EUROPEAN PERSPECTIVE

Congestion management in a RE dominated system

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DISPOSITON

- European transmission system outlook and planning
  – as seen from ENTSO-E/G scenarios
- Congestion manangement in a sector coupled system (Danish case)
- Questions

EUROPEAN ENTSO-E/G SCENARIOS AS A FRAMEWORK

EUROPEAN SCENARIOS - ENTSO-E/G

Three European scenarious with different climate ambitions

Higher European **autonomy** with renewable and decentralised focus

2022 2025 2030 2040 2050

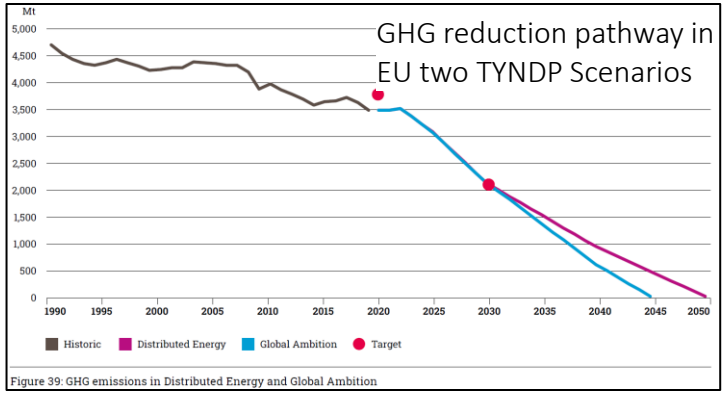
Distributed Energy

National Trends

Global Ambition

Aggregation of national policies and strategies as stated end of 2020

Global economy with centralised low carbon and RES options

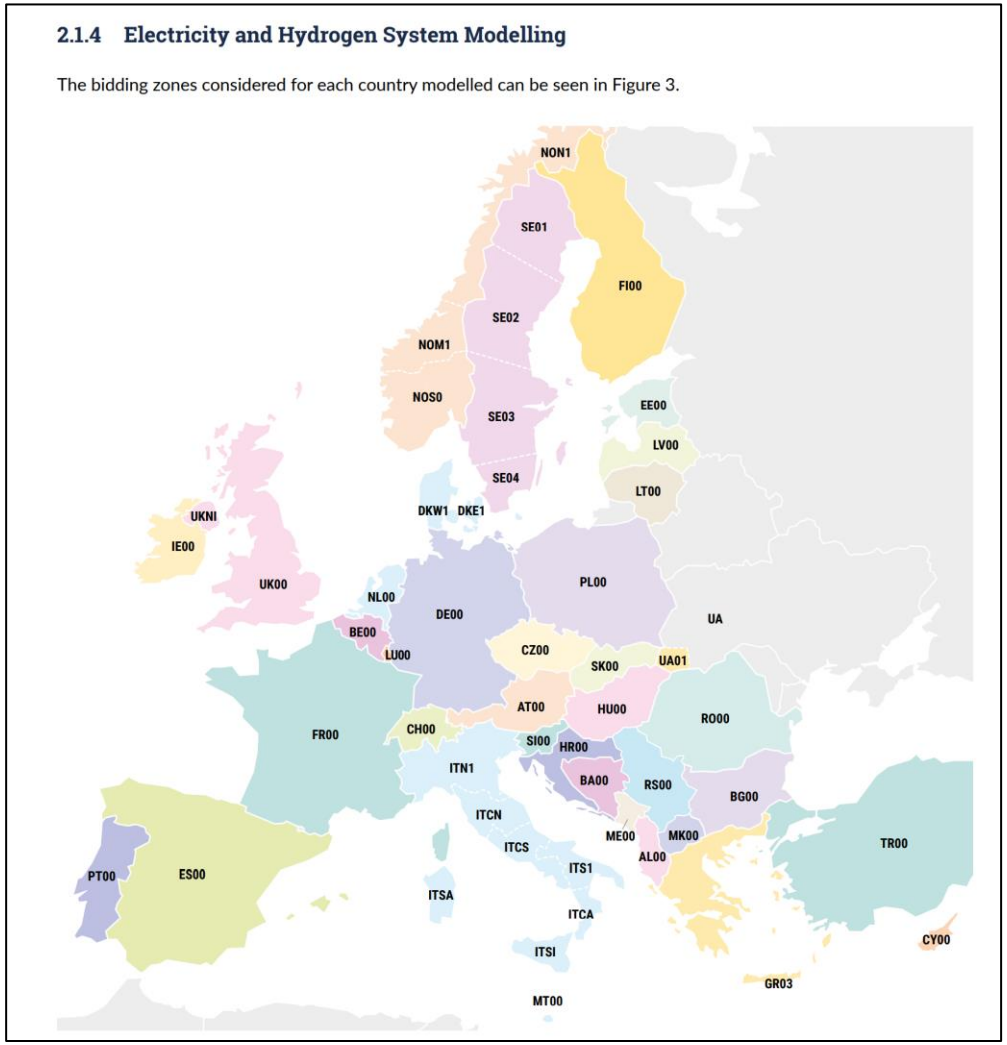


GHG reduction pathway in EU two TYNDP Scenarios

Figure 39: GHG emissions in Distributed Energy and Global Ambition

MARKET MODELLING OF EUROPE IN TYNDP

In the ENTSO-E/G proces power and gas system is analysed i future perspective



2.1.4 Electricity and Hydrogen System Modelling

The bidding zones considered for each country modelled can be seen in Figure 3.

- Power, methan and hydrogen analysed in ENTSO-E/G scenarios
- European countries and market areas analysed in scenarios

TYNDP = ”Ten Year Net Development Plan”

Scenarios used as perspectives for European power and gas system planning

SIGNIFICANT INCREASE IN ELECTRICITY CONSUMPTION

Final electricity consumption (excl. PtX etc.) increases significant

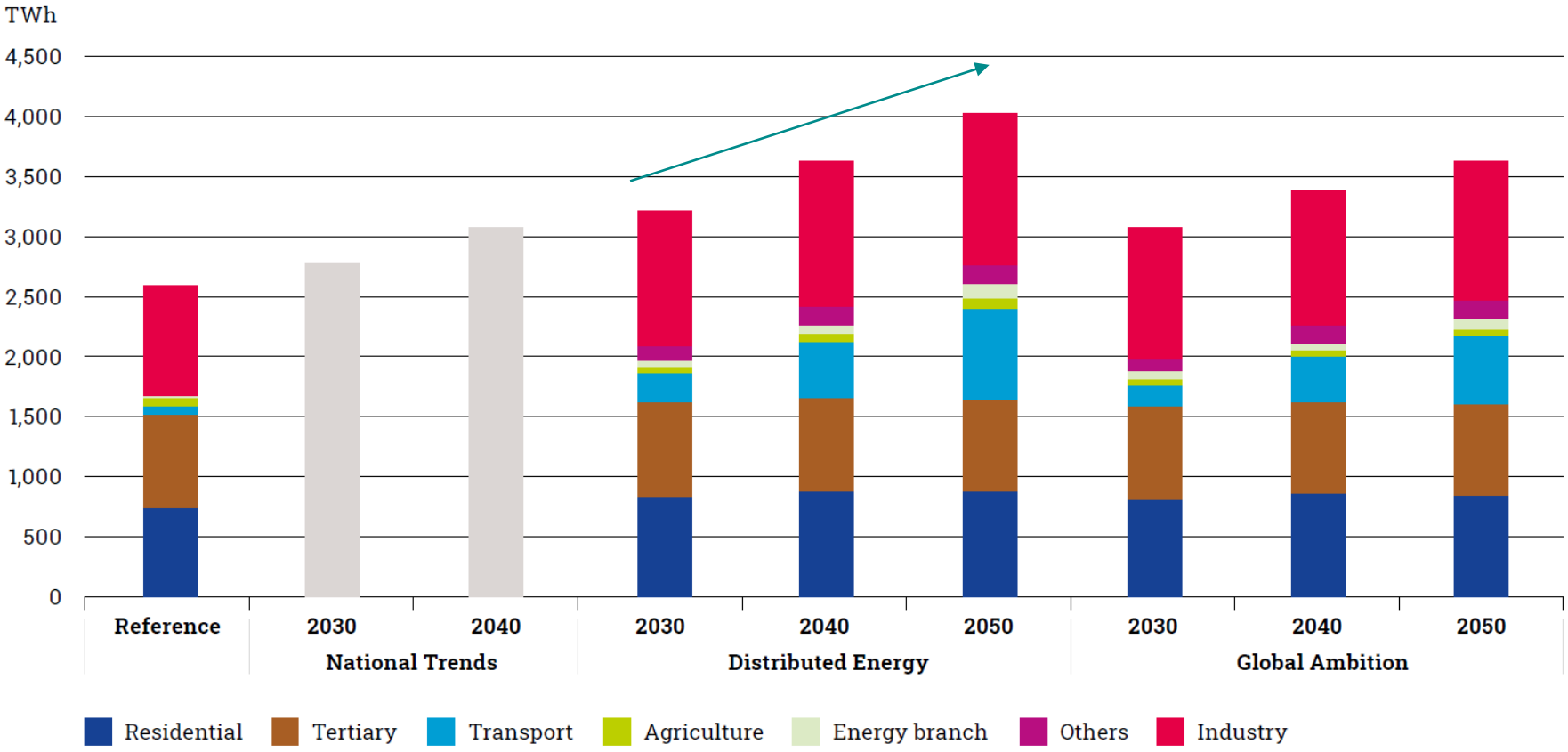


Figure 8: Final electricity consumption (excluding transmission and distribution losses) for EU27

A need for increased power system capacity to handle direct electrification of transport, heat and industry

ELECTRICY NEEDED FOR PRODUCTION OF HYDROGEN

Large increase in electrolyser capacity to produce green hydrogen for Europe

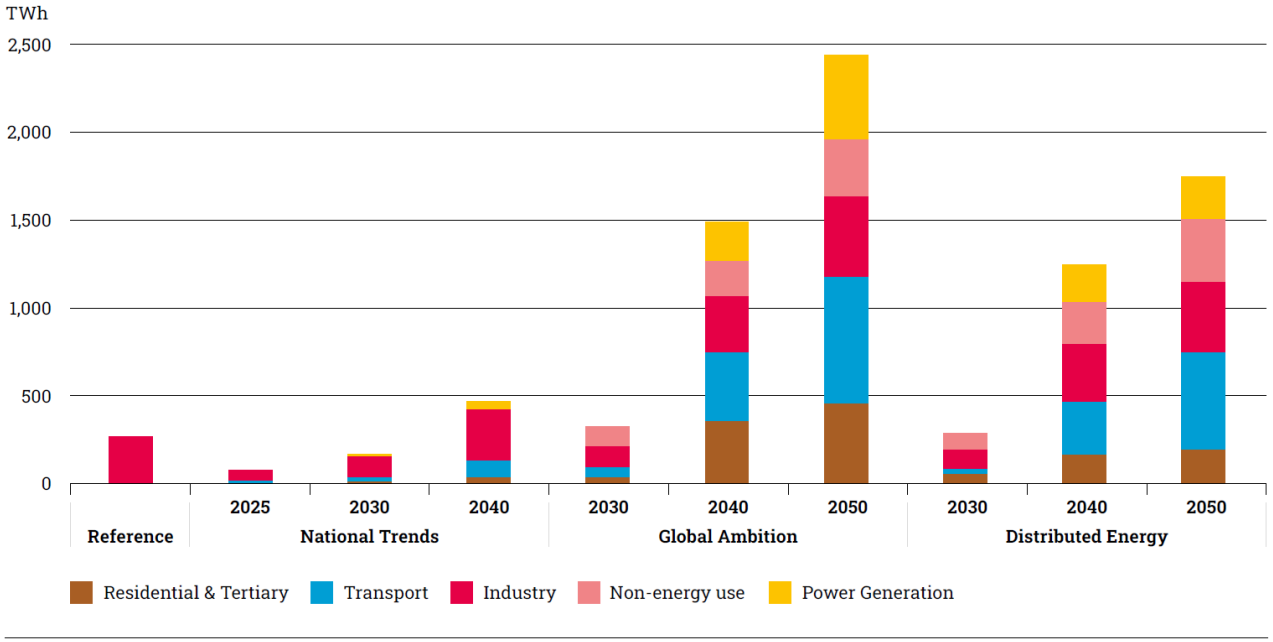
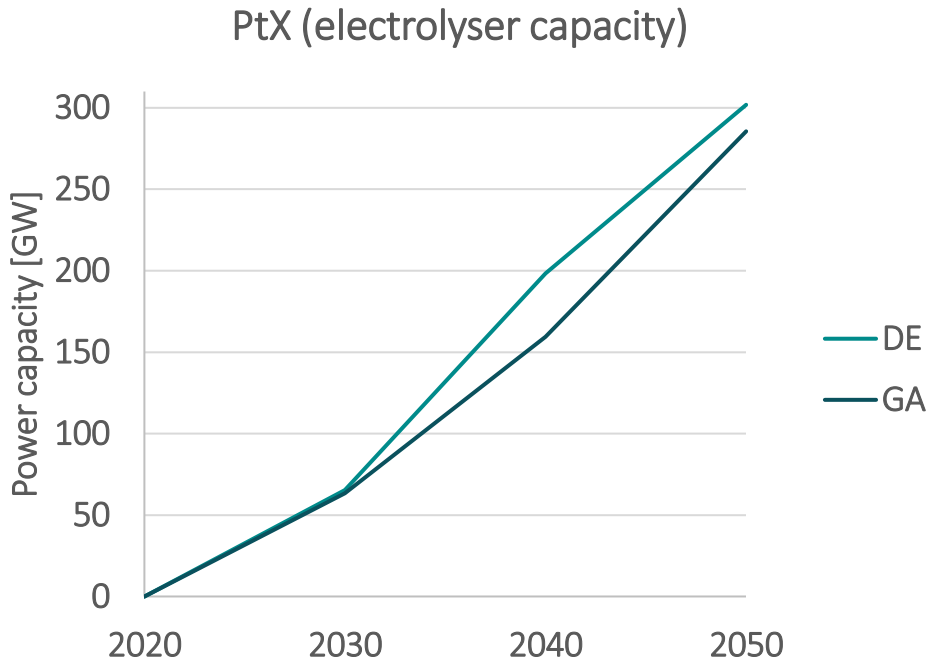
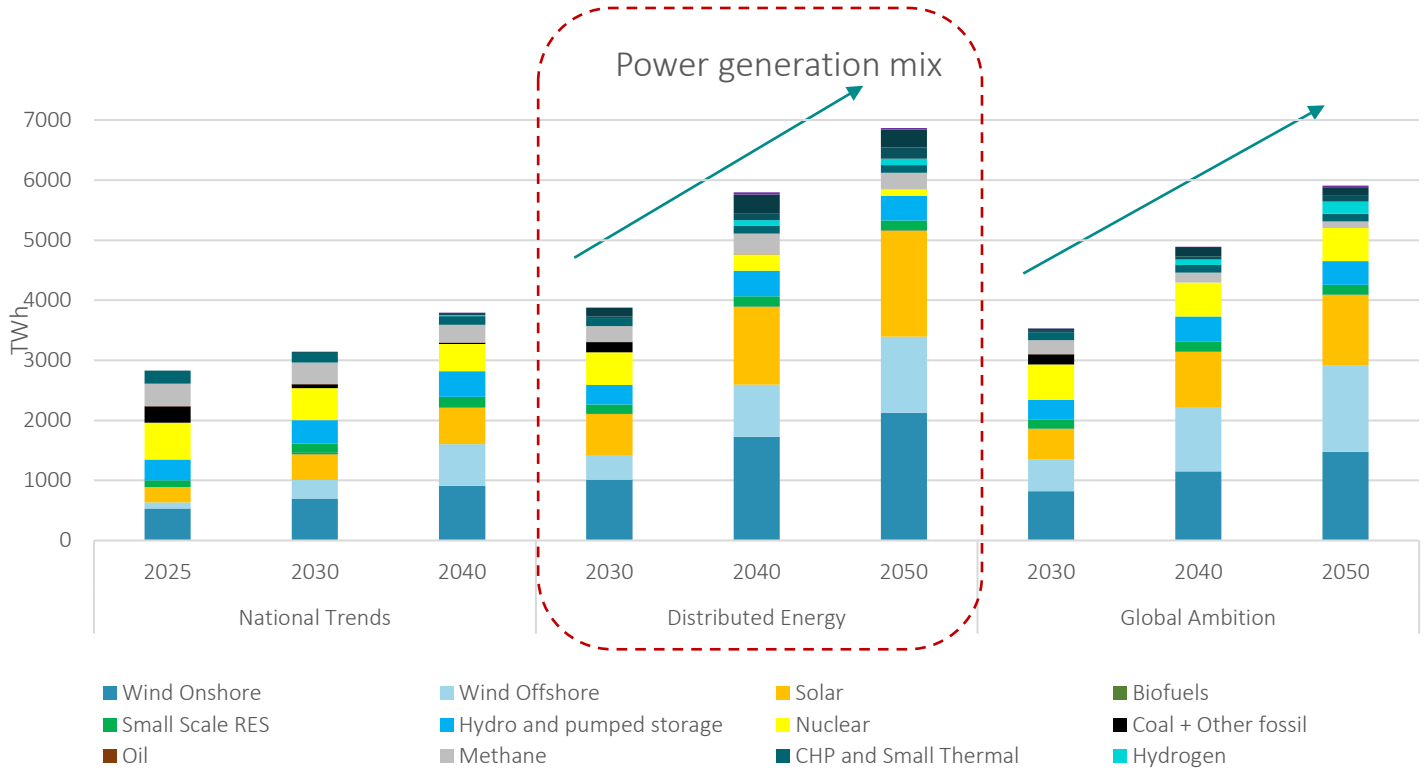


Figure 14: Hydrogen demand per sector for EU27 (excluding hydrogen from by-products and for conversion [P2M/P2L])



Power to X increases flexible power demand in Europe

ELECTRICITY PRODUCTION IN EUROPEAN SCENARIOS



High increase in electricity demand in Distributed Energy & Global Ambition

- Need for high electricification of transport sector (elect. vehicles)
- Electrification of heating
- Production of fuels by Power-to-X
- Electricity production is primarily realised from wind, solar, hydro and nuclear
- + Backup power capacity on methan and hydrogen

A need for R&D to op

SYSTEM NEED STUDY

European grid modelled in a model with sub-zones to identify congestion

Capacity from planned grid projects included

APPENDIX 2. INVESTMENT CANDIDATES (CAPACITY INCREASES) – CAPACITIES AND COST ASSUMPTIONS

The following capacity increases were proposed to the optimiser.

The capacity increases listed in this appendix include projects in the TYNDP 2022 portfolio and conceptual increases that do not correspond to existing projects. Cost assumptions are theoretical assumptions that include the assumed costs of reinforcement of internal networks that would be necessary for the cross-border capacity increases. When there are several values on the same border, a sequential consideration of the capacity increases has been proposed to the optimiser.

Real or conceptual	Border	Project direct[4] capacity (MW)	Project indirect capacity (MW)	Project CAPEX (M€) (including internal reinforcement)	Project yearly cost (M€/Year)
Conceptual	AL00-GR00	500	500	80	6
Conceptual	AL00-GR00	500	500	116	8
Conceptual	AL00-ME00	500	500	9	1
Conceptual	AL00-ME00	500	500	11	1
Real	AL00-MK00	500	500	81	9
Conceptual	AL00-MK00	500	500	48	5
Conceptual	AL00-MK00	500	500	78	8
Conceptual	AL00-RS00	500	500	25	2
Conceptual	AL00-RS00	500	500	93	7
Real	AT00	100	200	35	3

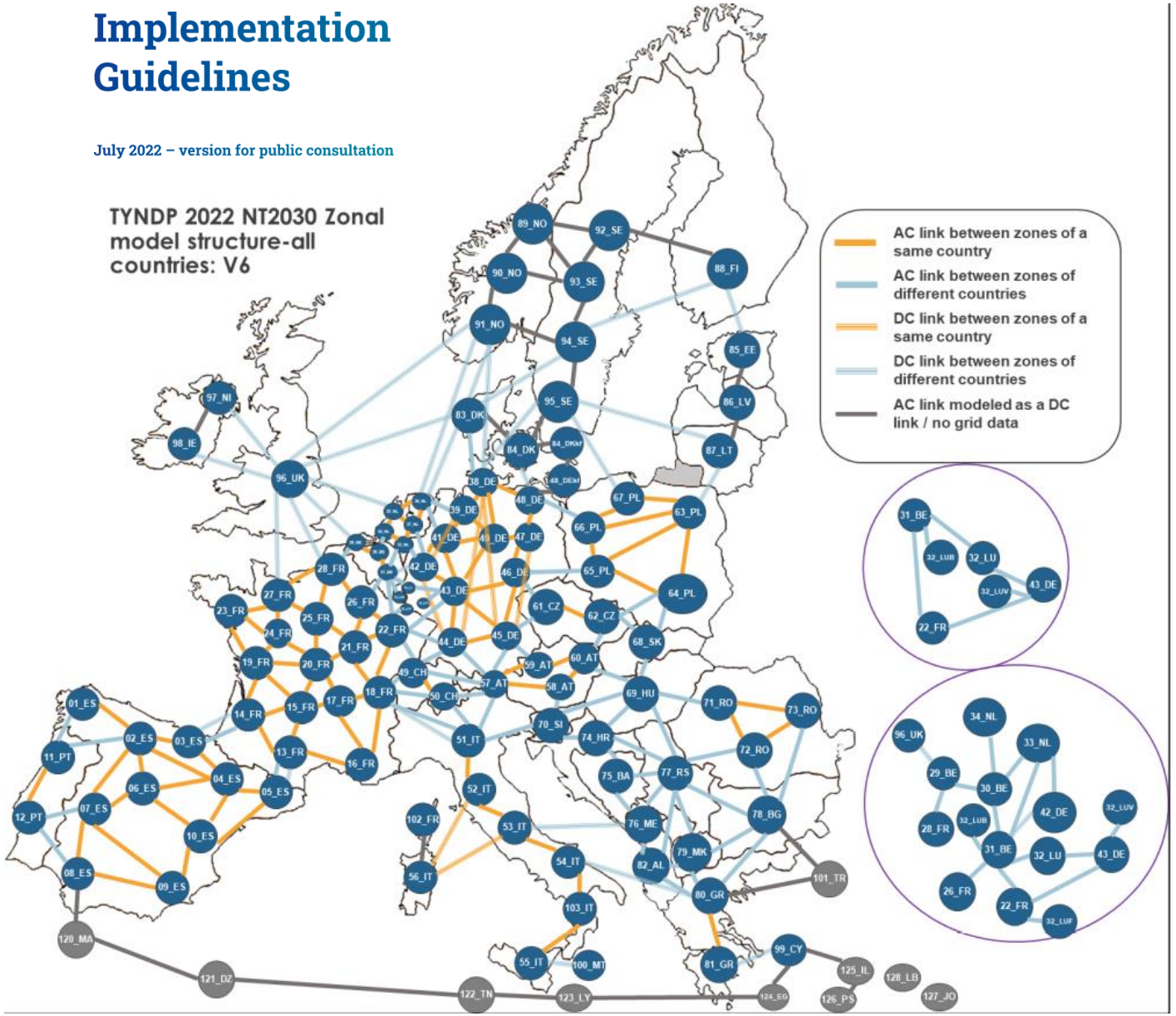
System needs analysed based on European scenarios

TYNDP 2022

System Needs Study

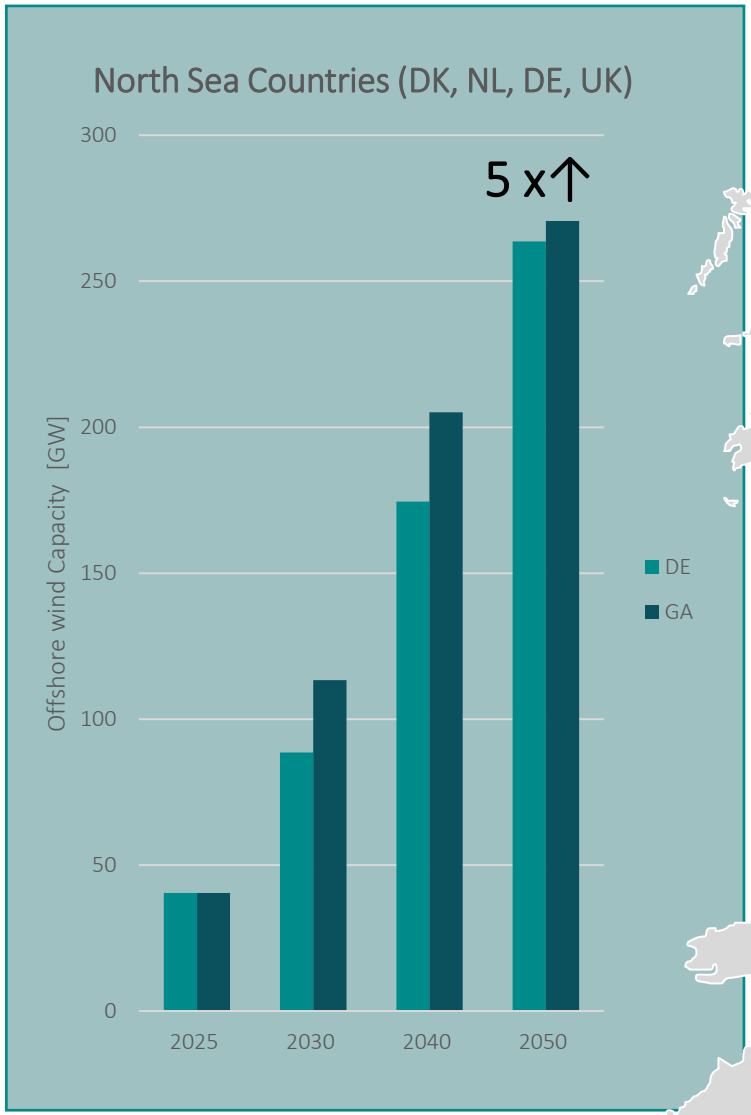
Implementation Guidelines

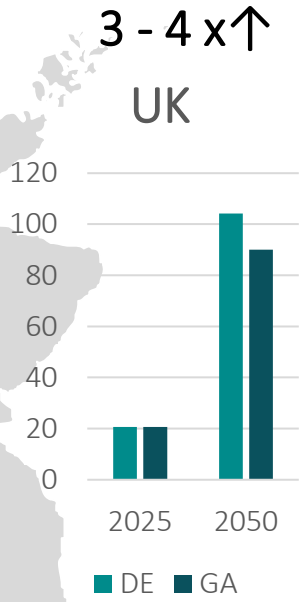
July 2022 – version for public consultation

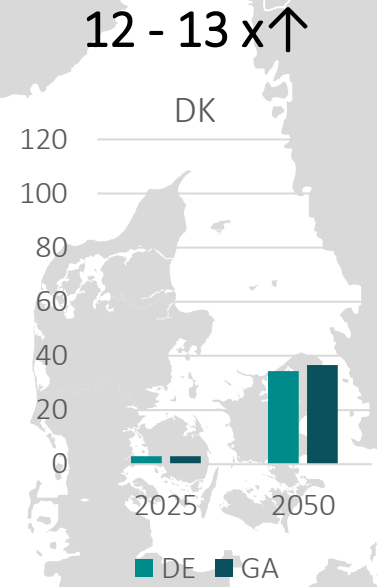


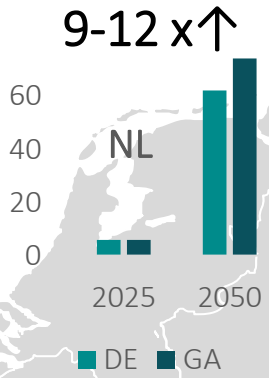
NORTH SEA AND DENMARK CASES

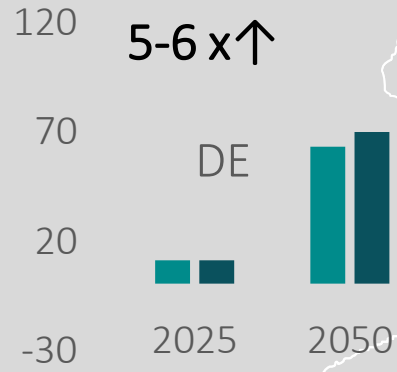
LARGE INVESTMENT IN OFFSHORE WIND IN THE NORTH SEA AREA







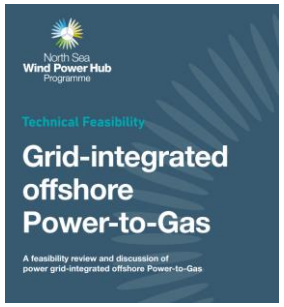




Very large increase in offshore wind in North-sea area

OFFSHORE CONCEPTS ANALYSED IN NSWPH

NORTH SEA WIND POWER HUB STUDY



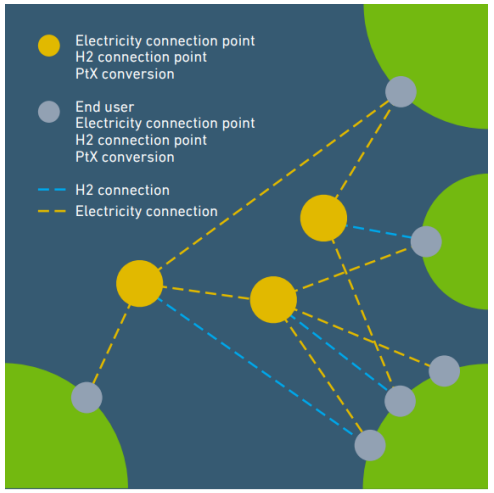
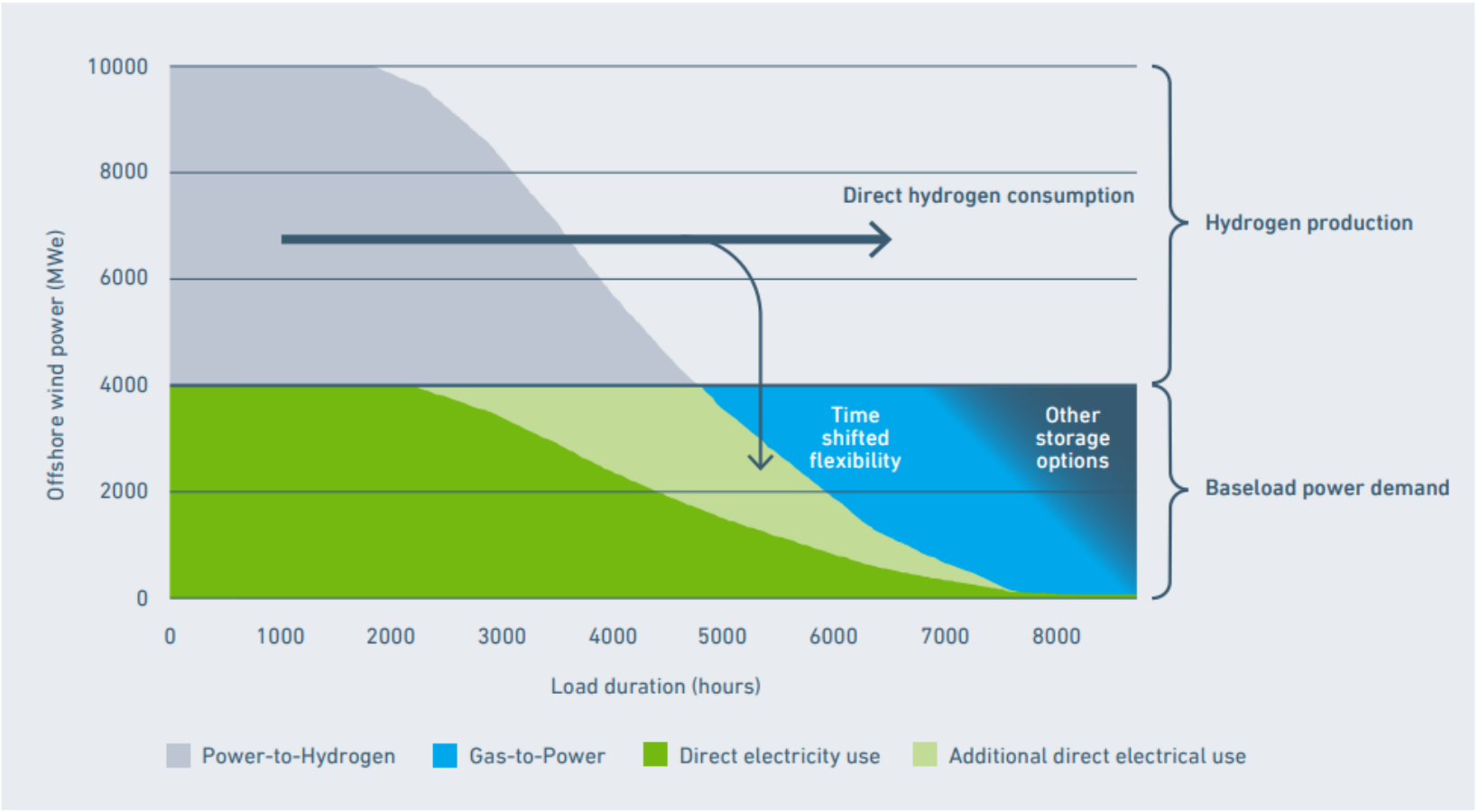
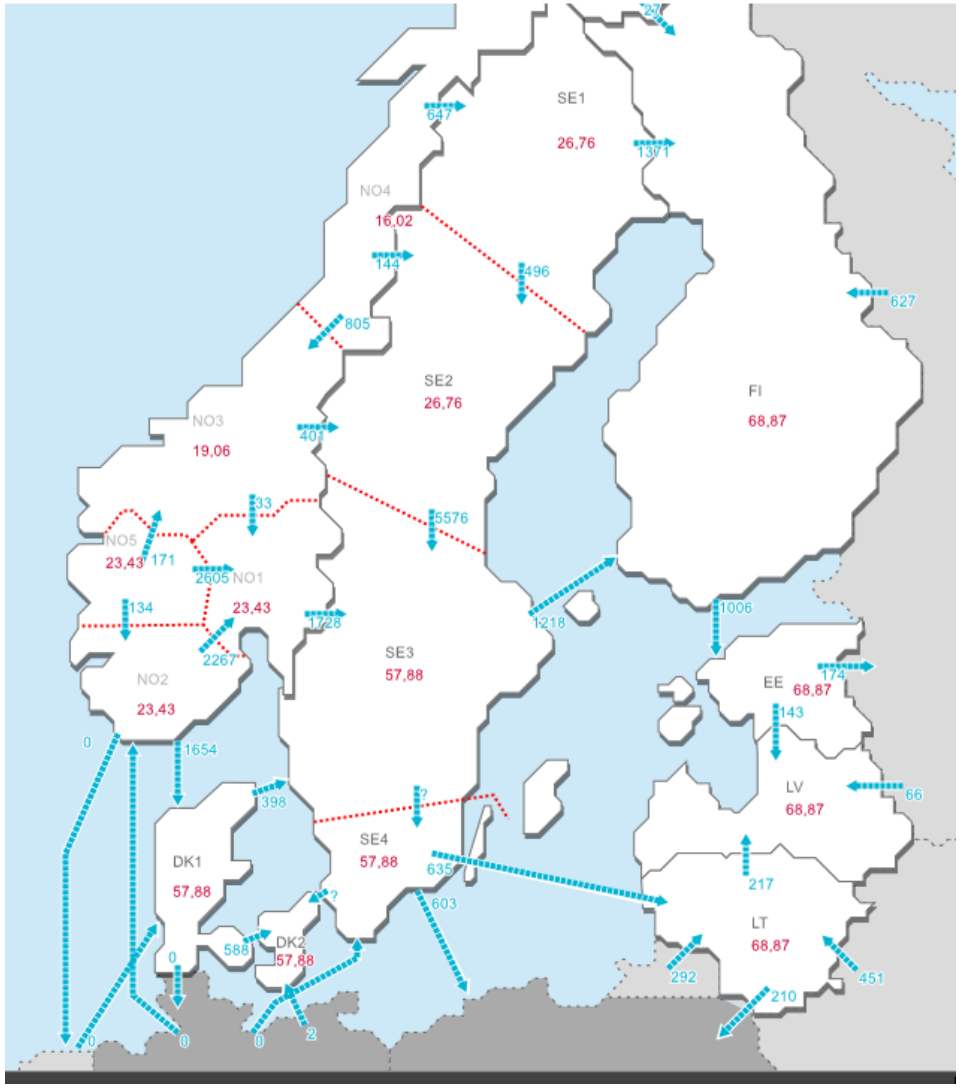


Figure 2b: Duration curve – grid-integrated scenario

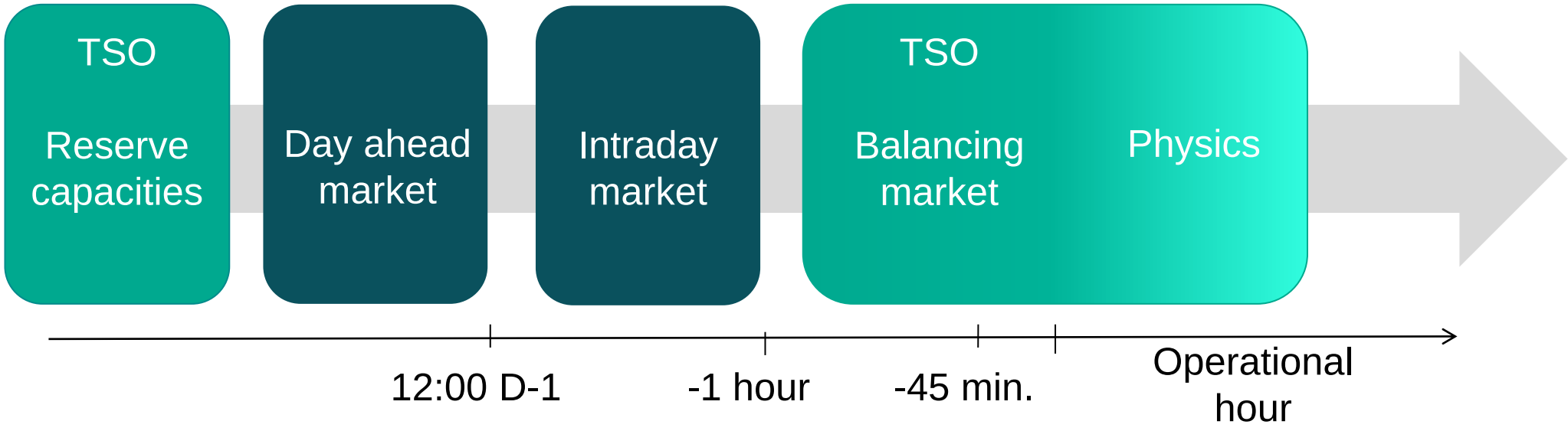


Offshore concepts with multiterminal hubs and PtX to handle congestion analysed

MARKET AND PHYSICS IN NORDIC AREA



THE ENERGY AND RESERVE MARKETS

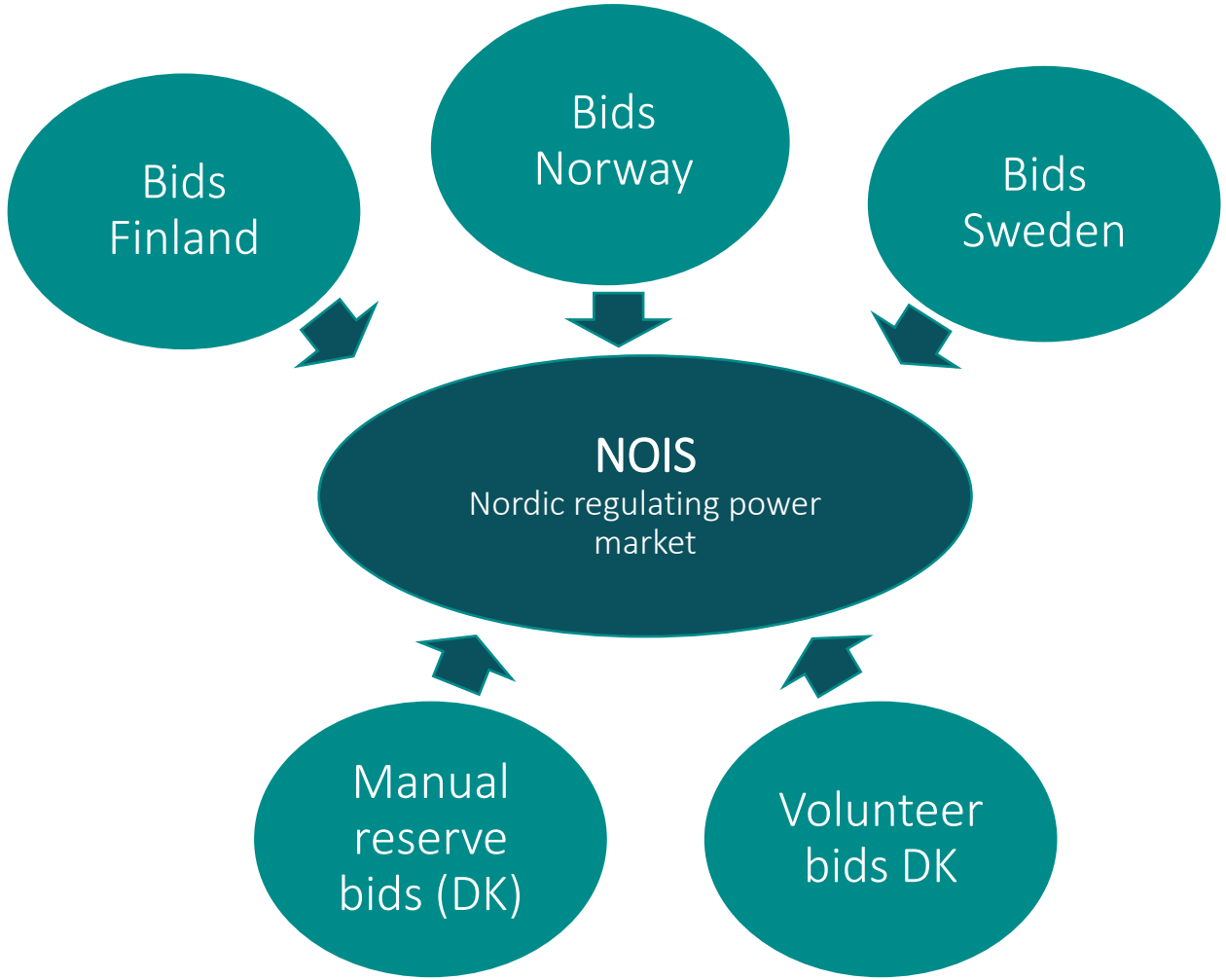


Increased demand for balancing services to handle fluctuations and internal bottleneces in the grid.
A change from 1 hour to 15 min time resolution

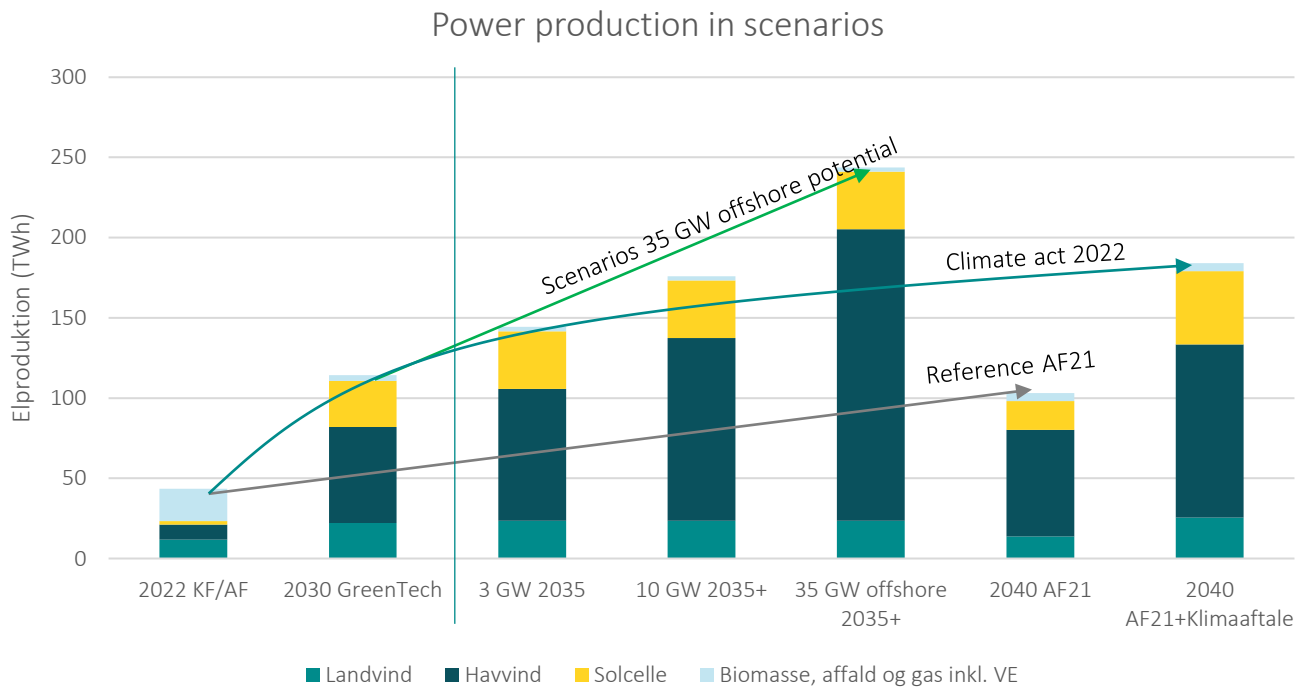
PURCHASE OF REGULATING POWER

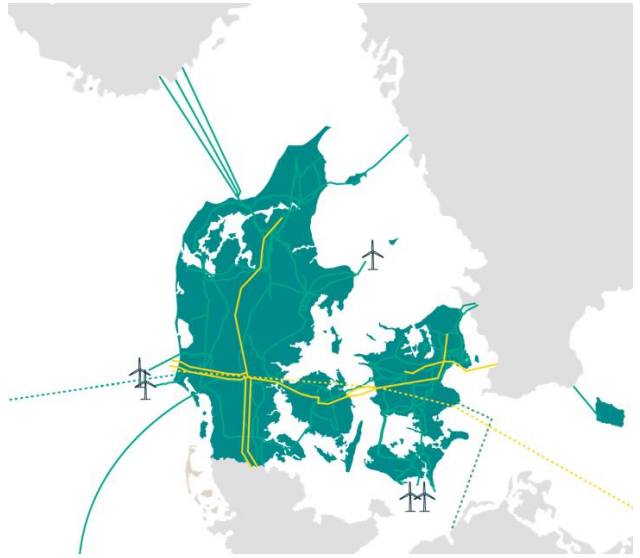
Energinet demands regulating power to be able to maintain the balance throughout the day

- Regulating power – standard product properties:
  - Requirements for activation time: 15 minutes
  - Gate closure time 45 minutes before the operational hour
- All bids are handled in the common Nordic regulating power market (NOIS), where bids compete across borders.
- Regulating power bids, used for special regulation, are settled according to pay-as-bid – so it won't affect the imbalance price.



SCENARIO ANALYSIS OF SECTOR COUPLING IN DENMARK





Scenarios with very high amount of renewables analysed in the danish energy system

PERSPECTIVES ANALYSED IN SCENARIOS

CO2 capture on biomass and waste CHP

Hydrogen stored in caverns

Multi-terminal energy HVDC hubs/islands with offshore PtX

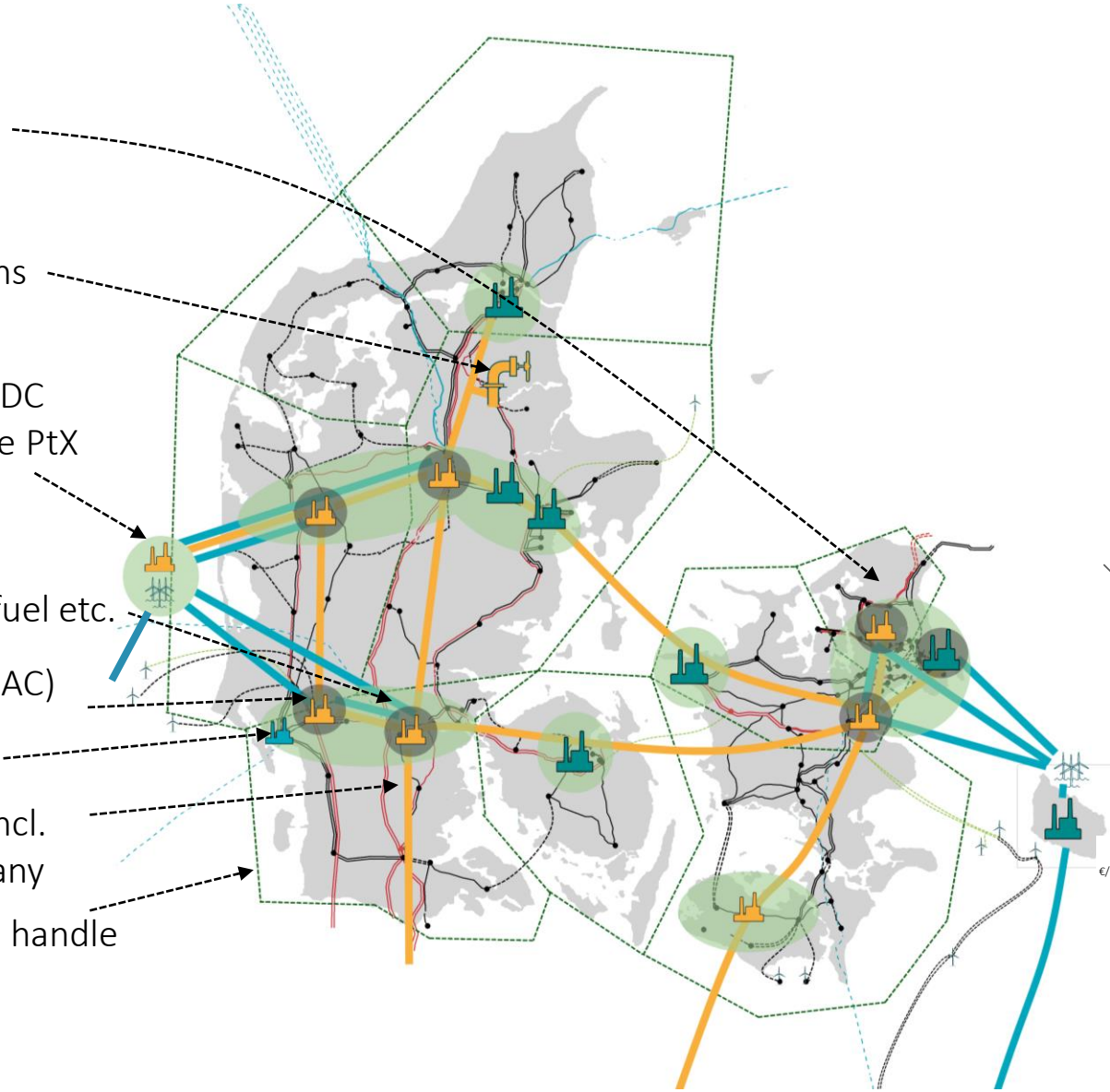
PtX units, refinary of Hydrogen and CO2 to Jetfuel etc.

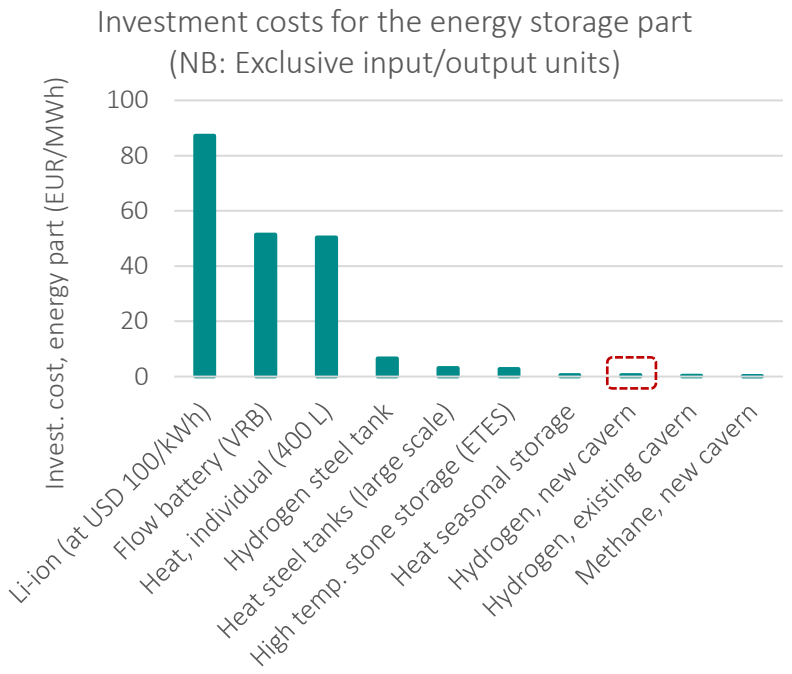
CO2 Direct Air Capture (DAC)

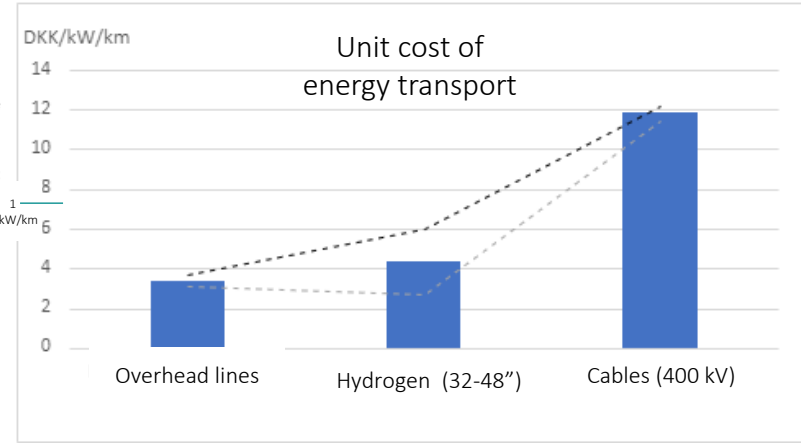
RE ammonia production

Hydrogen infrastructure incl. potential export to Germany

Smaller zones analysed to handle power grid congestion







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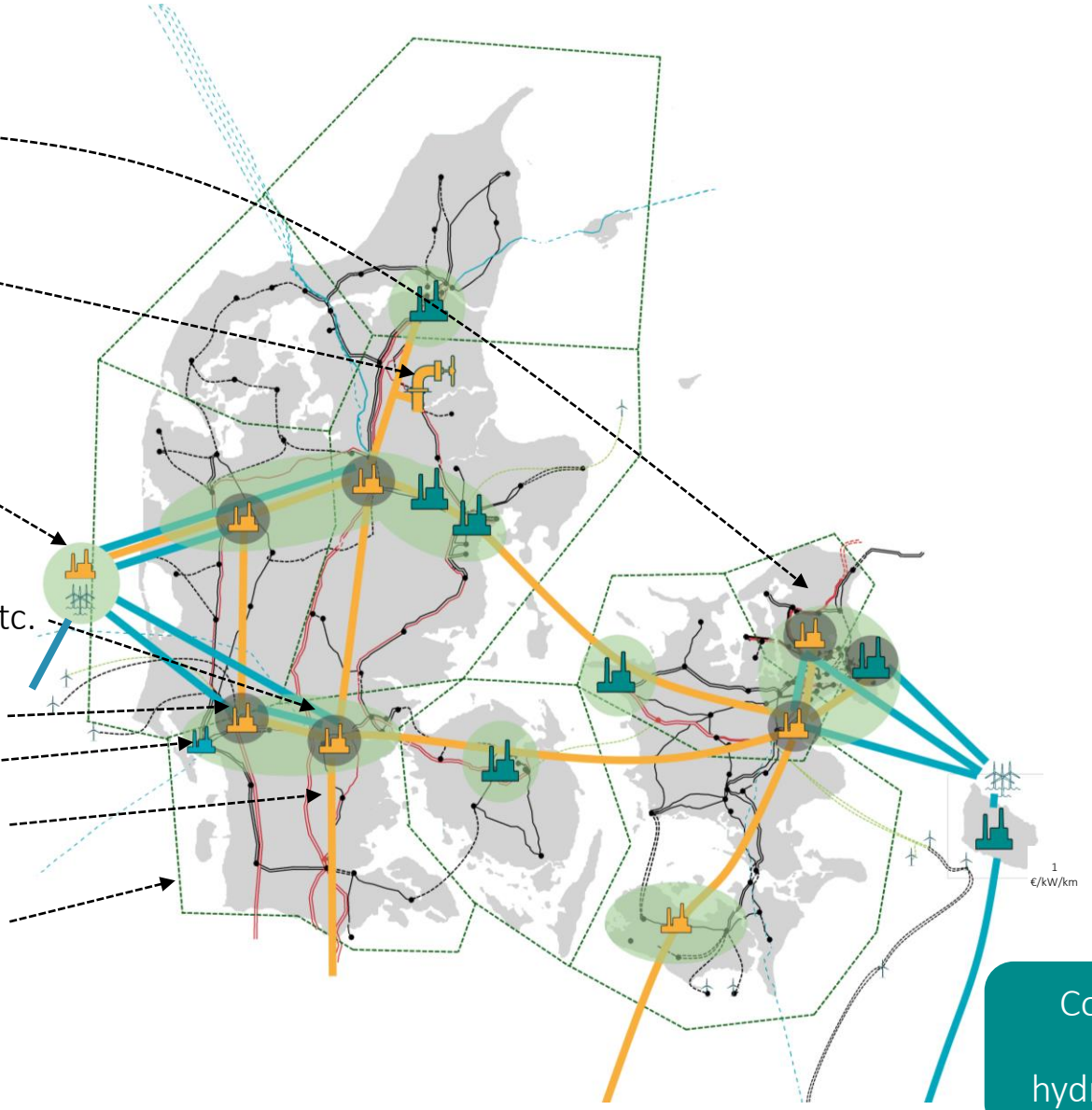
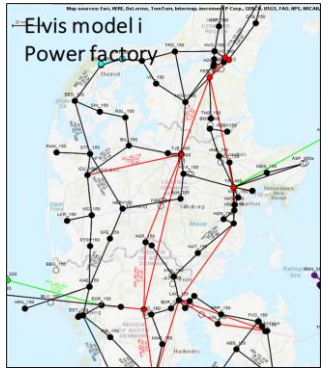
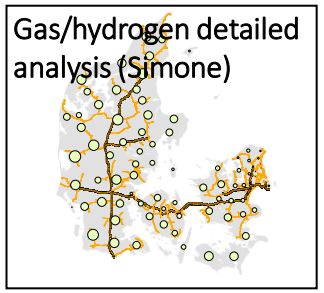
Market zones analysed to handle power grid congestion



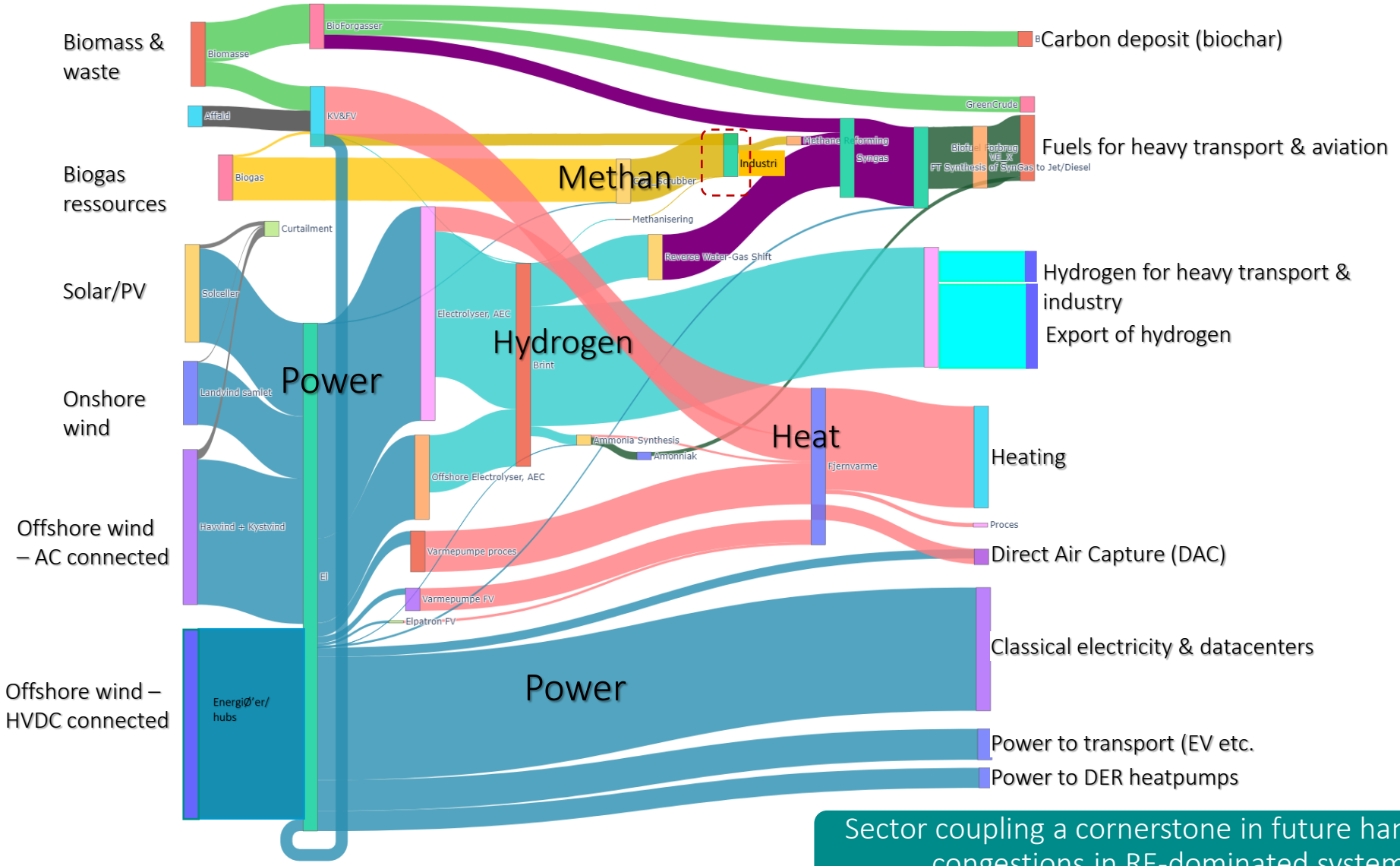
Detailed power-factory and Simone analysis to analysis physics more detailed





Combination of sector coupling in market models and more detailed power and hydrogen modelling in sector specific models

ENERGYFLOW
– EXAMPLE OF LONG TERM SCENARIE SECTOR COUPLED SYSTEM IN DK



Sector coupling a cornerstone in future handling of congestions in RE-dominated systems

SUMMING UP

- Very high ambitions for RE in Europe
- ENTSO-E/G scenario work is a central part in European planning to mitigate congestions
- Congestions management requires further coupling of market/physics
- Offshore concepts with meshed grids and sectorcoupling to mitigate congestion
- Co-optimisation of power and hydrogen system – in planning & in operation


Thanks for attention ☺