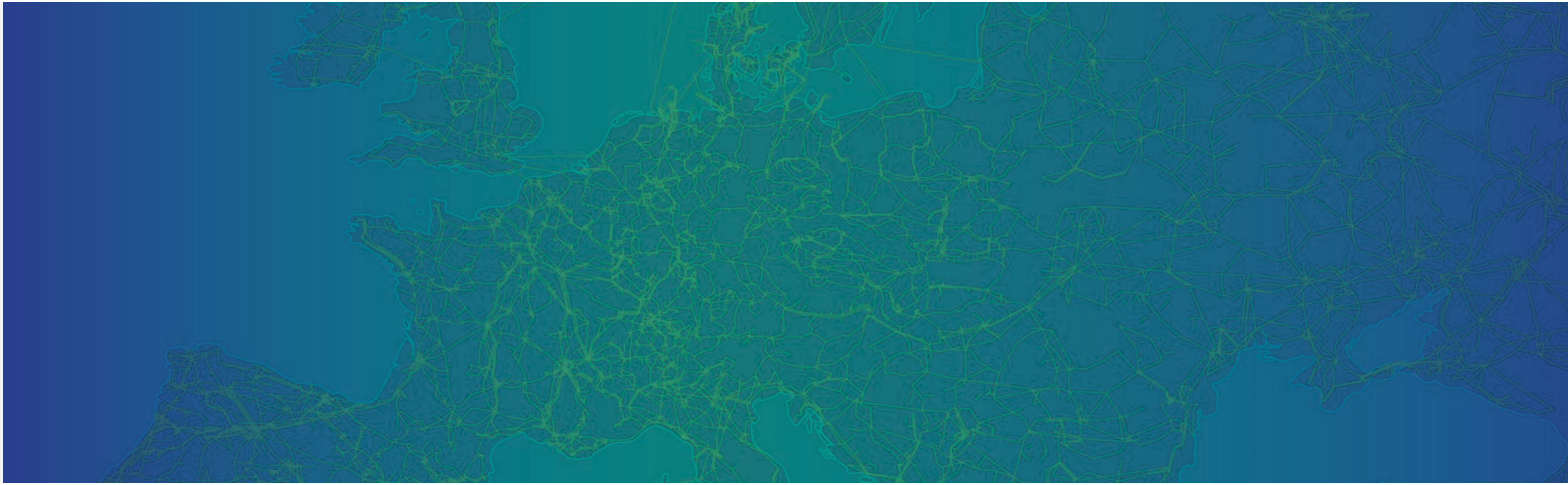
ENTSO-E's Vision 2030: Energy System Integration and Offshore Wind Developments

Webinar #4 of the ENTSO-E Vision 2030 series – 13 October 2020 – 14.00-16.00h



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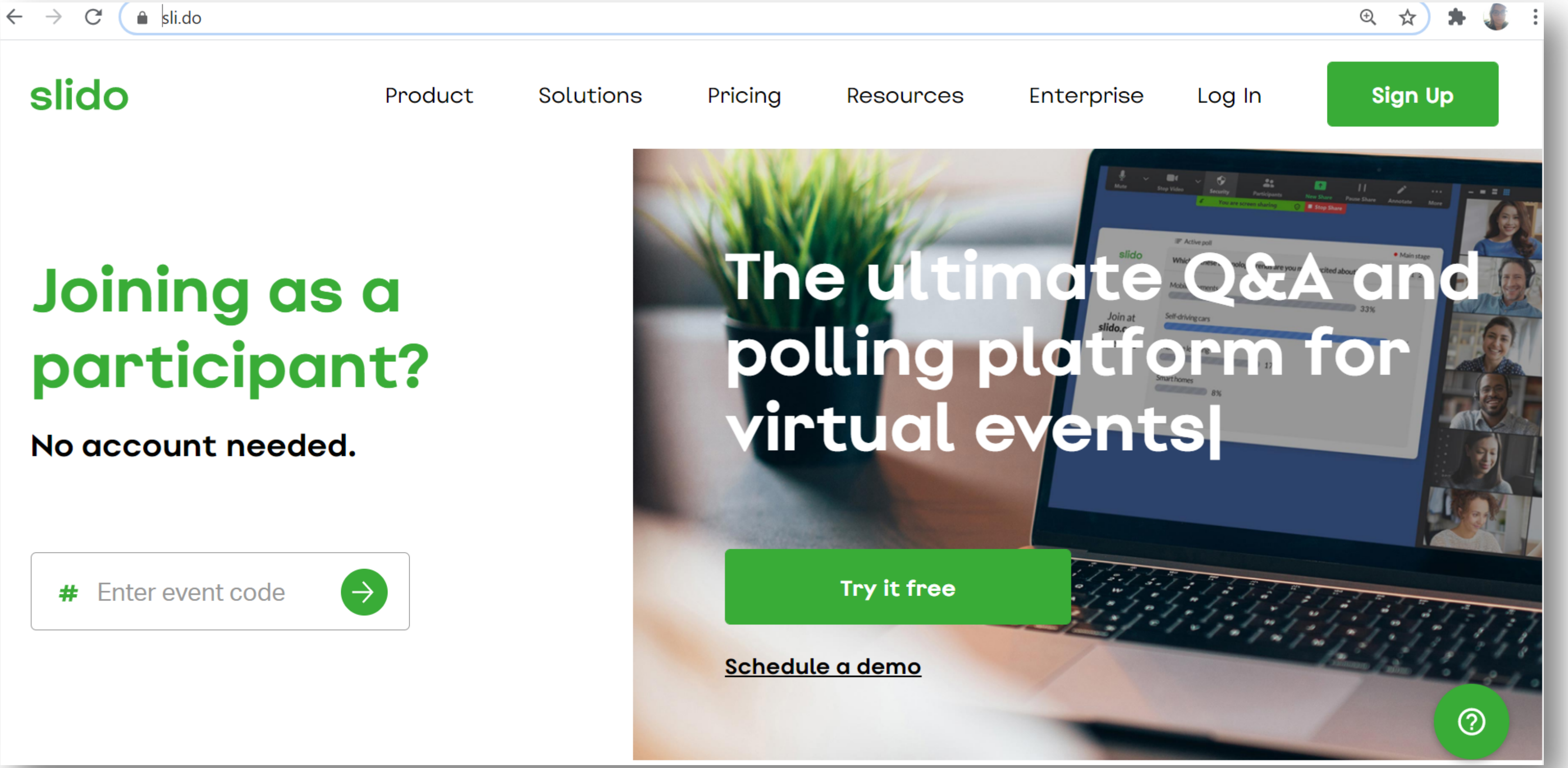

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ENTSO-E Vision 2030

Energy System Integration and Offshore Wind Developments

Webinar #4 of the ENTSO-E Vision 2030 series
13 October 2020 – 14.00-16.00h

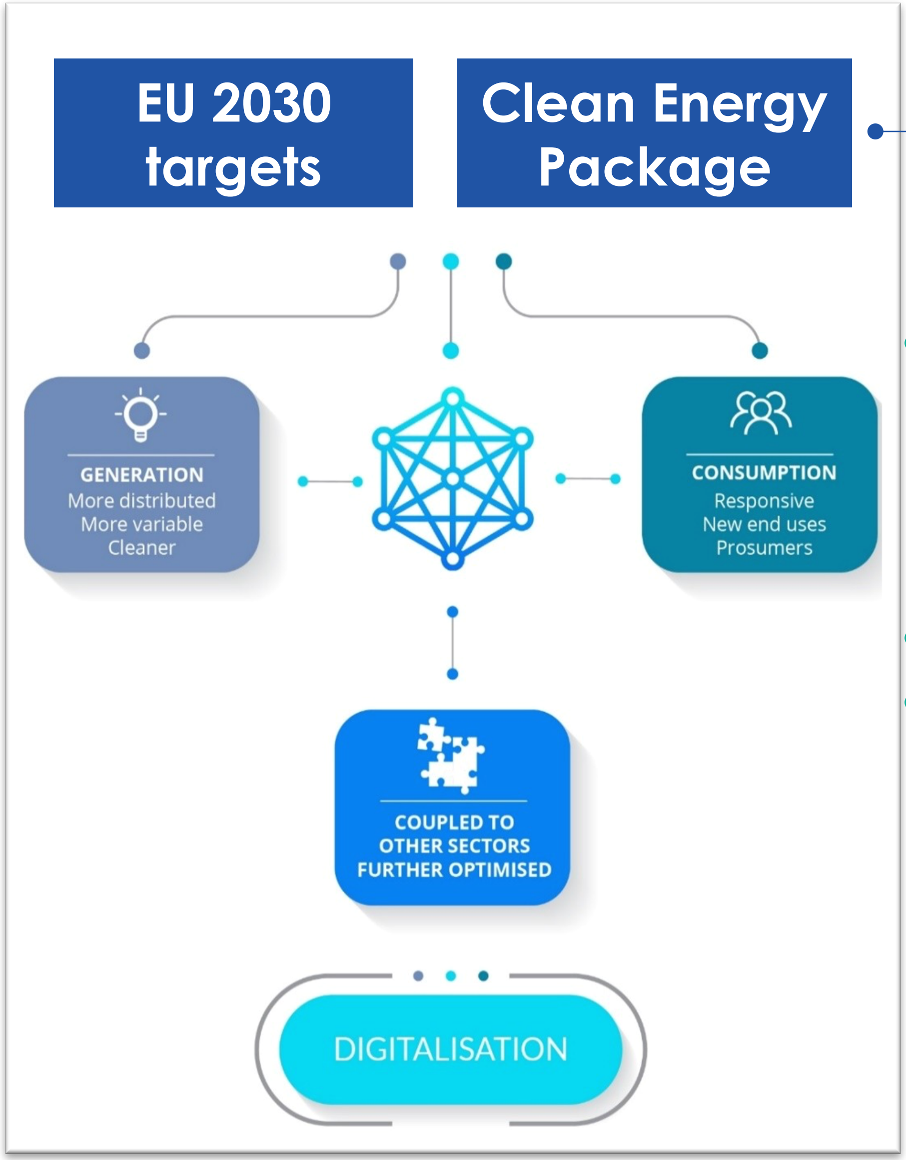
Dimitrios Chaniotis

Chair of ENTSO-E System Development Committee

Agenda

No	Subject	Time	Presenters
1	Welcome and introduction plus context of vision	10 min	**Dimitrios Chaniotis**, Chair of ENTSO-E System Development Committee
2	ENTSO-E view on system integration	15 min	**Gerald Kaendler**, Vice-Chair of ENTSO-E System Development Committee
3	The EU energy system integration and hydrogen strategies - challenges and opportunities for the power system on the path to climate neutrality	10 min	**Antonio Lopez-Nicolas Baza**, Deputy Head of Unit Renewables and CCS Policy, European Commission, DG ENER
4	DSO view on Decentralisation & System integration	10 min	**Paul Wilczek**, Head of Distribution & Market Facilitation, Eurelectric
5	ENTSO-E view on - offshore developments	10 min	**Antje Orths**, Convenor of ENTSO-E Offshore Development Core Group
	- offshore network technology	5 min	**Wilhelm Winter**, Convernor of ENTSO-E Working Group 2 - Security and system operation of tomorrow
6	Wind and transport for offshore development	10 min	**Giles Dickson**, Chief Executive Officer of WindEurope
7	Q & A on system integration and offshore	35 min	Moderator: **Dimitrios Chaniotis**, Chair of ENTSO-E System Development Committee
8	Wrap up	15 min	**Dimitrios Chaniotis**

A Vision reconciling political objectives and technical reality



2030 Scenarios
a shared view of the future

System Operation

Market Design

Working together towards a closer integration of system operation and markets

A robust and resilient expert-based 2030 vision
adapted to a **dynamic future**

Green Deal

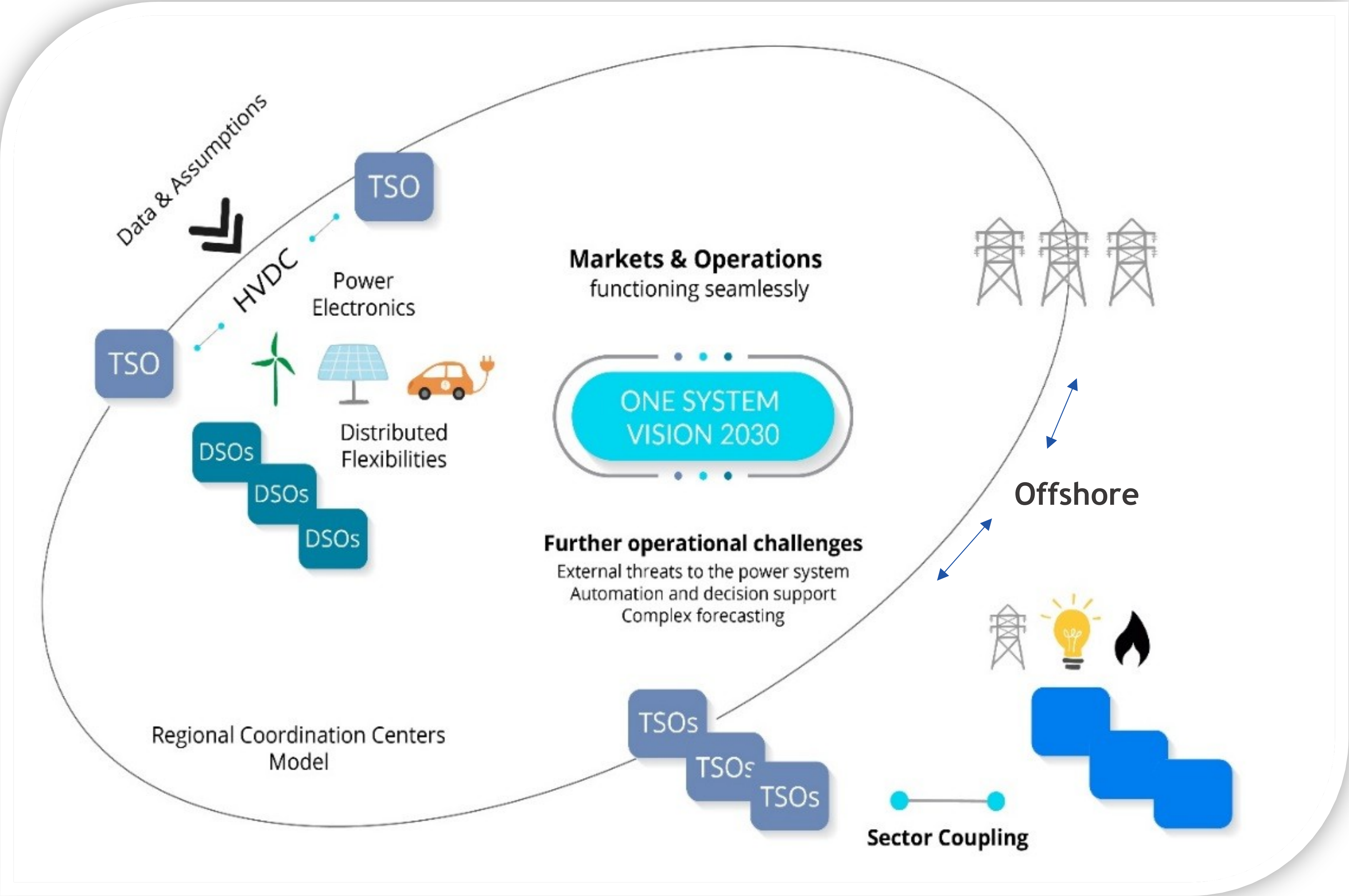
Climate law

Key drivers and major trends in the power system towards 2030

- **Distributed flexibilities** with close TSO & DSO cooperation
- **Power Electronics** towards hybrid AC/DC systems
- **Markets and physics** seamlessly integrated
- Wind generation and interconnections in the seas, **Offshore Grids**
- **Energy System Integration**, beyond power
- **Mastering operational challenges** - resilience, forecast, automation, artificial intelligence

A true System of Interconnected Systems

For the benefit of all European consumers



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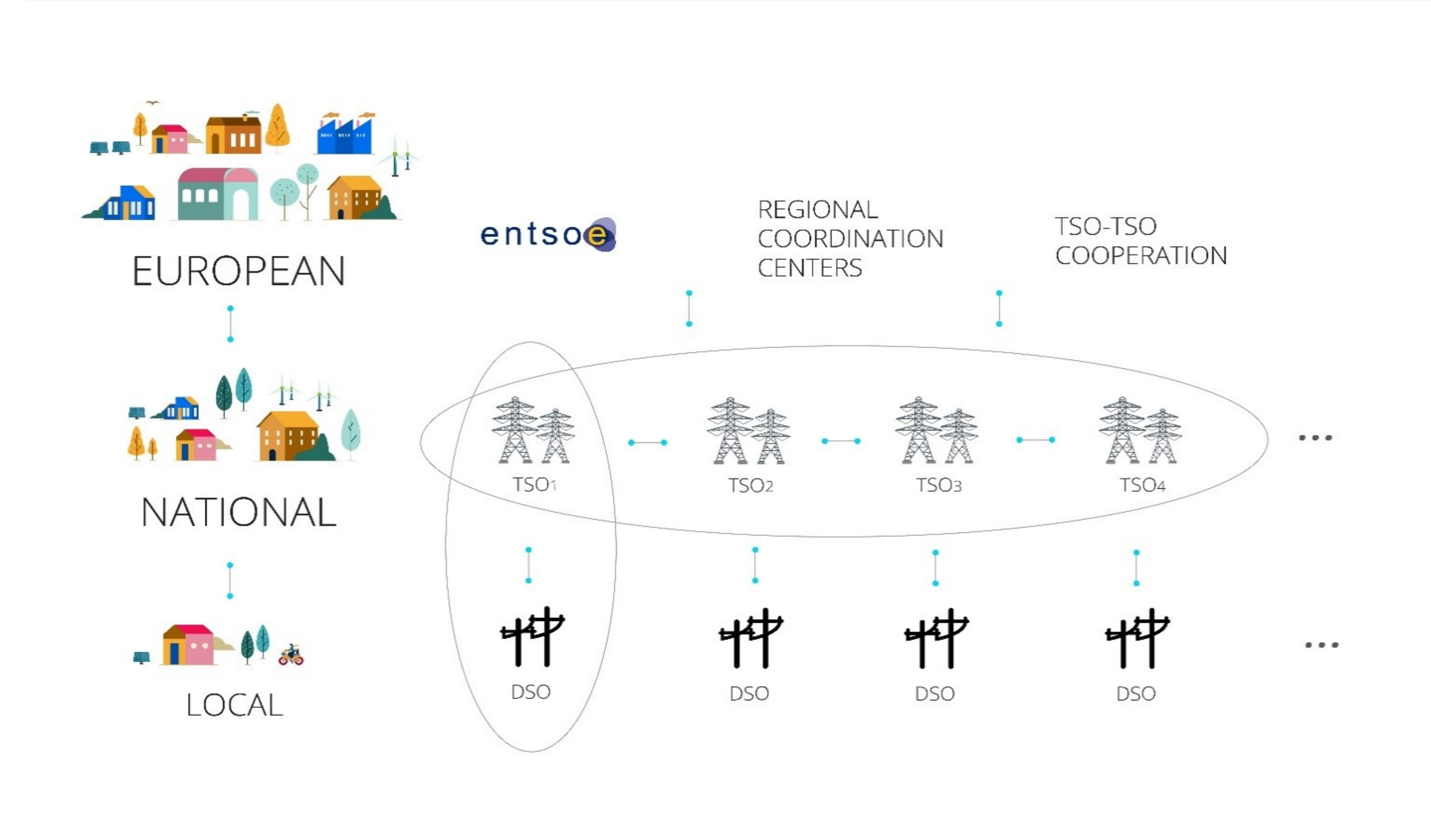
Building a 'System of Systems'



- Geographical scales
- Multilateral interfaces
- Interoperability
- System operators = key facilitators
- Governance involving stakeholders
- Putting consumers at the heart of the Energy Transition

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ENTSO-E's view on system integration

Gerald Kaendler

Vice-Chair of ENTSO-E System Development Committee

The objectives of sector integration and the contribution of ENTSO-E

The European Green Deal

- Climate neutrality
- High energy efficiency
- Minimal system costs
- Security of supply

Contribution of ENTSO-E

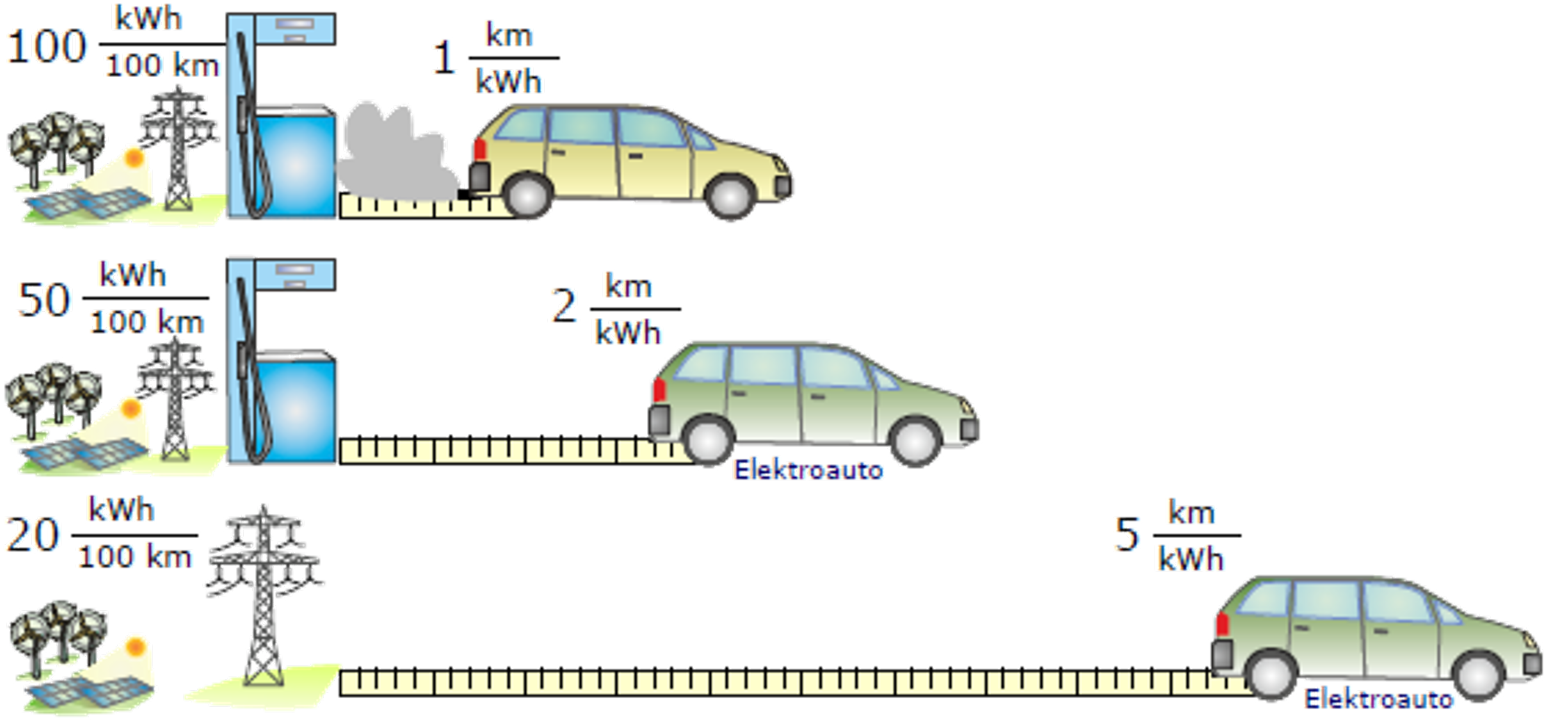
- Integration of variable renewable energy sources
- Facilitation of electrification of processes
- Interlinking energy sectors for a cost-efficient system
- Secure operation of electricity networks

The efficiency of electricity is key for climate neutrality

Internal combustion engine + diesel/ petrol (PtL)

Fuel cell vehicle + hydrogen (PtG)

Battery electric vehicle + electricity



Source: Quaschning, Volker (2016): Sektorkopplung durch die Energiewende. Hochschule für Technik und Wirtschaft HTW Berlin.

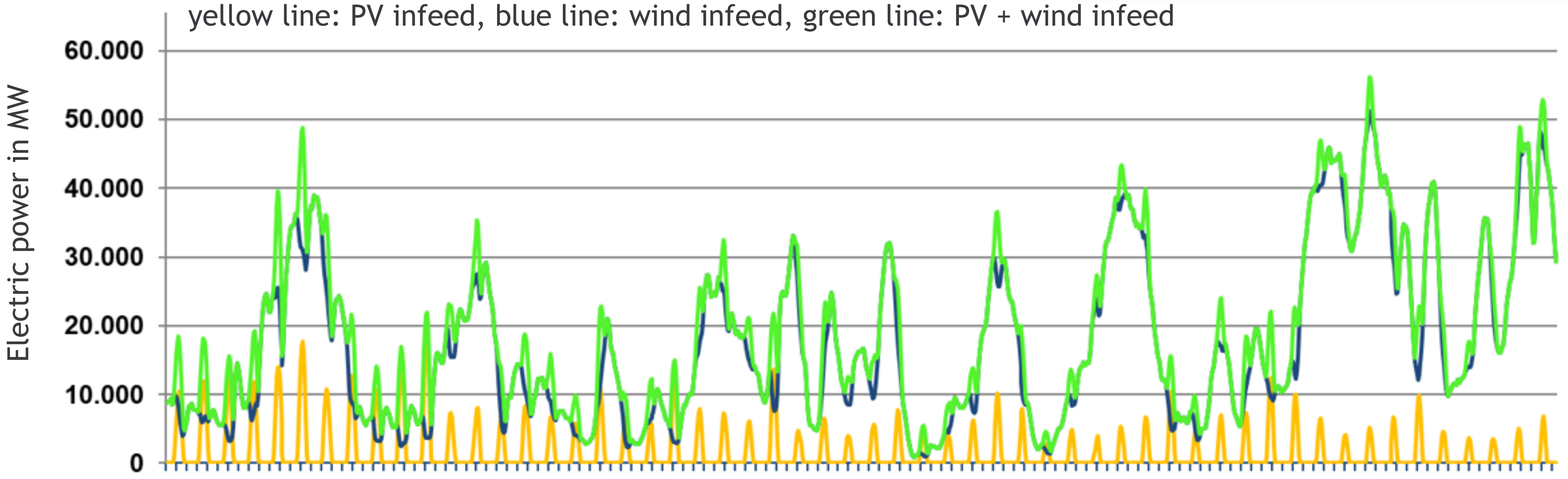
Variable renewable energy sources will provide most of the energy

Europe can be 60% powered by solar before 2050

Wind and solar will be very important energy sources to reach climate neutrality

The electric system cannot provide the flexibility needed past 2030

Europe can be 60% powered by solar before 2050

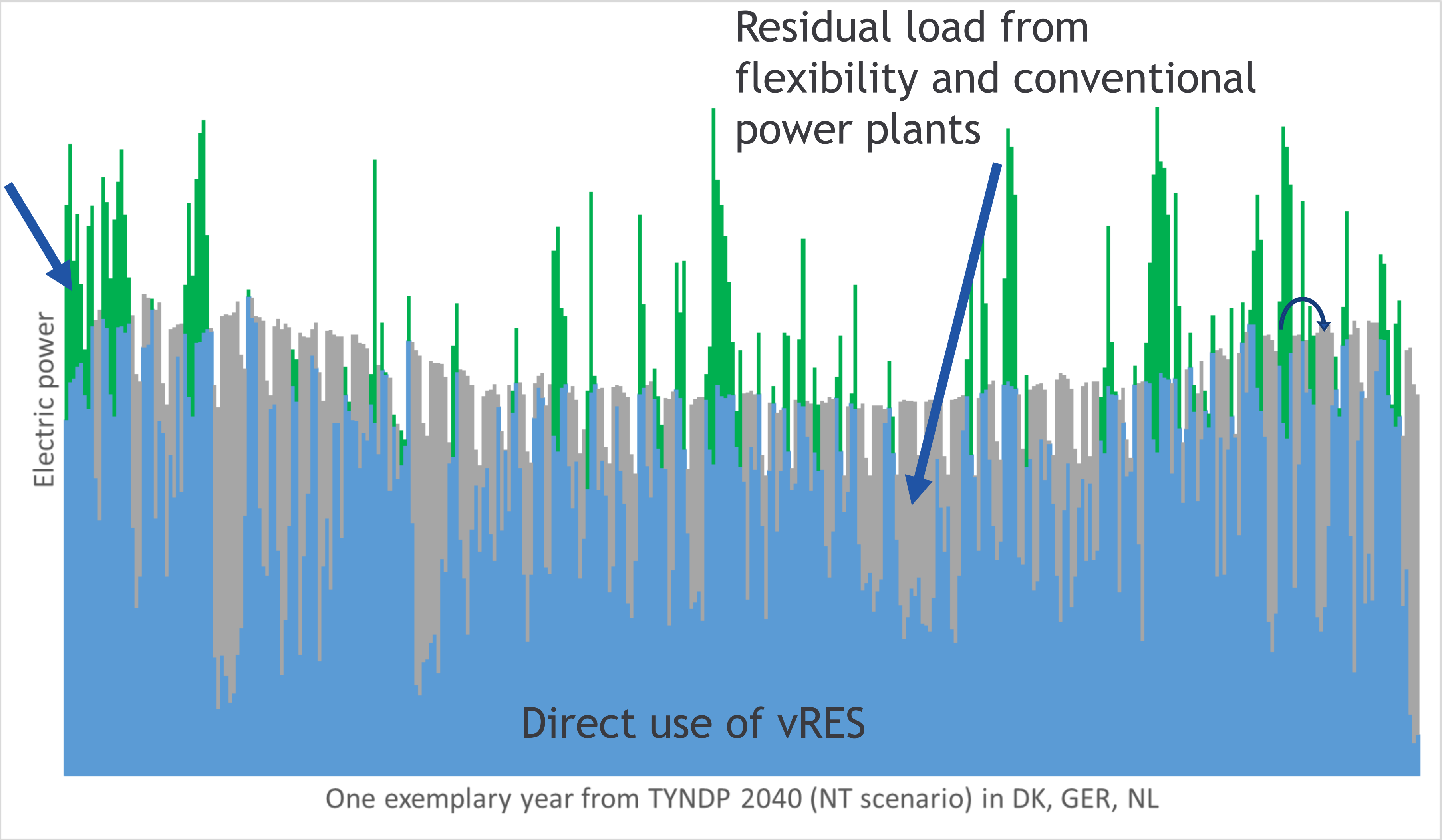


Two exemplary months from autumn 2019 in Germany

Wind and solar need the flexibility of other sectors

Flexibility is essential to utilise variable renewable energies

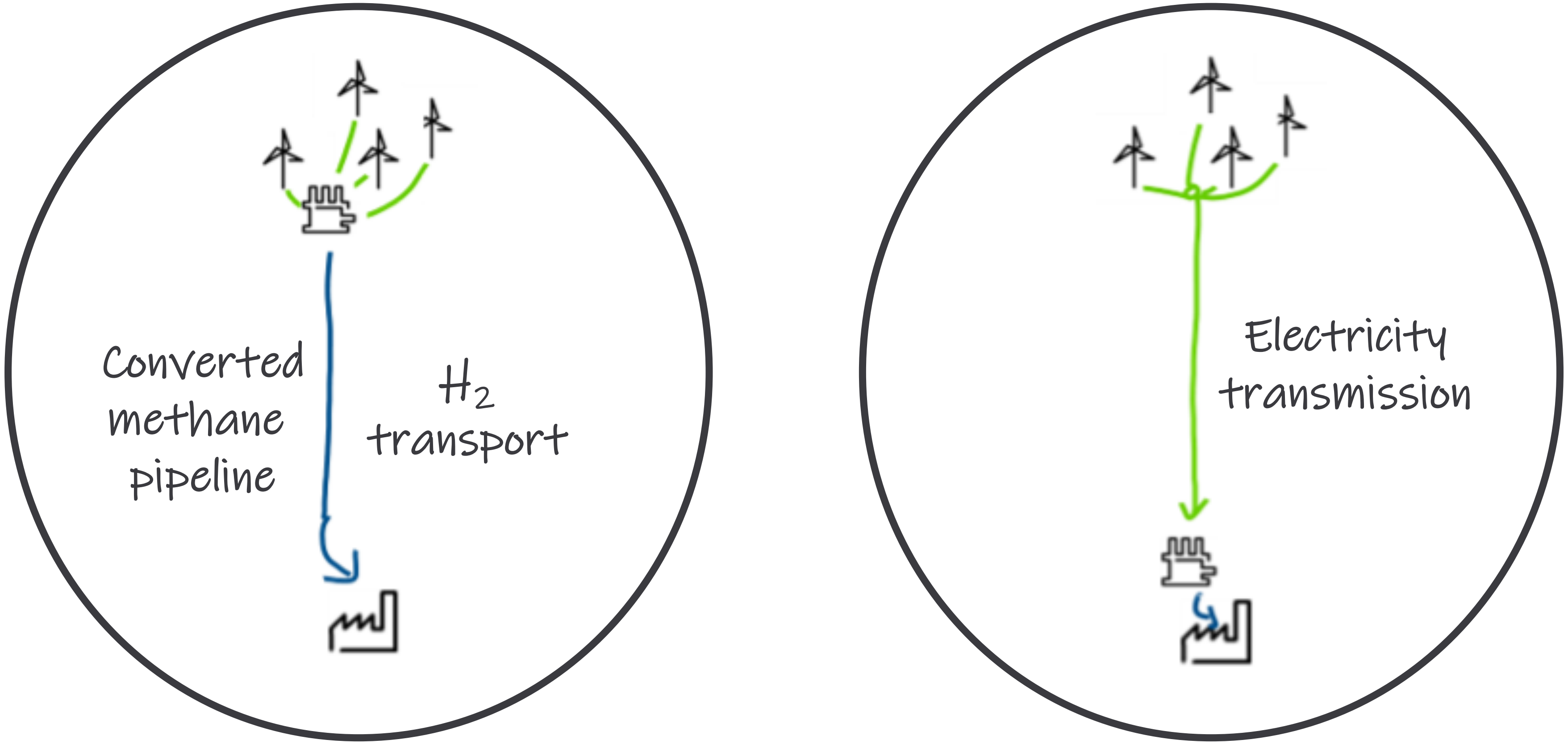
Surplus RES is always beneficial to decarbonise other sectors



Flexibility to balance the system

➢ The ‘one system view’ allows to operate the system in a way that enables further CO_2 reduction

Placement of electrolysers determines energy transport technology and infrastructure costs



Planning of electrolysers and H_2 network in TYNDPs
(EC hydrogen strategy)

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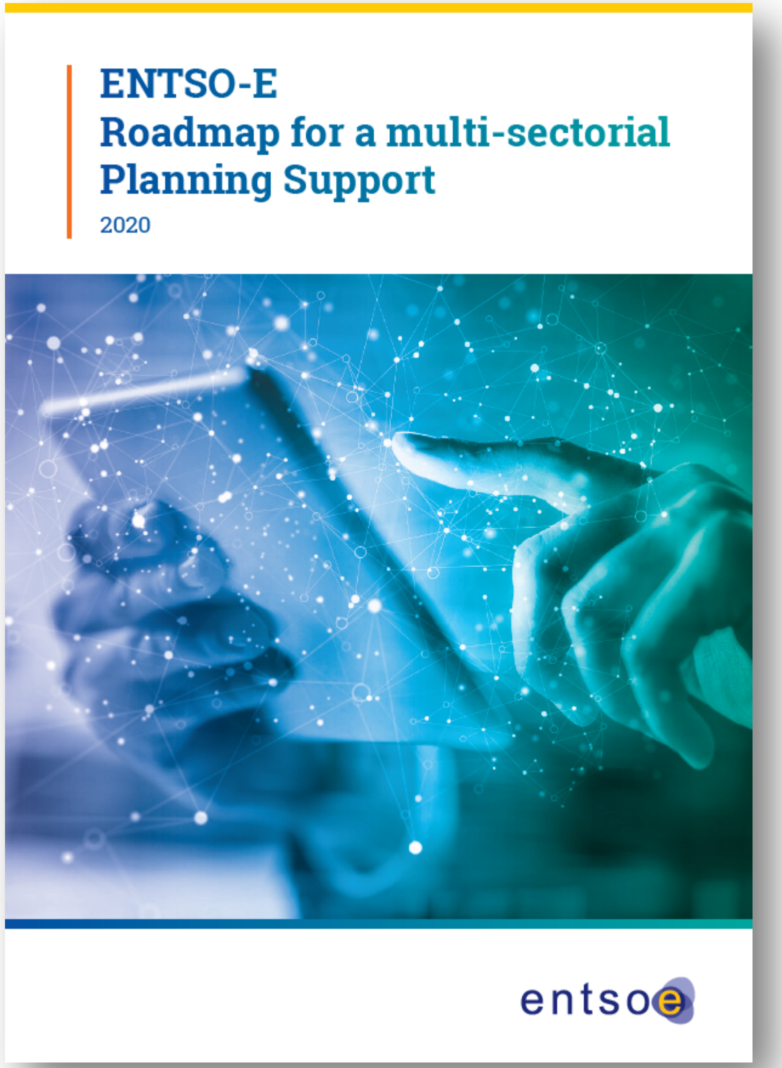
ENTSO-E's Multi-Sectorial Planning Support (MSPS) concept: paving the way to meet future energy system integration needs

- Greater coordination of the infrastructure planning in different sectors
- Increased stakeholder collaboration
- One energy system view
- Multi-sectorial scenarios building process
- Sector-specific infrastructure planning
- Multi-sectorial cost-benefit analysis and indicators



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ENTSO-E supports efficient system integration of renewables

Variable RES will decarbonise the future energy system

Multi-sectorial system planning minimises system costs

Electrified and flexible sector integration is efficient

Sound system operation supports security of supply

Thank you for your attention

The EU energy system integration and hydrogen strategies

Antonio Lopez-Nicolas Baza

Deputy Head of Unit Renewables and CCS Policy, European Commission, DG ENER

Powering a climate-neutral economy

The Energy System Integration and Hydrogen Strategies

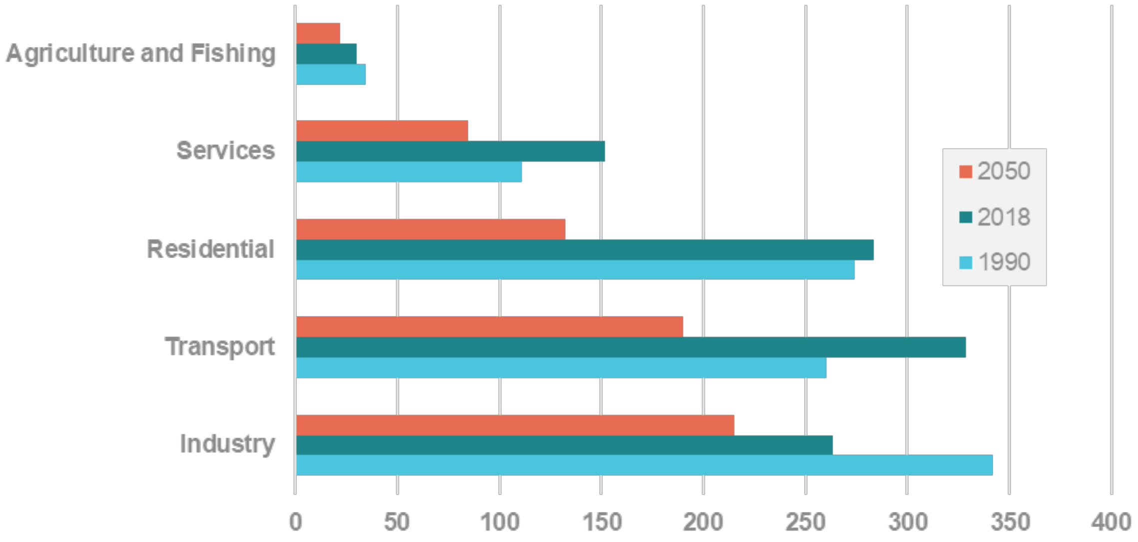
ENTSO-E Webinar Energy System Integration and Offshore Wind Developments

13October 2020

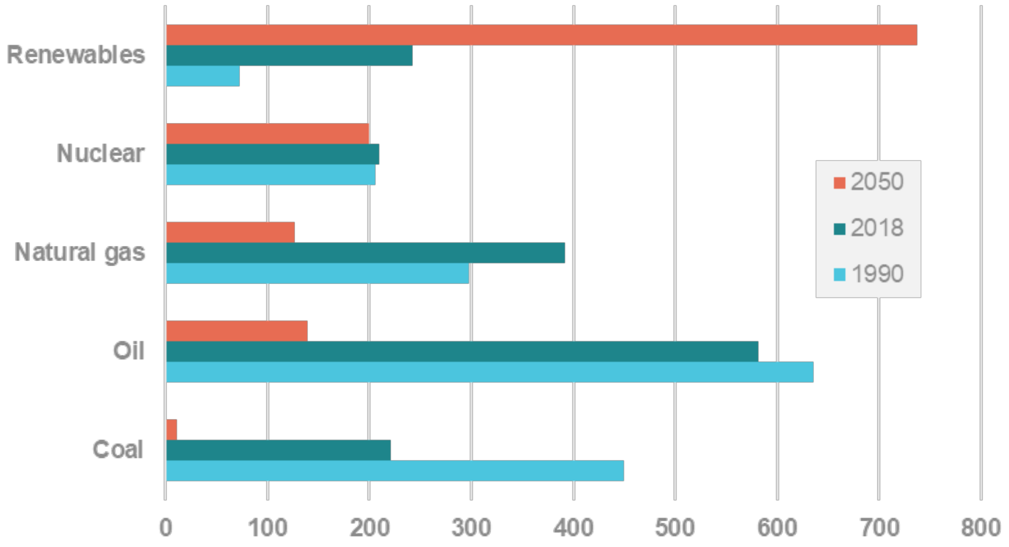
Antonio Lopez-Nicolas Baza
Dep. Head of Unit Renewables and CCS Policy
Directorate-General for Energy

Changing consumption and production patterns

Final energy demand per sector

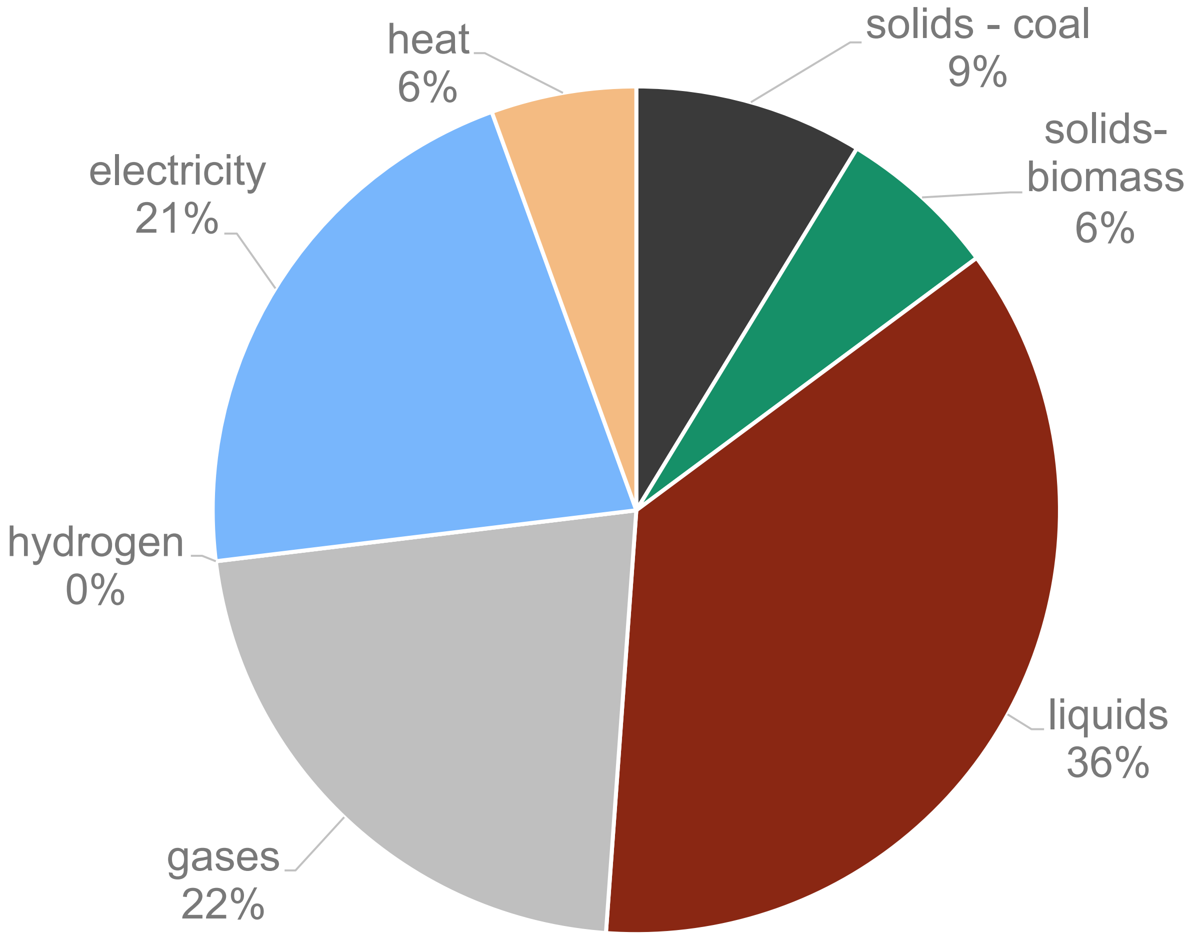


Consumption per energy supply source

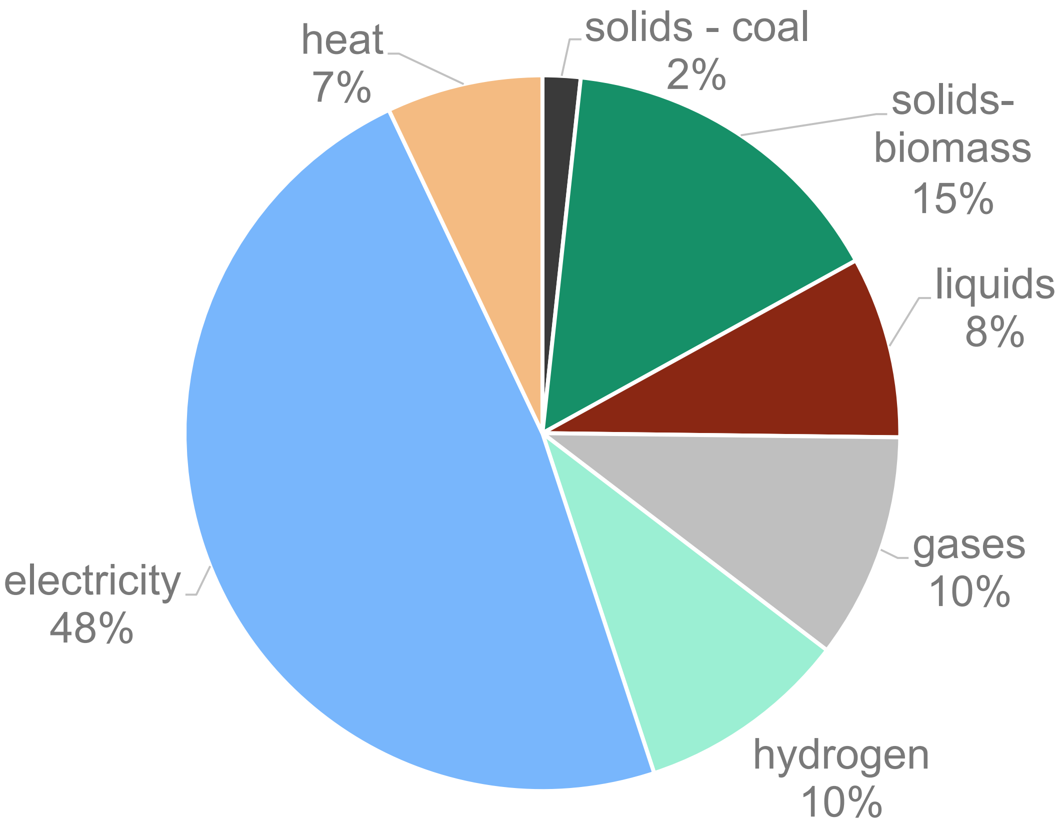


Source: Mtoe, based on EU28 Eurostat/LTS 1.5LIFE/TECH scenarios

Changing energy carriers



2018 (1648 MToe)



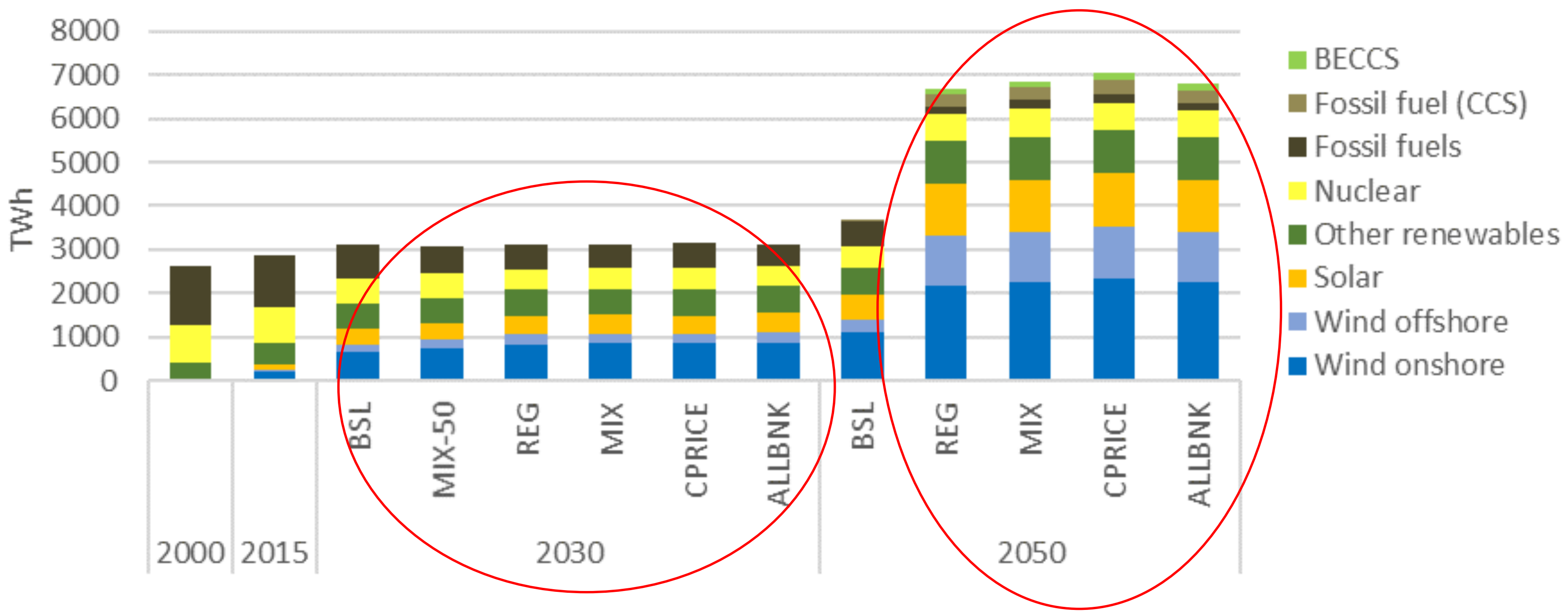
2050 (1213 Mtoe)

Source: Based on EU28 Eurostat/LTS 1.5LIFE/TECH scenarios

European Commission

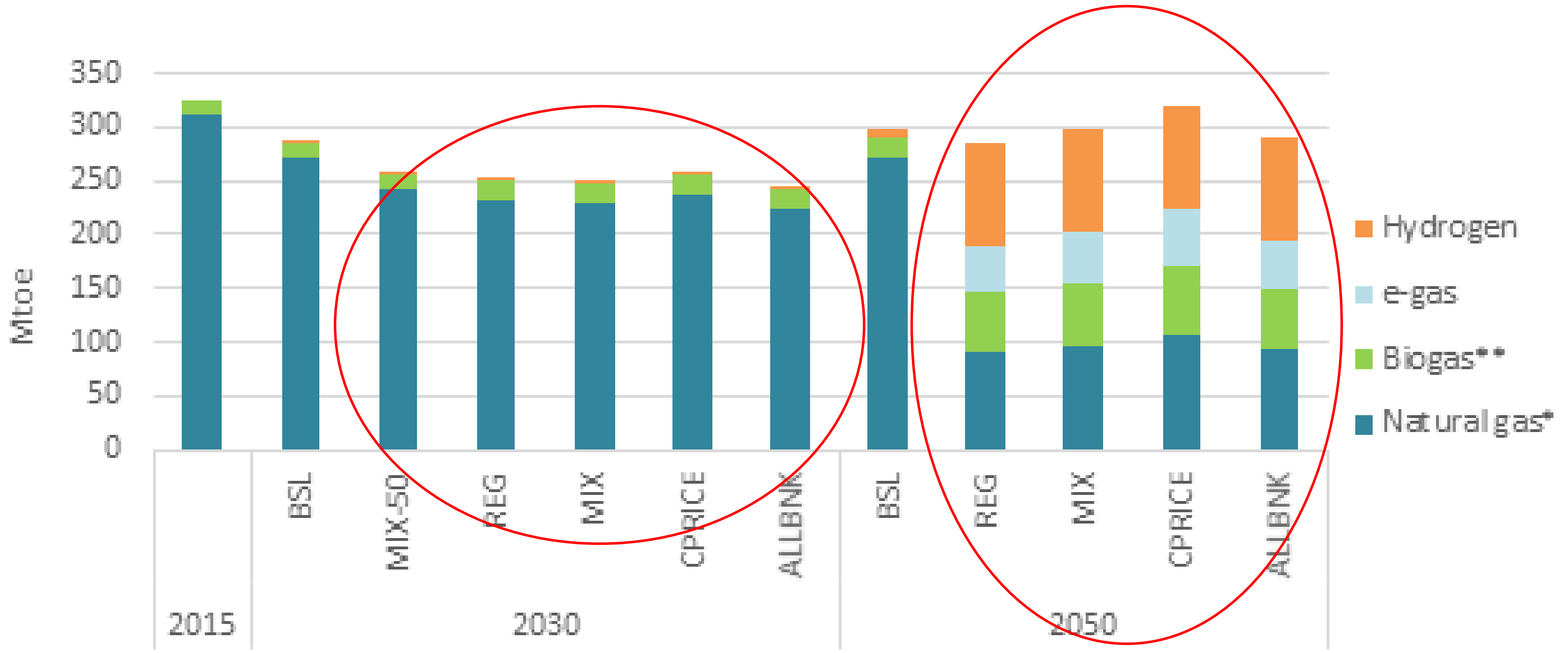
Electrification, based on renewables

Electricity production



Transformation for the gas industry

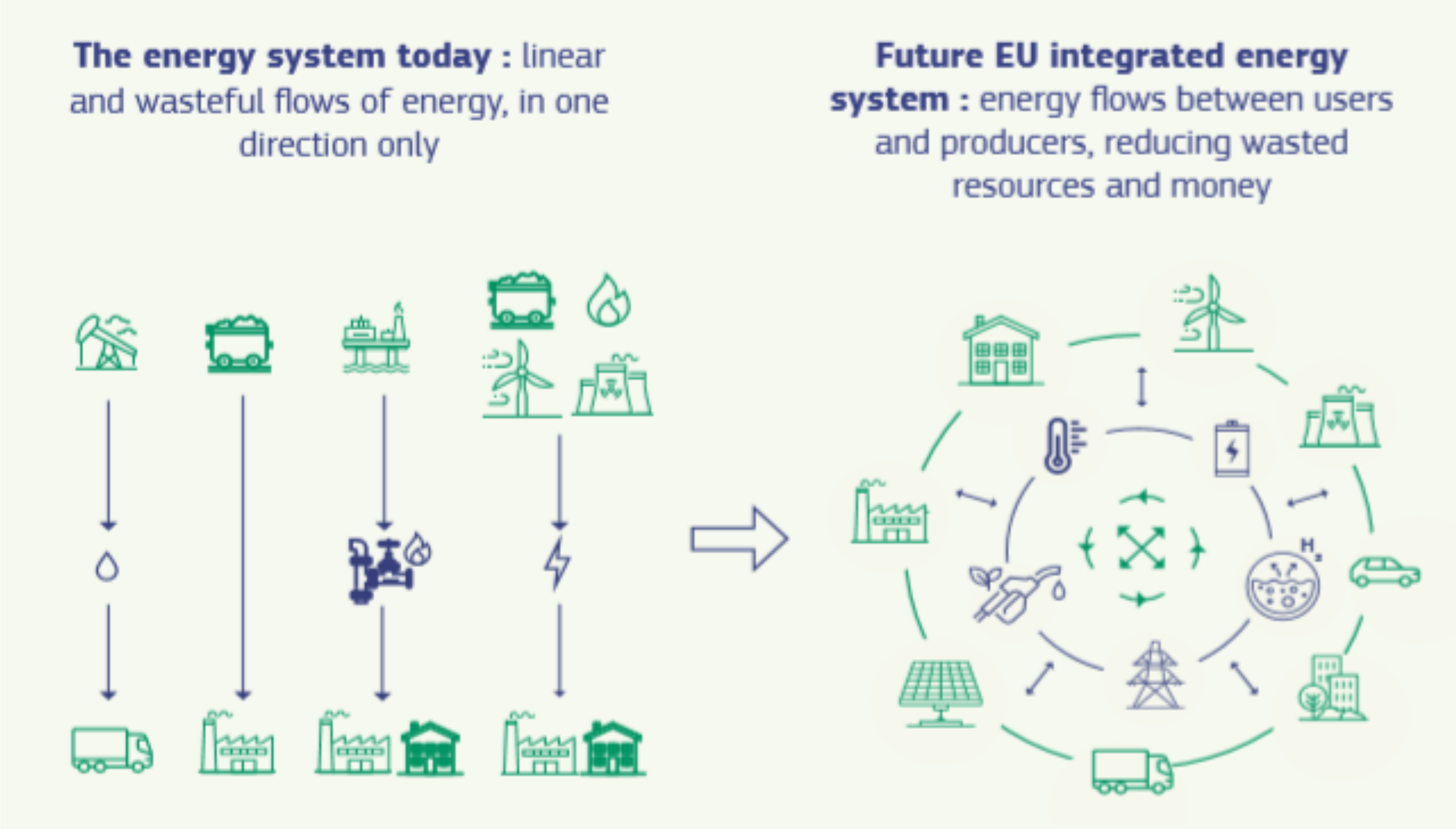
Consumption of gaseous fuels per gas type



European Commission

Why a Strategy for Energy System Integration? Why now?

What is energy system integration?



Energy System Integration (ESI) is the integrated planning and operation of the energy system ‘as a whole’, across multiple carriers, infrastructures and consumption sectors

Laying the foundation for a climate-neutral energy system

Energy System Integration Strategy

1. A more **circular and energy efficient** energy system

2. A **deep electrification** of consumption, based on **renewable electricity**

3. The use of **renewable and low carbon fuels (incl. hydrogen)** in hard-to-abate sectors

Hydrogen Strategy

A full value chain approach to upscale hydrogen

\+

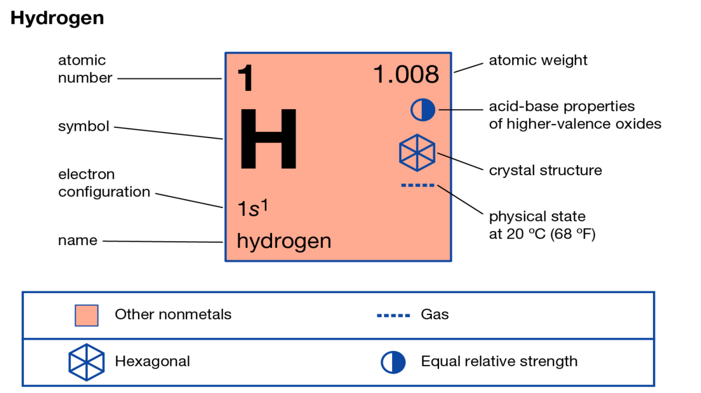
Clean Hydrogen Alliance

Making it happen – an action plan for Energy System Integration

Pillar	Actions oriented towards	Main tools involved (*)
A more circular and energy efficient energy system	• Better apply EEF principle & PEF • Build a more circular system	RED, EED, TEN-E
A deep electrification of consumption, based on renewable electricity	• Increased supply RES-E • Faster electrification end-use sectors • Roll out EV infrastructure & new loads integration	RED, IED, AFID, TEN-E, TEN-T, CO2 emissions for cars, EU funding, offshore RES, Renovation wave, NC Flexibility
RES & low carbon fuels for hard-to-abate sectors (incl. hydrogen)	• Promoting RES fuels from biomass • Promoting RES hydrogen • Enabling CCUS incl. for synthetic fuels	RED, Aviation/Maritime initiatives, EU funding + Hydrogen Strategy Follow-up
Energy markets fit for decarbonisation & distributed resources	• Creating a level playing field across carriers • Review gas regulatory framework • Improve customer information	ETD, ETS, State Aid, gas legislation, guidance on non price components
A more integrated energy infrastructure	• More integrated planning at gas, electricity, heat and hydrogen • Better governance	TEN-E, TEN-T, RED, EED, TYNDP
A digitalised energy system & supportive innovation framework	• Ensure digitalisation support energy system integration • Research and innovation as a key enabler	Energy Digitalisation Action Plan, NC cybersecurity, impact oriented research outlook

(*) Non-exhaustive list

Hydrogen – What and Why?



Hydrogen:

- Feedstock, fuel, energy carrier / storage, many applications
- Does not emit C02, no air pollution
- Essential to reach our climate ambition (hard-to-abate sectors)
- Europe is highly competitive in clean hydrogen technologies manufacturing

Which hydrogen:

Currently: **fossil- based hydrogen**

Our vision: **Renewable (clean),** and in a transitional period **low-carbon hydrogen** (fossil-based hydrogen with carbon capture and electricity based) for:

- Replacing **existing hydrogen** production
- **Industry** (fertilisers and green steel) **and transport**
  (Local buses, parts of rail, heavy duty road vehicles; in the longer term: maritime and aviation)

Issues:

- **Cost-competitivess**
- **Technological maturity (cost-effective electrolysers)**
- **Renewable energy & scale**

Thank you for your attention!

antonio.lopez-nicolas@ec.europa.eu

DSO view on Decentralisation & System integration

Paul Wilczek

Head of Distribution & Market Facilitation, Eurelectric

eurelectric

DSO view on Decentralisation & System integration

ENTSO-E vision week, webinar on Energy System Integration and Offshore Wind Developments, 13 October 2020,

Paul Wilczek, Head of Distribution & Market Facilitation, Eurelectric

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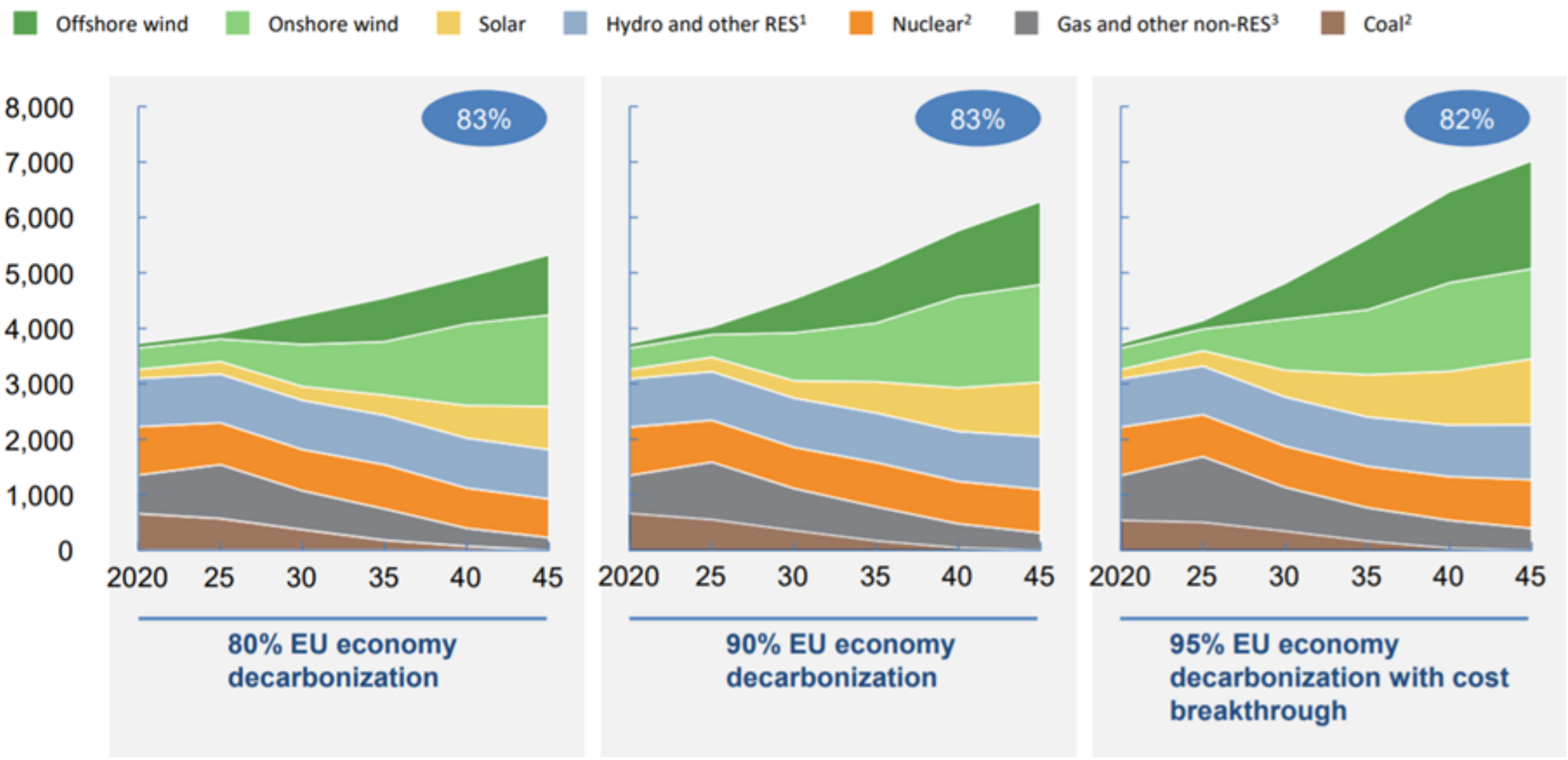
In a fully carbon neutral power sector, 80% of the electricity will come from renewable sources



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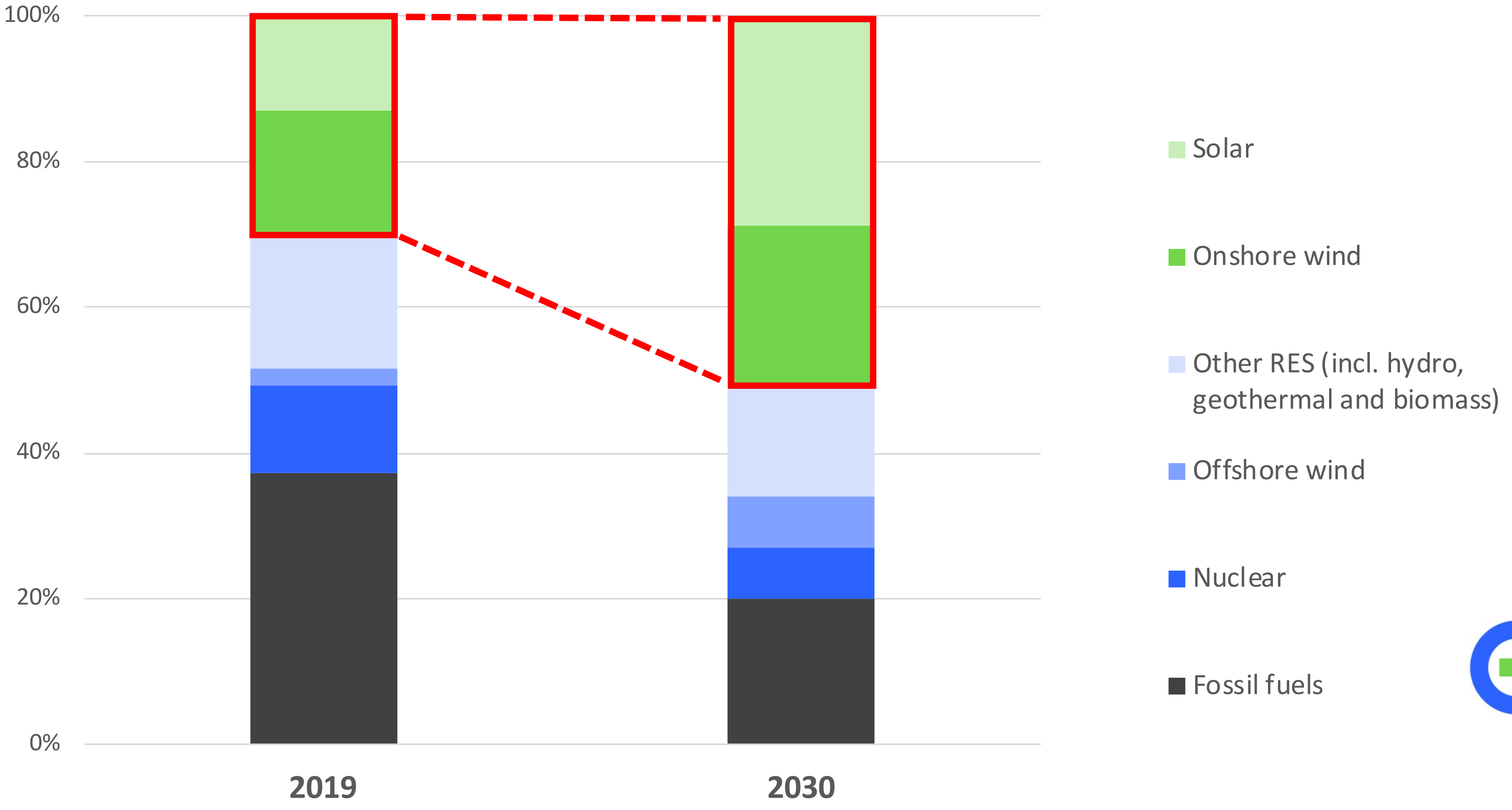
Source: Eurelectric, Decarbonisation Pathways, 2018

By 2030 already, over half of our power generation fleet will be decentralised – and connected at distribution grid level

Installed power generation capacities in Europe



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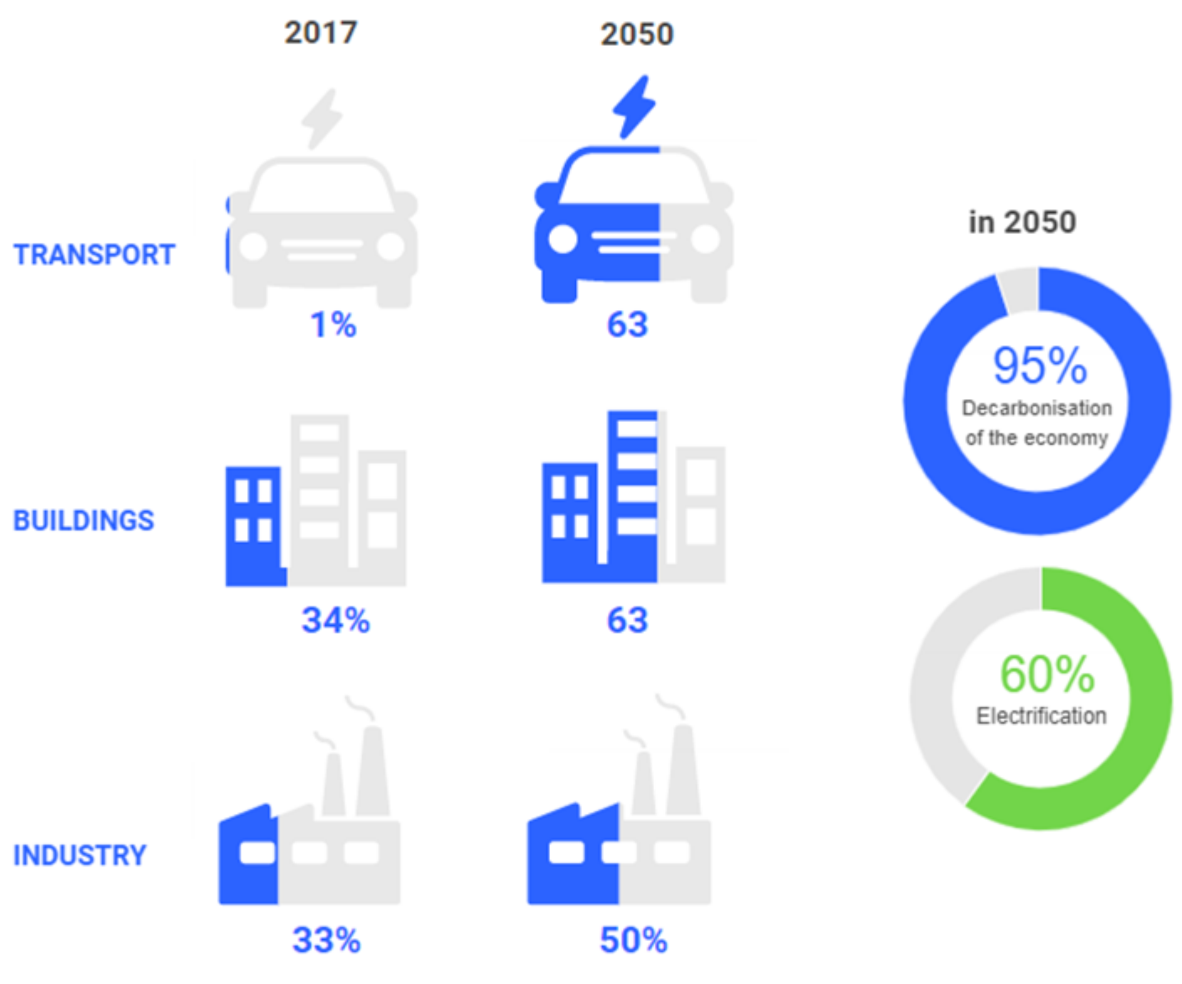
Decarbonisation of the power sector will be mostly electric, decentralised and involve other key sectors



Source: Eurelectric

- Customer choices are key
- x40 EVs in 2030
- x21 charging points in 2030
- Heat pumps ~18% of space heating market in 2030
- Investments in new industrial processes (e.g. steel, chemicals,…)

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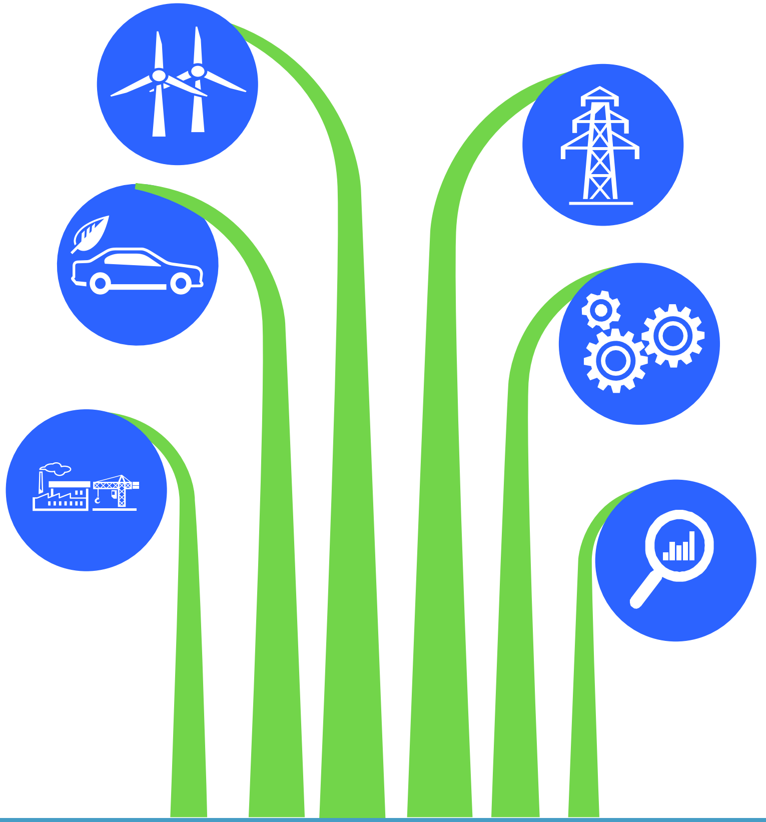
Future of DSOs: The current ‘connect and reinforce’ model is unsustainable – sector integration requires an integrated set of solutions

Renewables to meet approximately 80% of energy demand by 2050[1]

Consumption by EVs per year to be approximately 250TWh by 2050[1]

Electrification to add new load by approximately 2.1% per year[1]



Substantial new grid and transmission capacity to meet new peak demand

Refurbishment and replacement of existing assets

Greater visibility, monitoring and control of electricity flowing across grids

€60b
needed every year to reinforce and smarten the distribution grid[2]

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1. “Decarbonisation Pathways,” *Eurelectric*, www.eurelectric.org/decarbonisation-pathways/, accessed 11 January 2018.
2. “Impact assessment support study on: Policies for DSOs, distribution tariffs and data handling,” *European Commission*, ec.europa.eu/energy/sites/ener/files/documents/ce_vva_dso_final_report_vf.pdf, accessed 7 January 2019., accessed 18 January 2018

The new role of DSOs – From ‚pipes to platforms‘

Roles of DSOs increase in size and complexity due to ever increasing RES uptake and ongoing electrification trends in transport and other sectors

Key roles of DSOs so far: Network maintenance and System operation

- Plan, build and optimise the distribution grid
- Connect new customers
- Operate the grid
- Support system stability via services

Further DSO activities related to market facilitation

- Plan & connect EV charging infrastructure
- Integrate local storage facilities
- Unlock flexibility
- Smart-metering & data management

Already applied in many distribution grids today

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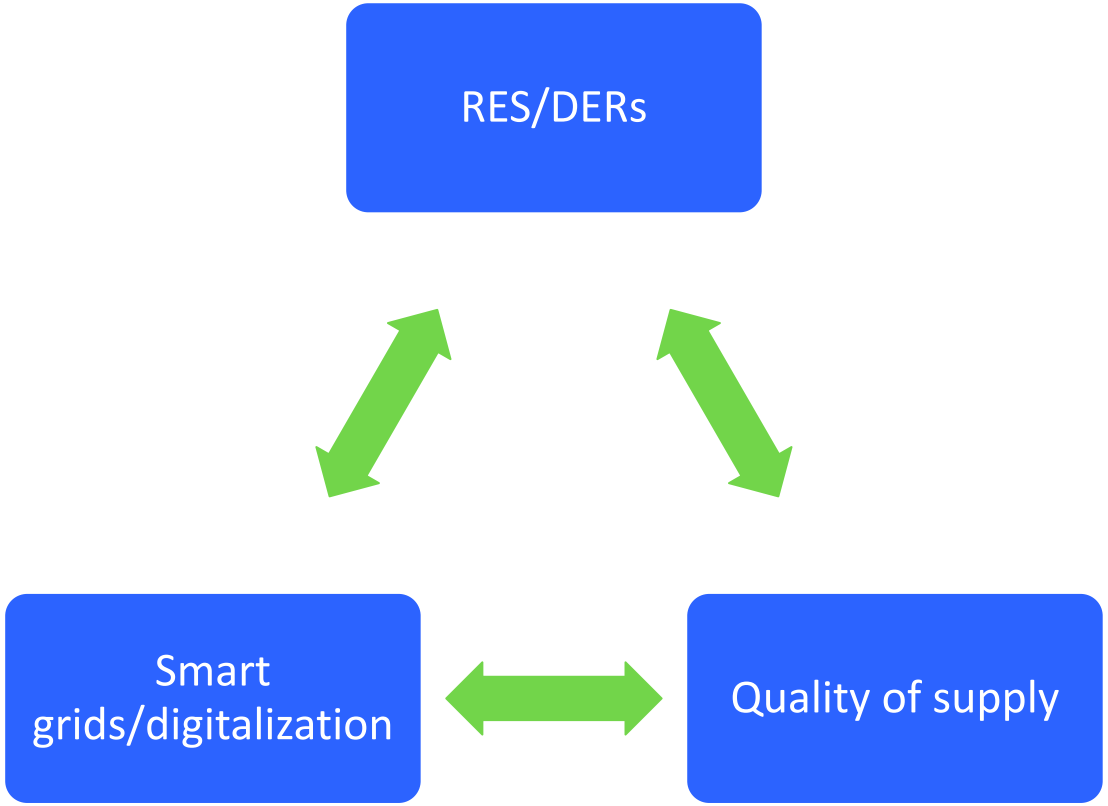
Main ingredient for success: Enhanced cooperation



TSO/DSO co-operation – Main aspects

- TSO/DSO co-operation in network planning will reduce the significant investment requirements.
- Both T and D level are keen to cooperate on this as done successfully for the joint ASM report especially in view of the responsibility of each operator for its own system.
- Prerequisite for successful future cooperation between DSOs & TSOs is mutual trust and a level playing field.

BUT:

Many DSOs today are facing lower investment incentives than a decade ago: Both the achievability and the adequacy of the regulated rate of return seem to have decreased since then, as has planning reliability.

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ENTSO-E's view on offshore developments

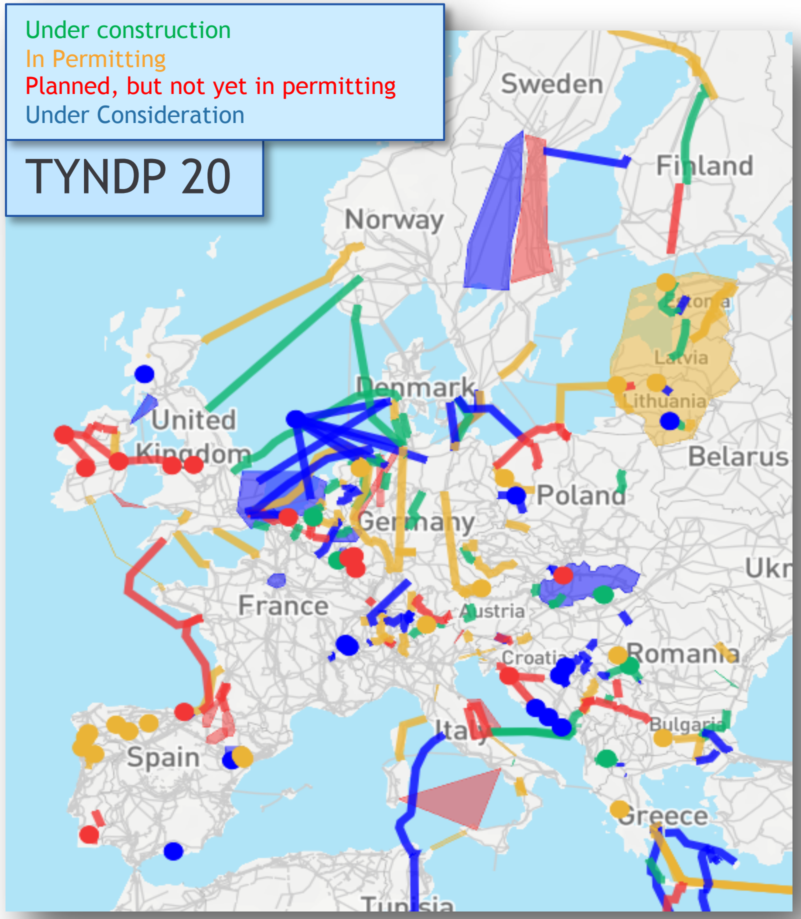
Antje Orths

Convenor of ENTSO-E Offshore Development Core Group

TSOs face a complete Remake of the European Electricity Production

This impacts the transmission infrastructure, which must evolve simultaneously.

Offshore is *one out of multiple aspects* necessary to consider when developing future energy systems
=> Application of a holistic view across time, space and sectors!



TSOs' role: Plan and Operate ONE System

Northern Seas Ministers 2019:

Integration of 70 GW by 2030

ENTSO-E Scenarios: 53-78 GW

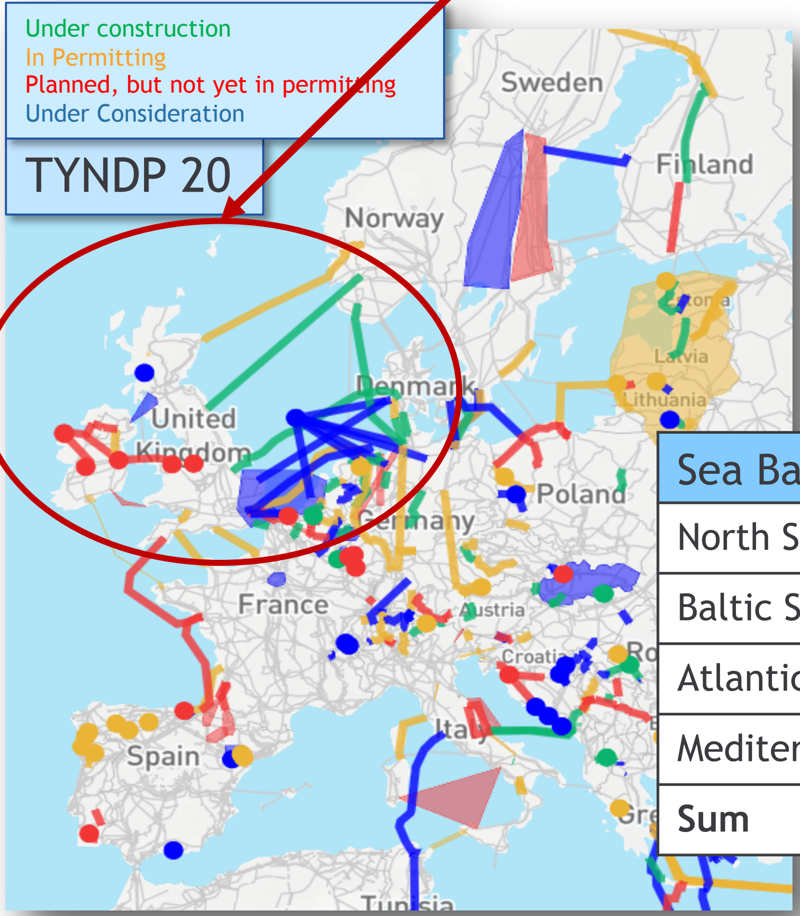
TSOs' Task:

- Integrate huge quantity of wind energy to consumption centers across Europe.

- Coordinate the planning of the development of *off- and onshore systems*, considering the entire system benefits, environmental protection and public acceptance.

TSOs' Strength

- cooperating for the operation of a large meshed, hybrid network.



2050 WindEurope windeurope.org

Sea Basin	GW
North Sea	212
Baltic Sea	83
Atlantic Ocean	85
Mediterranean	70
Sum	450

ENTSO-E Position on Offshore Development

Unprecedented grid- and spatial planning, engineering, construction and financing efforts are required on- and offshore to facilitate reaching the EU's decarbonisation targets

Key challenges:

- Costs
- Spatial Planning
- Integrated perspective over time, space and sectors
- System Balancing
- System Security
- Environmental protection and public acceptance

ENTSO-E's view of basic Pillars & Needs:

TSOs

1. Holistic Planning to ensure Timeliness
2. Modular & Stepwise Approach based on Consistent Planning Methods
3. Develop Interoperability to unlock Smarter Integrated System Operations
4. Keep the Energy Bills & Environmental Footprint low through Innovation

EC & Governments

5. A Future-Proof Regulatory Framework
   - Consistent Unbundling Rules
   - Incentivize forward-looking and Anticipatory Investments
   - Governments to ensure Confidence in Market- and System Operation Setups to provide a Robust Framework and Financial Security for Investors.
   - Hybrid Projects: Flexible Rules regarding contribution of MSs to EU climate target. Offshore Bidding Zones may be a promising solution for Market Integration

responsible

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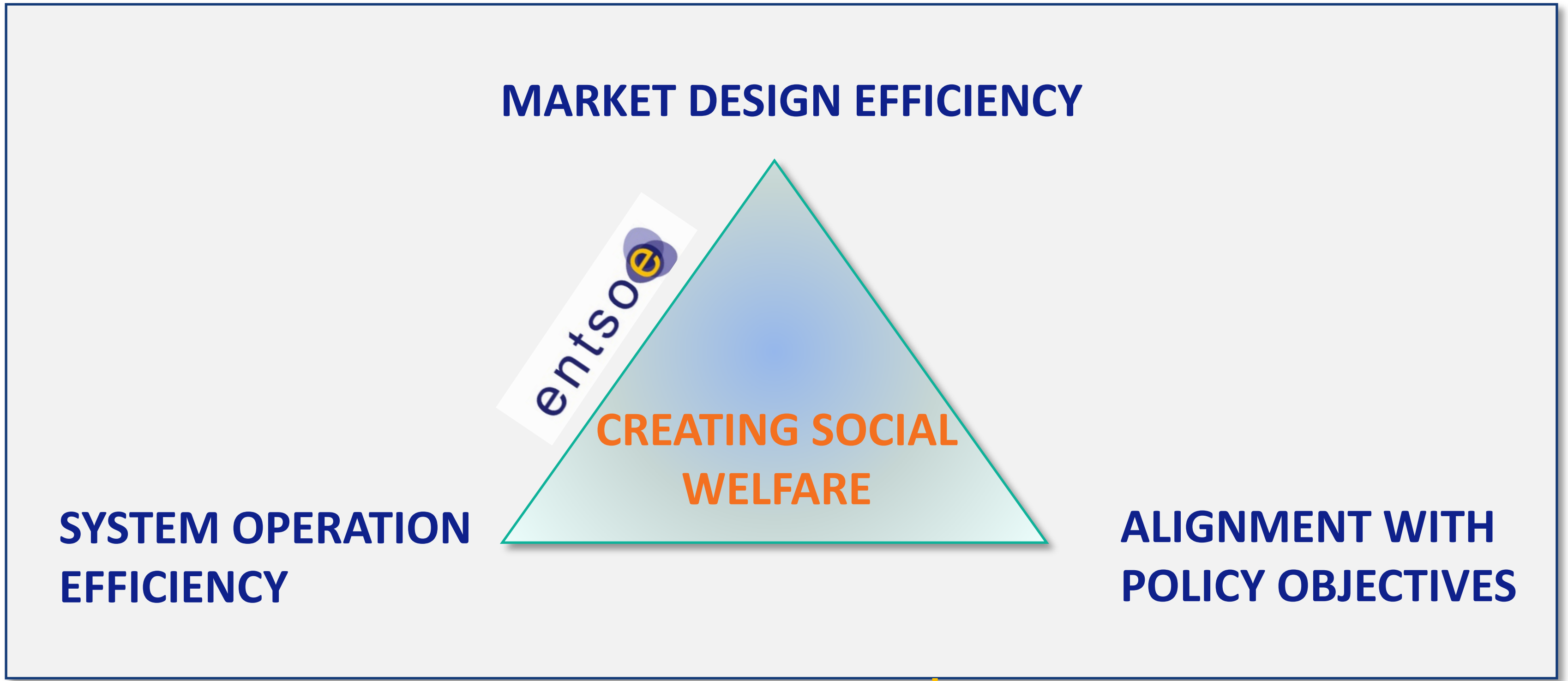
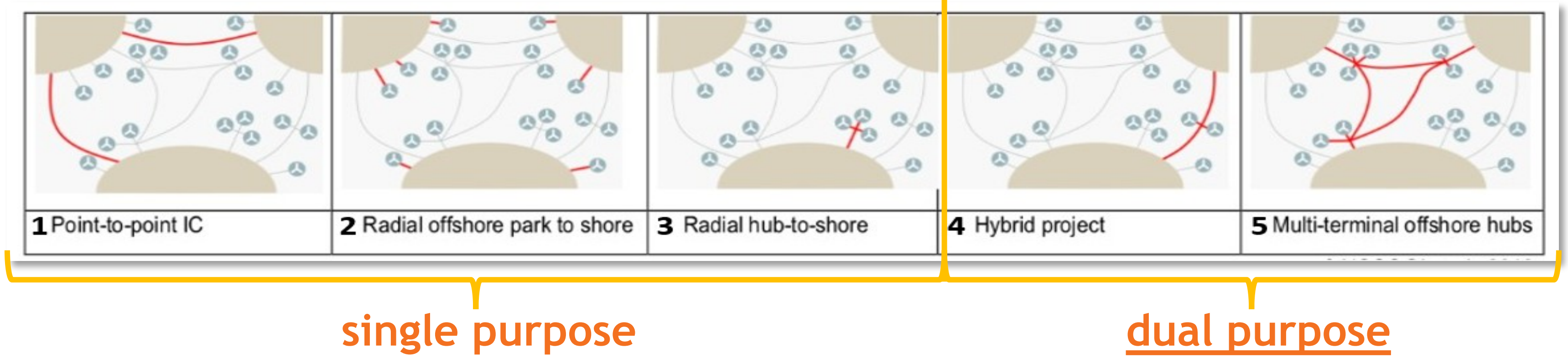
Market Design Objectives - Trilemma



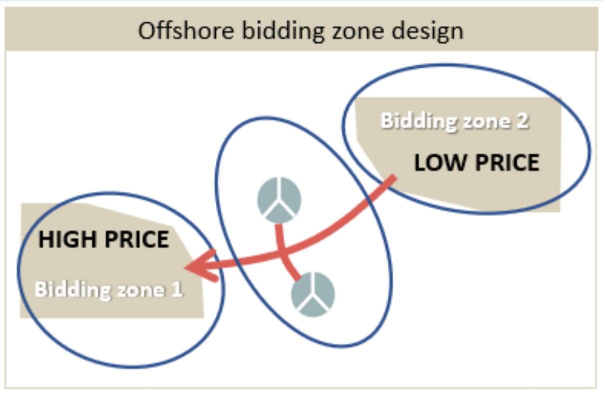


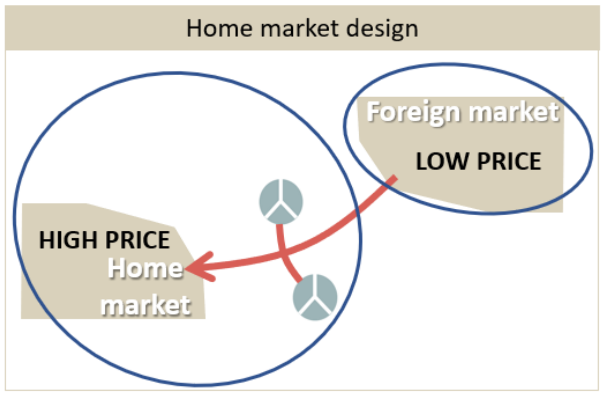
Source:
EE-Position Paper #1

Potential Market Designs: "OBZ and HM"

Offshore Bidding Zone Design

- A separate bidding zone is formed containing only offshore generation (and potentially demand) where
- "Grid connections" are interconnectors (cross-zonal capacity).
- **Offshore Wind Farms receives the price of the non-congested area *(= low price area)***





Home Market Design

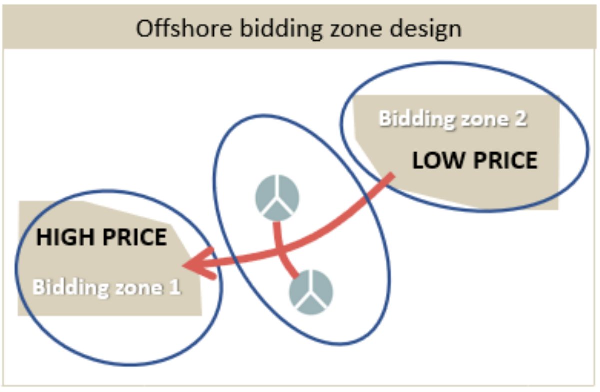
- Offshore generation is market- wise part of a specific bidding zone (the home market).
- Import capacity to this bidding zone is calculated by the TSO based on the forecasted residual transmission capacity after taking expected offshore generation into account.
- **Offshore Wind Farms receive the price of the home market. which can be *the high or low price*, depending on the flow direction.**

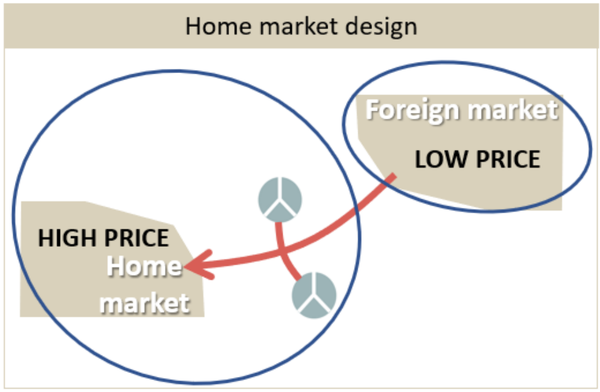
Reading note:
In the context offshore grid infrastructure, above two designs are currently seen as the main alternatives. Future developments might add further solutions which might become relevant
Compliance with regulatory rules is ignored on this slide

Comparison from a System Operation Efficiency Perspective

Offshore Bidding Zone Design

- Offshore grid constraints are fully considered in the market design in these timeframes
- Offshore imbalances and intraday trades don't have a major impact on TSO costs/risk
- Imbalance settlement reflects true balancing costs (balancing energy prices in the offshore bidding zone)
- Sufficient cross-border capacity to allow (self-) balancing is always available.





Home Market Design

- Offshore grid constraints are only partially considered in the market design in these timeframes
- Positive day-ahead imbalances might trigger additional redispatch- and countertrading measures
- Additional congestion management costs imposed on TSO
- Some risk of FRR-usage exists in case intraday trade happens just before gate-closure time.
- Sufficient cross-border capacity to allow (self-) balancing is always available

The key driver for efficiency in the intraday and balancing timeframes is efficient consideration of grid constraints in the markets.

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Evaluation of Perspectives and Criteria for two Designs

Perspective →

Criteria →

MARKET DESIGN EFFICIENCY

- Distribution of roles and responsibilities (TSOs / OWF developers)
- Scalability to meshed offshore system
- Compliance to the 70% requirement of the CEP
- Compatibility to Flow Based Approach (Advanced Hybrid Coupling)
- Competition and equal market access to capacity

CREATING SOCIAL WELFARE

SYSTEM OPERATION EFFICIENCY

- Consideration of Grid constraints
- When is TSO intervention needed (redispatch & counter-trading)
- Related costs
- Availability of cross-border capacity for (self-) balancing

ALIGNMENT WITH POLICY OBJECTIVES

- Market Revenues
- Allocation of CO_2 Credits

Policy makers need to trade off between pro´s and con´s and ultimately ensure that a holistic approach is taken on both,
- the market design and
- a stable investment framework for OWFs in offshore hybrid assets

> **Results** in the upcoming ENTSO-E Position on Offshore Market Issues – online soon!

Linking today's ENTSO-E messages -> Publications

ENTSO-E Position on Offshore Development

25 May 2020

25.5.

…Holistic Planning across Time, Space and Sectors..

Modular & stepwise approach based on consistent planning methods

Joint on-and offshore systems planning, considering the benefits of the entire system, environmental protection and public acceptance.

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ENTSO-E Roadmap for a multi-sectorial Planning Support

2020

16.7.

- Incorporation of new multi-sectorial elements into scenario-building and project-assessment phases.
- sector-specific assessment phases for most assets remain confined within a single sector
- However, some assessments are foreseen across sectors

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ENTSO-E Research, Development & Innovation Roadmap 2020–2030

29.6.-20.8.

Towards One System of Integrated Systems

- Optimise cross sector integration
- ..

Power Grid - Backbone of Energy systems

Cyber Physical System

- Enable large scale offshore wind energy into the grid
- Enable secure operation of widespread hybrid AC-DC systems
- …

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- ➢ Prepare tomorrow's offshore grid infrastructure, in particular hybrid projects
- ➢ Support EU strategic autonomy and sustainable competitiveness

Thank you!

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Convenor Offshore Development Core Group
ano@energinet.dk

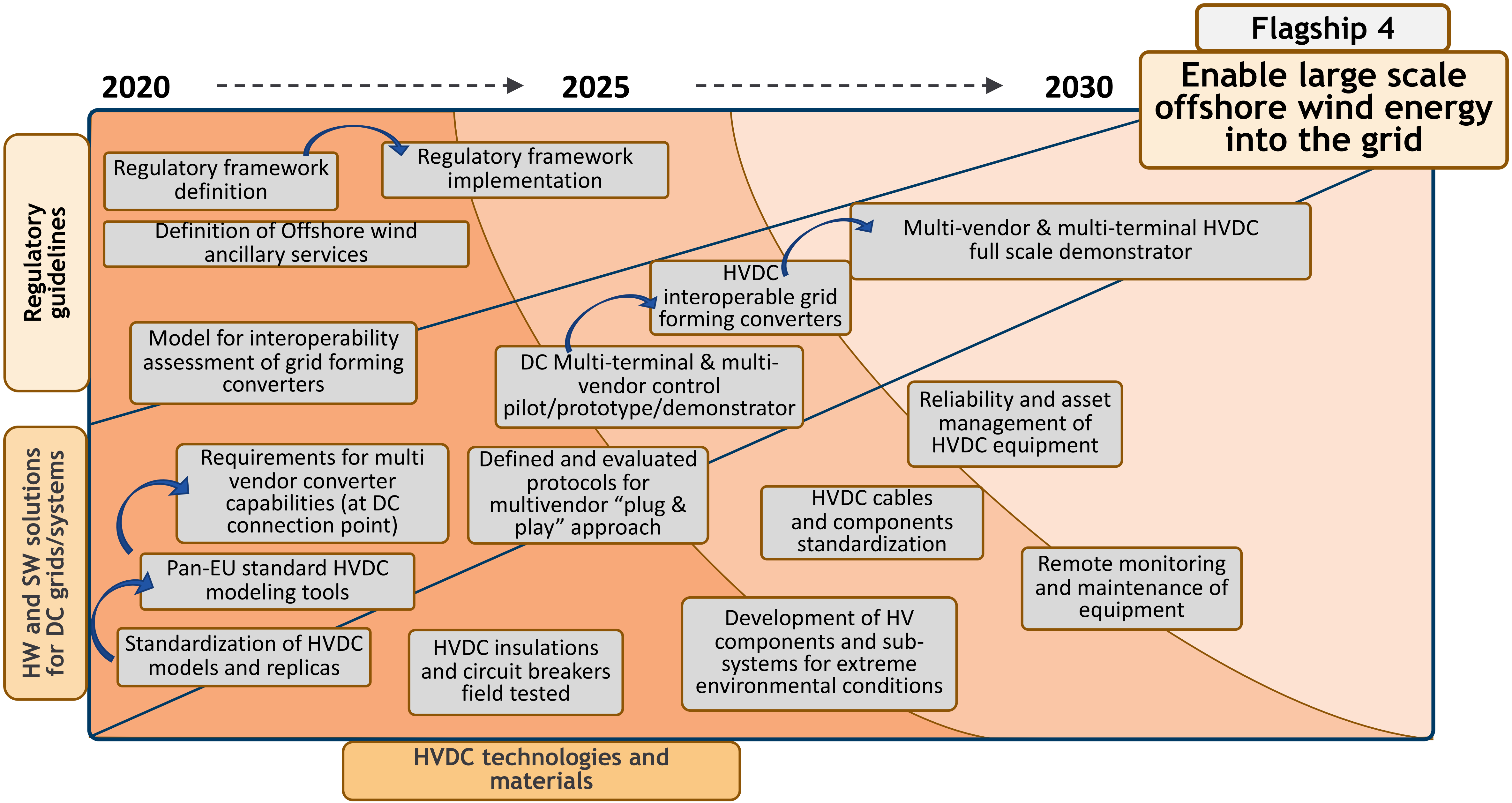
Reliable Sustainable Connected

ENTSO-E's view on offshore network technology

Interoperability - Opportunities and Challenges: Unlocking multivendor multiterminal HVDC systems

Wilhelm Winter

Convernor of ENTSO-E Working Group 2 Security and system operation of tomorrow



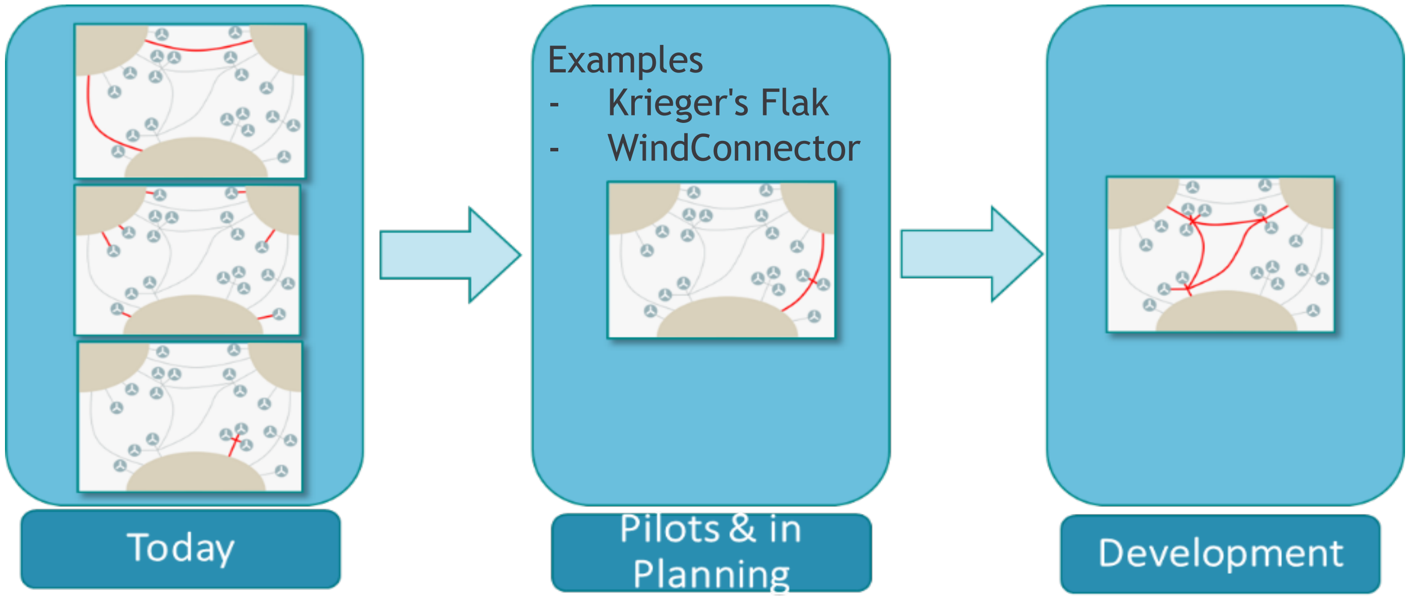
Flagship 4
Enable large scale offshore wind energy into the grid
2020
2025
2030
Regulatory guidelines
HW and SW solutions for DC grids/systems
HVDC technologies and materials
Regulatory framework definition
Regulatory framework implementation
Definition of Offshore wind ancillary services
Model for interoperability assessment of grid forming converters
DC Multi-terminal & multi-vendor control pilot/prototype/demonstrator
HVDC interoperable grid forming converters
Multi-vendor & multi-terminal HVDC full scale demonstrator
Reliability and asset management of HVDC equipment
Requirements for multi vendor converter capabilities (at DC connection point)
Defined and evaluated protocols for multivendor “plug & play” approach
HVDC cables and components standardization
Pan-EU standard HVDC modeling tools
Standardization of HVDC models and replicas
HVDC insulations and circuit breakers field tested
Development of HV components and sub-systems for extreme environmental conditions
Remote monitoring and maintenance of equipment

Potential development of offshore grid infrastructure

Opportunities and Challenges for HVDC offshore grid development

Multiple configurations and approaches of development
(TYNDP 2020, RegIP RGNS (chapter 5))

i. Country-to-country subsea interconnections,
ii. Radial offshore wind connections (single park) to shore,
iii. Radial offshore wind connections (several parks via hubs) to shore,
iv. Hybrid projects, (combination of offshore wind connections and interconnections) and
v. Multiterminal offshore platforms combining interconnections (with or without offshore wind being connected).

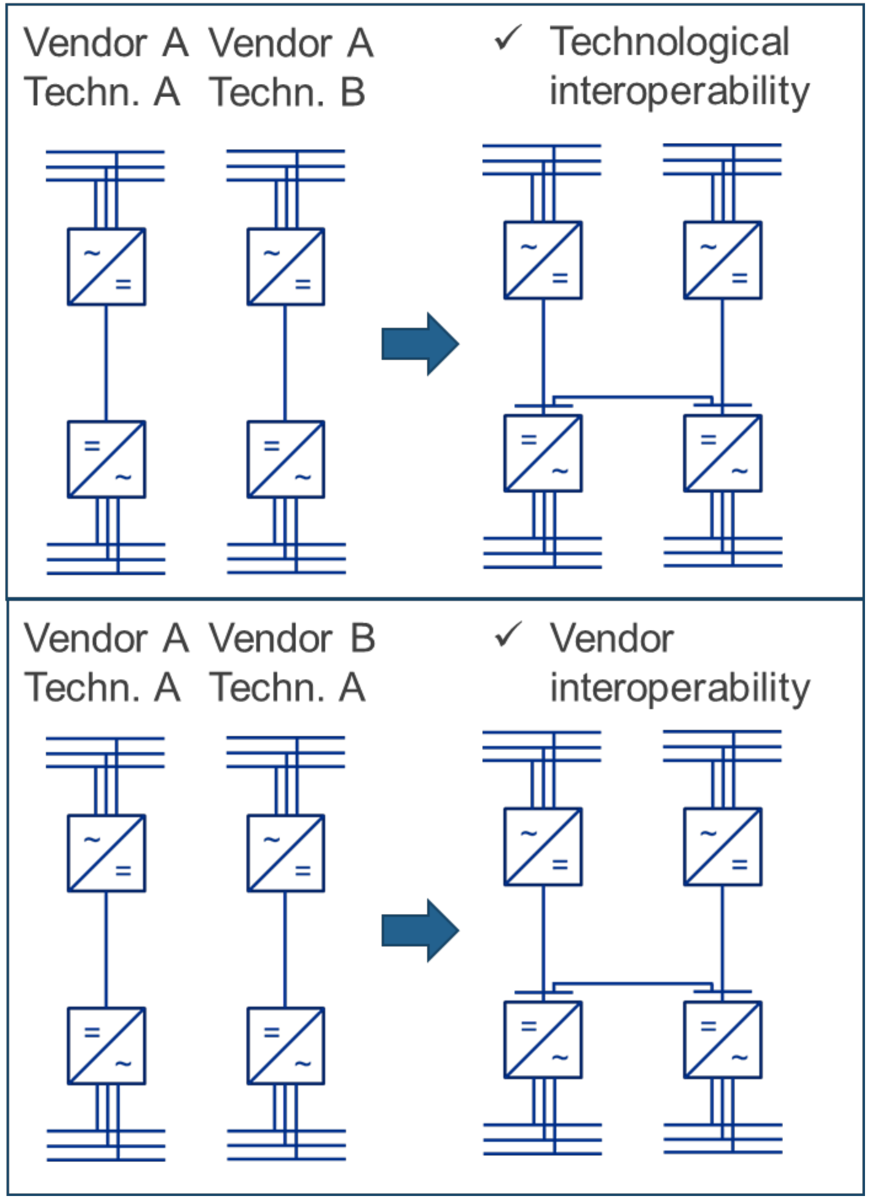


➢ **HVDC grids only can grow at the required pace, if interoperability is not an implementation risk for TSOs.**

Kinds of interoperability

- **Technological interoperability**
  - Operation compatibility of different technologies (not mandatorily different vendors)
  - Assuring of correct operation of different technologies lies predominantly in the hand of the vendor

- **Vendor interoperability**
  - **<u>Option 1</u>:** Operation compatibility of same technologies, but from different vendors
    <u>Option 2</u>: Compatibility of different technologies, and from different vendors
  - **Main barrier:** Tuning of controls with different proprietary developments
  - Need for a standard interface allowing the TSO a detailed planning (for drawing specifications) and correct tuning for operation



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Interoperability: The enabler for HVDC multiterminal development

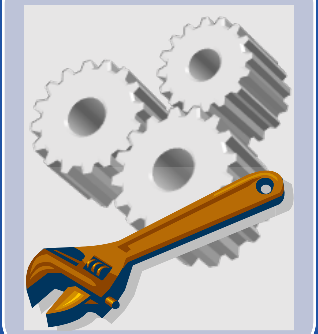
Opportunities and Challenges

- Interoperability remains the enabler for HVDC multiterminal development

✓ Research projects defined requirements and formulated innovation steps for interoperability

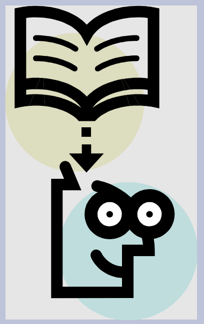
➢ Still a few open issues to be solved for the implementation in real projects

➢ TSOs need to lead relevant studies



Technical issues

- Standardization
- Modelling requirements
- Demonstration in target environment
- Functional and operational requirements
- Protection of MT HVDC systems
- Revision of planning approaches



Non-Technical issues

- Ownership
- Procurement
- Warranties
- Regulation

Wind and transport for offshore development

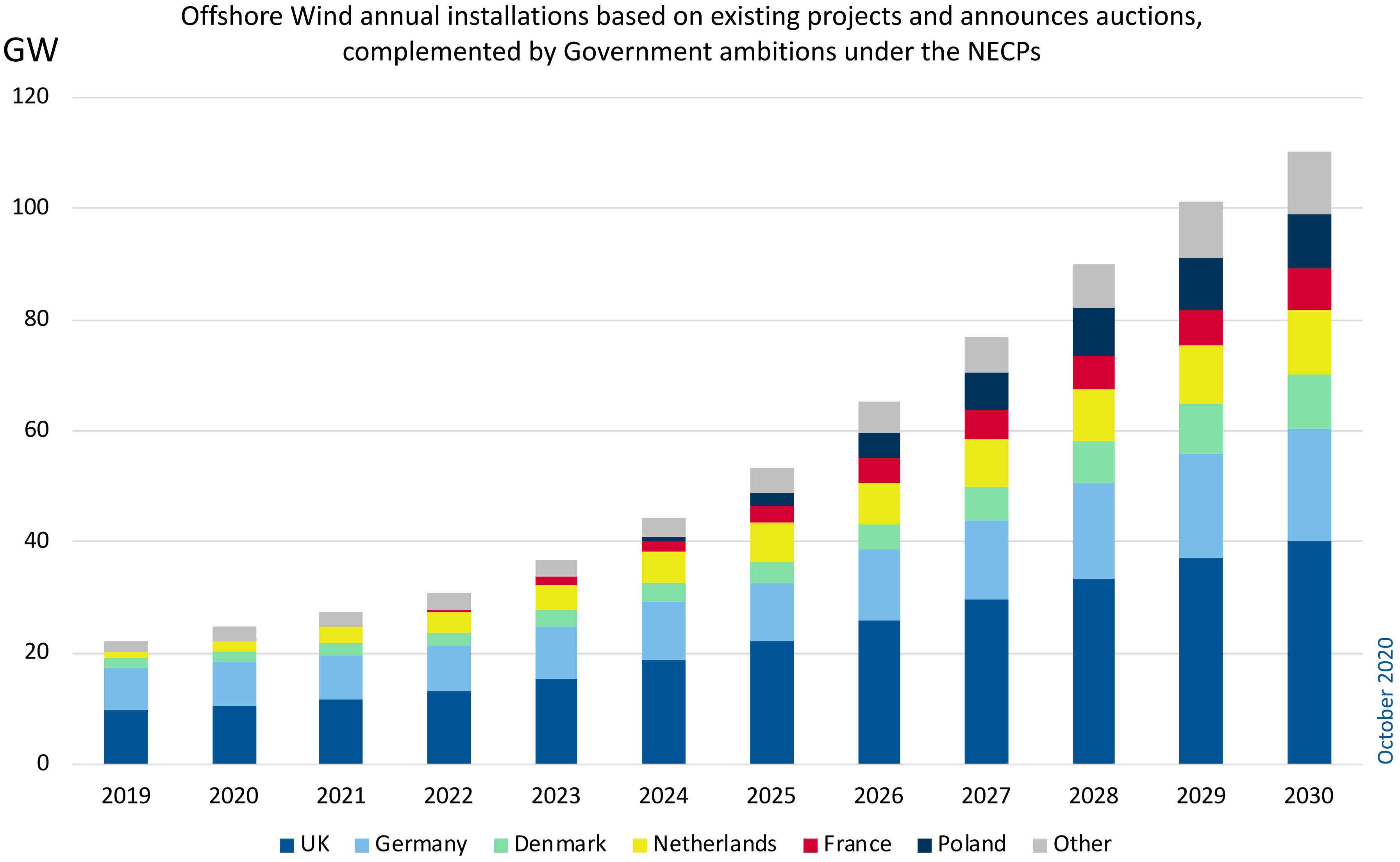
Giles Dickson

Chief Executive Officer of WindEurope

The future of the power system: Energy system integration, offshore development

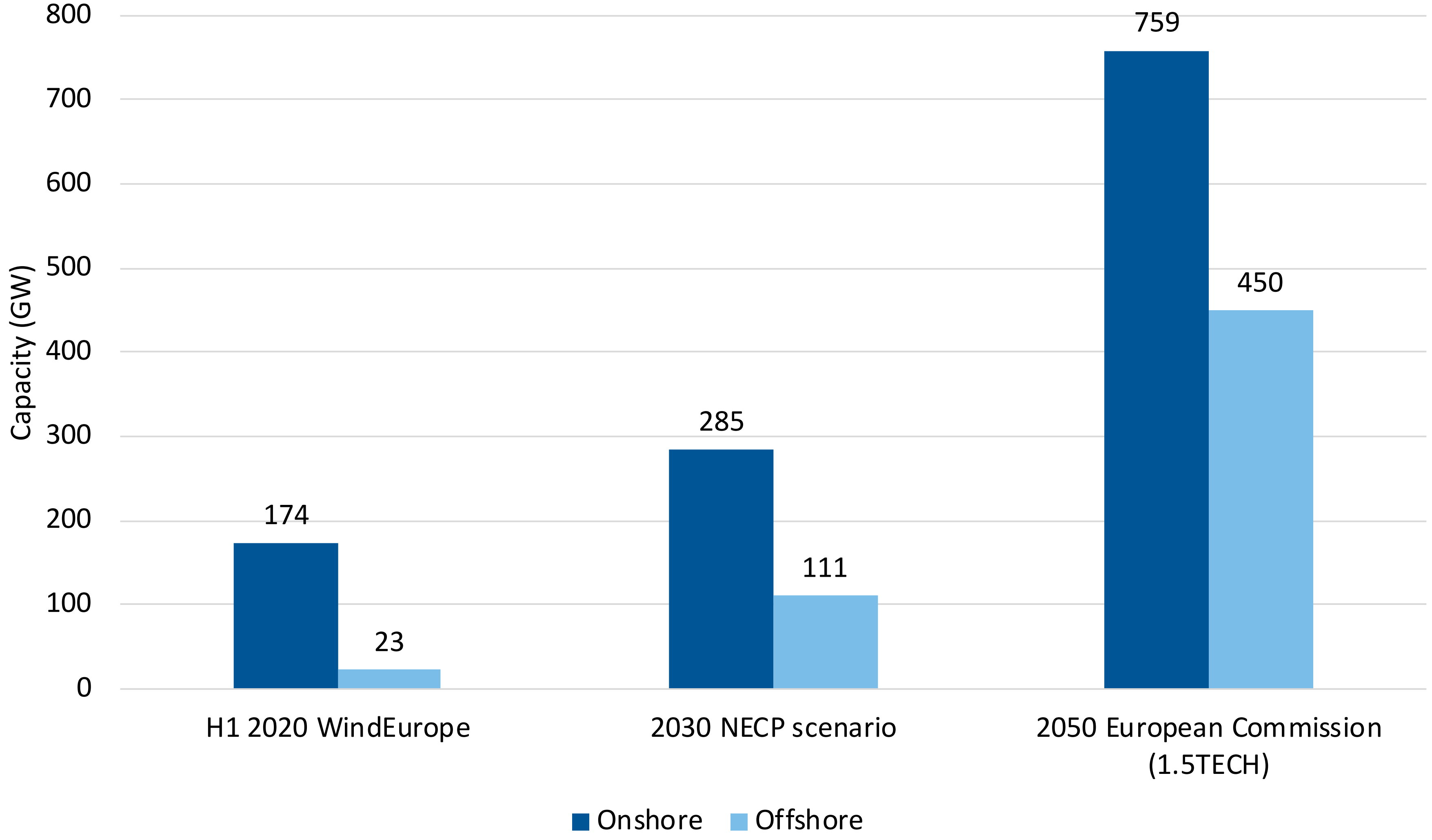
Giles Dickson, CEO WindEurope

Europe’s offshore capacity to grow 5x by 2030



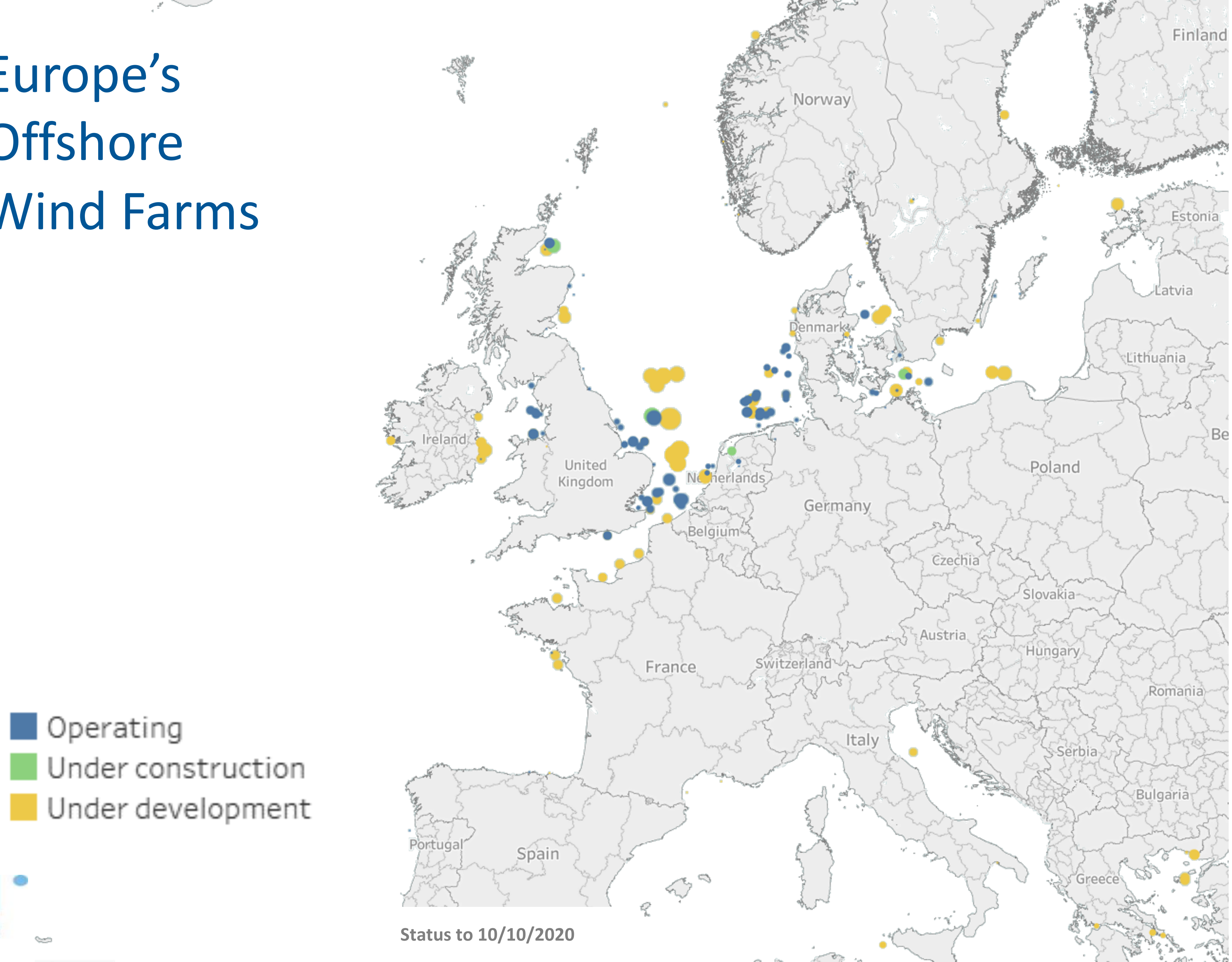
Source: WindEurope

Huge increase in wind capacity coming



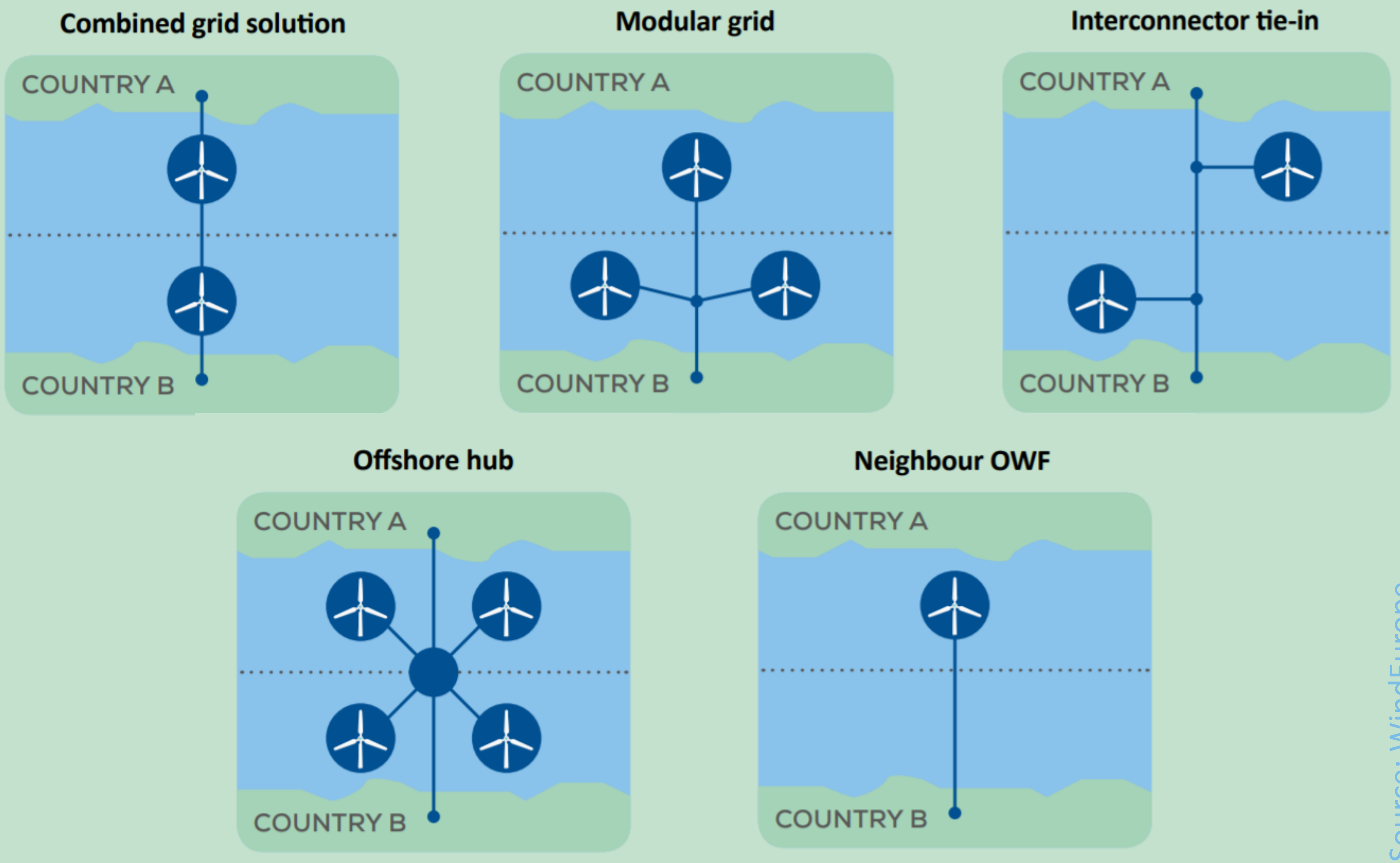
EU27+UK. Source: 2030 WindEurope NECP scenario, 2050 EC long-term strategy

Europe’s Offshore Wind Farms



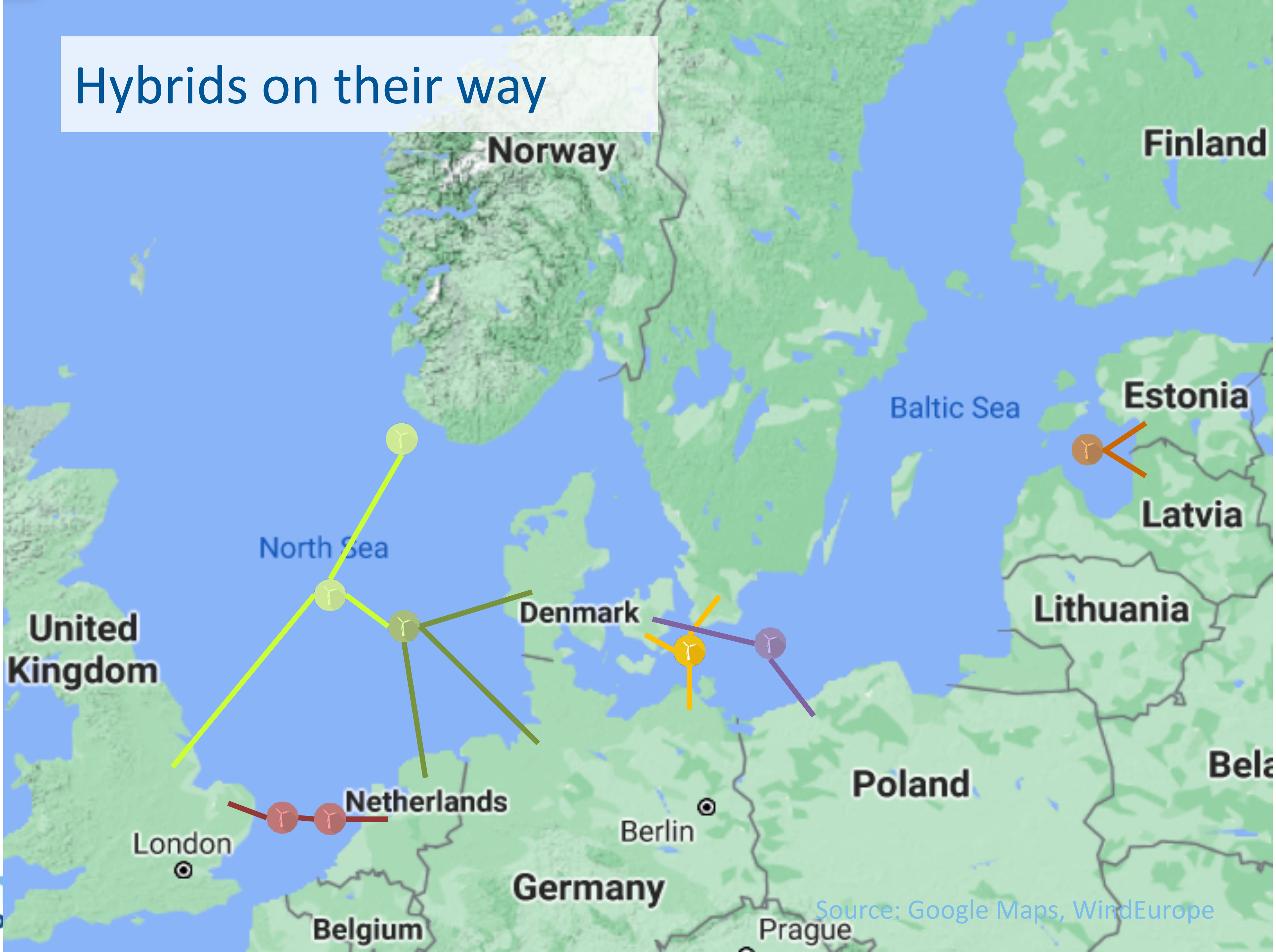
Status to 10/10/2020

Offshore hybrid projects



Source: WindEurope

Hybrids on their way



Source: Google Maps, WindEurope

windeurope.org

WindEurope, Rue d'Arlon 80
1040 Brussels, Belgium

Q&A on system integration and offshore

Dimitrios Chaniotis

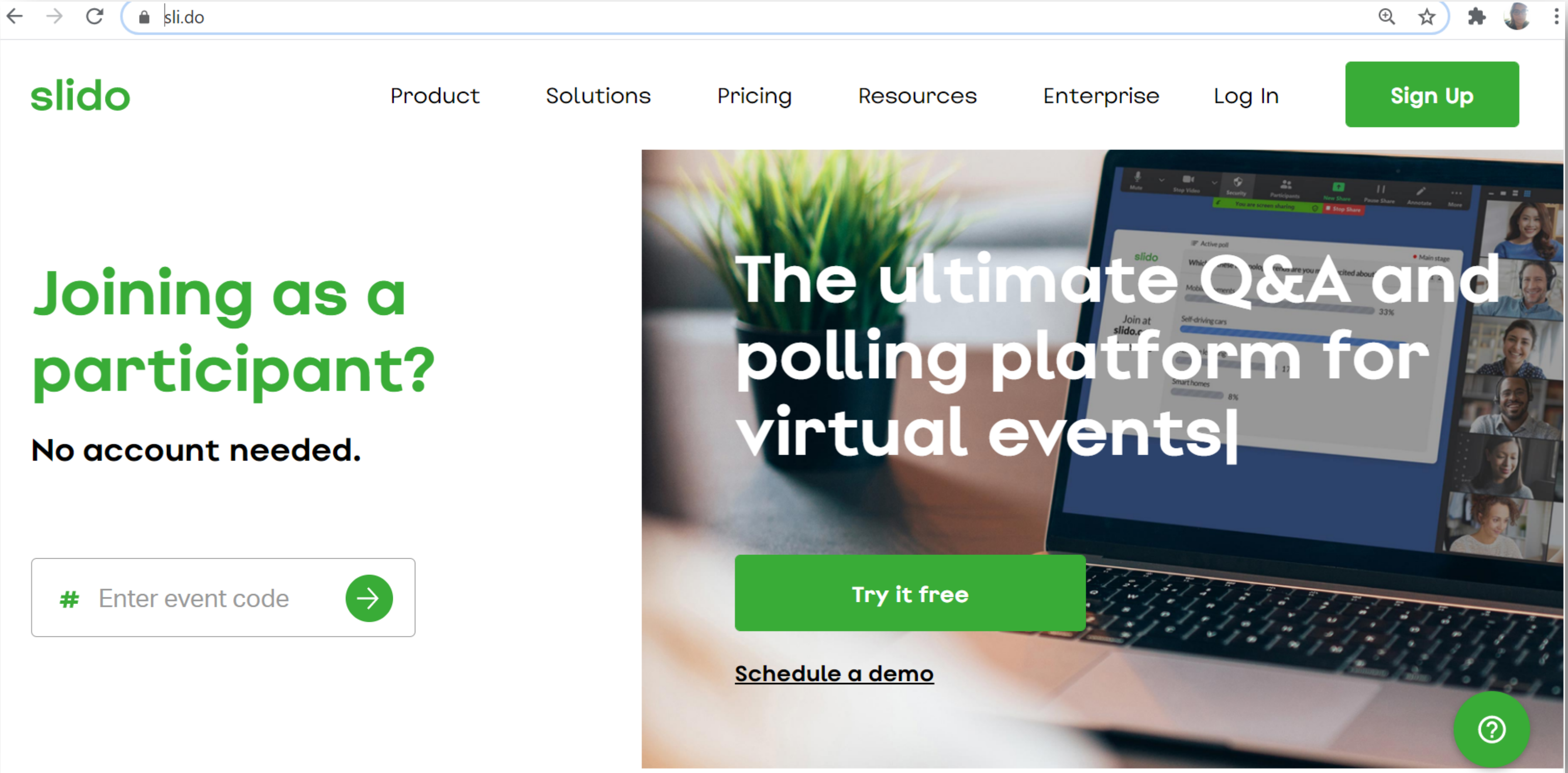
Chair of ENTSO-E System Development Committee

Open floor to Questions & Answers

- *For questions and comments =>* **Sli.do!**
- *Don't forget to add your name and title to your question*

Sli.do # EWeek-4

How to login to Sli.do



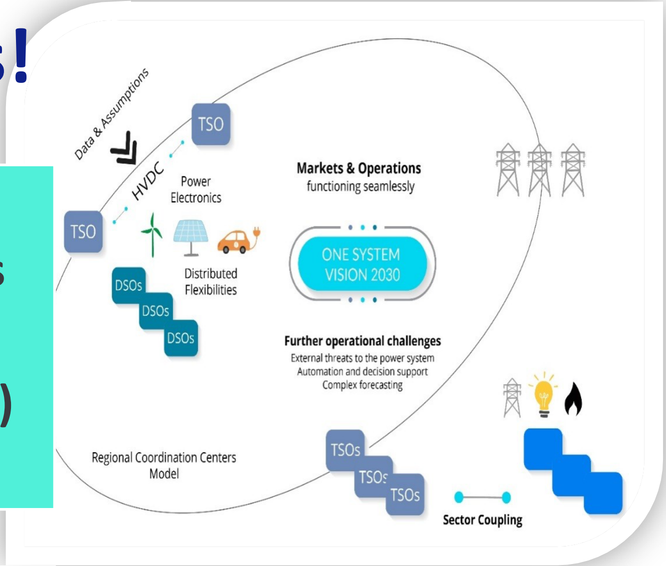
Go to www.sli.do and enter **EWeek-4** or scan the following QR with your phone to login

Wrap up

Dimitrios Chaniotis

Chair of ENTSO-E System
Development Committee

Inside the Vision – Join us for the next webinars!



Main Trends and Drivers, 2030 scenarios, overall Vision (12 October/10-12 CET)	Market Design options for the future (12 October/14-16 CET)
Unleashing the potential of flexibilities (13 October/ 10-12 CET)	System Integration and Offshore Development (13 October/14-16 CET)
Innovation for the future: AC/DC networks & operational challenges (14 October/10-12 CET)	Putting all the pieces together: a system of systems for the future (14 October/14-16 CET)

Next webinars

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