Energy system scenarios for Denmark & Europe – *towards 2030, 2035 and 2050*

Joint FutureGas-CITIES-InnoSE Gas Workshop

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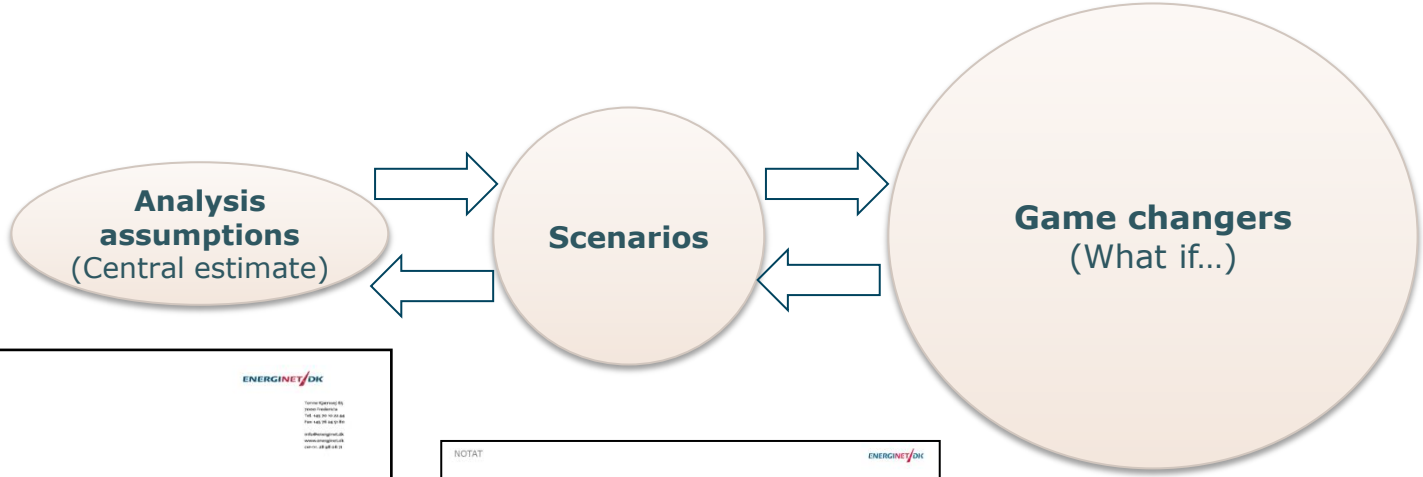
Analysis assumptions – Scenarios - Gamechangers



http://www.energinet.dk/EN/El/Udvikling-af-elsystemet/Analyseforudsaetninger/Sider/default.aspx

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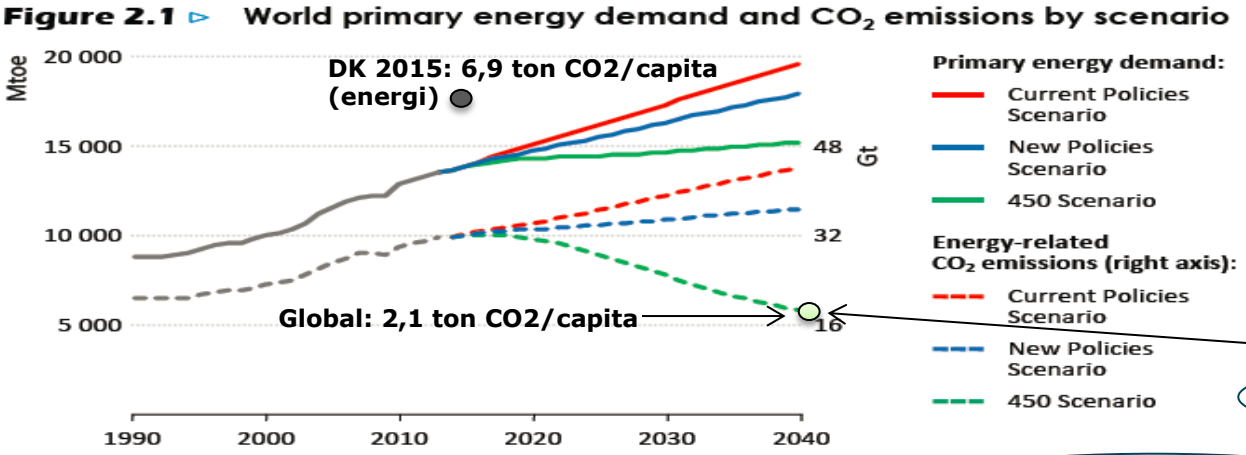
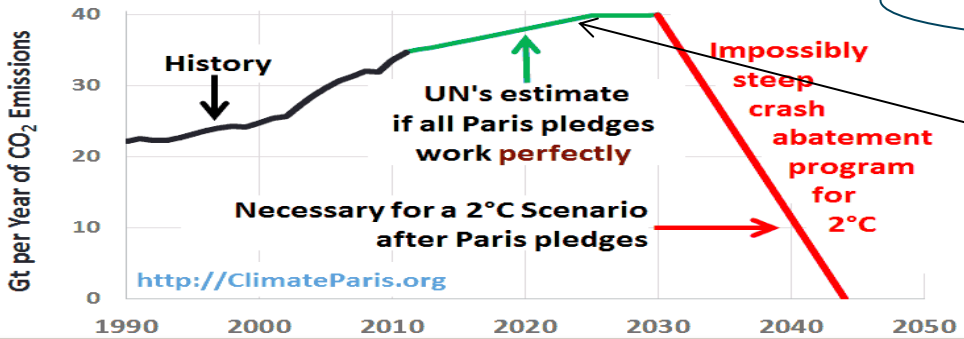
Global contekst – IEA WEO and COP 21



IEA 450 PPM ≈

Mission Innovation
More global R&D



Target:
"Well below 2 degr."

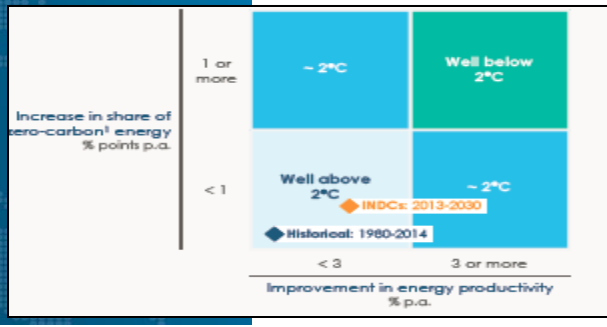
INDC's

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

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

- *A need for scenarios to handle uncertainties*

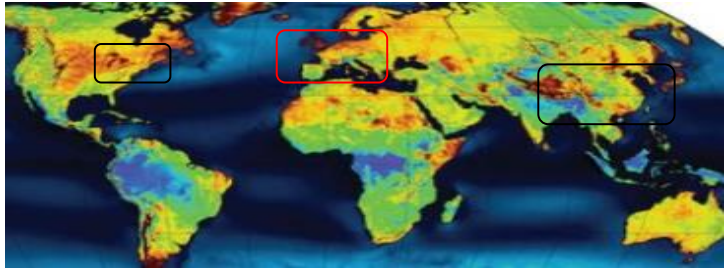
Global plans (INDC's) – significant grow in wind/solar



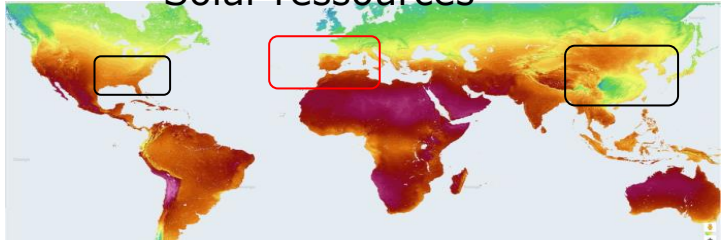
- INDC's does not lead to needed reduction in CO2 if "Well below 2 degr" should be realised
- A need for even more wind, solar, RE-fuels and energy efficiency

Europe – a case with wind and solar mix

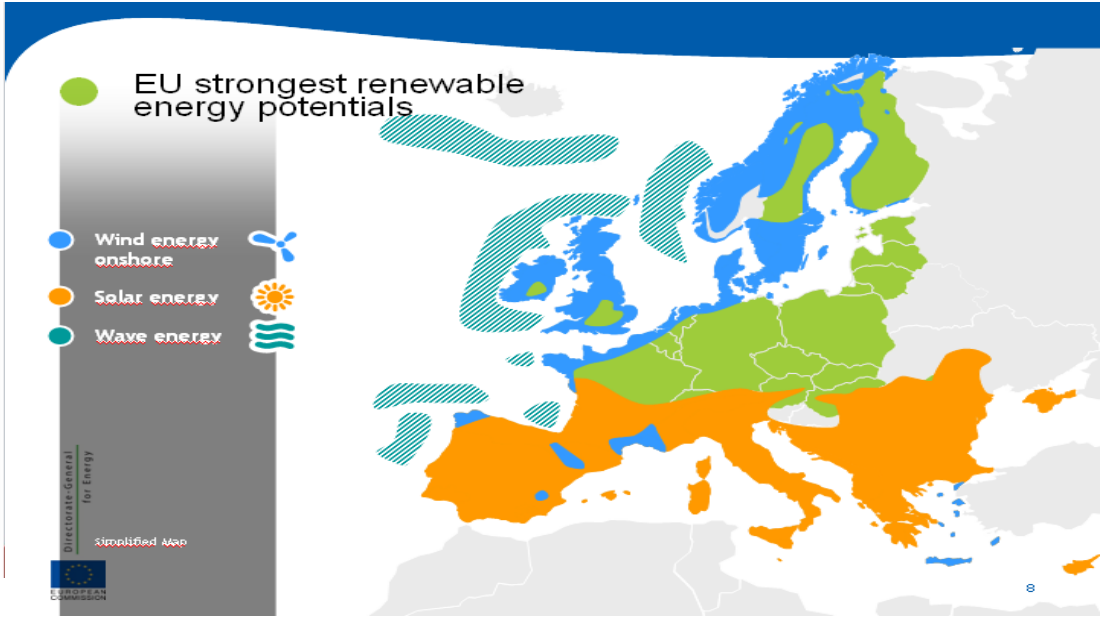
Wind ressources



Solar ressources



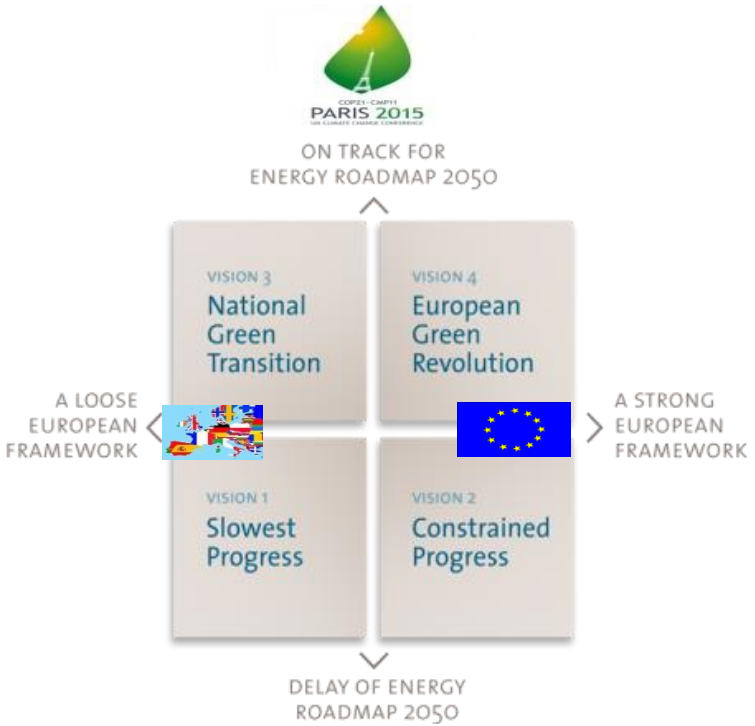
Population densities



Europe – A high population density region with a mix of wind and solar ressources
- *A representative case*

European scenarios – to cope with uncertain future

Tyndp 2016

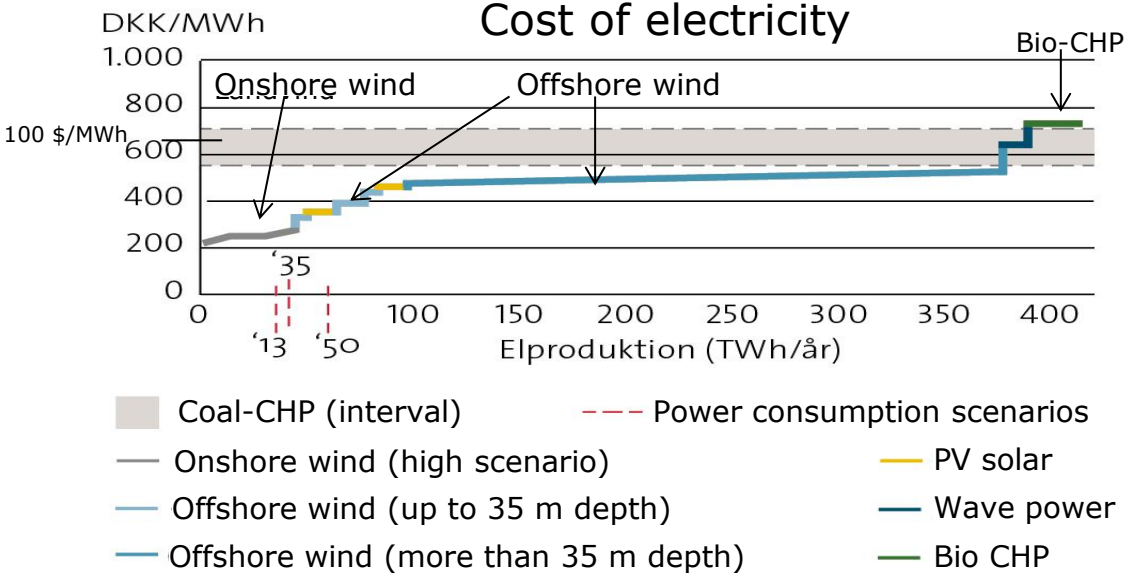


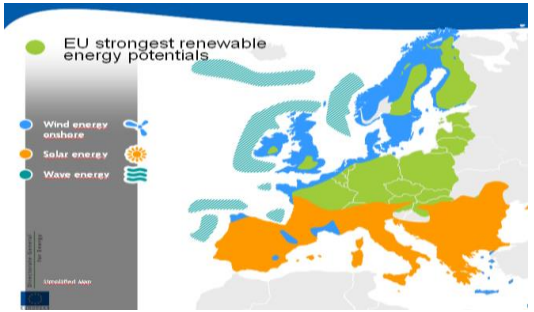
Tyndp 2018 – (work in progress)

- **Distributed generation**
  - High impact from ”local” prosumer solutions
  - EU on track with 2050 vision
  - High oil prices (IEA New policies) and high CO2 prices
  - 50% electricity from wind/solar in 2040
- **Global climate action**
  - Strong international green framework
  - EU on track with 2050 vision
  - Moderate oil prices and very high CO2-prices (IEA 450 PPM)
  - 50% electricity from wind/solar in 2040
- **Sustainable Transition**
  - EU not fully on track with 2050 vision
  - Low oil/natural gas prices and moderate CO2-prices (IEA Low oil price scenario)

RE-electricity potential ressources DK

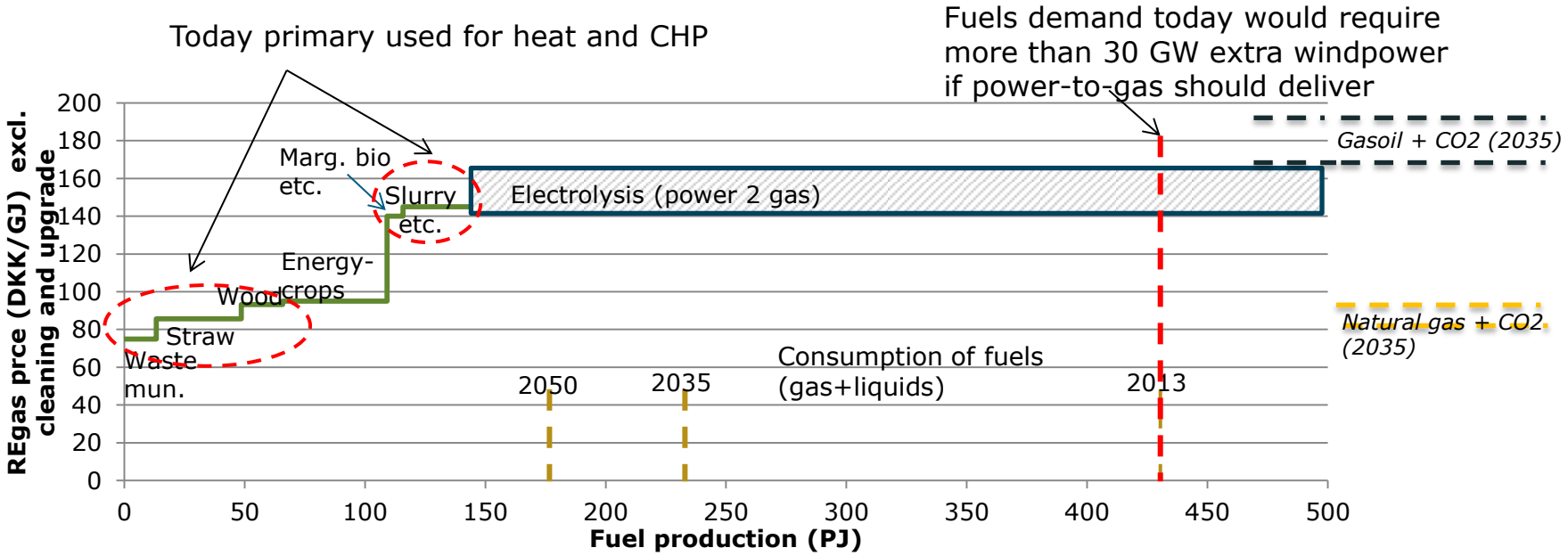
Socio-economic cost of energy 2030 excl. integration (LCOE)





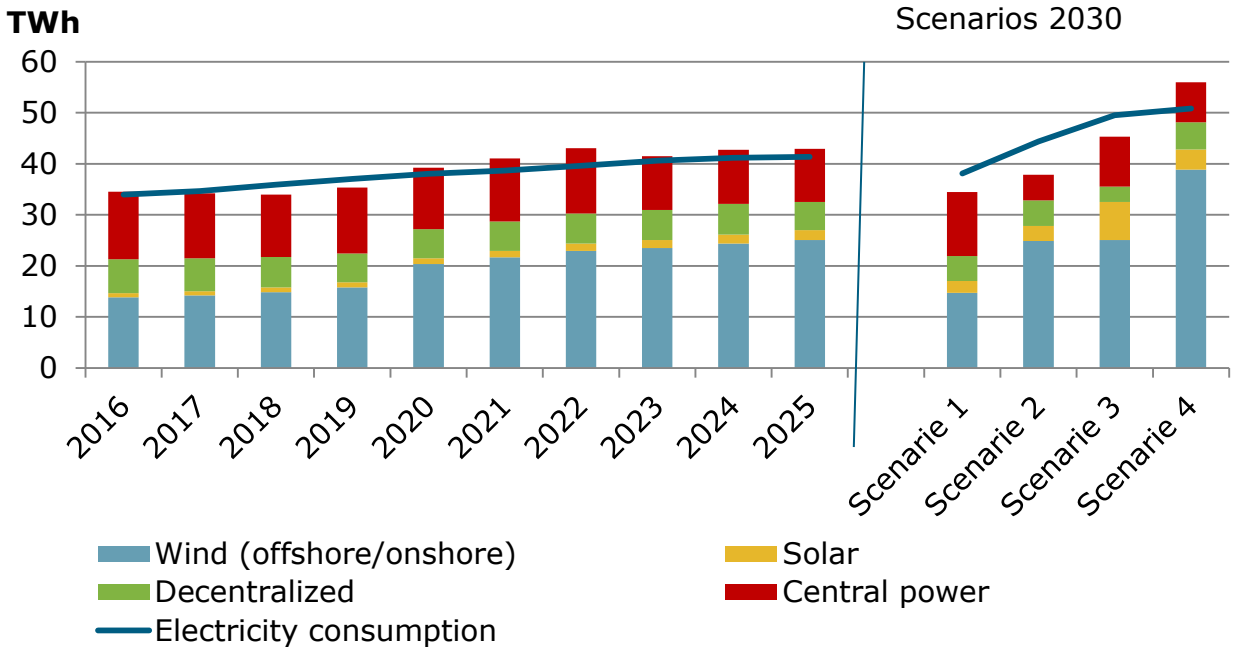
Technology data 2014/2015 and 4% discount
Solar large scale not illustrated

Ressources and cost for fuels
(2030 if all biomass is allocated to fuels)



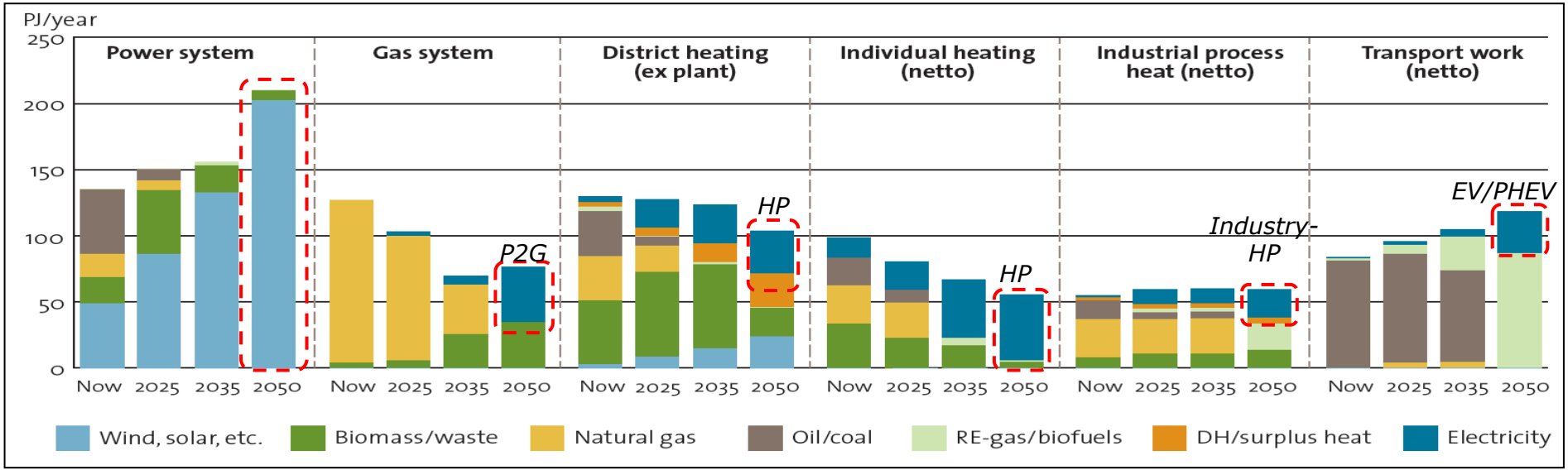
A significant demand for fuels – electrification is needed to solve the "fuel" challenge
Natural gas cheaper than gasoil – RE-gas cheaper than biofuels

Power production

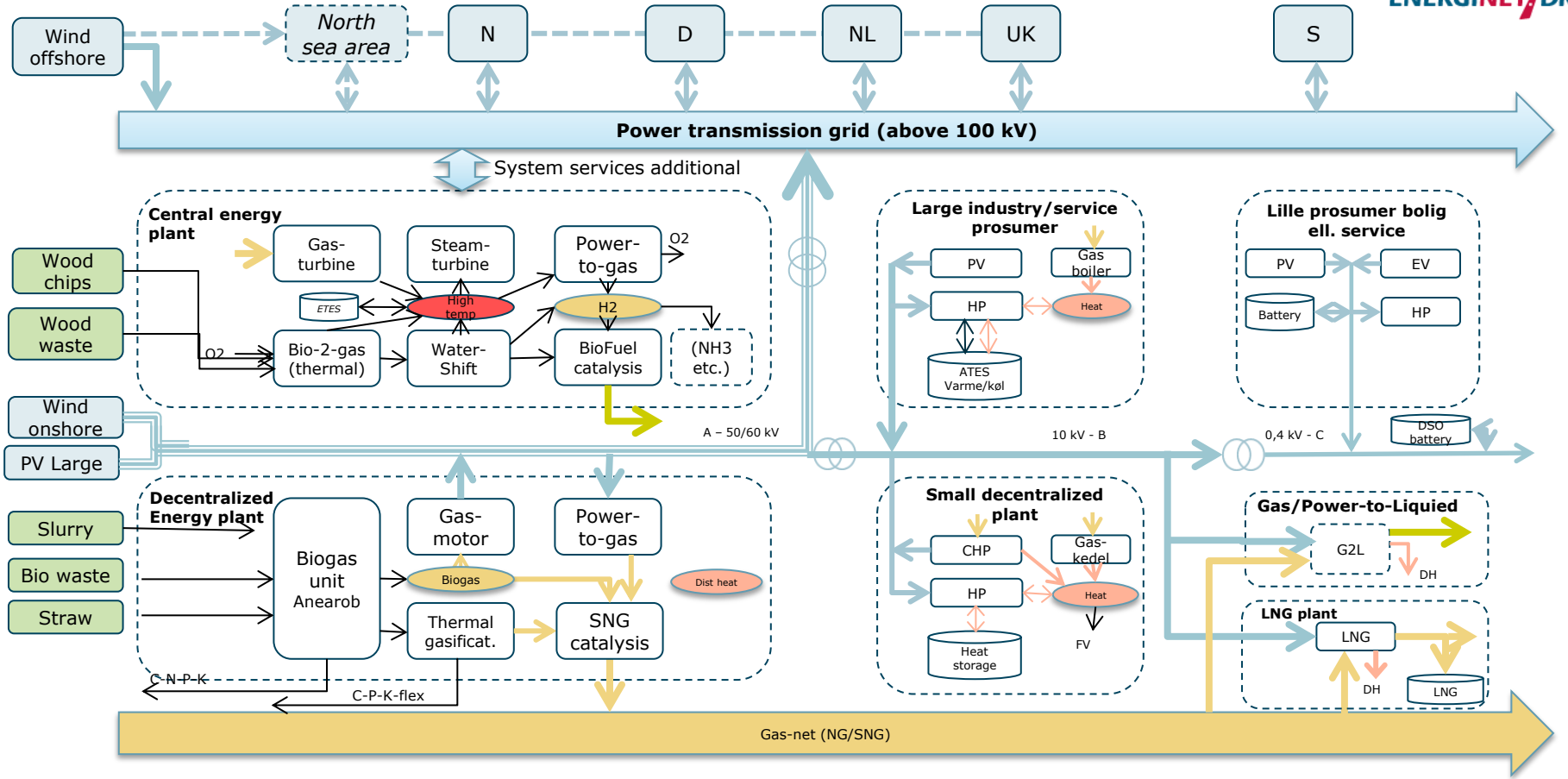


- A high electrification in scenario 3 and 4
- Wind/solar increased

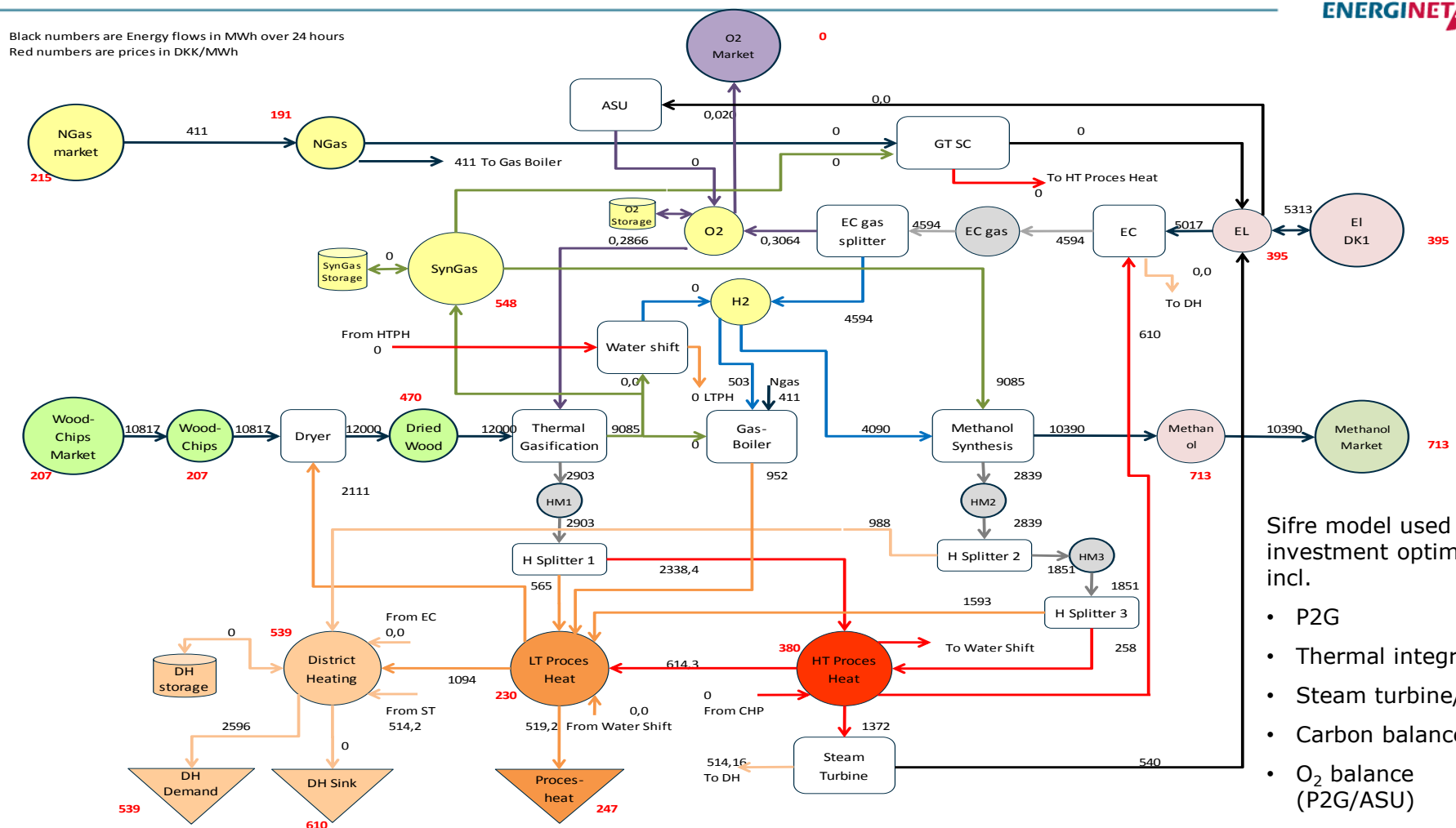
Post 2030 - Towards RE-based energy supply in 2050



System integration at different plant types



System analysis of a central energy plant with Sifre model



Sifre model used for investment optimization incl.

- P2G
- Thermal integration
- Steam turbine/SOEC
- Carbon balance
- O_2 balance (P2G/ASU)

2035 - Reference with fossil free power and heat system

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Import power

Transit

Power-system

Export power

Solar

Bio CHP and boiler

Gas CHP/boiler

Electrolysis

Central Heat pumps

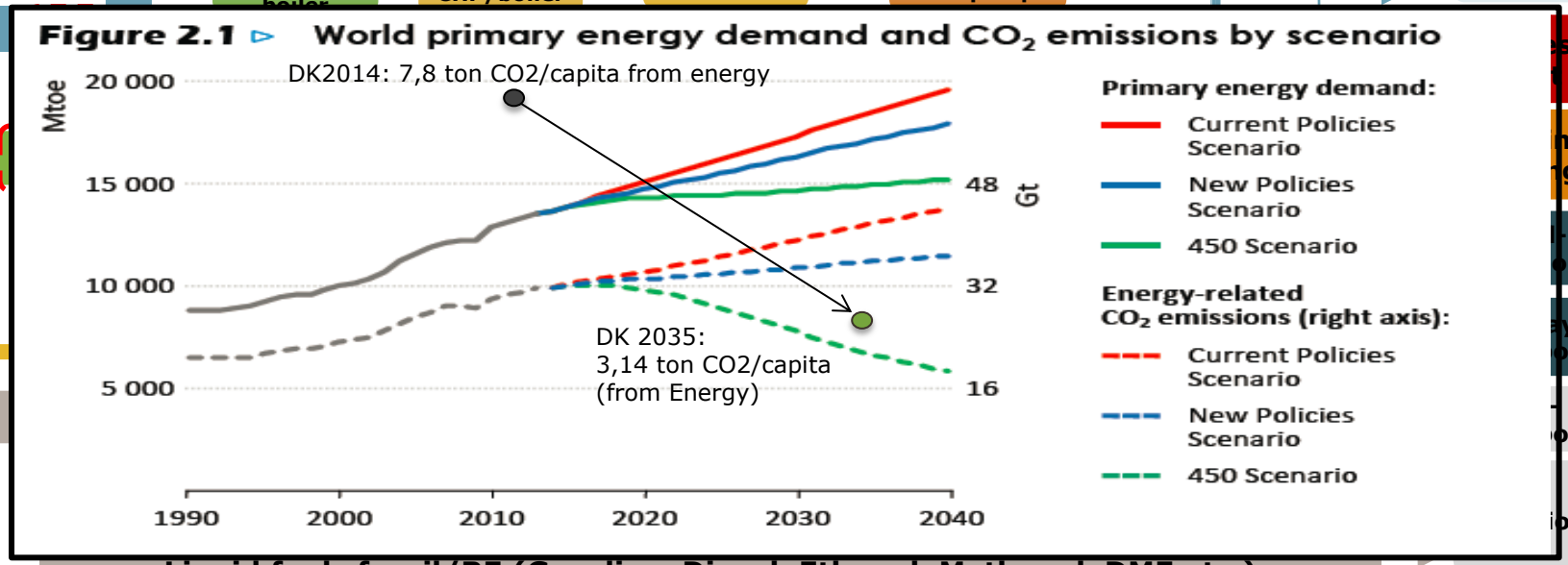
El-proces Light,it,cool

Wind

Bio, waste etc.

Natural gas

Fossil oil



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

14 mio ton CO2

10 TWh=36 PJ

Feasibility study 2035+ – reduced fossil oil demand

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Import power

Solar

Wind

Bio, waste etc.

Natural gas

Transit

Power system

Export power

Bio

Gas

Central heat

El-proces

Transit

Gas storage

Aviation

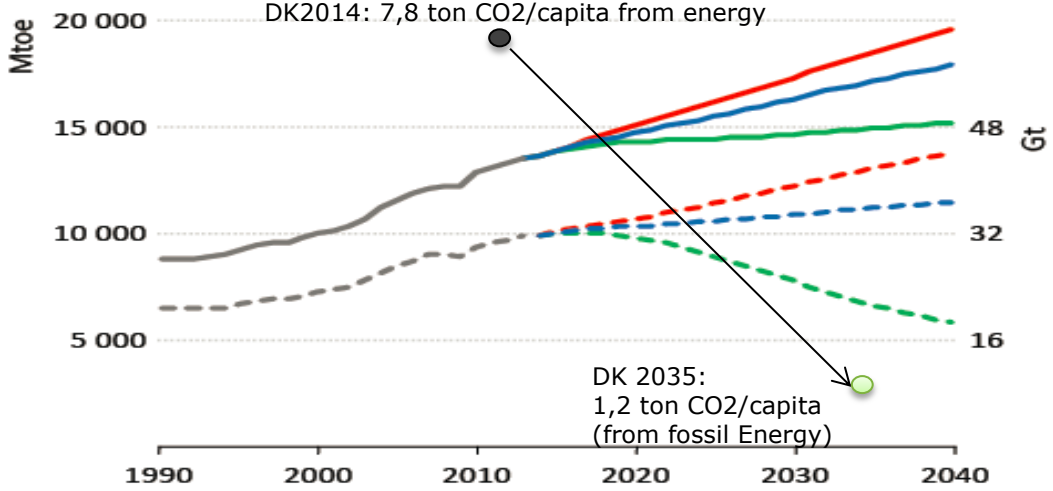
6 mio ton CO2

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



Summing up

- The COP21 (Paris) aggreement i very ambitios. A need for very large increase in wind and solar power
- A high need for electrification heat, transport sector to reduce CO2 and reduce need for fuels
- A need for fuels (gas/liquieds) for heavy transport, aviation, peak-power
- A need for further development of new central energy plants – suited for wind/solar dominated regions
- A need for further development of decentralized bio-energy plants (biogas/power-to-gas) solving the energy-agro integration


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