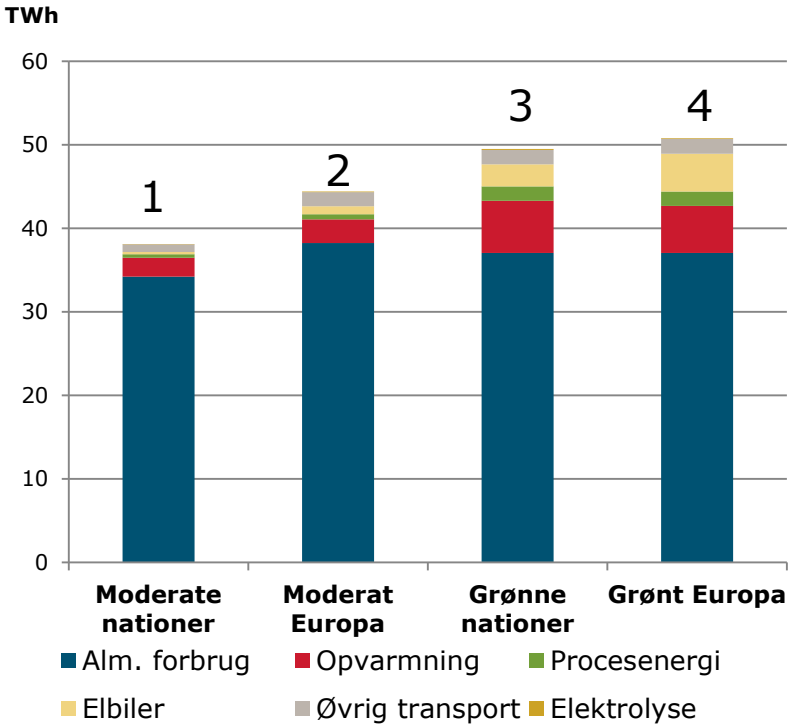
Offshore wind in Scenario 4 is a case with ”Green Europa” and to be seen as a ”European investment”

Power production



- A high electrification in scenario 3 and 4
- Wind/solar increased

Electricity consumption



- Increased electricity for heating sector – Especially in scenario 3 and 4
- From 3% (scenario 1) to 35% electric vehicles (EV/PHEV) in scenarios 4

Udlandsforbindelser i AF2016 og scenarier 2030

Forbindelse	Navn	AF16 2030		Scenarie 1		Scenarie 2		Scenarie 3		Scenarie 4	
		Eksport	Import	Eksport	Import	Eksport	Import	Eksport	Import	Eksport	Import
Østdanmark - Sverige	Øresund	1700	1300	1700	800	1700	1300	1700	1300	2500	2500
Østdanmark - Tyskland	Kontek	585	600	585	600	585	600	585	600	585	600
Østdanmark - Tyskland	Kriegers Flak	400	400	400	400	400	400	400	400	400	400
Vestdanmark - Norge	Skagerrak	1632	1632	1132	1132	1632	1632	1132	1132	1632	1632
Vestdanmark - Norge	DKW-OSL							700	700	700	700
Vestdanmark - Sverige	Konti-Skan	740	680	740	680	740	680	370	340	740	680
Vestdanmark - Tyskland		3500	3500	1500	1500	3500	3500	3500	3500	3500	3500
Vestdanmark - Holland	COBRAcable	700	700	700	700	700	700	700	700	700	700
Vestdanmark - Østdanmark	Storebælt	590	600	590	1200	1190	1200	1190	1200	590	600
Vestdanmark - England	Viking Link	1400	1400	0	0	1400	1400	1400	1400	1400	1400
Østdanamark - Polen				600	600	0	0	0	0	600	600

Energinet scenarios towards 2030

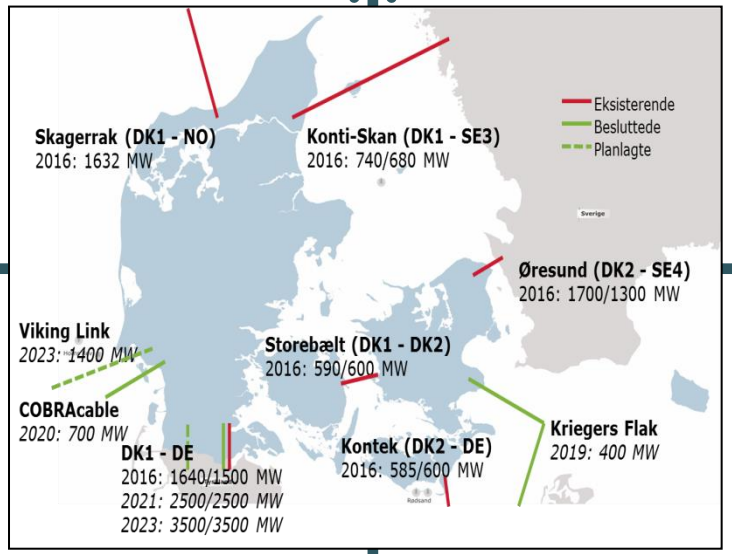
Scenario 3 – Green Nations

Scenario 4 – Green Europe

- DK1-Norway +500 MW
- DK2-Poland: +600 MW
- DK2-Sweden: +800 MW

High focus RE

National focus



EU
Energy Union

- DK1-Norway (-500 MW)
- No DK1-UK connection
- DK1-D (-2000)

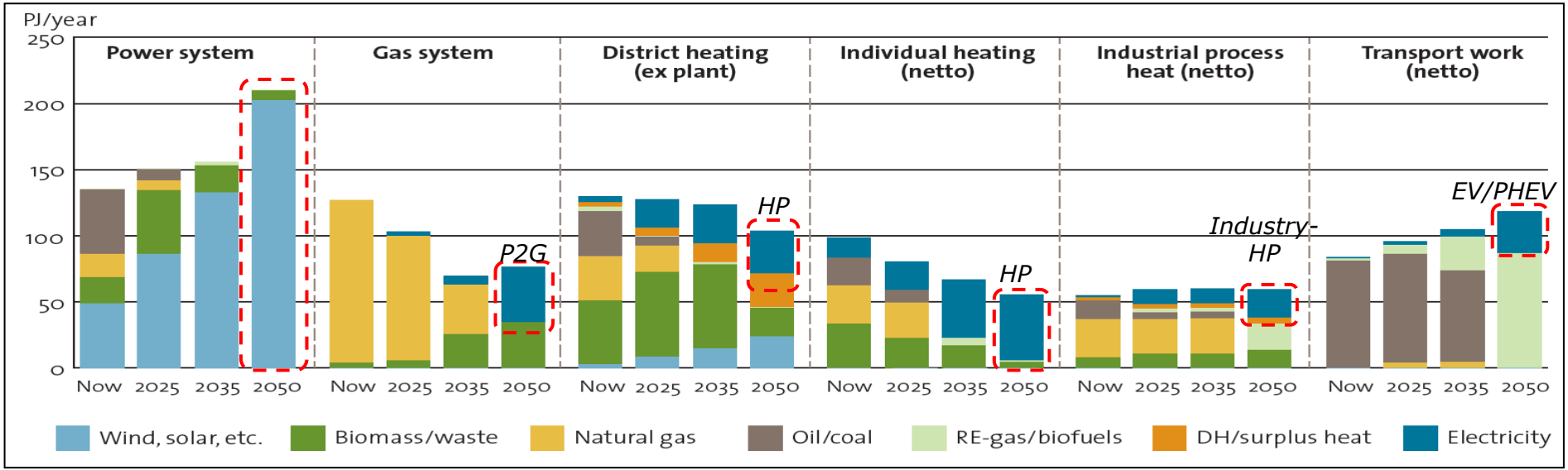
- DK2-Poland +600 MW

Low focus RE

Scenario 1 – Moderate Nations

Scenario 2 – Moderate Europe

Post 2030 - Towards RE-based energy supply in 2050



2035 - Reference with fossil free power and heat system

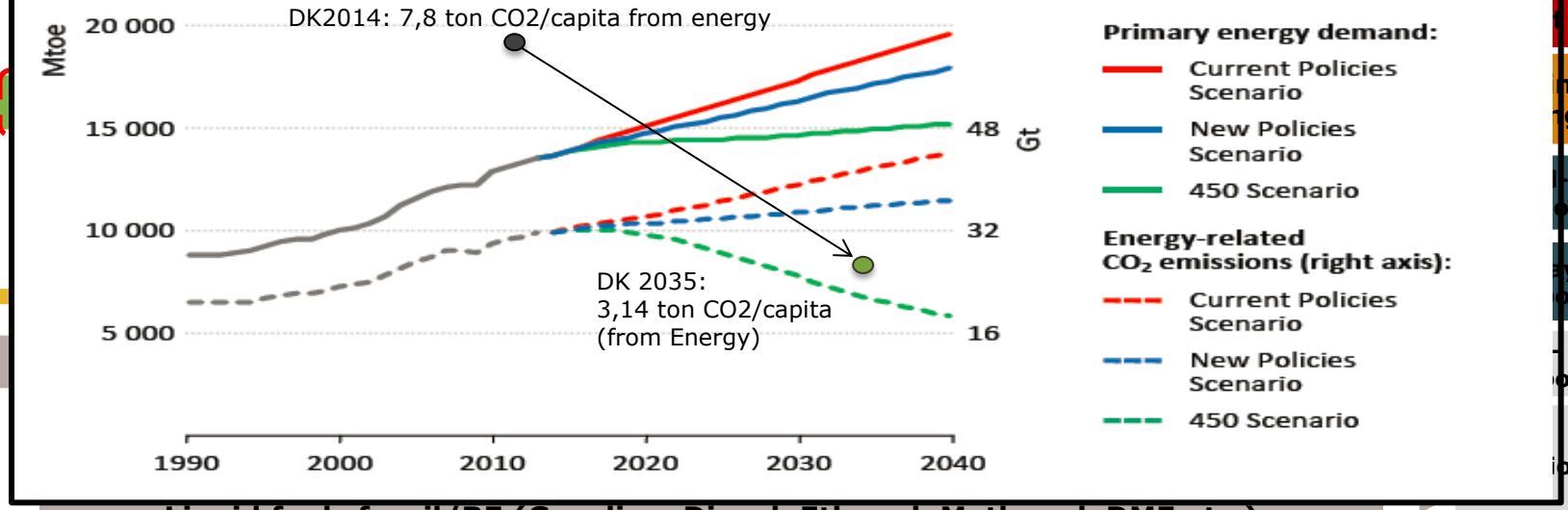
Import power
Solar
Wind
Bio, waste etc.
Natural gas
Fossil oil

Transit
Power-system

Export power
El-proces
Light,it,cool

Bio CHP and boiler
Gas CHP/boiler
Electrolysis
Central Heat pumps

Figure 2.1 ▷ World primary energy demand and CO_2 emissions by scenario

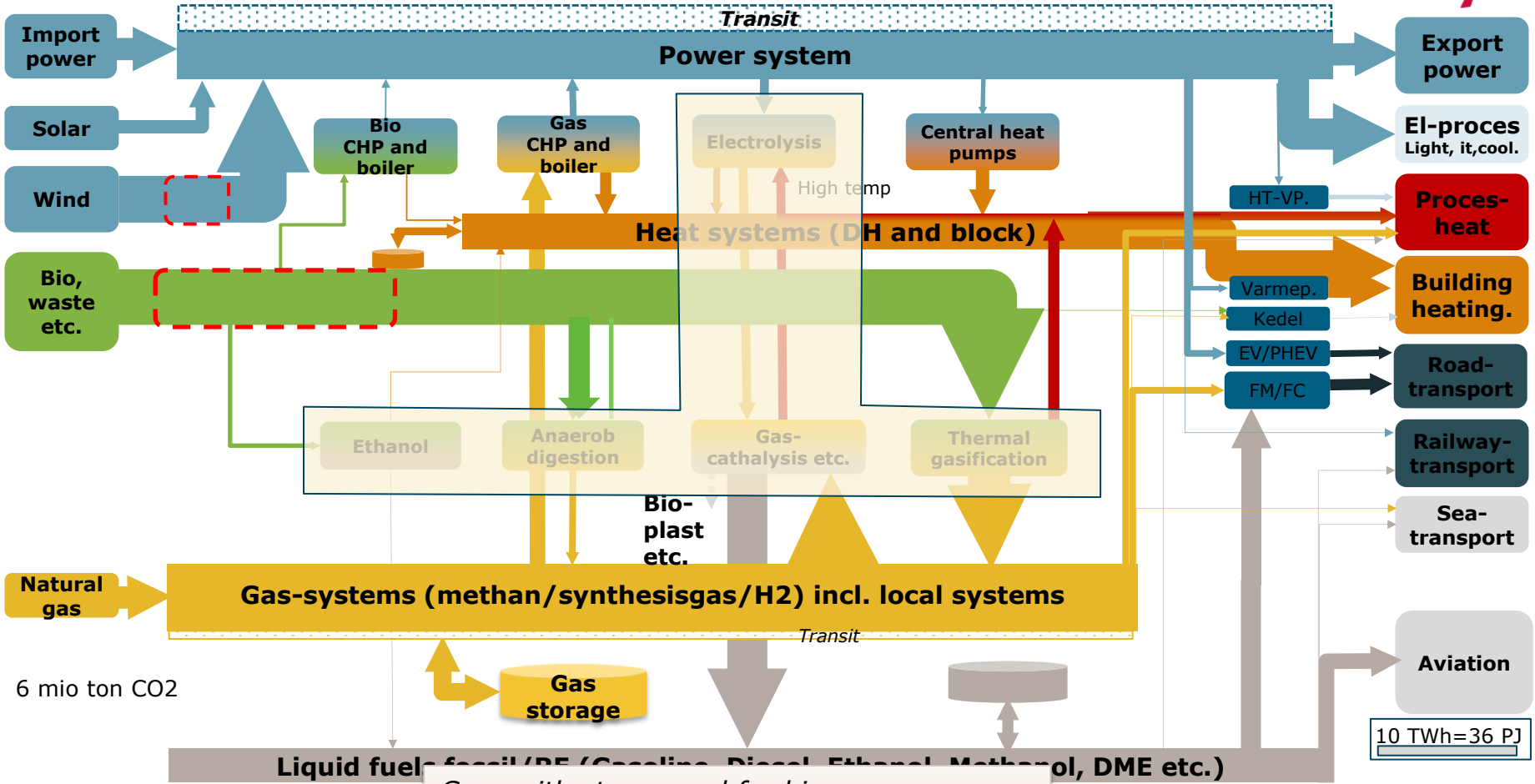


Liquid fuels fossil/RE (Gasoline, Diesel, Ethanol, Methanol, DME etc.)

14 mio ton CO2

10 TWh=36 PJ

Feasibility study 2035+ with reduced fossil oil demand



Case with straw used for biogas

Feasibility study 2035+ – reduced fossil oil demand

ENERGINET.DK

Import power

Solar

Wind

Bio, waste etc.

Natural gas

Transit

Power system

Export power

Bio

Gas

Central heat

El-proces

Transit

Gas storage

Aviation

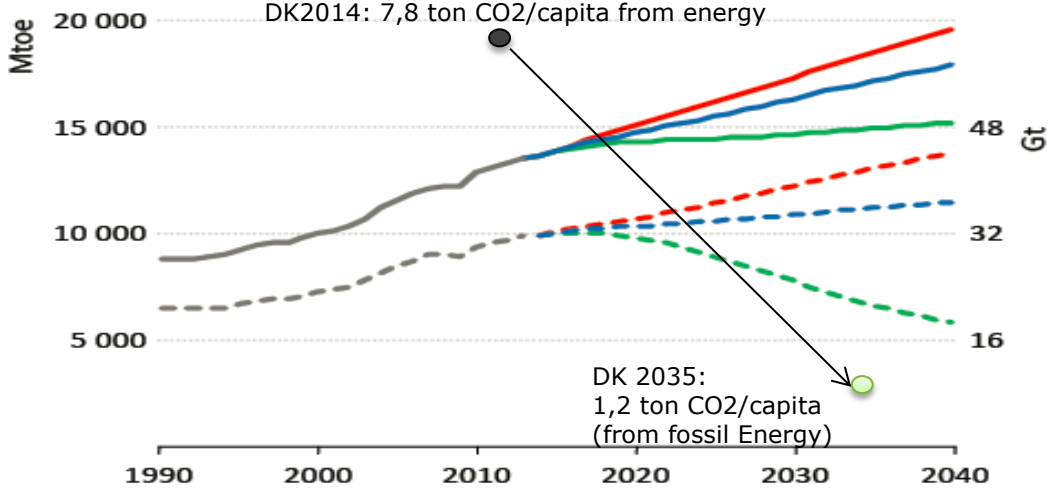
6 mio ton CO2

10 TWh=36 PJ

Liquid fuels fossil/RE (Gasoline, Diesel, Ethanol, Methanol, DME etc.)

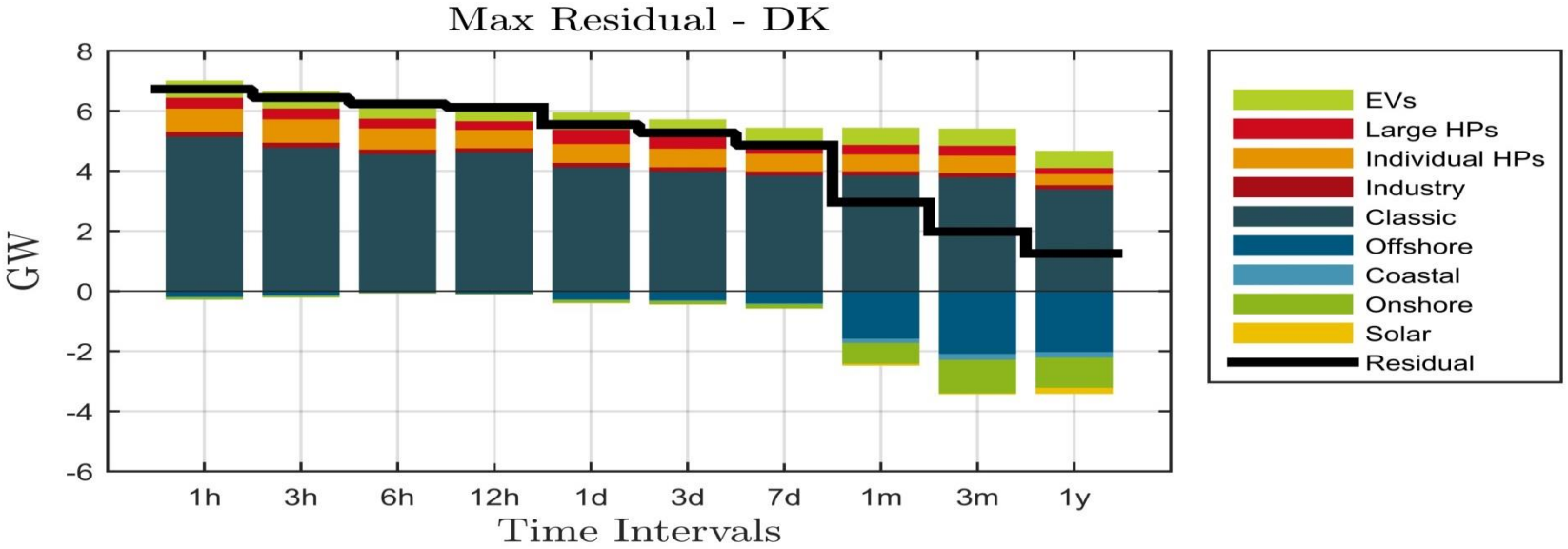
Case with straw used for biogas

Figure 2.1 ▷ World primary energy demand and CO_2 emissions by scenario



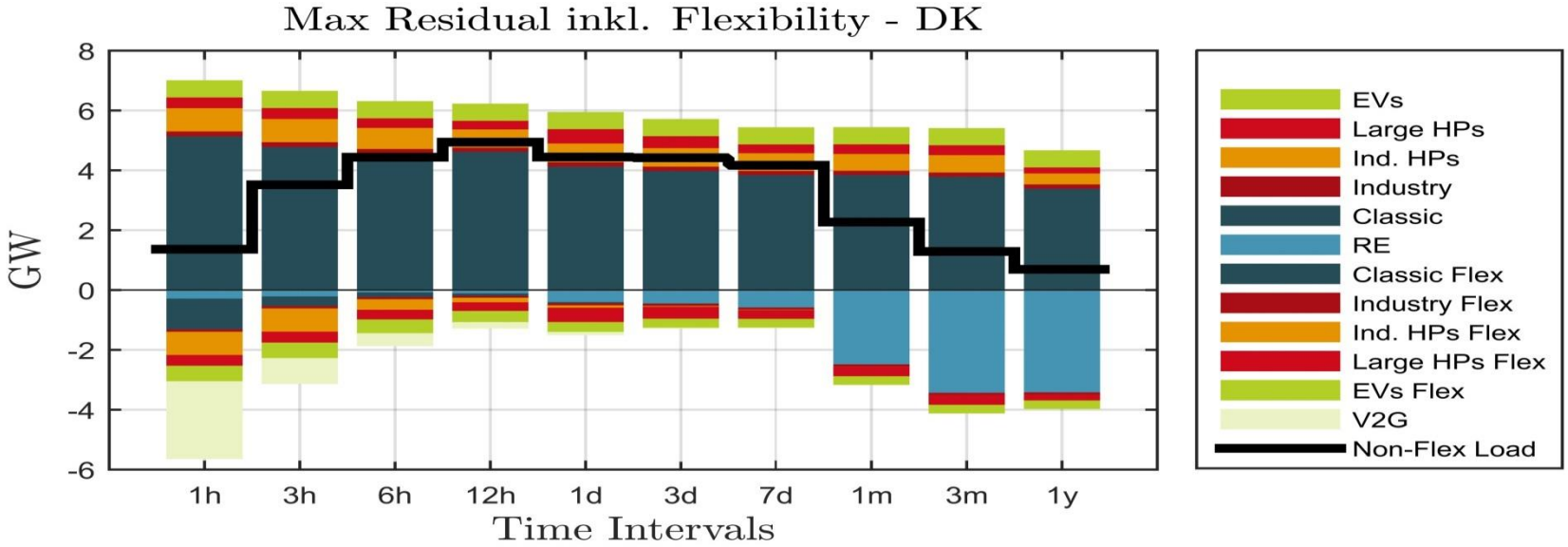
Max Residual load in Periods of 1 Hour to 1 Year (2035 scenario)

(analysis based on 10 year DTU wind time series)



Residual load = Consumption – wind/solar

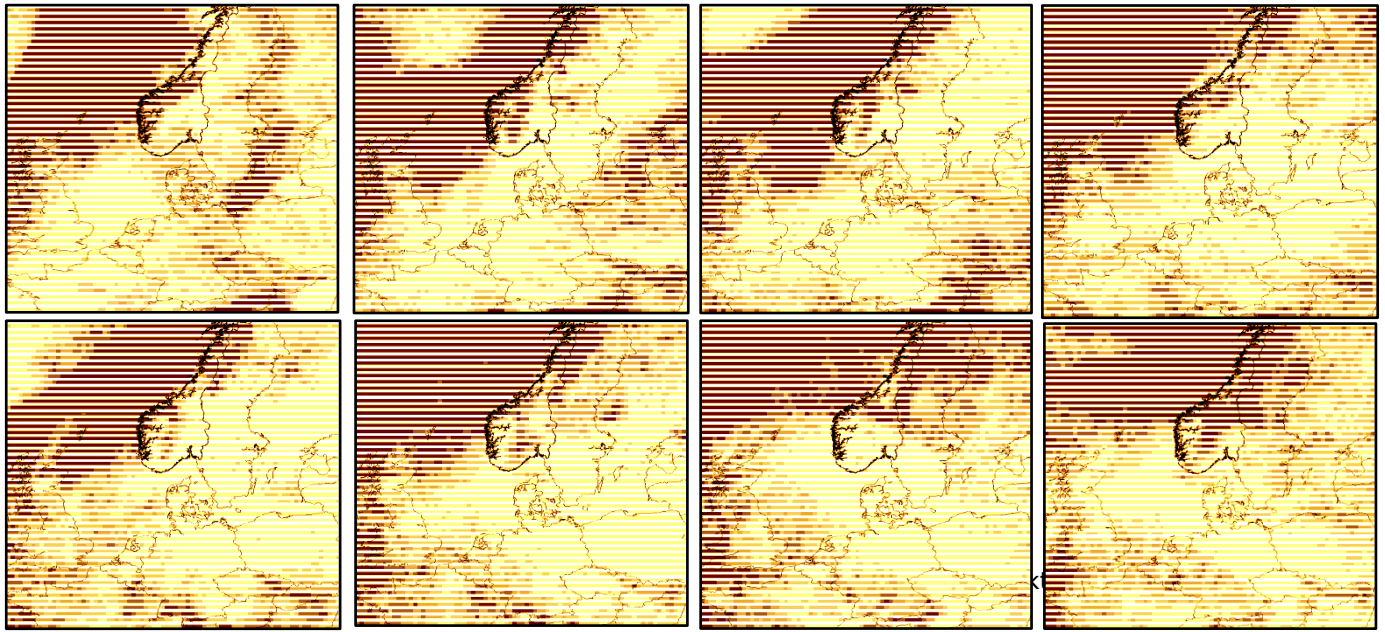
Use of flexible load to reduce peak demand

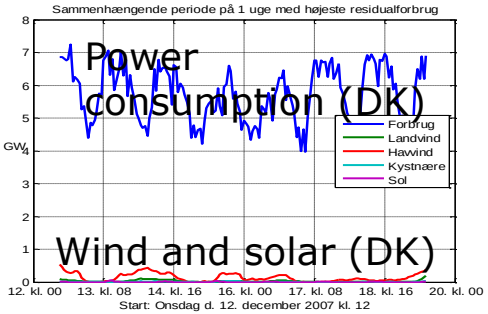


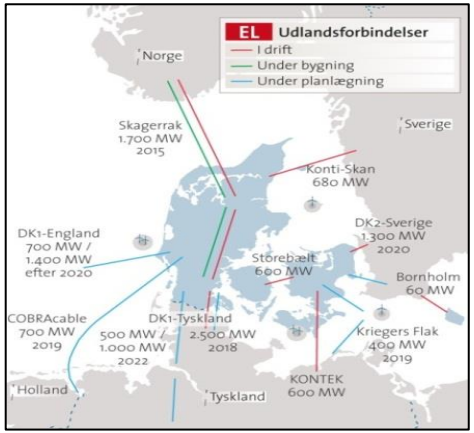
Now the max residual load is in a 12 hours period

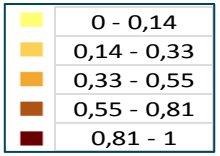
Windpower in North sea region in a week with ”Worst case i DK”

From 12/12 kl. 24.00 and 7 days ahead



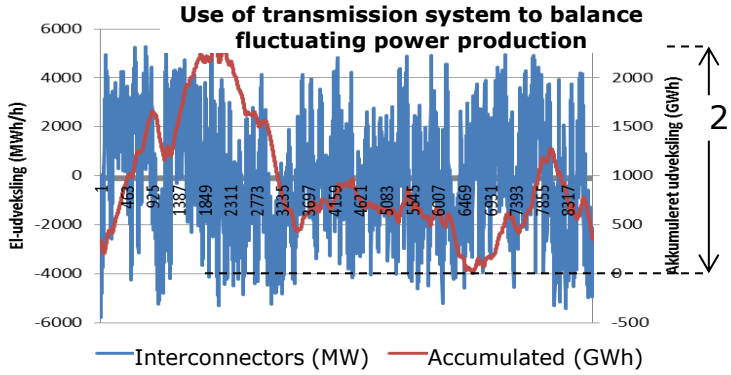






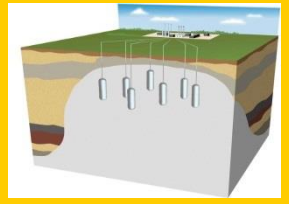
- *Essential to use the geographical spread of windpower*

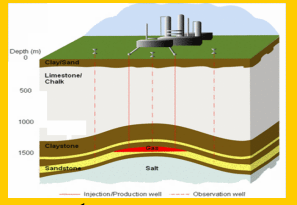
Use of transmission system to balance wind/solar



2,3 TWh

Gas storage (11 TWh methan-gas)
Energy input to power-to-gas





Transmission system:
Interconnectors yearly accumulated energy in 2035
(2,3 TWh)

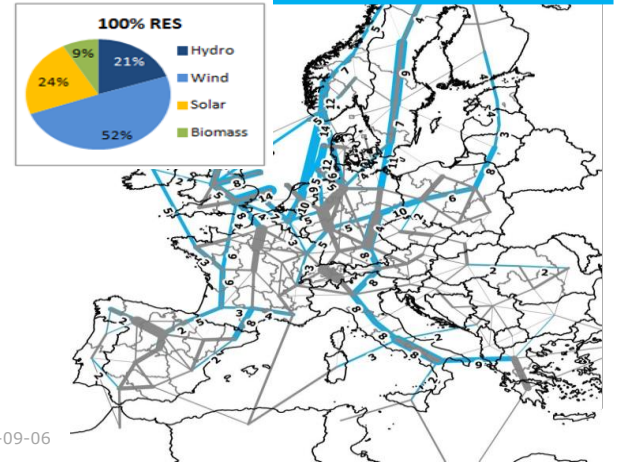
District heat+storage

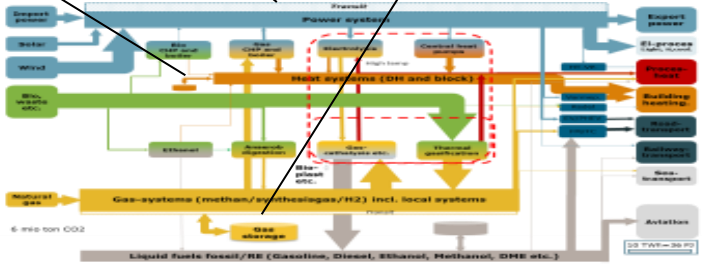
Indivi. heat pump

El- og plugin hybrid

case 2035

A 2050 EU scenario 100% RES





Summing up

- The COP21 (Paris) aggreement i very ambitios. A need for very large increase in wind and solar power
- In Scenario 3 and 4 (Green Nations and Green Europe) the COP21 target is in high focus
- A need for international power-system integration and integration of power, heat,gas/fuel systems to balance the fluctuating wind


Thank you for attention
Link: www.energinet.dk/energianalyser