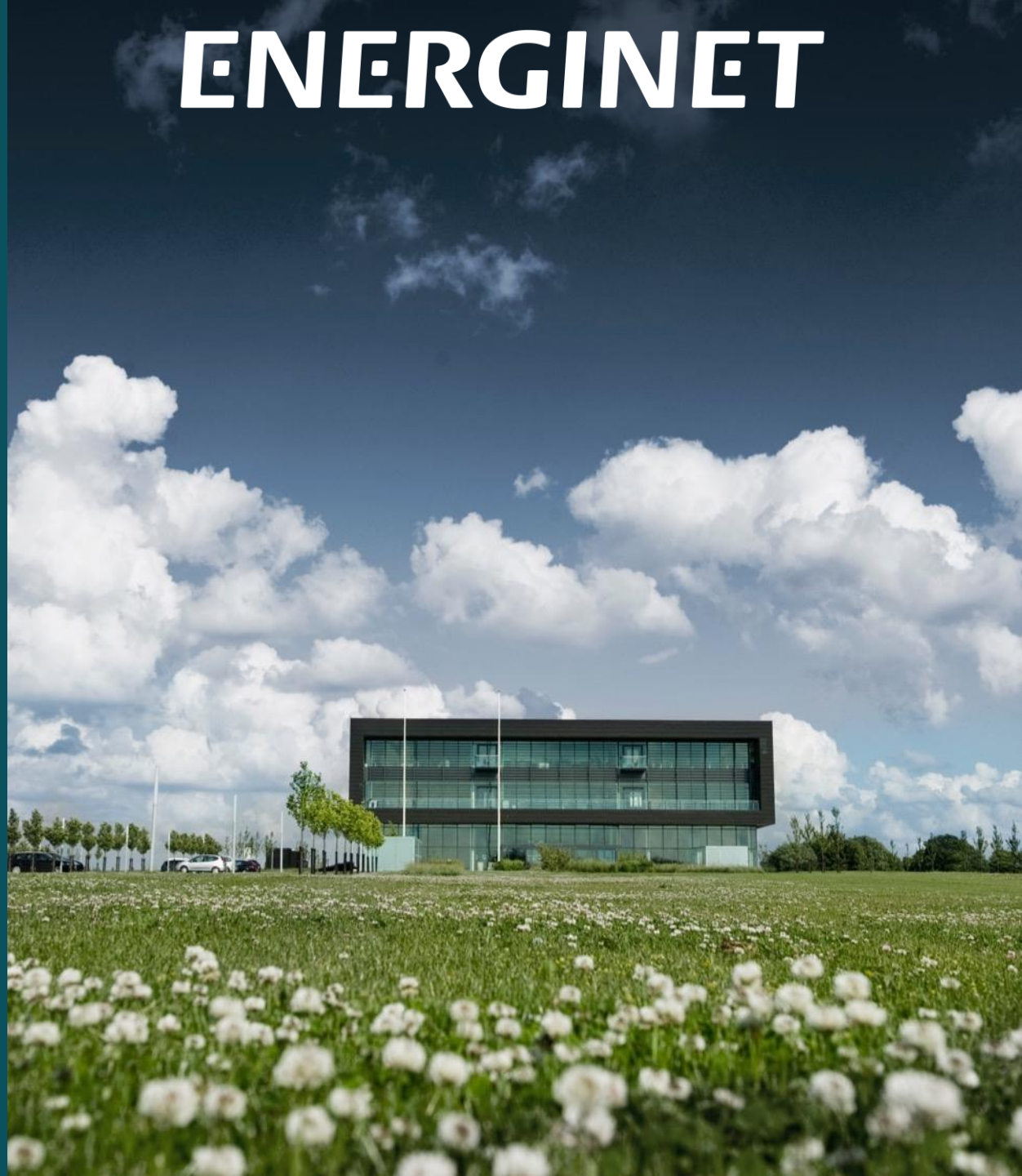
GLOBAL LESSONS- THE DANISH EXPERIENCE

13 September, 2023

Peter Markussen, Senior Director, Energinet System Operation

GLOBAL PST CONSORTIUM

Founding TSO



ENERGINET

THE ENERGY BACKBONE

We operate and develop the electricity transmission grids and gas pipelines in Denmark.

ENSURE BALANCE

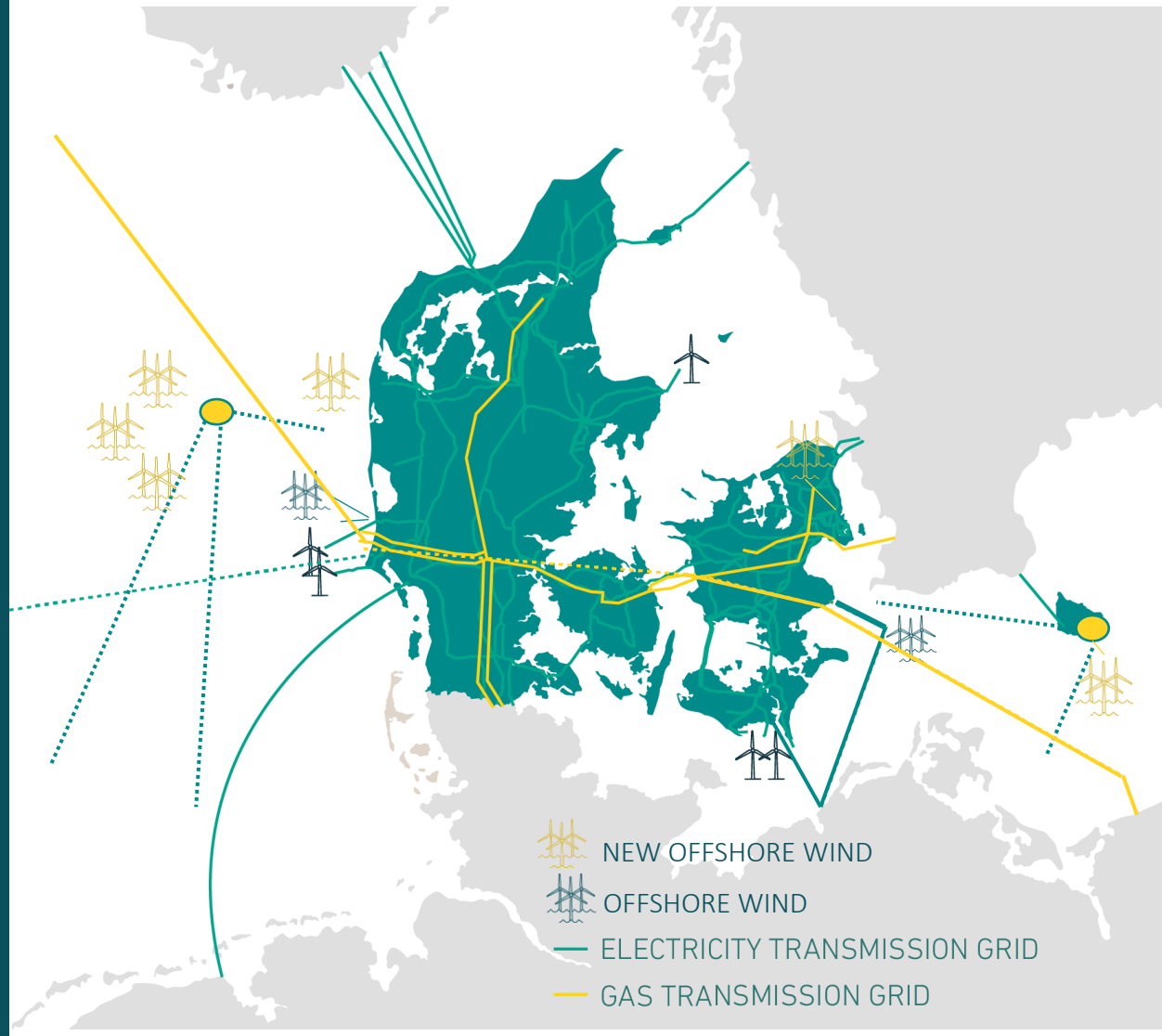
We have the day-to-day and long-term responsibility for the overall electricity and gas system in Denmark.

WORKING FOR THE SOCIETY

Owned by the Danish Ministry of Climate, Energy and Utilities we safeguard society's interests as we move to a 100% green energy system.

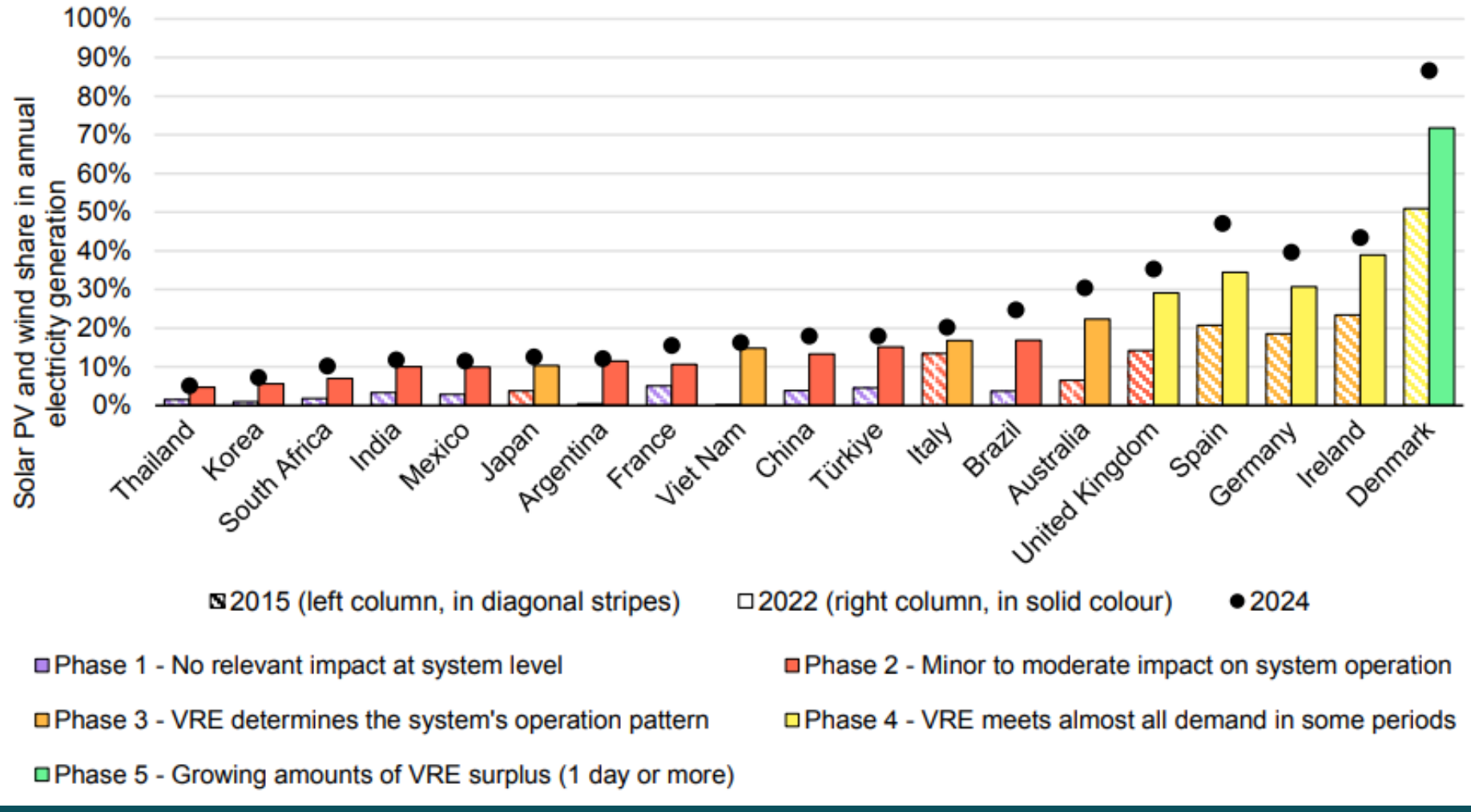
Appr. 2000 Employees

ENERGINET



Energy island location, new OSW and connections only illustrative

Variable renewable energy shares and phases for selected jurisdictions, 2015, 2022 and 2024



Renewable Energy Market Update - June 2023 (windows.net)

THE DANISH ENERGY TRANSITION

MAIN TOOLS FOR GREEN TRANSITION

- Stable and holistic energy planning
- Clear mandate for TSO and transmission build out
- Flexible electricty production and interconnectors
- Market based regulation and electricity markets
- Digitalization of operation and markets

DANISH GREEN TRANSITION

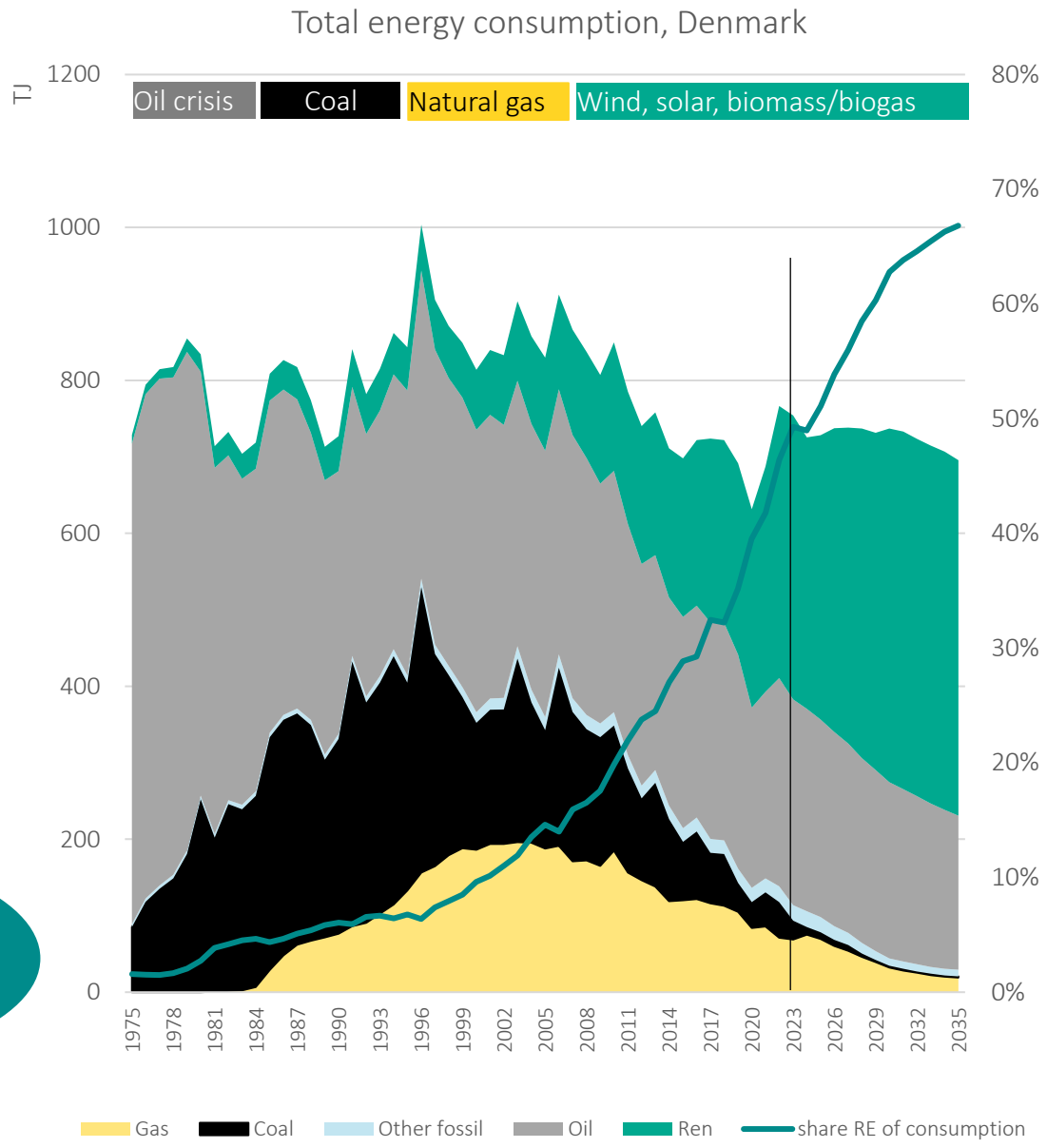
2022: 60% green VRE electricity
40% biomethane

2030: 100% green VRE electricity
100% biomethane

2050: Zero Carbon society

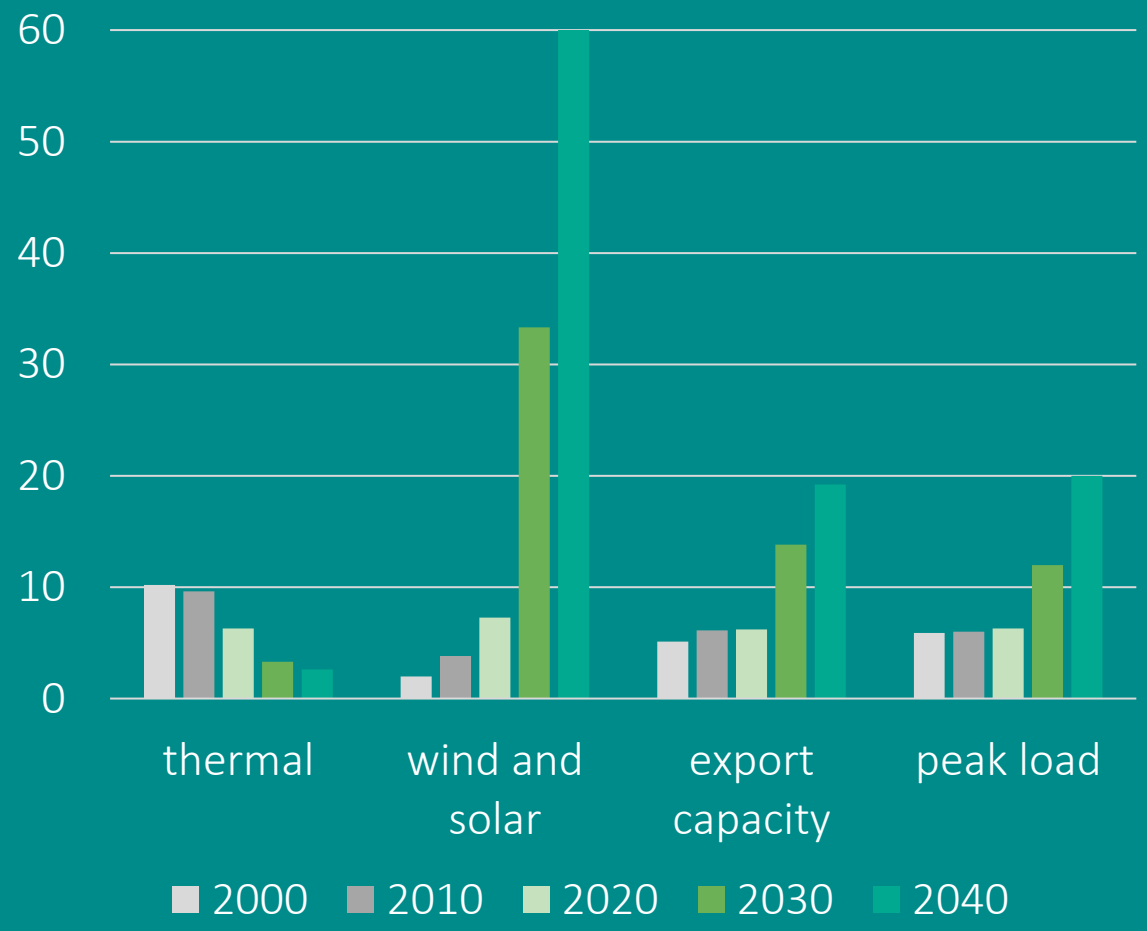
Electricity security of supply 2022:
99.996%

ENERGINET



WHAT HAS BEEN ACHIEVED IN THE LAST 20 YEARS ACCELERATES TOWARD 2040

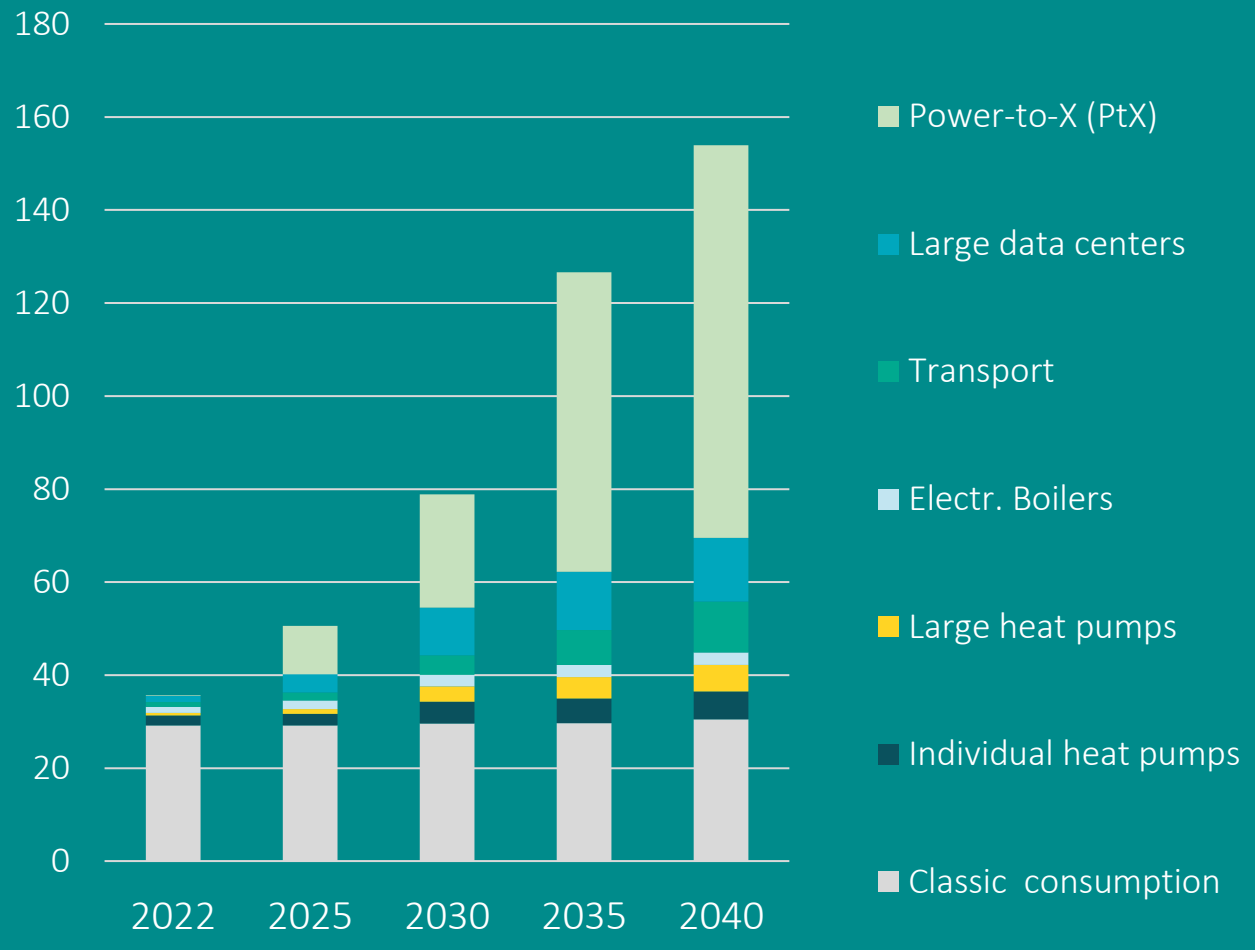
Electricity generation and peak capacity, GW



Source: Danish Energy Agency, draft assumptions 2022

ELECTRIFICATION DRIVES THE CHANGE TO A CLIMATE NEUTRAL ENERGY SYSTEM

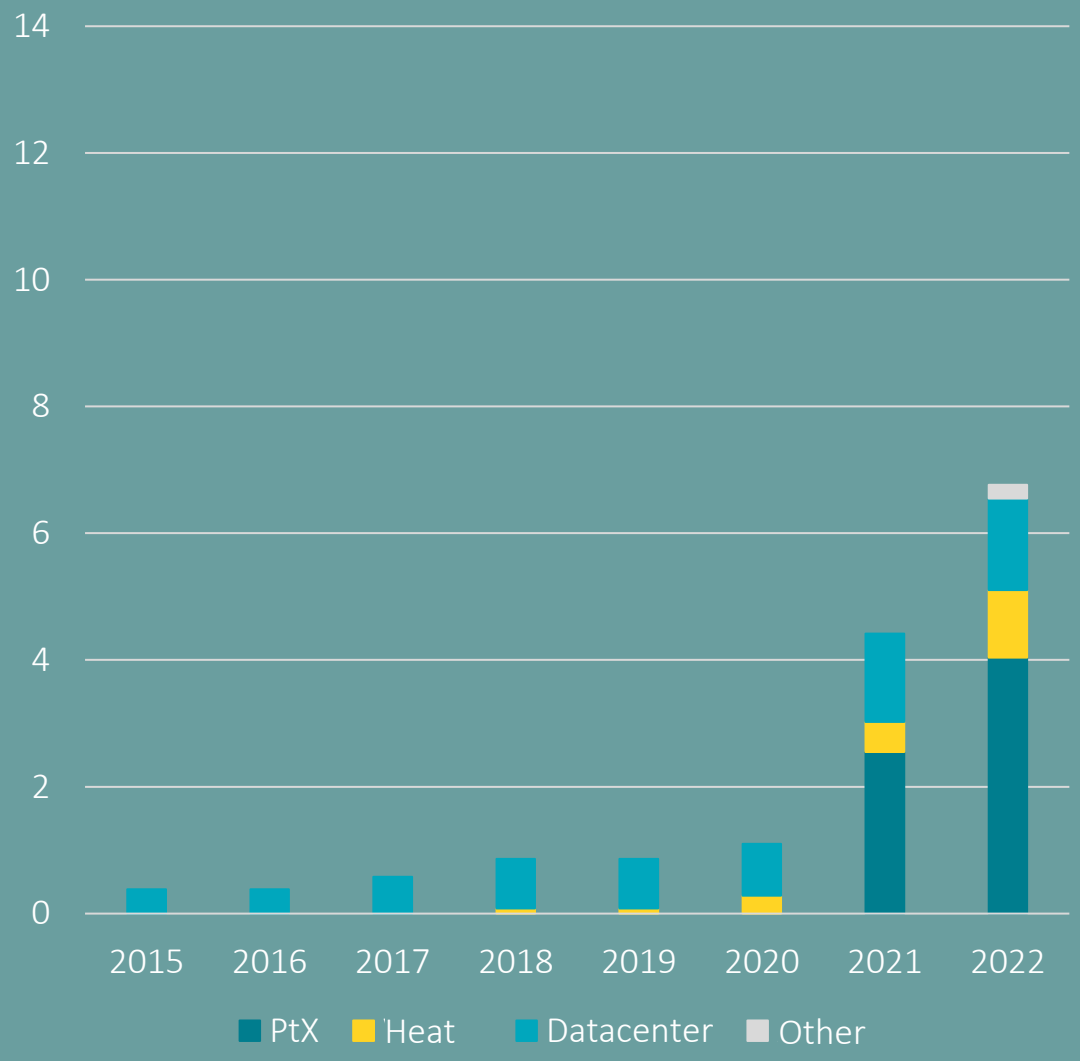
Electricity consumption, TWh



Source: Danish Energy Agency, draft assumptions 2022

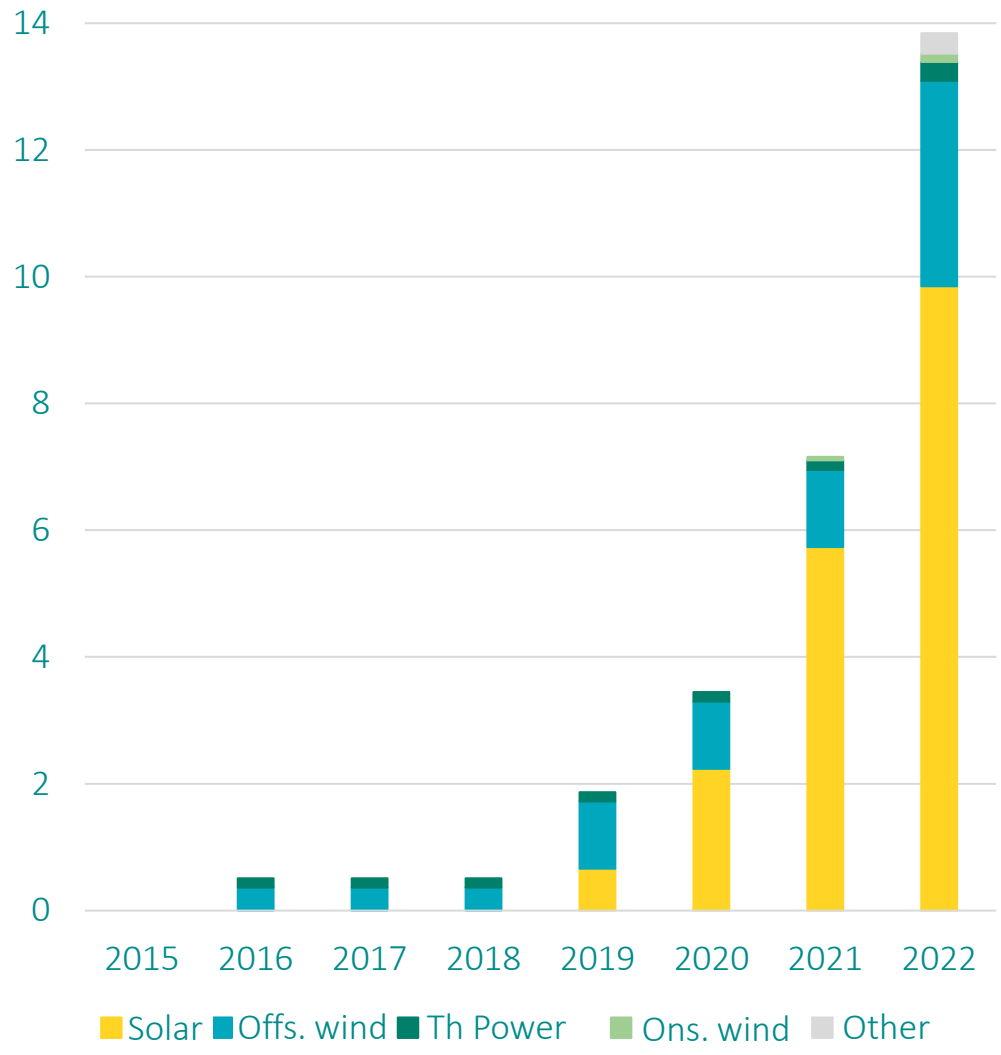
CONNECTION OF NEW CONSUMPTION

Total capacity (GW) in proces or connected 2015-2022



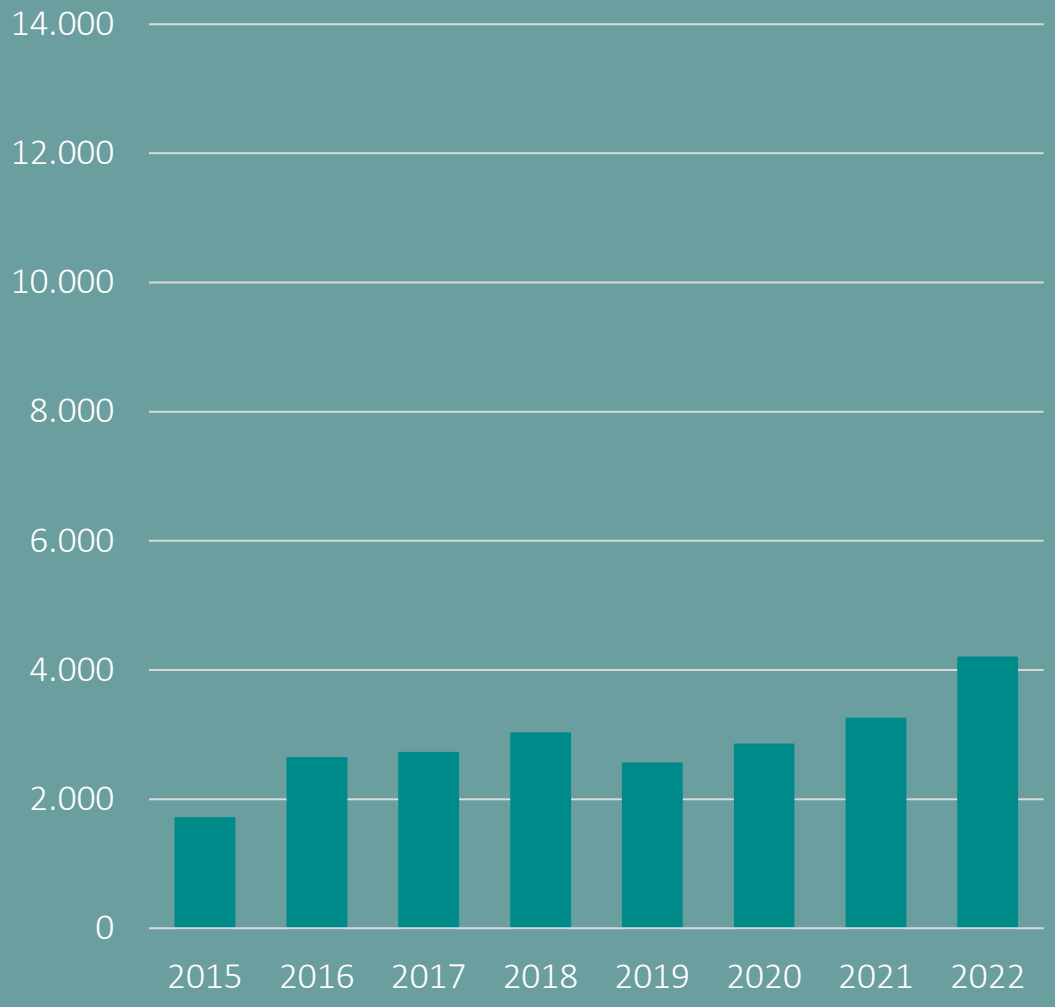
CONNECTION OF VARIABLE RENEWABLE ELECTRICITY

Total capacity (GW) in proces or connected 2015-2022



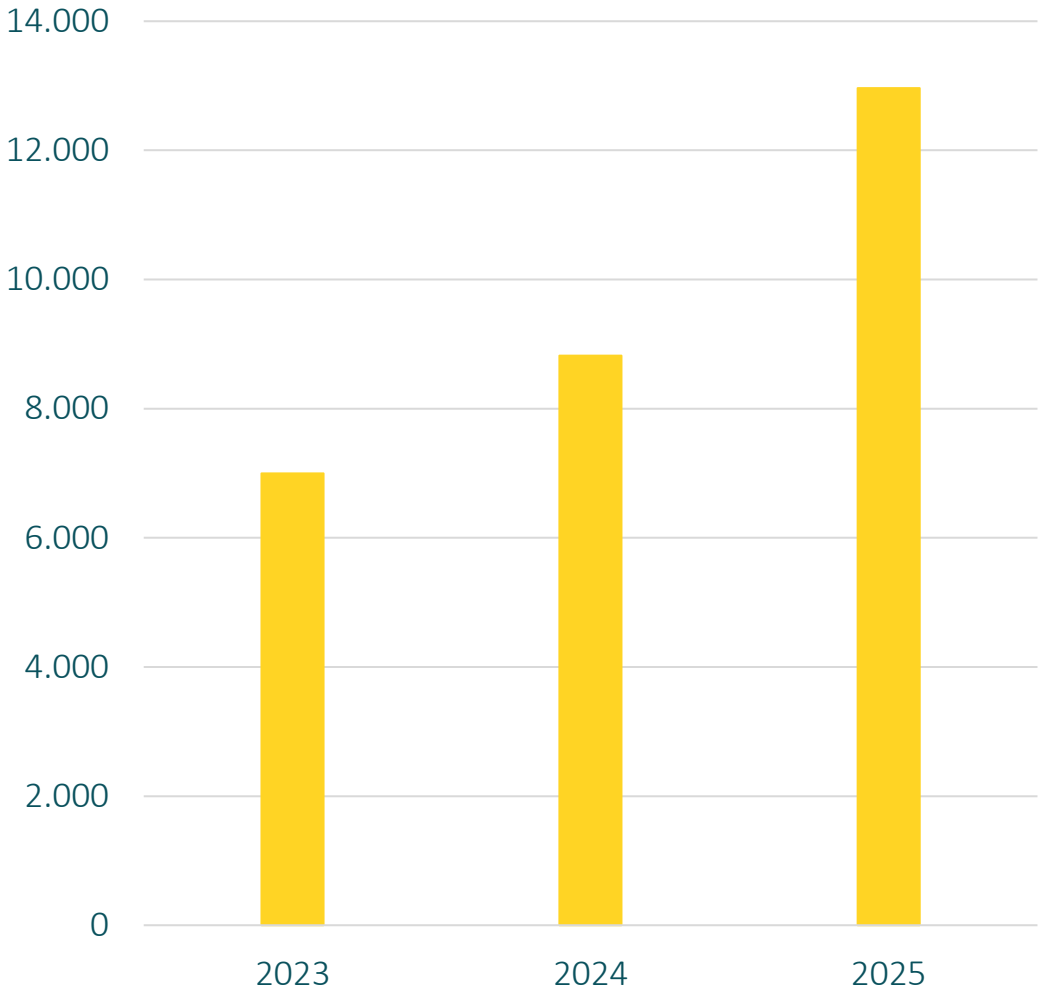
HISTORIC INVESTMENT IN ELECTRICITY TRANSMISSION

Realised DKK MIO. 2015-2022



EXPECTED INVESTMENT IN ELECTRICITY TRANSMISSION

BUDGET DKK MIO. 2023-2026



GRID PLANNING

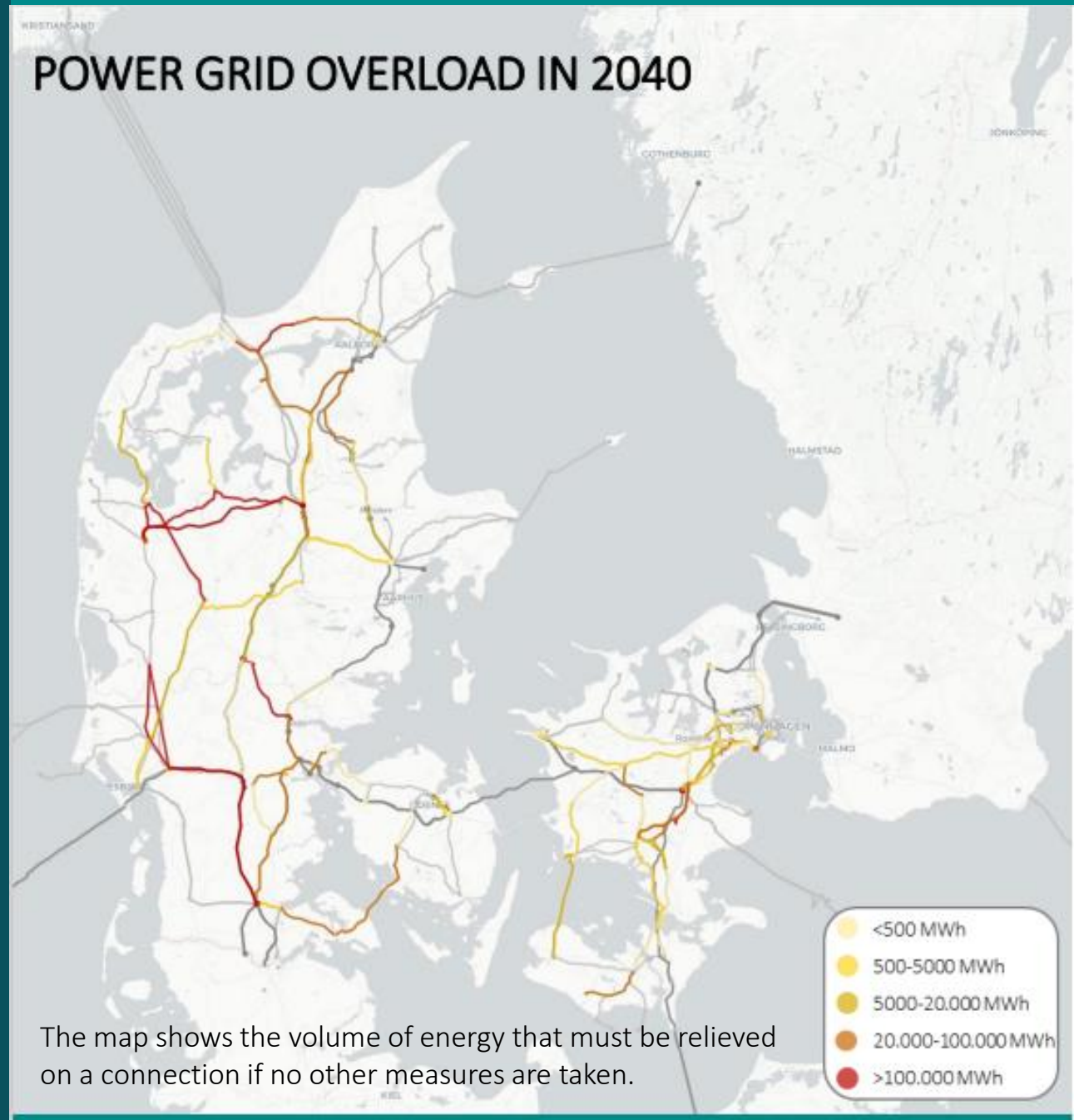
Bi-annual grid plan by Energinet.

The electricity system needs will be solved with mix of:

- Grid investments
- Operational solutions
- Market solutions
- Stakeholder dialogue (location)
- Tariff reforms

Uncertainty on expected VRE build and manage with sensitivities and anticipatory investments

Long-term development plan for the power grid 2022 (energinet.dk)



The map shows the volume of energy that must be relieved on a connection if no other measures are taken.

HISTORIC DEVELOPMENT FOR WIND (AND SOLAR) INTEGRATION

- Before 2008: Renewable electricity is prioritized production (EU regulation) and balanced by TSO
- 2008: Wind and solar own balancing responsibility and introduction of negative electricity prices
- 2010: Anholt offshore wind park (400 MW) to voluntary curtail if negative prices
- 2012: wind/solar participate in balancing market
- 201x: Cooperation with DSO on grid congestion planning
- 201x: technology neutral grid connection requirements
- 2020: first wind turbine installed without subsidies
- 2021: Development of public capacity map with DSO
- 2022- : changes in tarif and rules for grid connection cost

FUTURE ACTIONS TO ACCELERATE CONNECTION, REDUCE COSTS AND OPTIMIZE USE OF EXISTING GRID

CONSTRUCTION SOLUTIONS:

- Direct lines – relevant for offshore wind and elelctrolyzers
- Pooling of projects for etablishing new substations

PLANNING SOLUTIONS:

- Technology neutral grid planning – seperate identification of needs with solutions
- Electricity price optimized grid connections
- Market dialogue on expected new investments in solar and wind
- Digitilization of connection process for improved transparency

MARKET SOLUTIONS:

- Tariff reform to give location signal and reflect on actual costs for connection
- Negative electricity prices
- Local flexibility markets for congestion handling
- Flexible pro-sumers, hourly paid/billed

OPERATIONAL SOLUTIONS:

- Forecast based dynamic line rating
- New digital tools in control center for improved real time information and forecasts

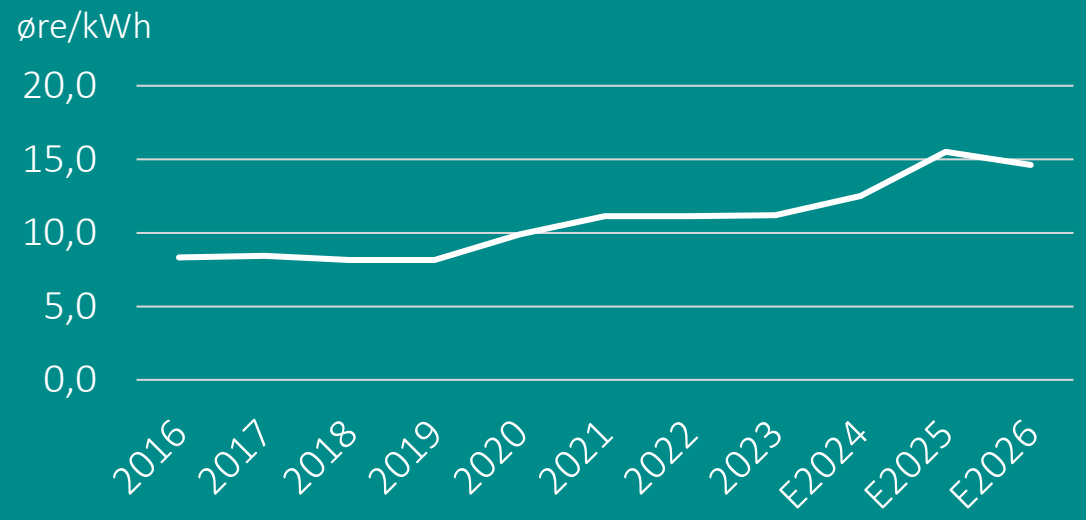
TARIFF DEVELOPMENT

GRID TARIFF COSTS

- Administration and depreciation
- Operation and Maintenance
- Grid loss

SYSTEM TARIFF COSTS

- Ancillary services
- System operation
- Market and systemdevelopment
- DataHub



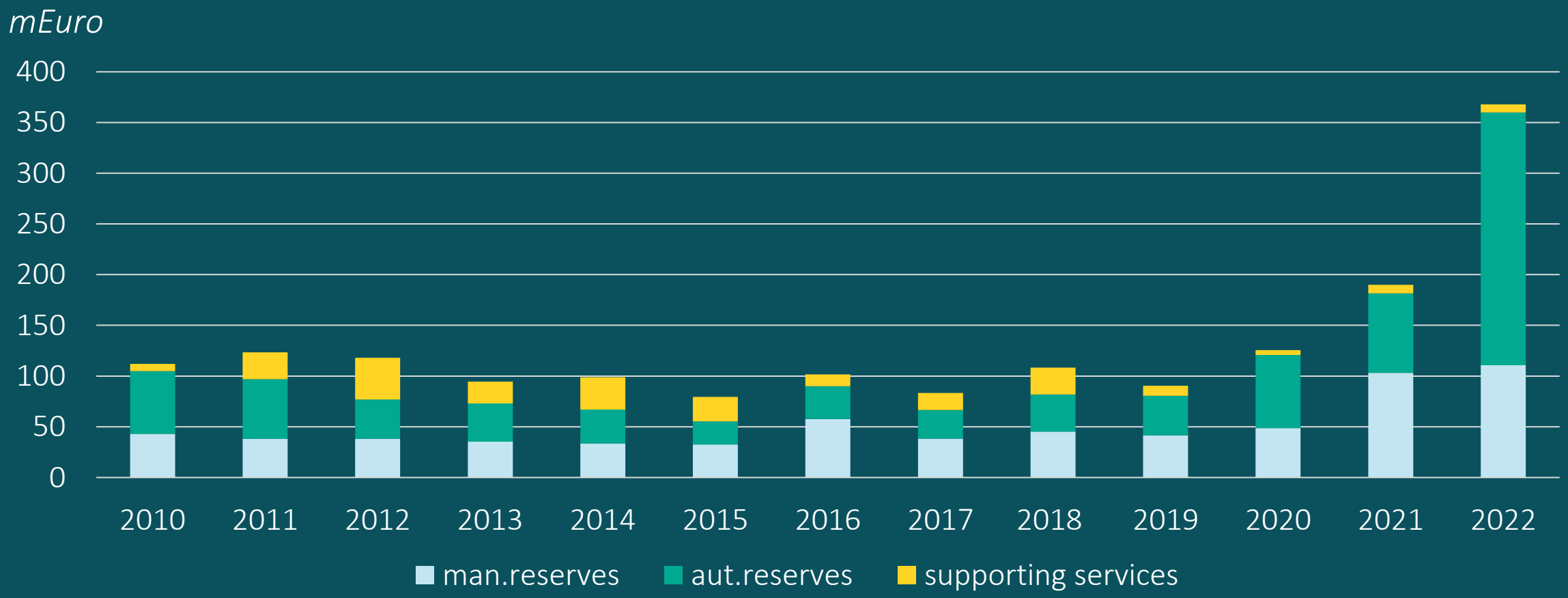
INCREASING TARIFF WITH HIGHER SHARE OF VRE

- Driven by both higher investments in grid, ancillary services and system operation
- Balanced by increased electricity consumption and congestion income from interconnectors
- Tariff reform being implemented for ”true costs”

Energinet tariff reform

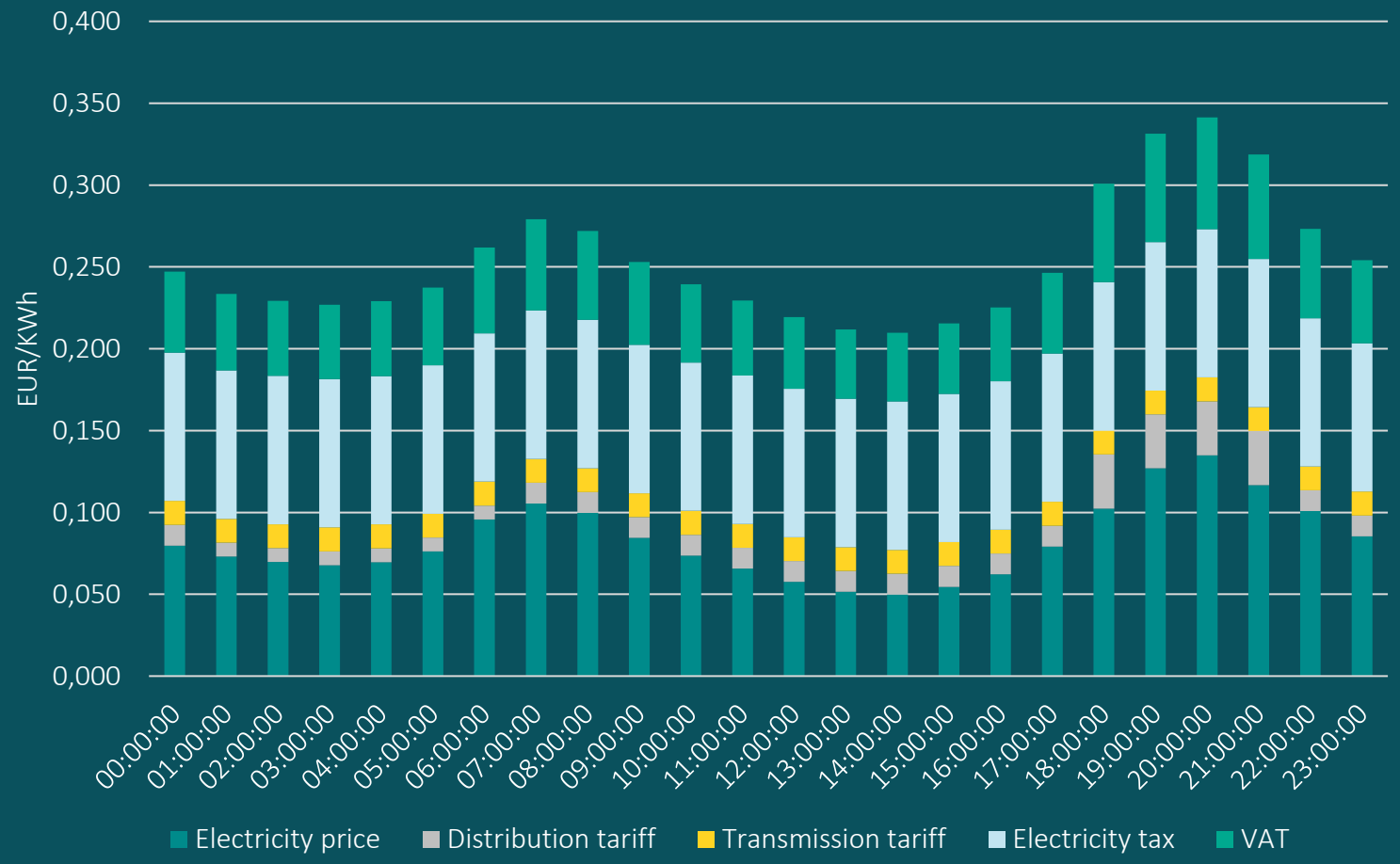
ENERGINET HISTORIC ANCILLARY SERVICE COSTS

INCREASING COSTS: CHANGE IN EUROPEAN REGULATION, NEW PRODUCTS, LIMITATION IN SHARING OF CAPACITY RESERVES, HIGHER ELECTRICITY PRICE, NEW SUPPLIERS, NEW PRODUCT DEFINITIONS, INCREASED IMBALANCES



TRANSPARENT ELECTRICITY PRICES FOR FLEXIBLE CONSUMPTION AND ADAPTION TO VOLATILE PRODUCTION

Average hourly electricity price August 2023 – with tariffs & taxes added



The tariffs and taxes added to the average spot price :

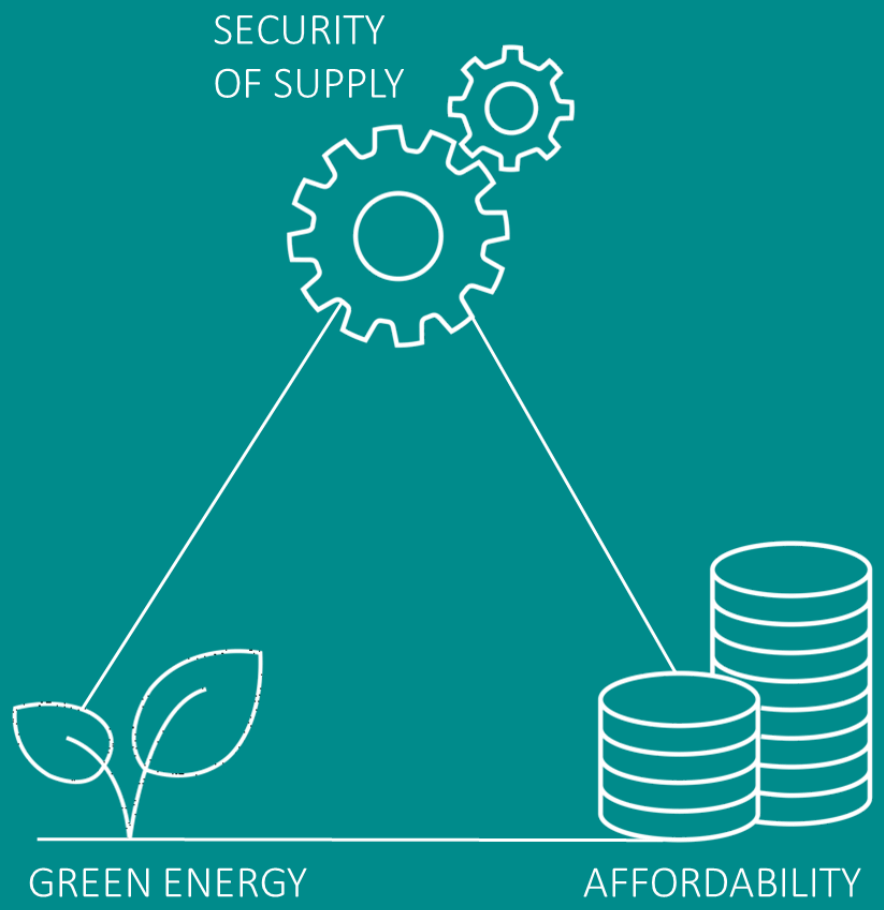
- From **Energinet**: the transmission tariff
  - The consumption tariff: *0.015* EUR/KWh
- From **Distribution**: the distribution tariff
  - Low load: *0.008* EUR/KWh
  - High load: *0.013* EUR/KWh
  - Peak load: *0.033* EUR/KWh
- The **electricity tax** rate*: 0.091* EUR/KWh
- **25% VAT** on the total price

RECOMMENDATIONS TO INCREASE VALUE AND REDUCE COSTS FROM VRE INTEGRATION

- Transparency important for investors to develop projects and business case
- Optimize use of existing grid with operational solutions – incl. digitilization for real-time operation
- Dialogue with stakeholders on location and connection solutions
- Use of market solutions for flexibility, reduce costs for curtailment and efficient management
- Adapt tariff, grid planning and connection regulation to reflect future energy system needs and technology neutral solutions

FROM TECHNOLOGY SOLUTION TO INCENTIVES

A BALANCING ACT



BACK UP

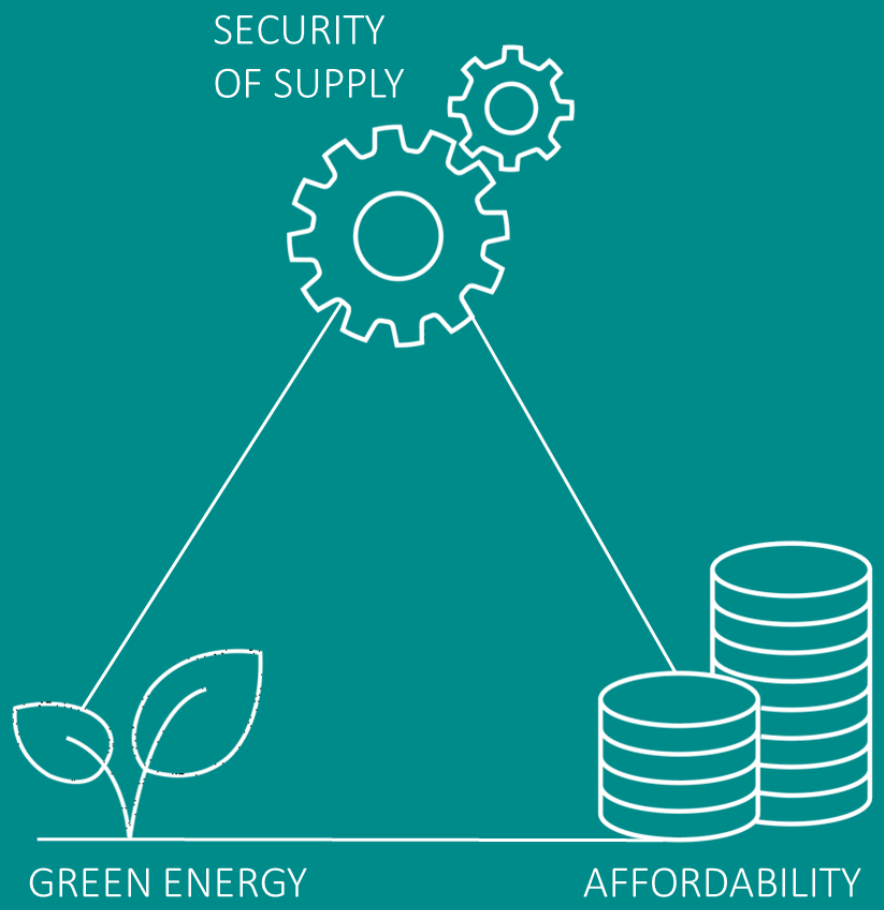
THANKS FOR YOUR ATTENTION

VISION

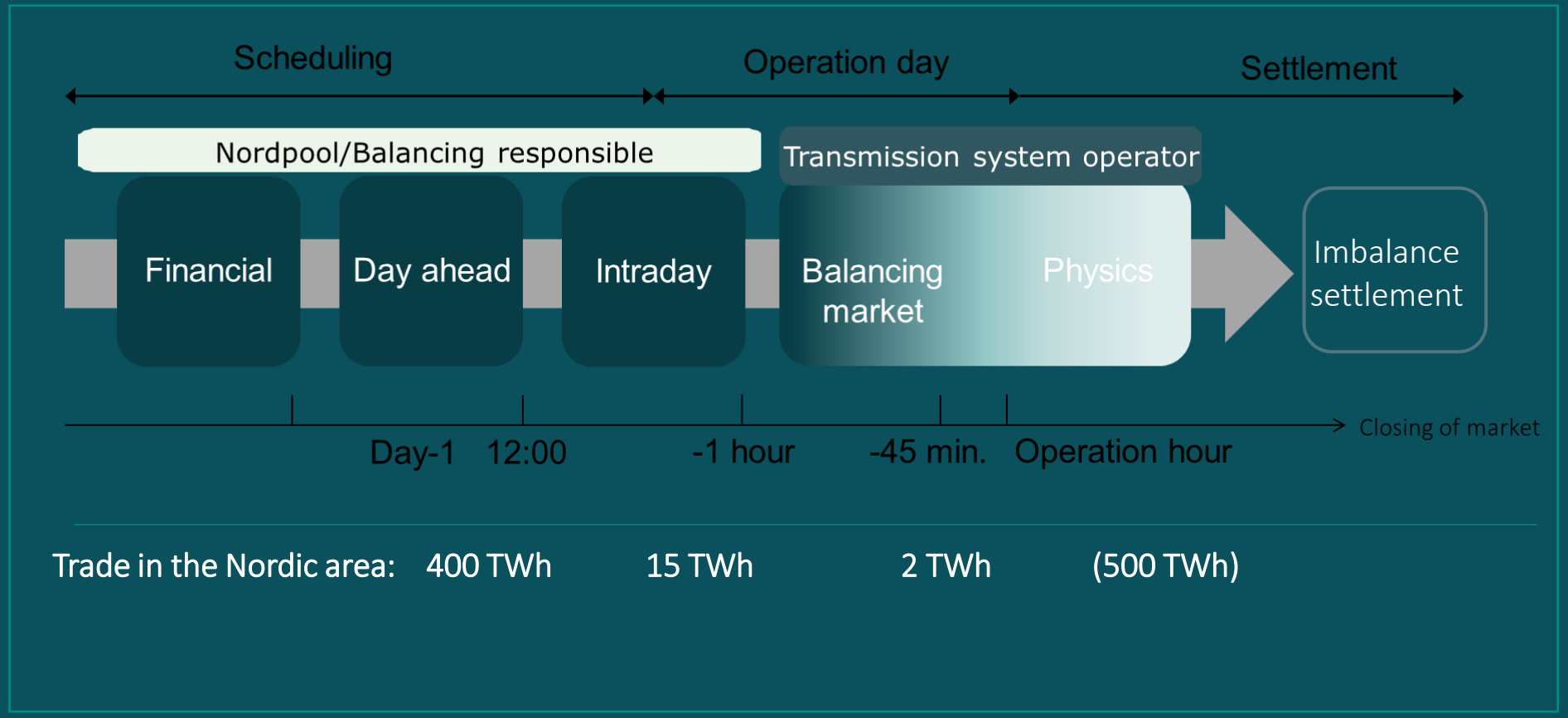
GREEN ENERGY FOR A BETTER WORLD

For more information please contact: pmr@energinet.dk or visit www.energinet.dk/EN

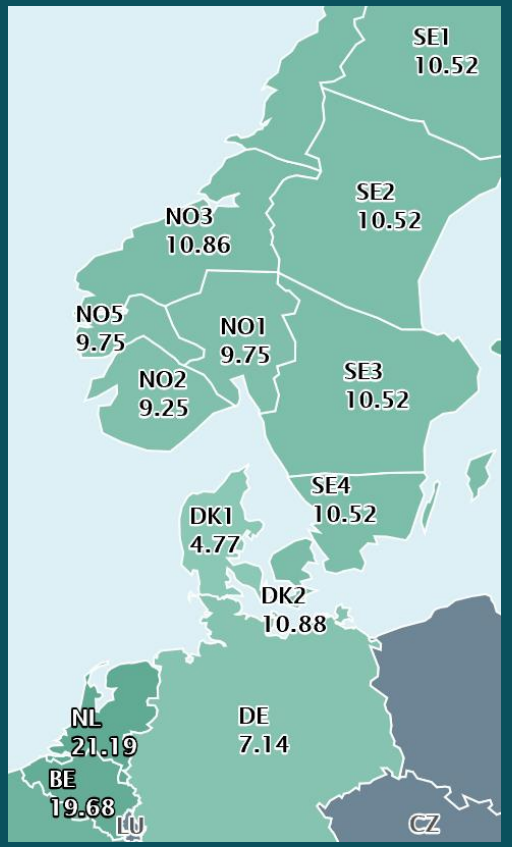
A BALANCING ACT



EUROPEAN ELECTRICITY MARKETS FOR DISPATCH AND REGIONAL/NATIONAL MARKETS FOR BALANCING

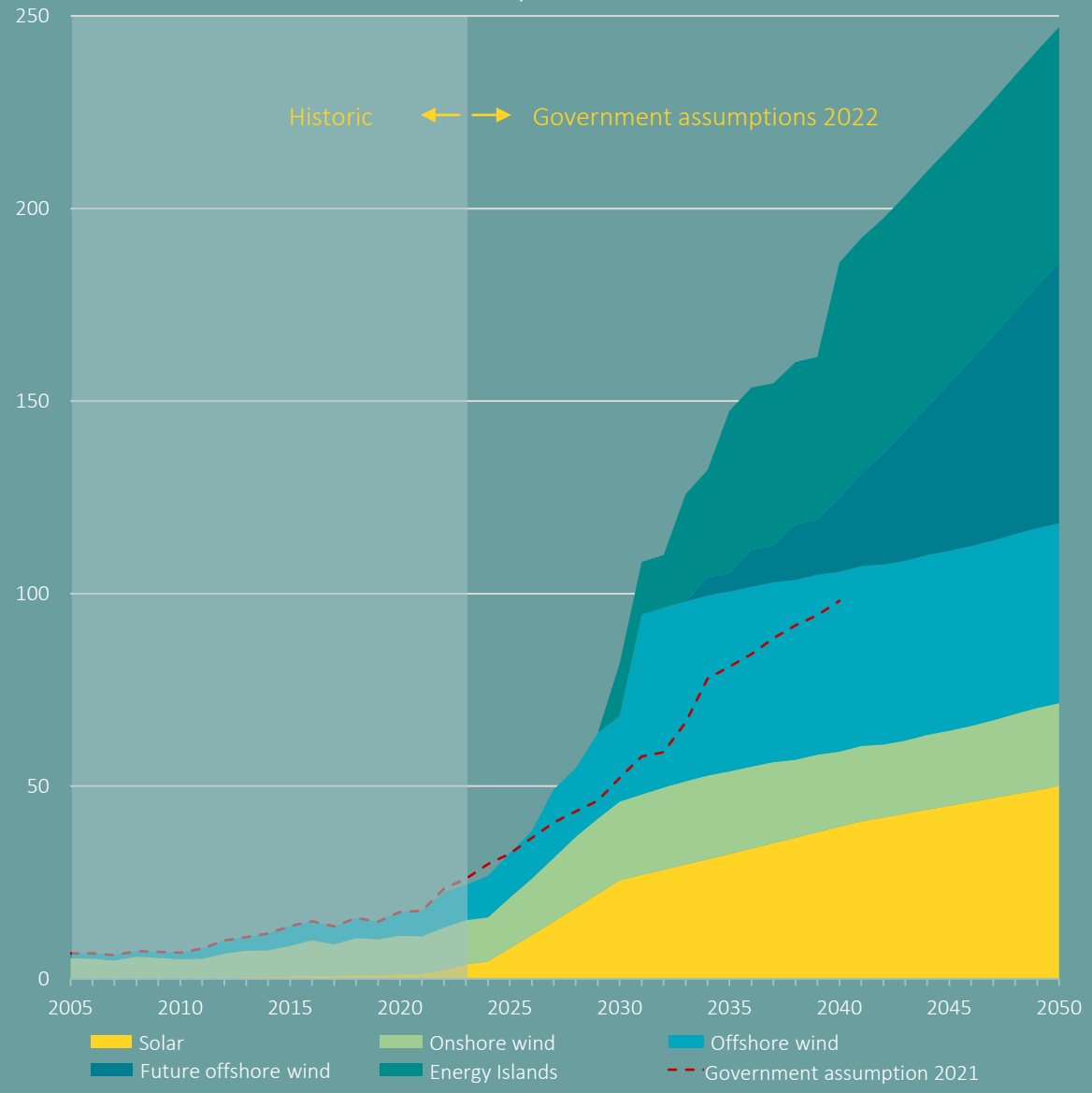


Trade in the Nordic area:	400 TWh	15 TWh	2 TWh	(500 TWh)



Electricity production (TWh)

Assumptions 2022



Electricity consumption (TWh)

Assumptions 2022