Offshore Wind Development in Europe – ENTSO-E's ONDP 2024

21 October 2024 - ESIG Fall Technical Workshop, Providence, Rhode Island, USA

Antje Orths – Convenor ONDP24

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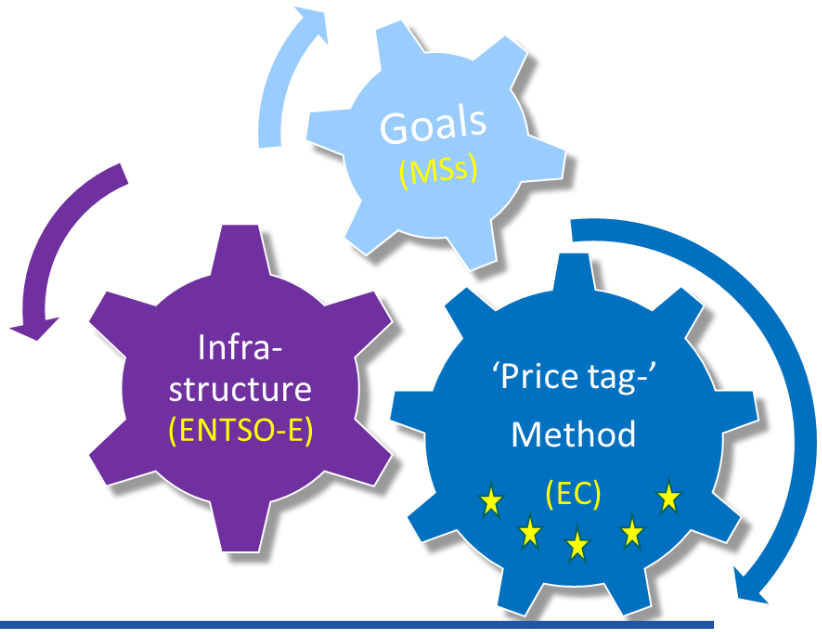
Legal Context – Who does what?

Collaboration at all level is decisive!



EU 2022/869

Art. 14.1 — 1. MSs offshore-RES Sea basin Agreements — 24/01/2023 ✓

Art. 14.2 (entsoe) — 2. ENTSO-E's Strategic Offshore-NDPs — 24/01/2024

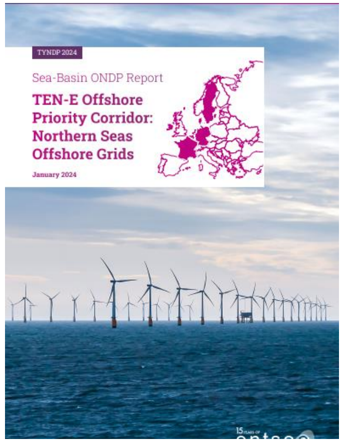
Art. 15.1 — 3. Guidance for Sea basin Cost-benefit-cost sharing (SB-CBCS) — 24/06/2024

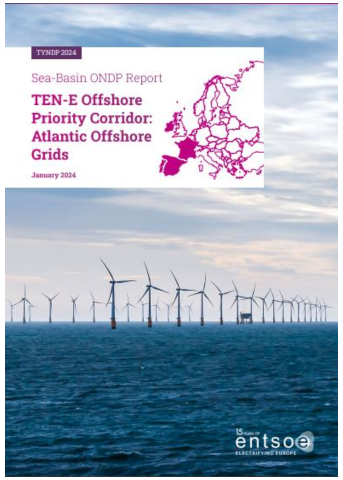
Art. 15.2 (entsoe) — 4. Results of applied methodology — 24/06/2025

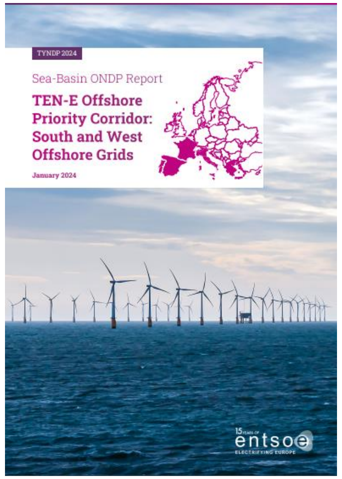
4.1 Revision of Offshore Targets — 24/12/2024

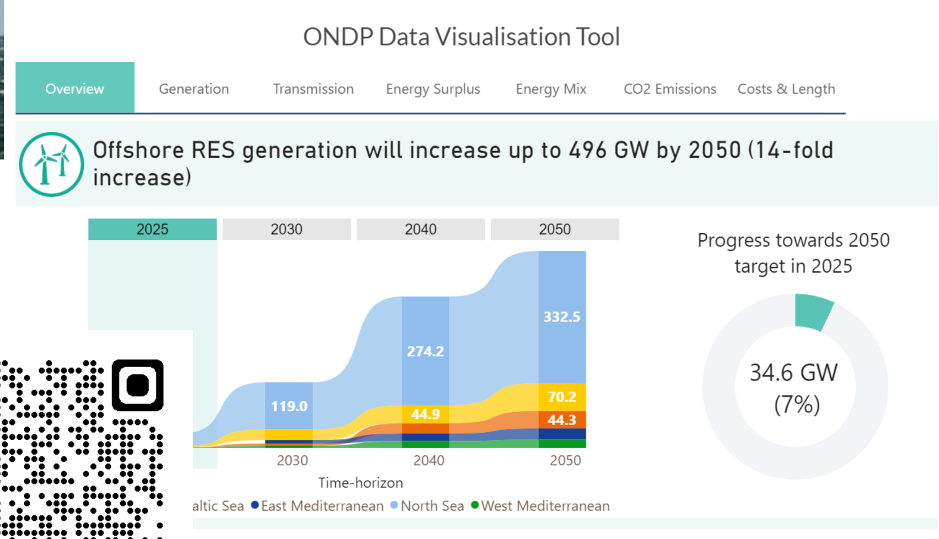
The ONDP Package

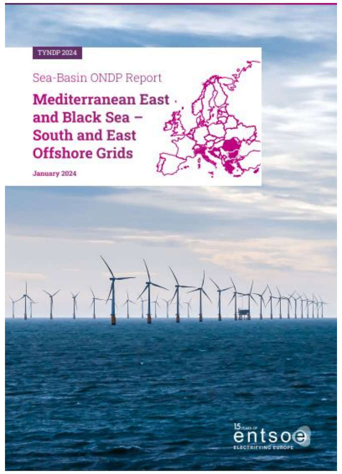
The Offshore Network Development Plan (ONDP) translates the MSs' non- binding offshore RES capacities into Network Infrastructure Equipment Needs and -Costs











Visit the online ONDP- site to find the reports, the interactive data platform, a film ….

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TYNDP 2022 Capacities and ONDP24 offshore adjustments

Ambitious development of renewables across Europe

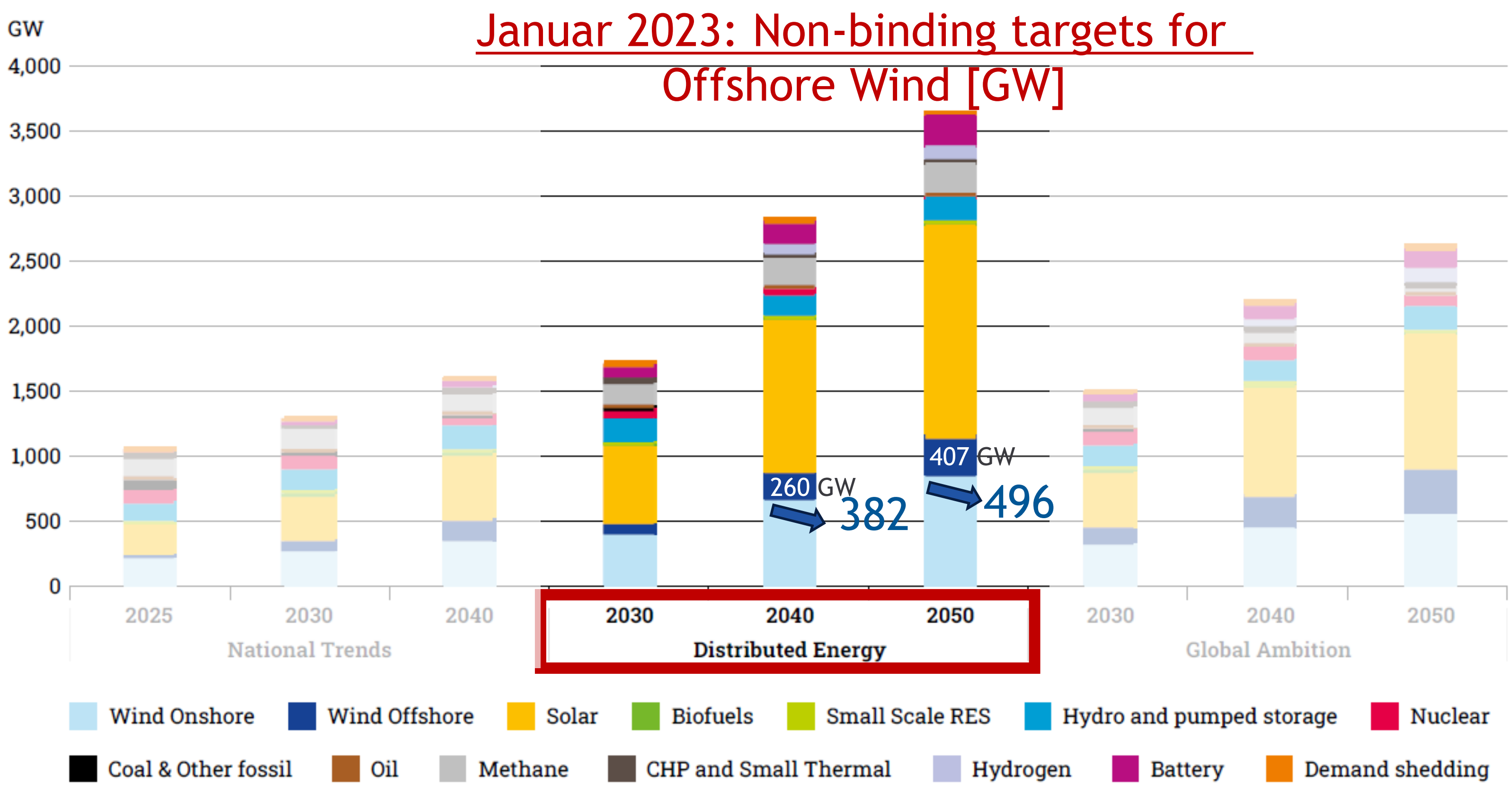
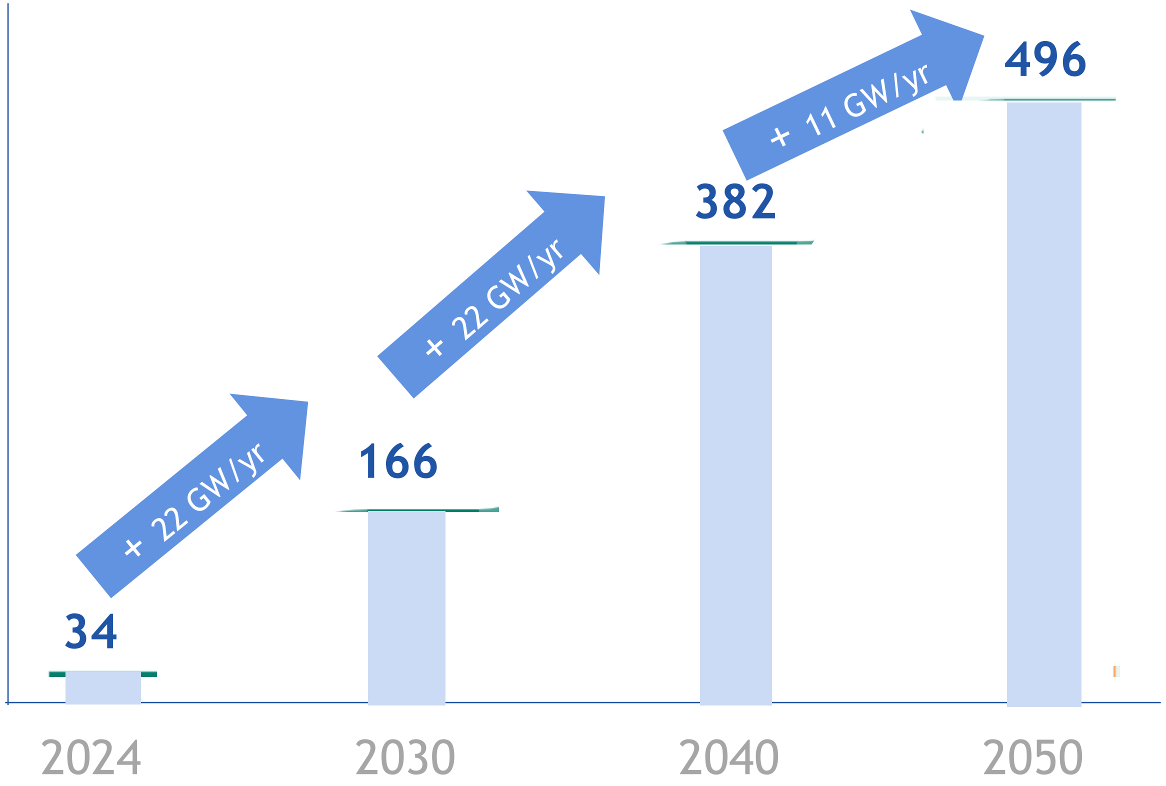


Figure 24: Capacity mix for EU27 (including prosumer PV, hybrid and dedicated RES for electrolysis)

Find the details of the TYNDP22 Scenarios here

Need for Speed…for Generation and Transmission

Offshore RES Generation capacity [GW]



…BUT: average speed last 10 years was + 2.5 GW/yr

Today's offshore RES is only 7% of offshore RES foreseen in 2050

Annual installations of offshore RES and Infrastructure need to accelerate significantly => requires to be **9 times faster** than during the last decade!

Live DEMO of Vizualisation Tool

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Need for Speed…for Generation and Transmission

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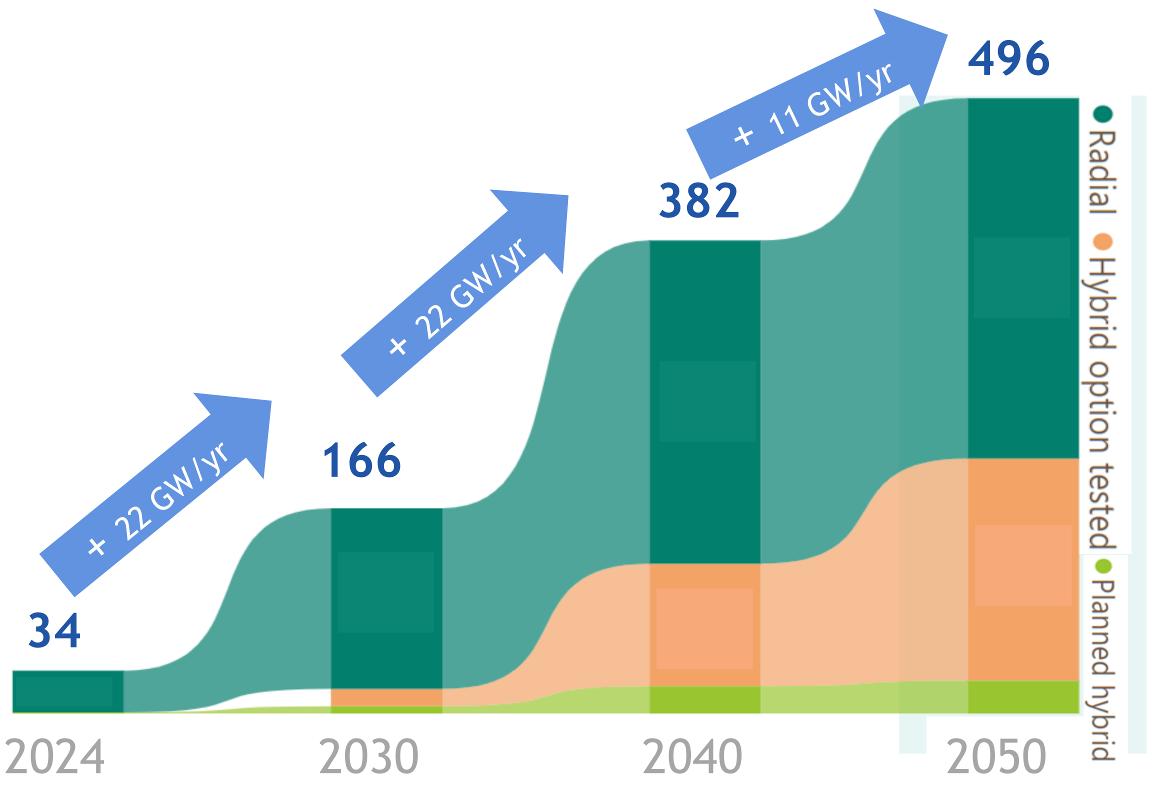

…BUT: average speed last 10 years was + 2.5 GW/yr

Today's offshore RES is only 7% of offshore RES foreseen in 2050

Annual installations of offshore RES and Infrastructure need to accelerate significantly => requires to be **9 times faster** than during the last decade!

To translate offshore RES capacities into Network Infrastructure Equipment Needs and –Costs, about half has been tested to be connected as via hybrid infra

Live DEMO of Vizualisation Tool

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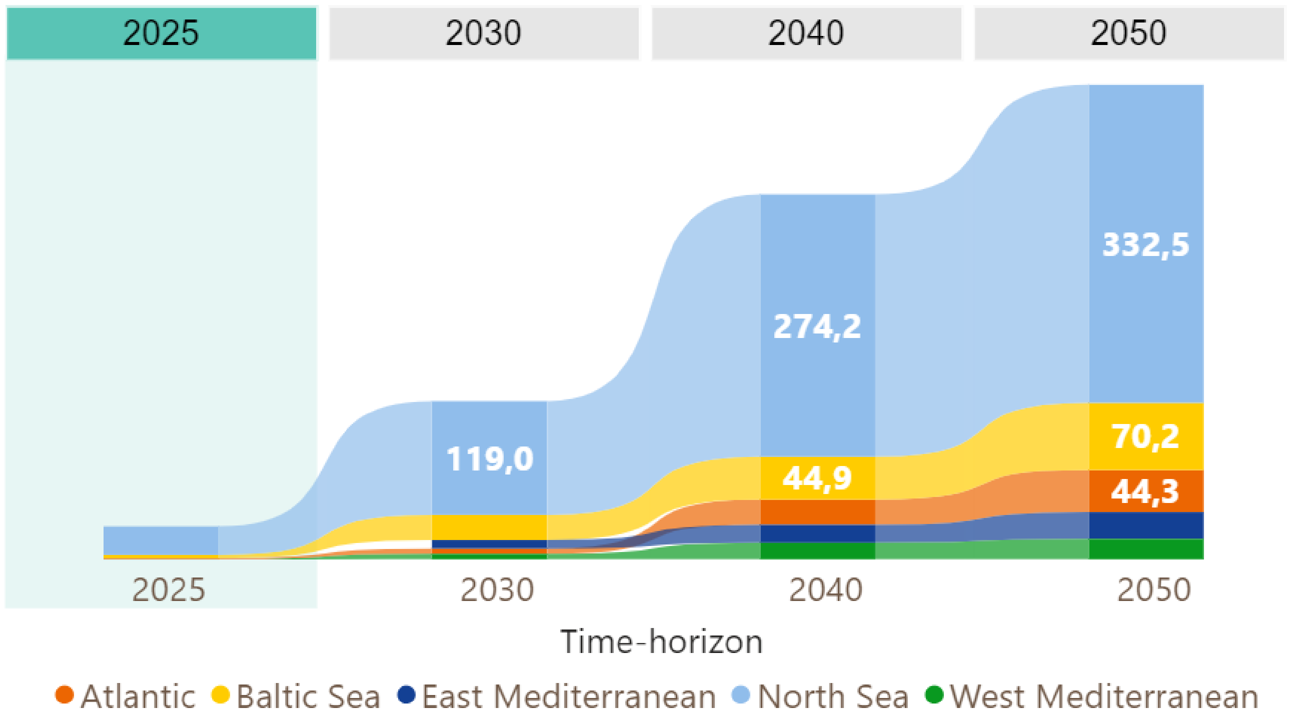
Offshore RES Ambitions are unevenly spread

Offshore RES Generation capacity [GW] per Sea Basin



Today’s offshore RES is will increase 15-fold by 2050

Most offshore RES expected in the Northern Seas, followed by the Baltic Sea

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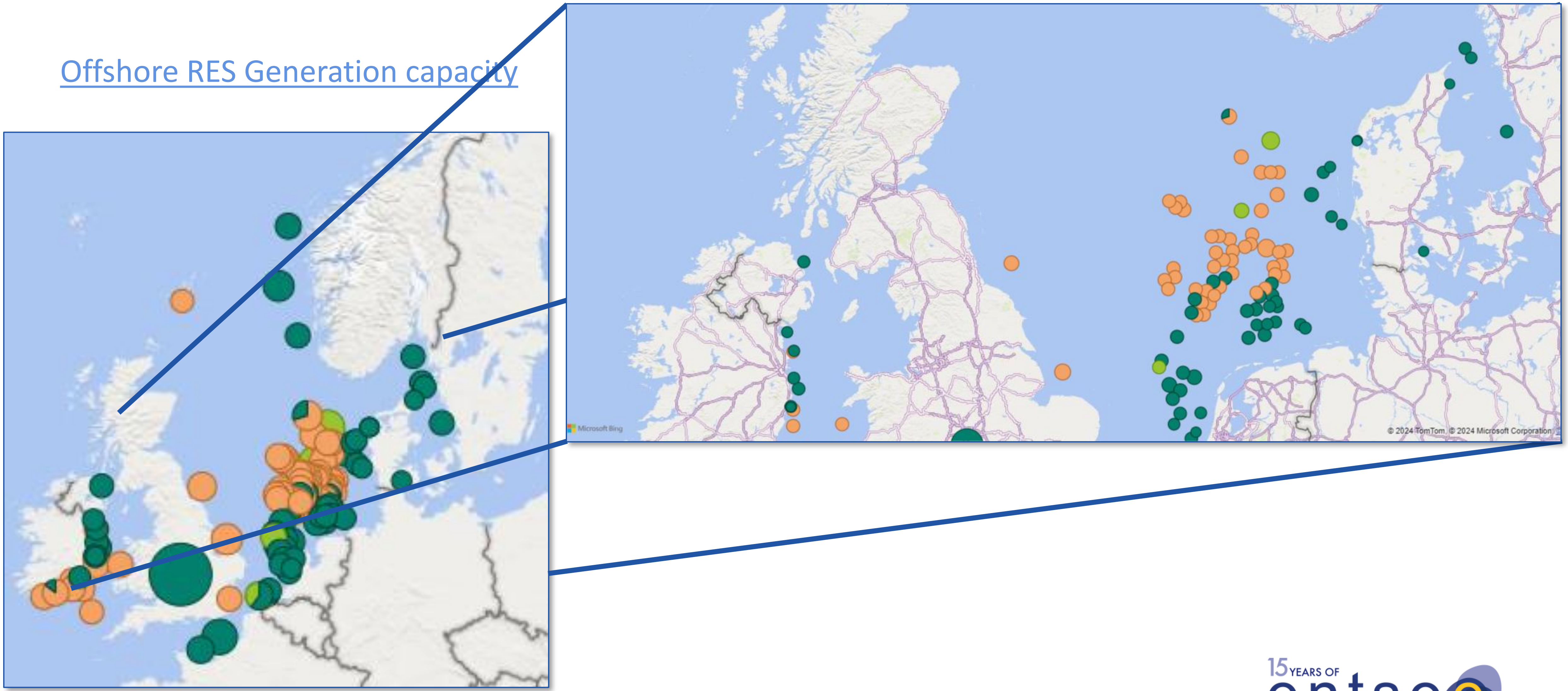
Generation Location

[Offshore RES Generation capacity]



Live DEMO of [Vizualisation Tool]

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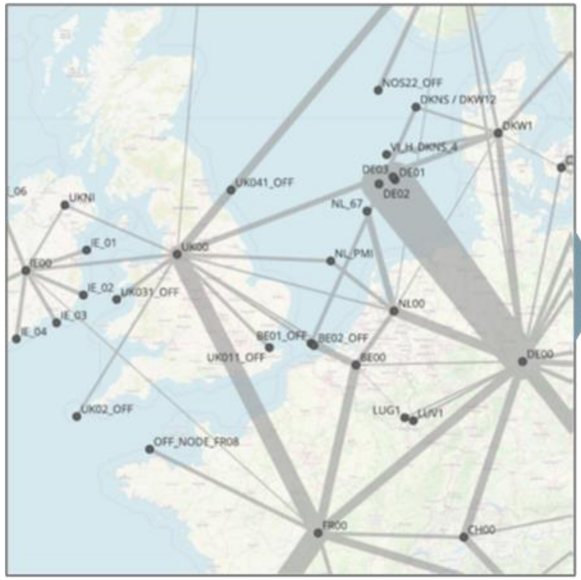
The ONDP in four steps

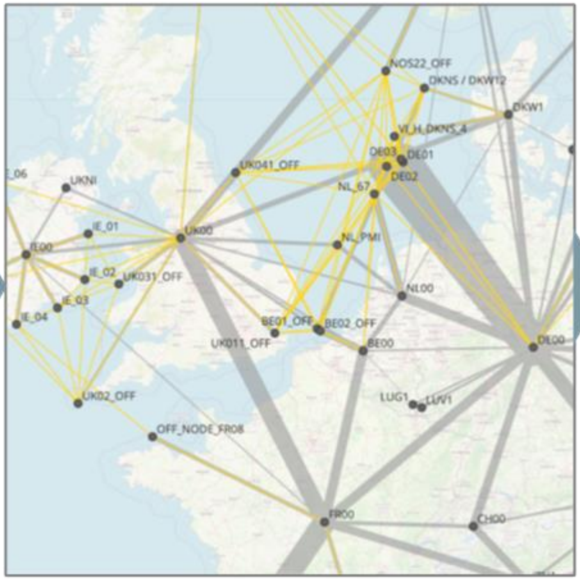
Check the [Vizualisation Tool]

Schematic Visualisation:

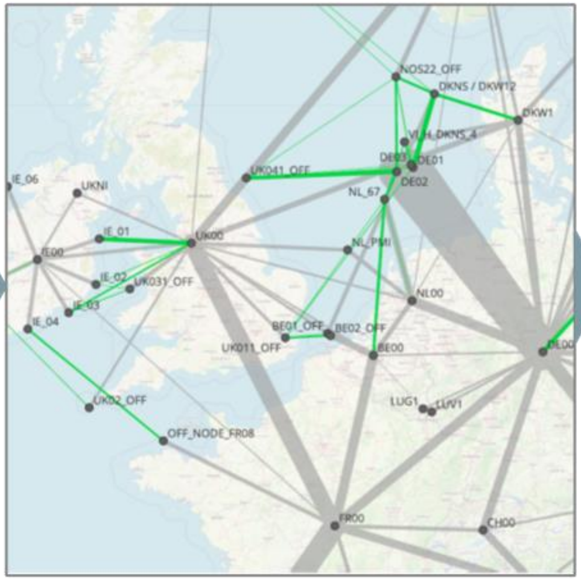
1 *Creation of the starting grid* *



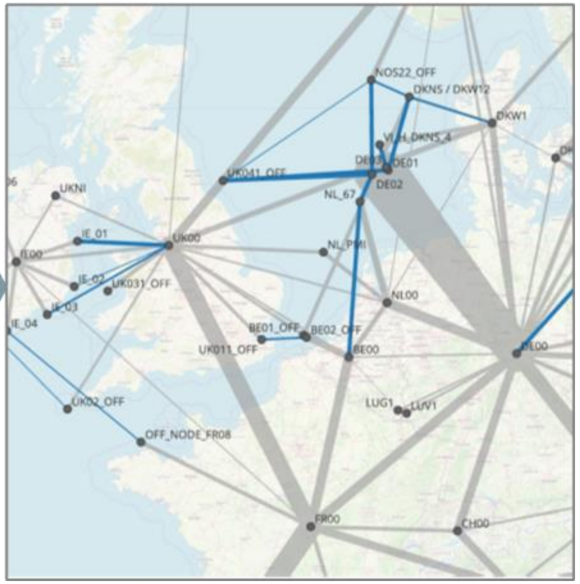
2 *Identification of expansion candidates*



3 *Linear optimisation* **



4 *Post-processing in regional groups*



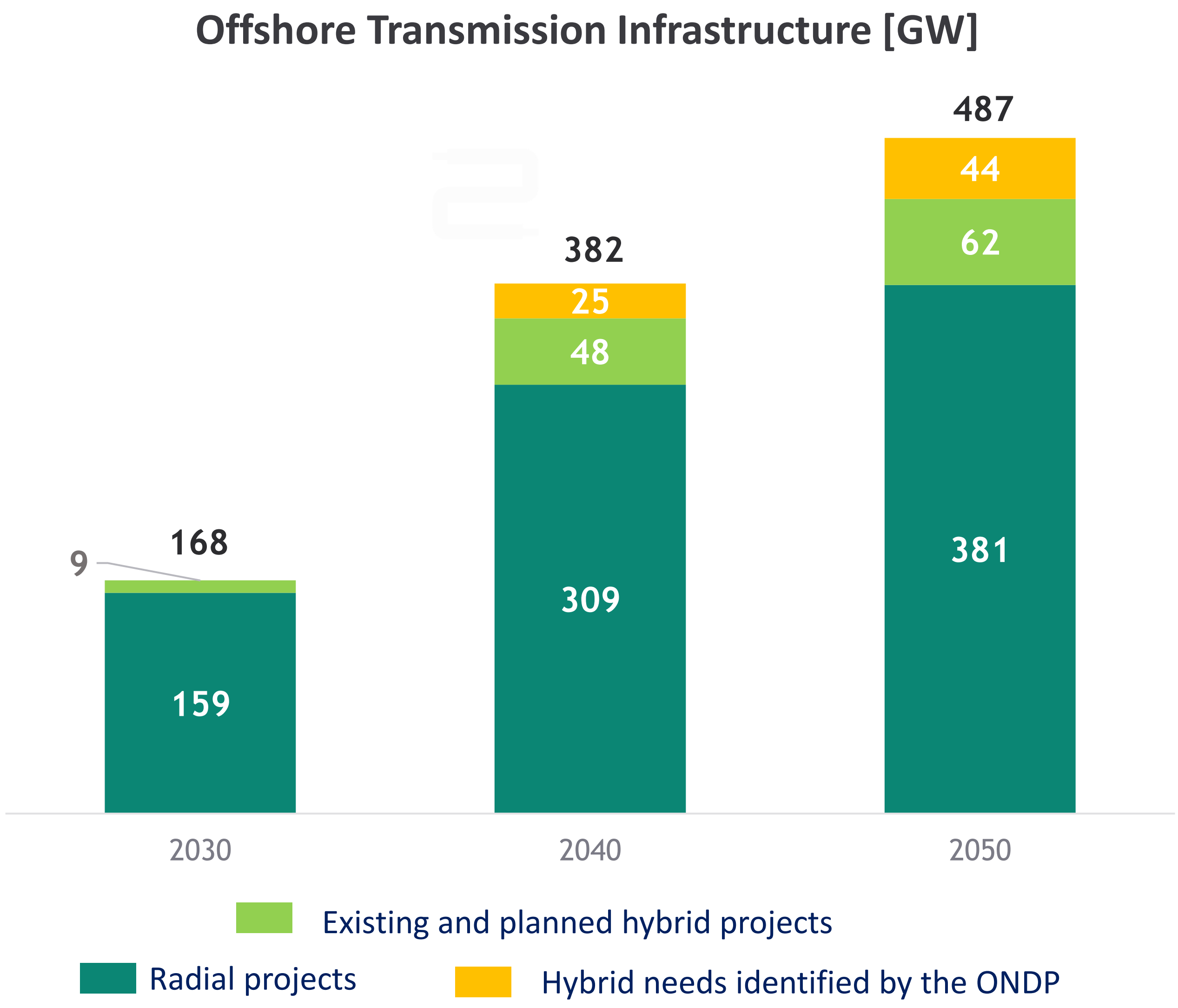
* 2030 for 2040
2040 for 2050

** minimize TOTEX

*** check plausibility and adjust

The TYNDP22 model and Distributed Energy Scenario was used
Investigations focused on offshore infrastructure only. Onshore to follow

Results: Offshore Transmission Infrastructure Needs



Most offshore RES is expected to be connected via radial connections

The supply chain will be crucial for delivering the needed infrastructure in time

Need to balance the rapid deployment of offshore grid infrastructure with the imperative to preserve and restore our marine environment.

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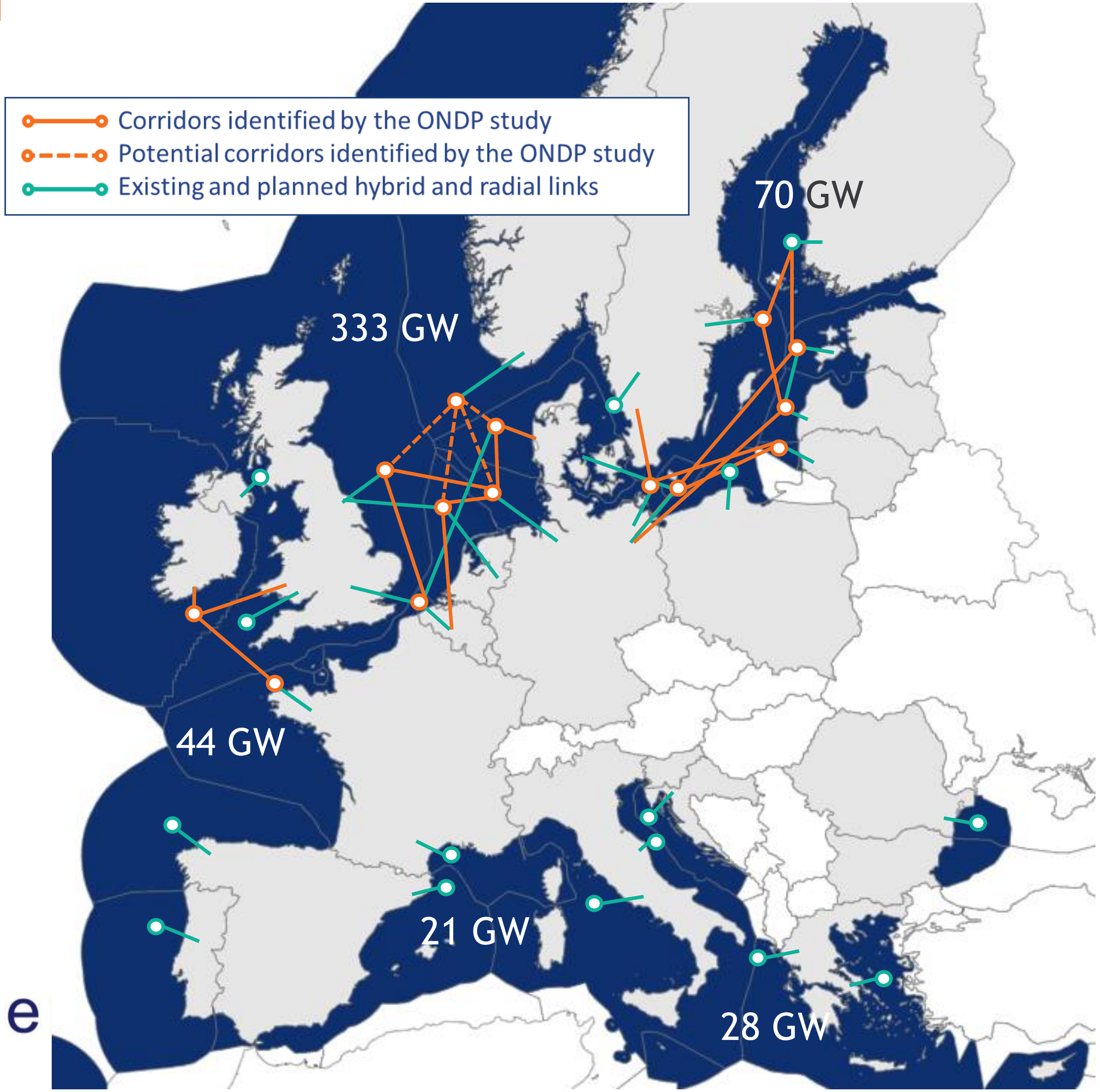
Offshore infrastructure & environmental protection go hand in hand

	Maritime Spatial Planning • Stakeholder engagement • Ecosystem-based approach • Sea basin approach • Data collection • Network of protected areas
	Mitigation • Habitat disturbance • Underwater noise • Collision • EMF and heat emissions
	Enhancement • Nature inclusive design • Offsite restoration

Up to 1 out of 7 GW will be connected via Offshore Hybrid Corridors



The future European offshore transmission system will be a combination of radial offshore RES connections, classical point-to-point interconnections, offshore hybrid projects combining both functions and multi-purpose solutions integrating energy sectors

Hybrid corridors will progressively grow to link to up to 14% of offshore RES in 2050
… the major part will be connected radially

DC Circuit breaker is not yet commercially attractive
Without it, converter stations + AC substation instead
DC Circuit breaker facilitates three times higher cross-border connection capacity* at similar costs

*similar to 1/3 of TYNDP22 identified capacity needs

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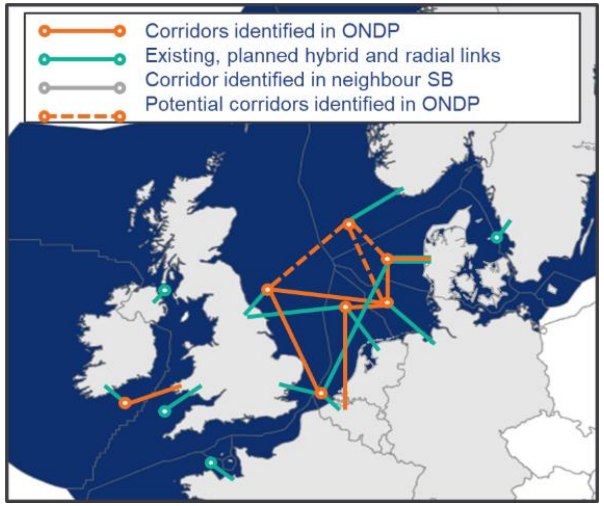
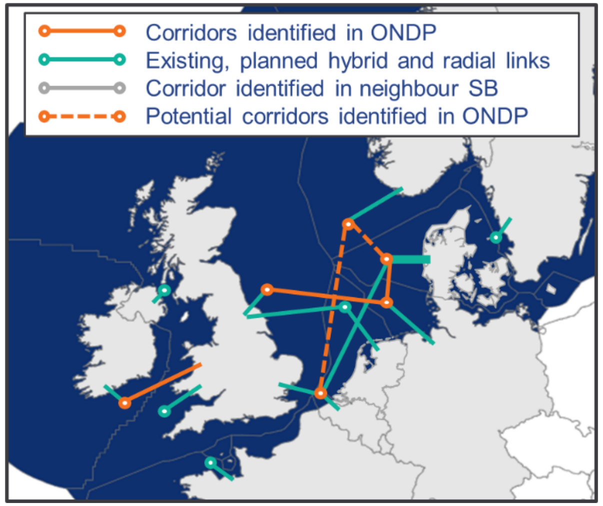
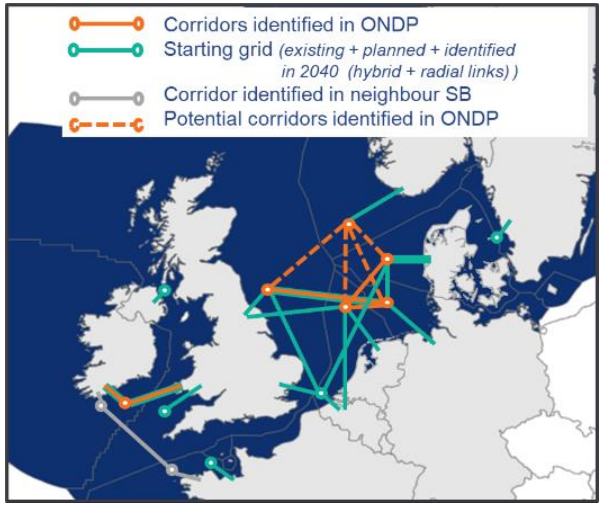
2040/2050 Offshore Infrastructure – with/ without HVDC-circuit breaker … Example Northern Seas

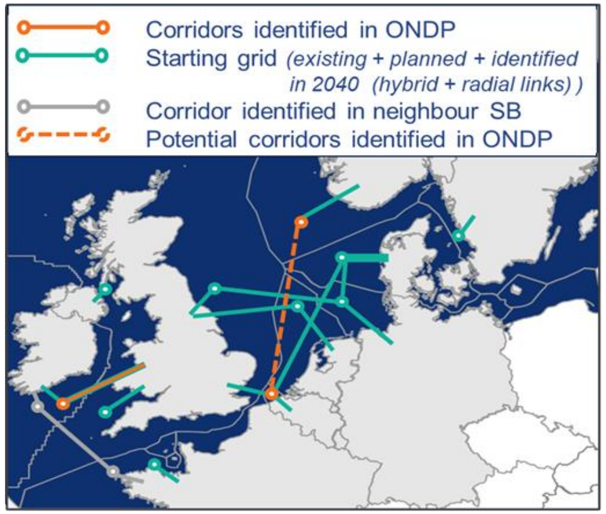
2040





2050





With DC-breaker | Without DC-breaker

Selected corridors*

	With DC-breaker	Without DC-breaker
2031-2040	21.5 GW 4,300 / 21,000 km 148 bn€	7.5 GW 2,200 / 19,000 km 148 bn€
2041-2050	8.5 GW 1,900 / 8,000 km 59 bn€	3.0 GW 1,800 / 8,000 km 57 bn€

- DC Circuit breaker is not yet commercially attractive
- Without it, converter stations + AC substation instead
- **DC Circuit breaker facilitates three times higher cross-border connection capacity at similar costs**

*All costs refer to low-cost assumptions

The Shopping List is long…

Route length
Up to 54,000 km
up to 36,000 km (NS)

DC converter stations offshore
158 ..172 units
NS: 93 ..103 units
with .. .w/o

AC substations offshore
123..137 units)
NS: 30…40 units
with … w/o

403 bn€*
255 bn€ (NS)

DC converter stations onshore
167…176 units
100…104 units (NS)
w/o … with

DC circuit breaker sets
Up to 34 sets
Up to 21 sets (NS)

Credit mages top and bottom left: TenneT NL
Credit Image bottom right: Hitachi Energy

* low-cost assumption

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Benefits and challenges of offshore corridor development

Energy Security Increase

Resulting from cross-border interconnections and increased redundancy

Price-convergence

Hybrid corridors would contribute to reduce price difference between market nodes

Better utilisation of offshore RES

Hybrid corridors reduce green energy surplus and help to avoid up to 5 to 8 Mton CO_2 annually

System risk

e.g. comply with reference incident measures as stated in network codes and guidelines

Operational challenges

No experience yet with operation of HVDC systems.

Offshore RES development

is at risk in case coordination across multiple actors fails - complex coordination is decisive

& General challenges with

- Infrastructure supply chain (incl. workforce)
- Ports availability
- Environmental impact
- Flexibility

New TEN-E -> EC Consultant Report, Dec 2023

Sea Basin Cost-Benefit and Cost-Sharing as a new task

Article 15

Offshore grids for renewable energy cross-border cost sharing

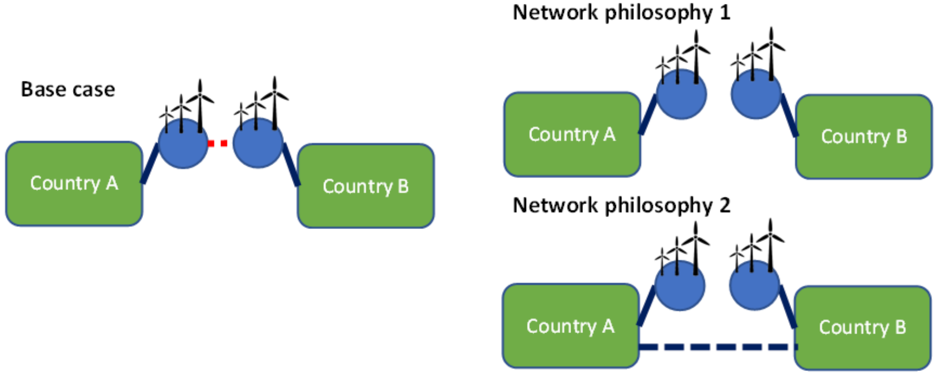
1. By 24 June 2024, the Commission shall, with the involvement of the Member States, relevant TSOs, the Agency and the national regulatory authorities, develop guidance for a specific cost-benefit and cost-sharing for the deployment of the sea-basin integrated offshore network development plans referred to in Article 14(2) in accordance with the non-binding agreements referred to in Article 14(1). This guidance shall be compatible with Article 16(1). The Commission shall update its guidance when appropriate, taking into account the results of its implementation.

2. By 24 June 2025, the ENTSO for Electricity, with the involvement of the relevant TSOs, the Agency, the national regulatory authorities and the Commission, shall present the results of the application of the cost-benefit and cost-sharing to the priority offshore grid corridors.

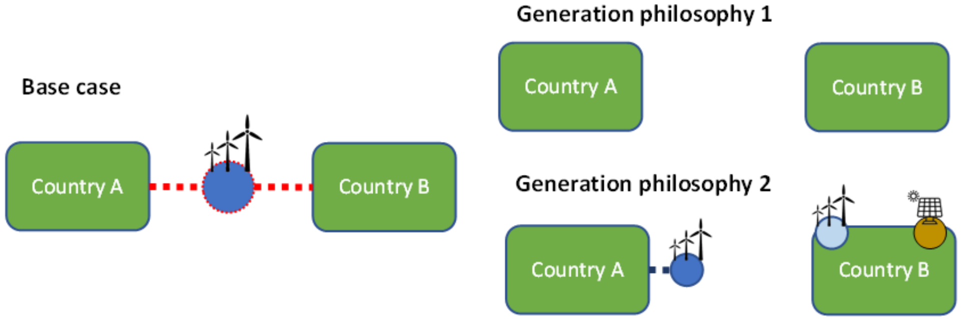
[Study on the allocation of costs and benefits for offshore infrastructure in EU sea basins]

The EC has published a study on the topic of cost-sharing for offshore infrastructure to develop the Guidance.

Network Philosophies



Generation Philosophies



EC Guidance, Summer 2024

Sea Basin Cost-Benefit and Cost-Sharing as a new task

The EC has published their
“Guidance on collaborative Investment frameworks for offshore energy projects”
in summer 2024


EUROPEAN COMMISSION

Brussels, 27.6.2024
C(2024) 3998 final

COMMUNICATION FROM THE COMMISSION

Guidance on collaborative investment frameworks for offshore energy projects

EN EN

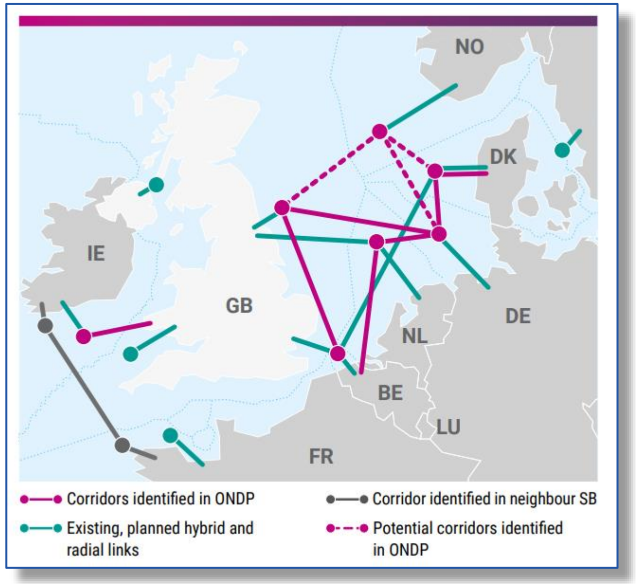
<u>ENTSO-E to deliver:</u>

- Sea basin CBA
- Sea basin Cost benefit cost sharing

- Project specific CBA ..

Which costs to share?

- Hybrid transmission expansion
- With / without radial part?
  - Or only extended radial part?
- Onshore net expansion?



Uncertainty of Benefits

- Which countries to include in the long run?
- Separation of benefits to be attributed to transmission and generation
- How to deal with different timelines for project realization?

Thank you!

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