

Ten-Year Network Development Plan



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Introduction

Who we are



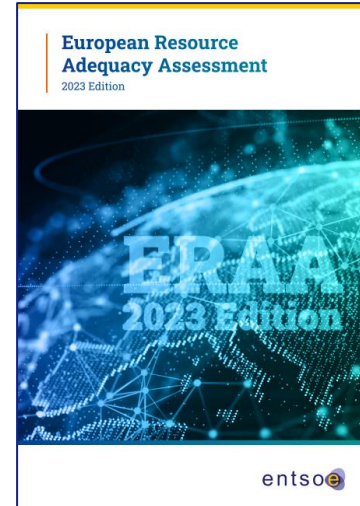
- ENTSO-E – **European Network of Transmission System Operators for Electricity**, since 2009.
- **Cooperation** of the European transmission system operators (TSOs), **responsible for the secure and coordinated operation of Europe’s electricity system**
- **40 member TSOs**, representing **36 countries**, around **500 000 km of power lines** and serving about **520 million citizens**

What we do

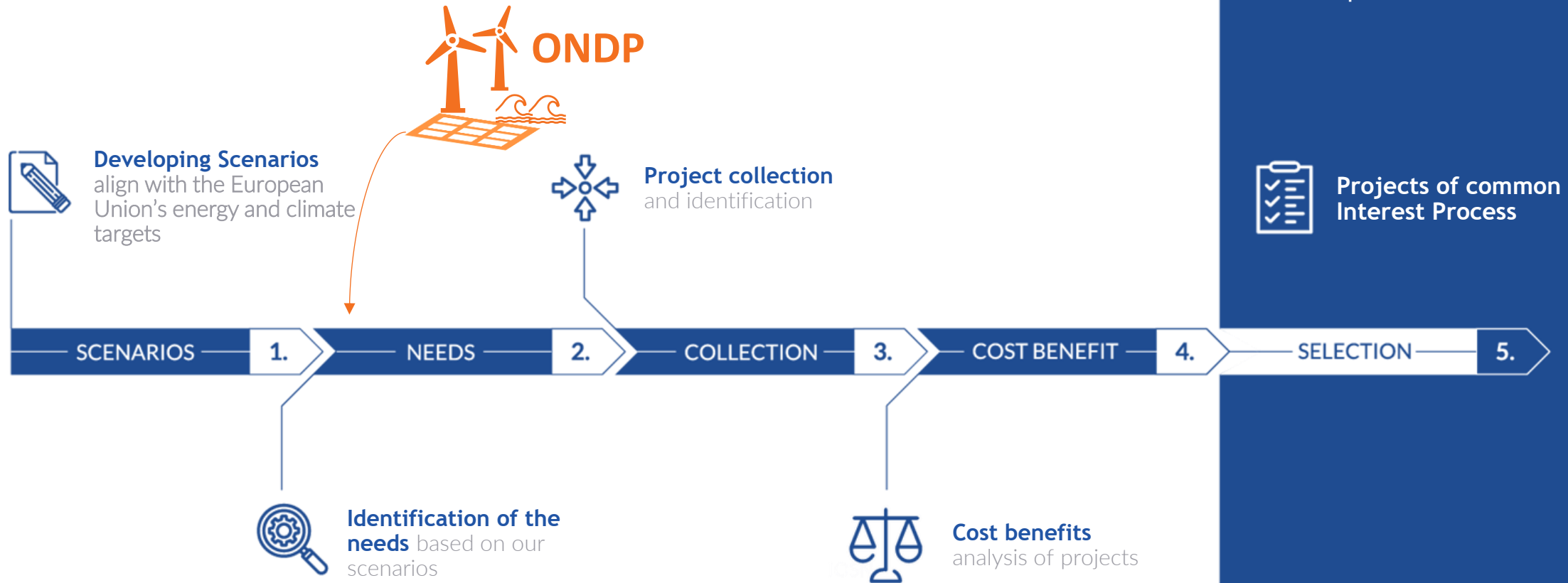
Legally mandated tasks

coming from the Third Clean Energy package

- **Coordinated long-term grid planning** (TYNDP)
- **Security of supply and adequacy analysis** (seasonal outlooks, European Resource Adequacy Assessment)
- **Development and implementation of technical rules** (e.g. network codes)
- **Coordination of research, development and innovation activities**
- **Development of platforms for data sharing** with market participants



The Ten-Year Network Development Plan



Process of European Projects of Common Interest led by the European Commission

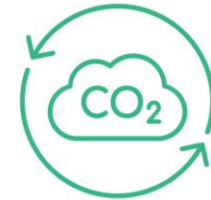
Projects of common Interest Process



Scenarios

Scenarios for the ten-year network development plans

The scenarios provide a sound basis to develop an infrastructure that is fit for purpose for a net-zero energy system, with the current available knowledge.



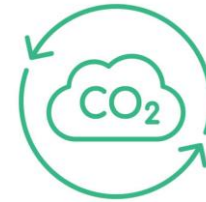
Trans-European Networks for Energy



Article 12

Scenarios for the ten-year network development plans

The scenarios provide a sound basis to develop an infrastructure that is fit for purpose for a net-zero energy system, with the current available knowledge.



Trans-European Networks for Energy



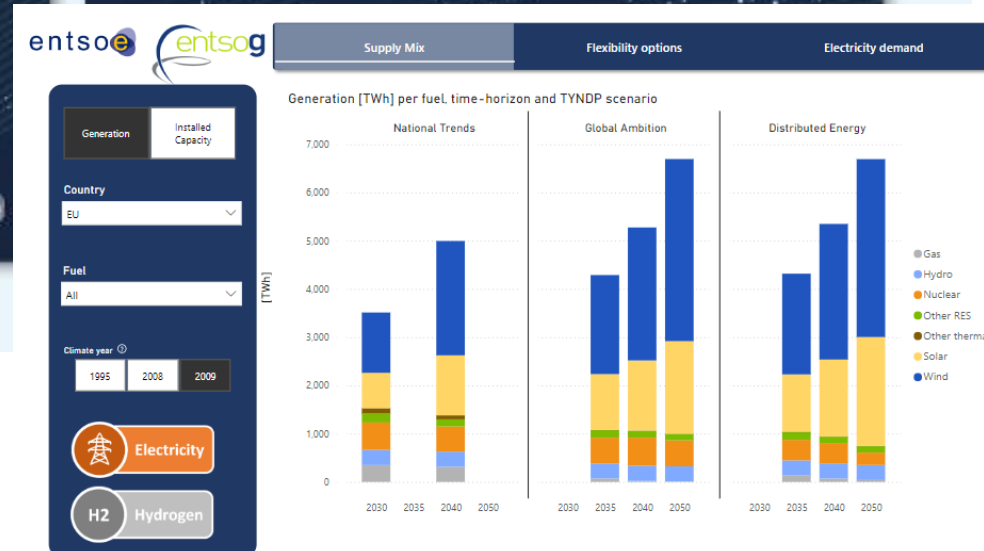
Article 12

...ENTSO for Electricity and ENTSO for Gas scenarios are fully in line with the energy efficiency first principle and with the Union's 2030 targets for energy and climate and its 2050 climate neutrality objective and shall take into account the latest available Commission scenarios, as well as, when relevant, the national energy and climate plans....

The TYNDP 2024 Scenarios package was published in May 2024



Download the complete Package



Full datasets & results
Visualisation Platform
Consultation Summary Report

2024 Scenarios are the result of extensive stakeholder engagement

Extensive stakeholder engagement especially on input parameters and methodologies

Webinars, workshops, public consultations, stakeholder roundtables

Stakeholder Reference Group

Transparency: reports, availability of input and output datasets, enhanced data visualisation tool

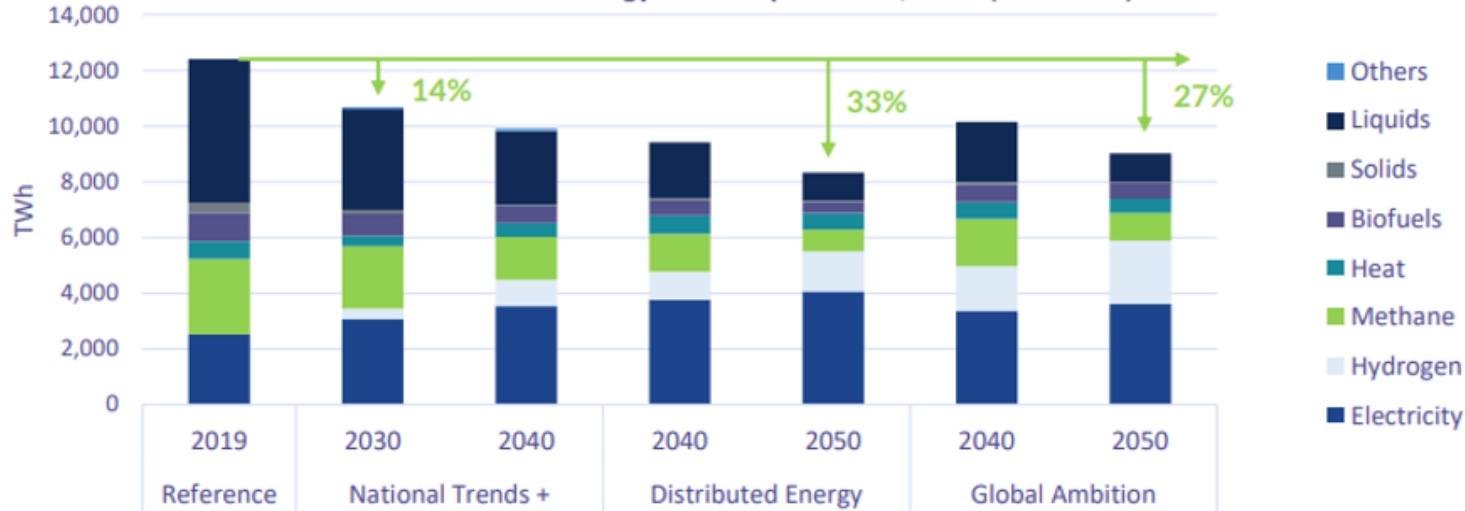
Stay informed on the scenarios' development!

<https://www.entsos-tyndp-scenarios.eu/>

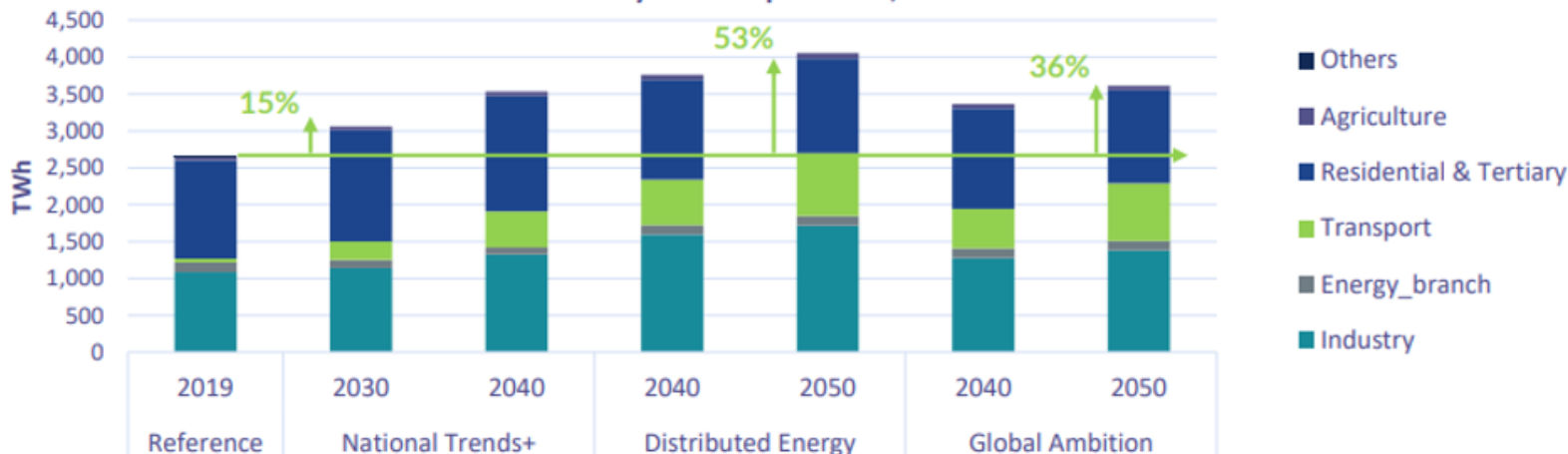


Energy efficiency is key step to achieve the EU Climate and Energy objectives

Final Energy demand per carrier, EU27 (all sectors)

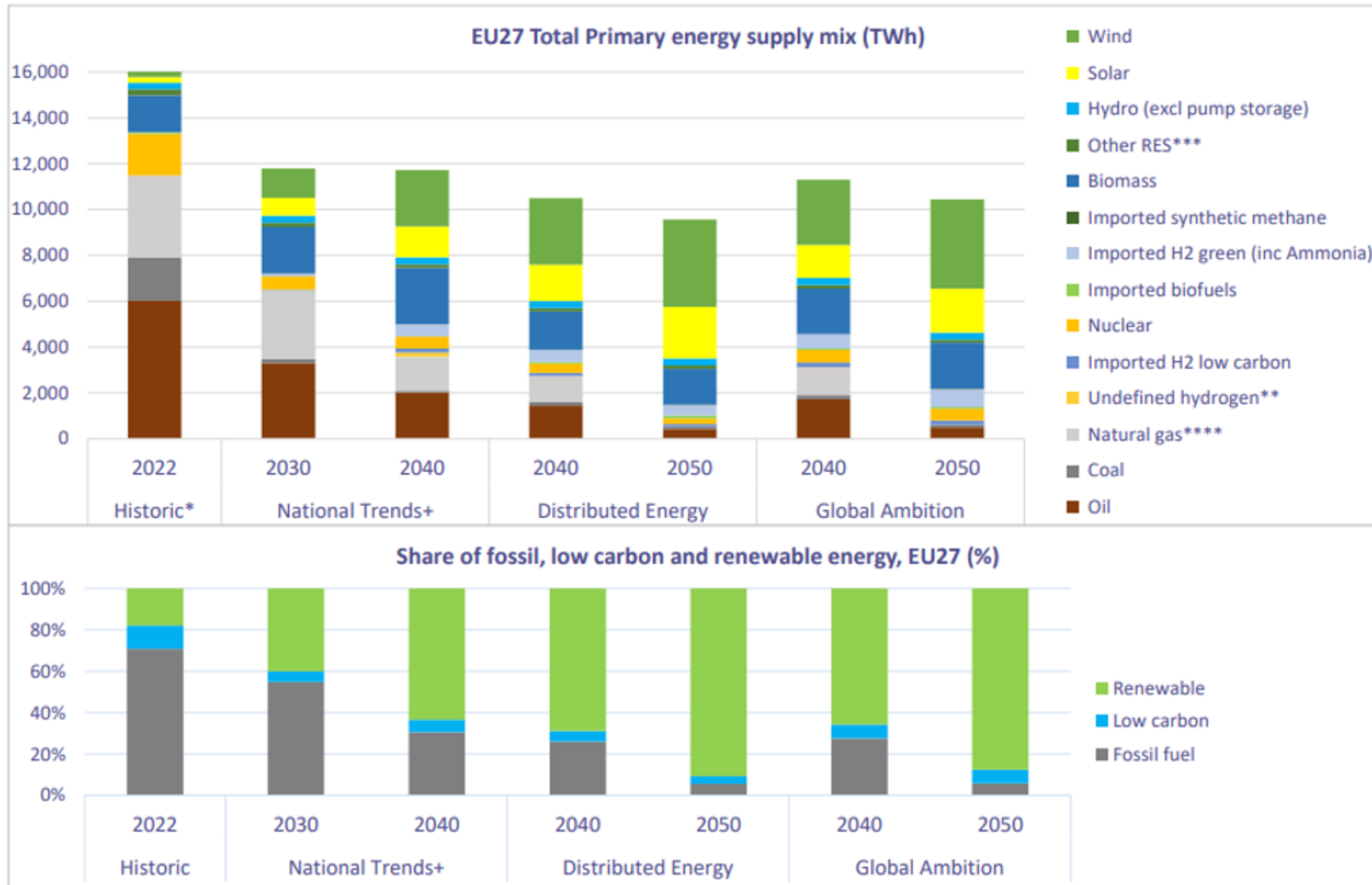


Electricity demand per sector, EU27



- ✓ Increase in direct electricity is most energy efficient solution to achieve EU's energy and climate targets.
- ✓ Active participation of end consumers through behavioural adaptation
- ✓ Continued improvement of existing technology options and emerging technologies
- ✓ Sector integration, further integration of the H2 system

Ambitious development of renewable energy across Europe



- ✓ Solar and wind generation witness remarkable growth, reaching threefold by 2030 and approximately ninefold by 2050 in the envisioned scenarios
- ✓ Natural gas supply phased out by 2050
- ✓ Low carbon sources like nuclear and blue hydrogen supply also contribute to decarbonise the energy system

Identification of System Needs and Offshore Network Development Plan

Identification of System Needs

One economic needs configuration, multiple solutions

Non-infrastructure solutions

Addressing tomorrow's challenges will require the parallel development of a diverse range of solutions, including for example storage, the role of prosumers and generation, in addition to reinforcing the transmission grid.



Demand side response



Regulation



Smart Grids



Storage



Smart Sector Integration



Market design



Operational measures

Electricity infrastructure solutions

Our study uses interconnection transmission capacity and storage and peaking flexibility to express the needs because it is based on electricity TSOs' expertise, data and models, but solutions extend beyond electricity infrastructure.



Transmission lines



Energy Storage



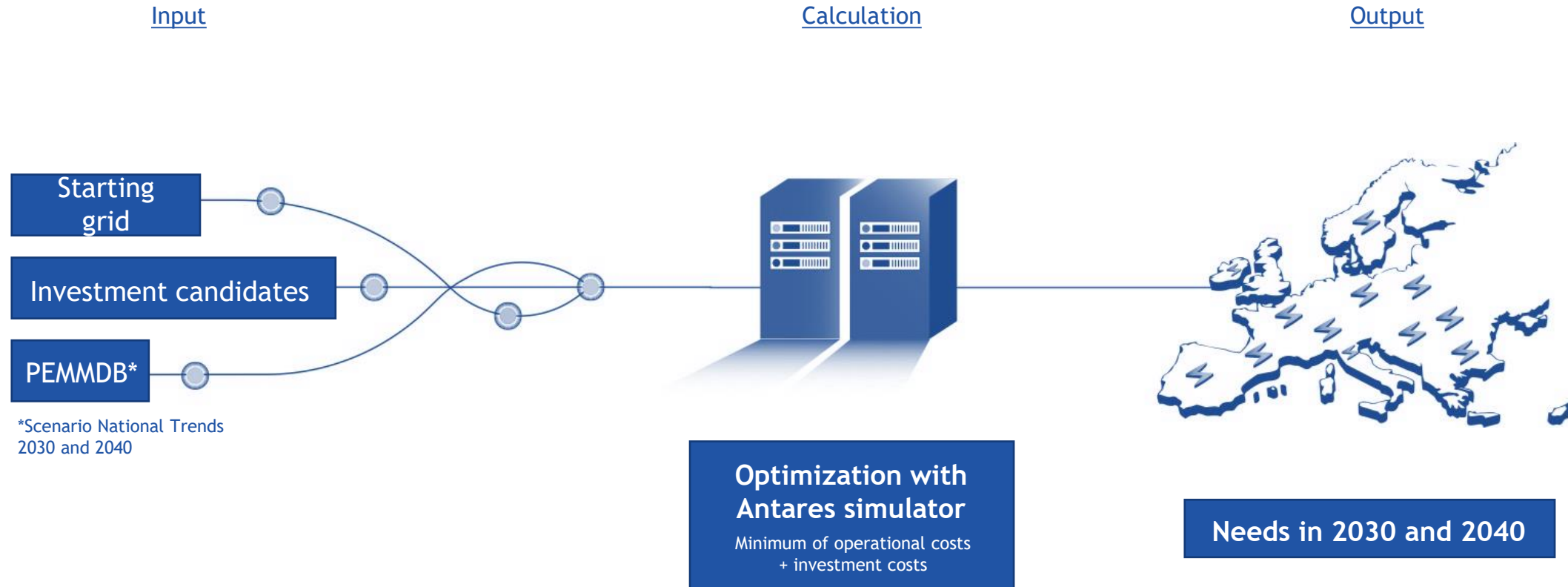
Peak units



Hybrid solutions

Identification of System Needs

Study Process Overview



Energy Infrastructure- Investments in electricity grids



Investment Needs 2040 IoSN ENTSO-E TYNDP2022

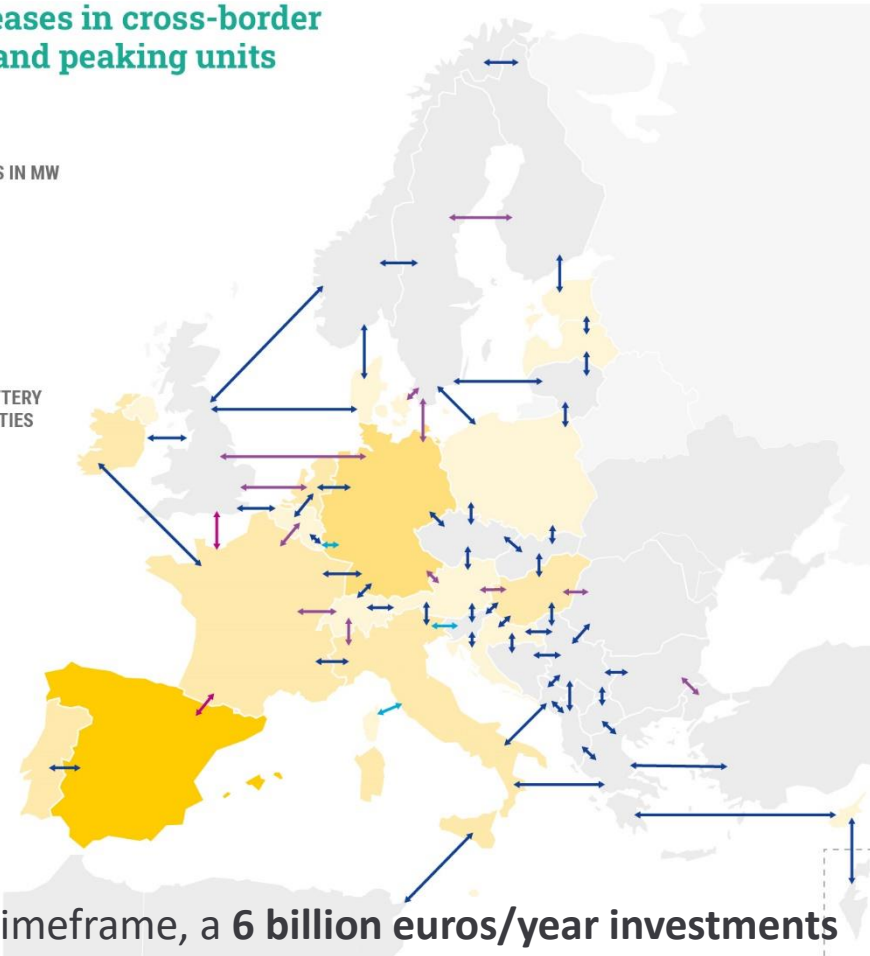
Opportunities for increases in cross-border transmission, storage and peaking units capacity in 2040

CROSS-BORDER CAPACITY INCREASES NEEDS IN MW (ADDITIONAL TO THE STARTING GRID 2025)

- ←→ < 500 MW
- ←→ 500 → 2,000 MW
- ←→ 2,000 → 4,000 MW
- ←→ > 4,000 MW

STORAGE NEEDS IN MW (ADDITIONAL TO BATTERY CAPACITIES IN NT2030 AND TO 2040 CAPACITIES FOR OTHER STORAGE TECHNOLOGIES)

- < 1,000 MW
- 1,000 → 5,000 MW
- 5,000 → 10,000 MW
- > 10,000 MW



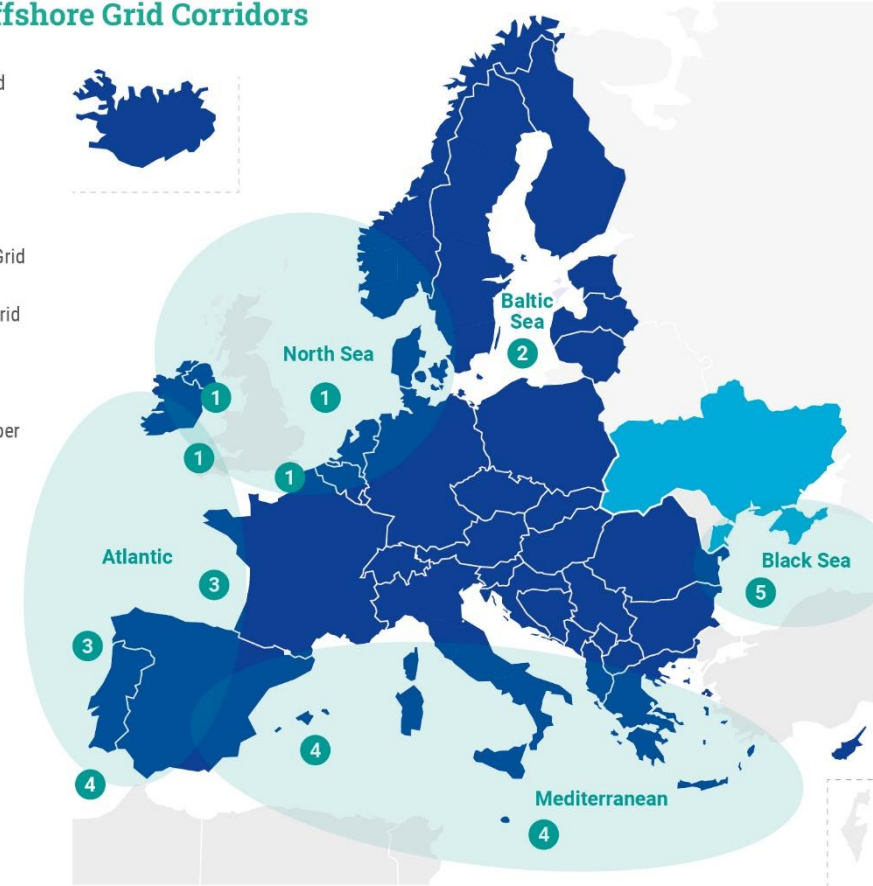
In the 2025-2040 timeframe, a **6 billion euros/year** investments (in cross-border capacity, storage and peaking units) produces a **9 billion/year** increase in socio-economic welfare.

Priority Offshore Corridors TEN-E

TEN-E Priority Offshore Grid Corridors

- 1 Northern Sea Offshore Grid (NSOG)
- 2 Baltic Energy Market Interconnection Plan (BEMIP offshore)
- 3 Atlantic Offshore Grid
- 4 South and West Offshore Grid (SW OFFSHORE)
- 5 South and East Offshore Grid (SE OFFSHORE)

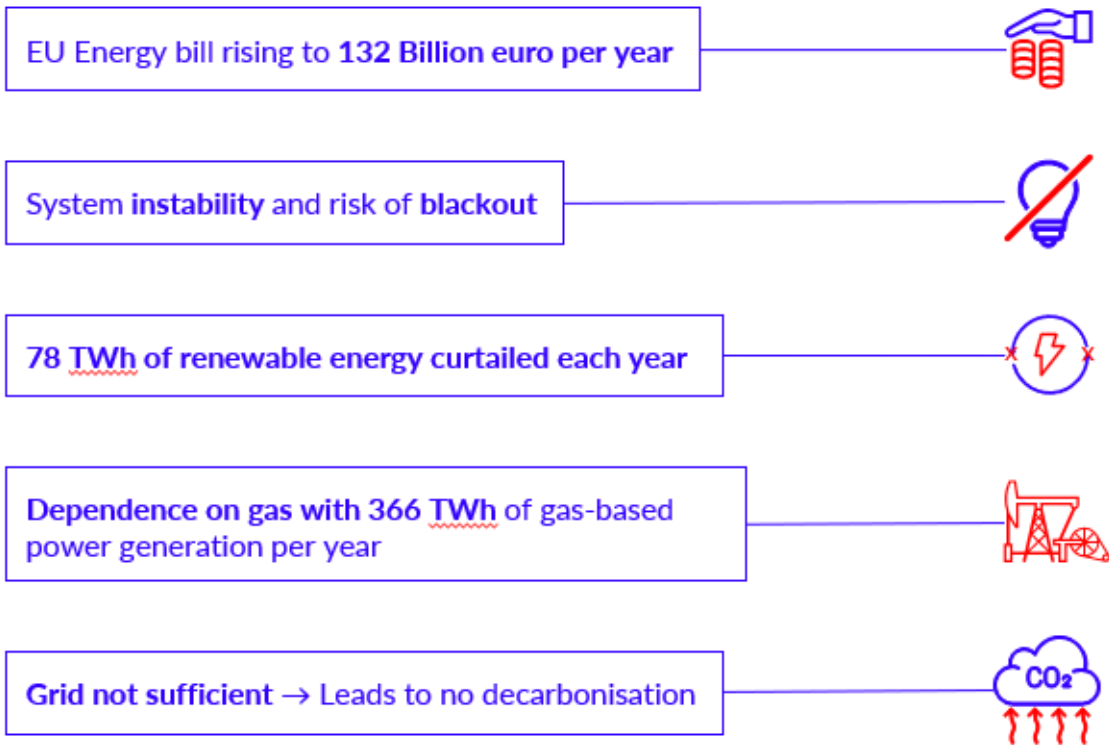
- ENTSO-E Member
- ENTSO-E Observer Member



How addressing system needs benefits Europe

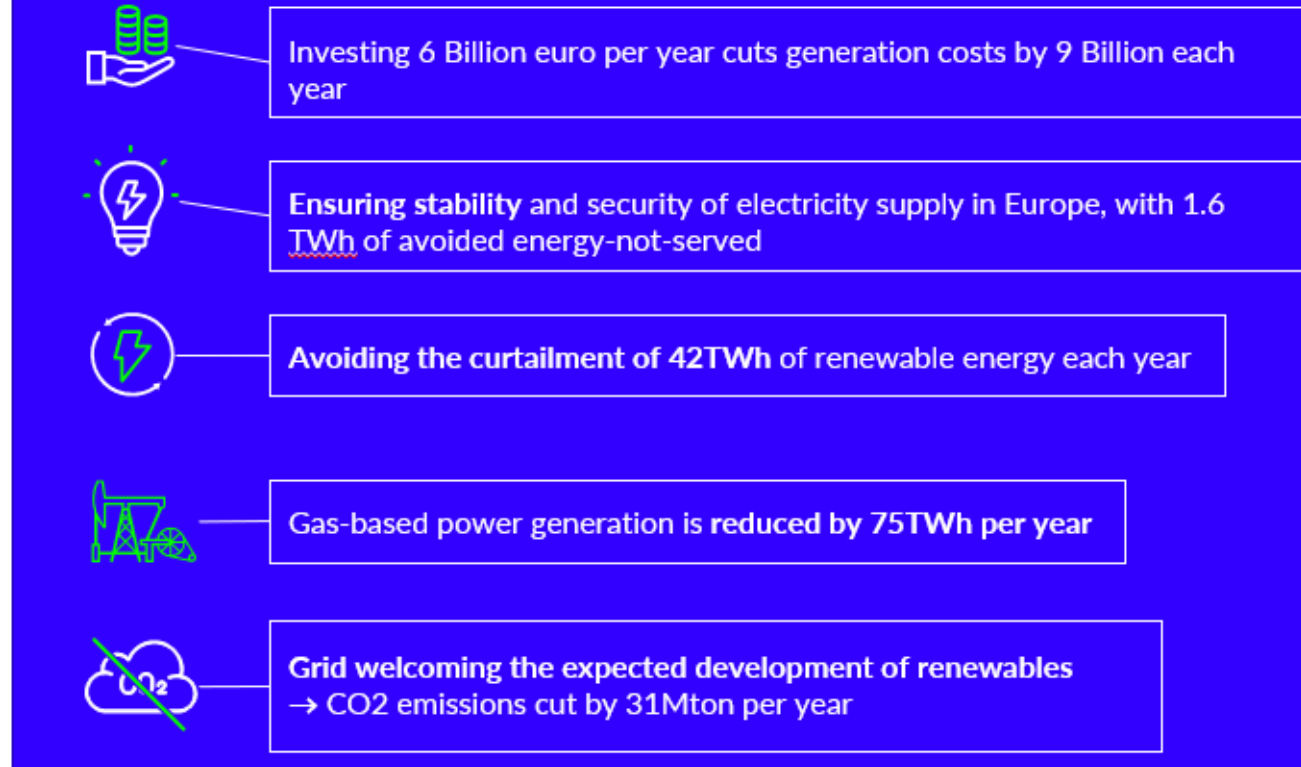
What would happen in 2040 if...

We stopped investing in the power system in 2025?



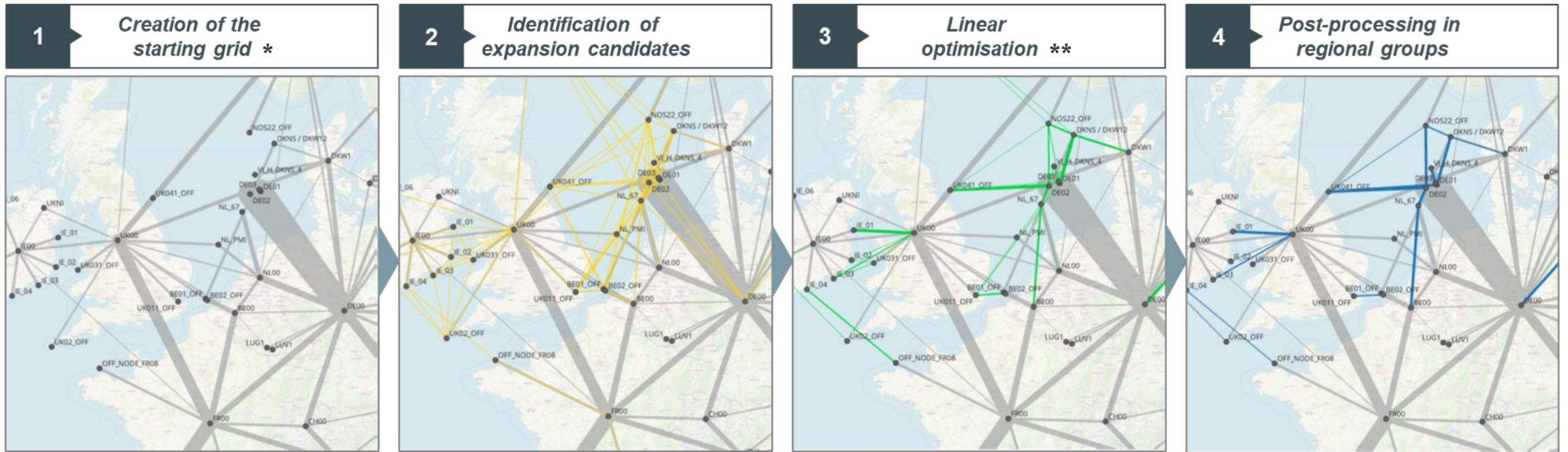
What would happen in 2040 if...

We addressed system needs?



The ONDP Approach, summarized in four steps

Schematic Visualisation:

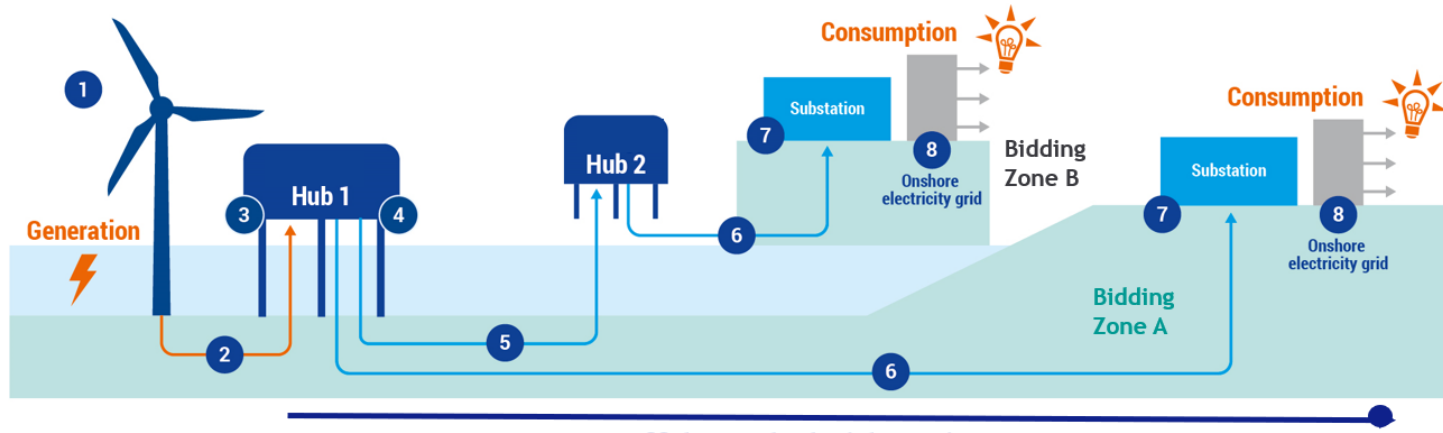


* 2030 for 2040
2040 for 2050

** minimize TOTEX

*** check plausibility and adjust

Offshore Hybrid Project – What is it?



Asset List:

- | | | | |
|---|-----------------------|---|-------------------------------|
| 1 Offshore RES | 3 DC Connection Point | 5 Interconnector cables from hub to hub | 7 Onshore Substation |
| 2 Cables connecting offshore wind farm to hub | 4 On hub assets | 6 Transmission cables from hub to shore | 8 Onshore Grid Reinforcements |

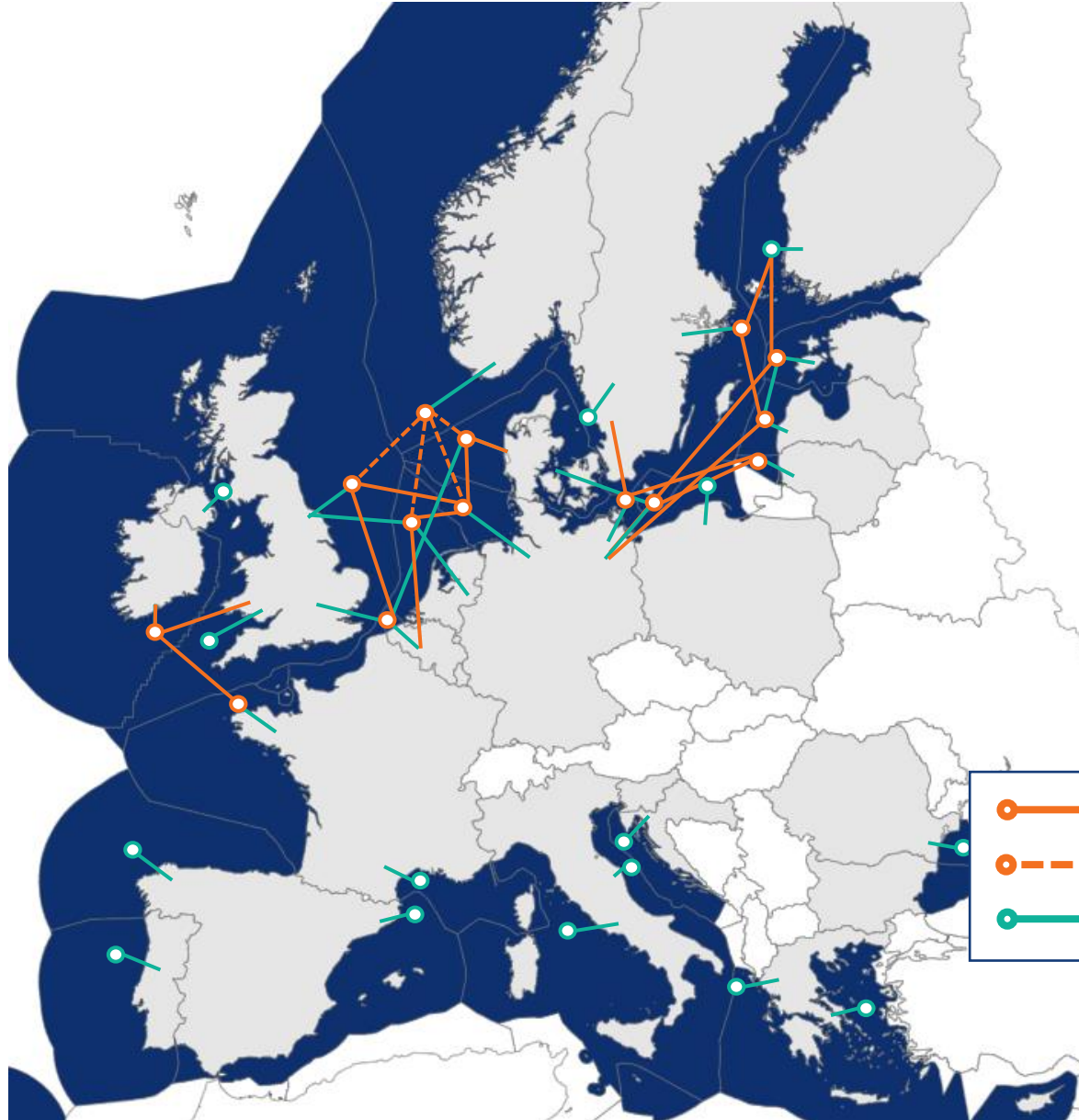
Offshore hybrid project

Common terminology on- and offshore → Same legislation applies

The term “**offshore hybrid project**” refers specifically to the **transmission infrastructure** connecting two countries (or bidding zones) and connecting the OWF to shore. Generation assets are out of scope. (also called “dual purpose project” or “hybrid interconnector”)

“Multi-purpose”: additionally crossing energy sectors

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

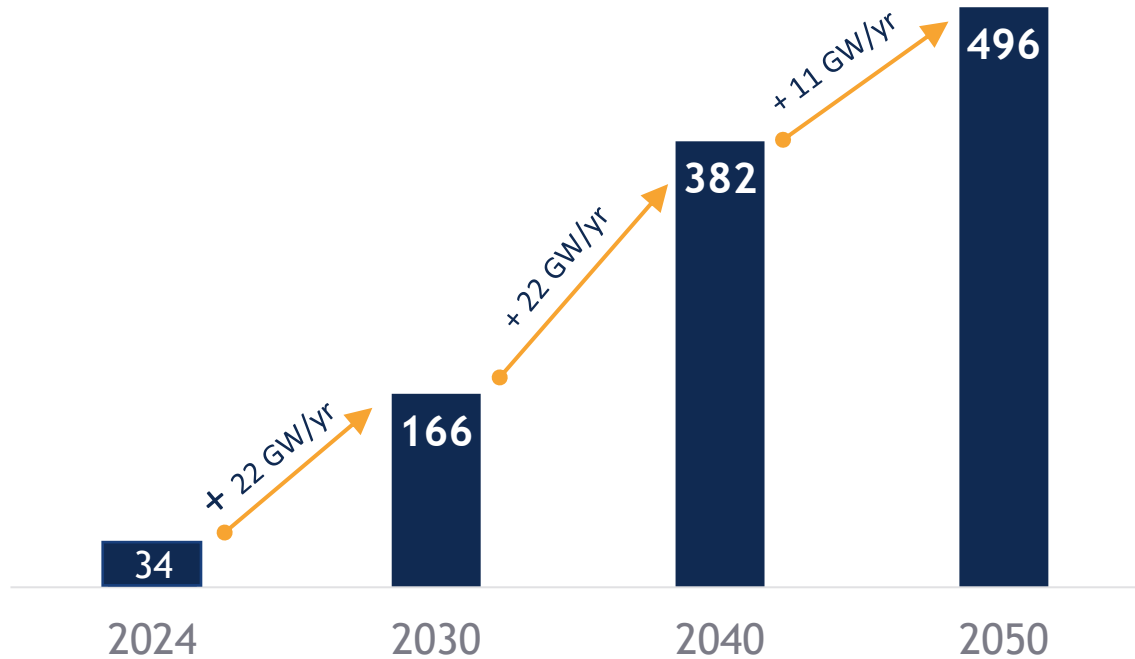


Hybrid corridors will progressively grow to link to up to 14% of offshore RES in 2050

- Corridors identified by the ONDP study
- - -●- - - Potential corridors identified by the ONDP study
- Existing and planned hybrid and radial links

Need for Speed...for Generation and Transmission

Offshore RES Generation capacity [GW]
average annual growth per decade



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



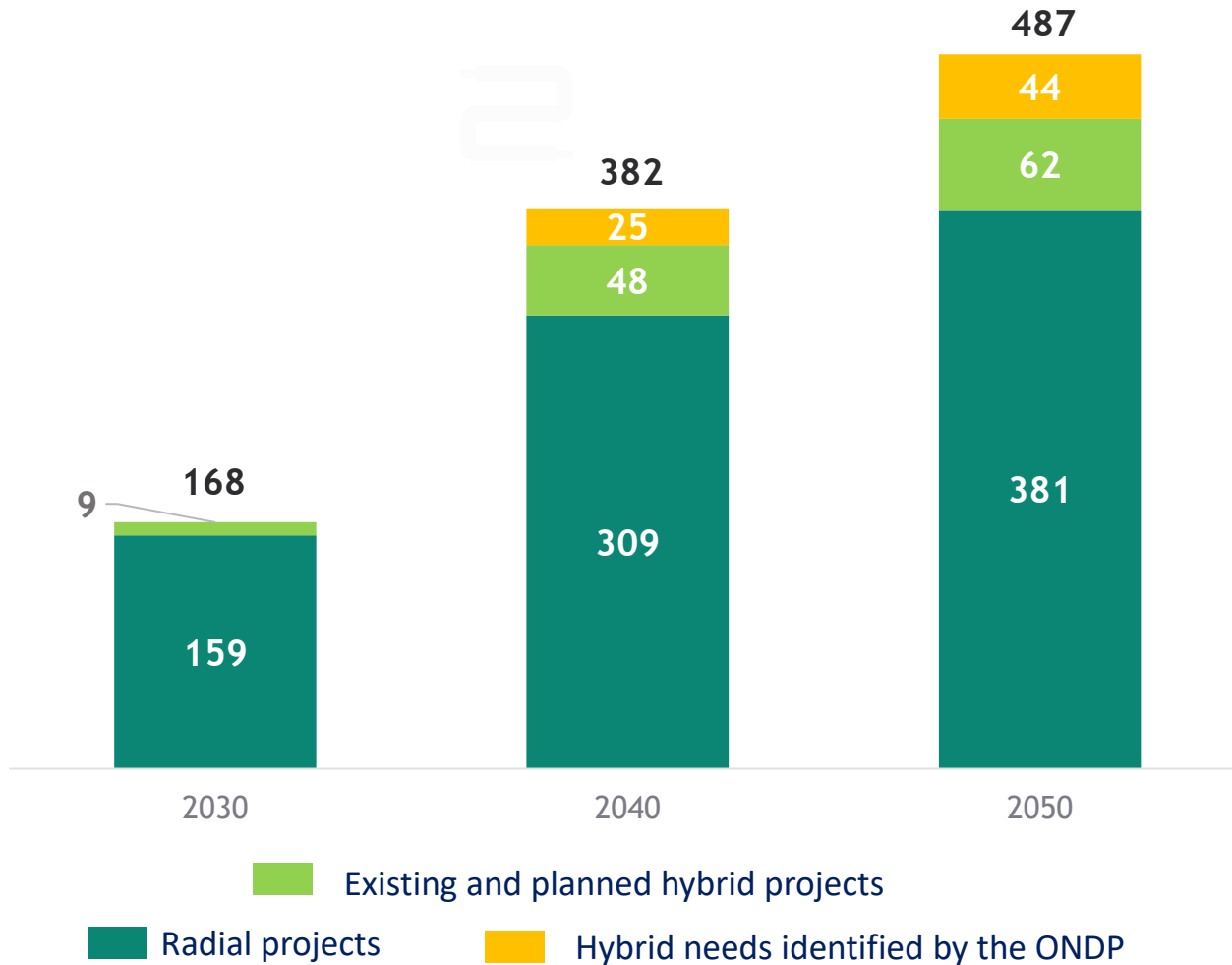
Annual installations of offshore RES and Infrastructure need to accelerate significantly

...BUT: average speed in the last 10 years was + 2.5 GW/yr



Results: Offshore Transmission Infrastructure Needs

Offshore Transmission Infrastructure [GW]



Most offshore RES is expected to be connected via radial connections



The value 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.



Project Portfolio

Project portfolio: 176 Transmission projects



Project Type

- Storage
- Transmission

Onshore/Offshore

- Offshore hybrid
- Offshore interconnector
- Offshore radial
- Onshore

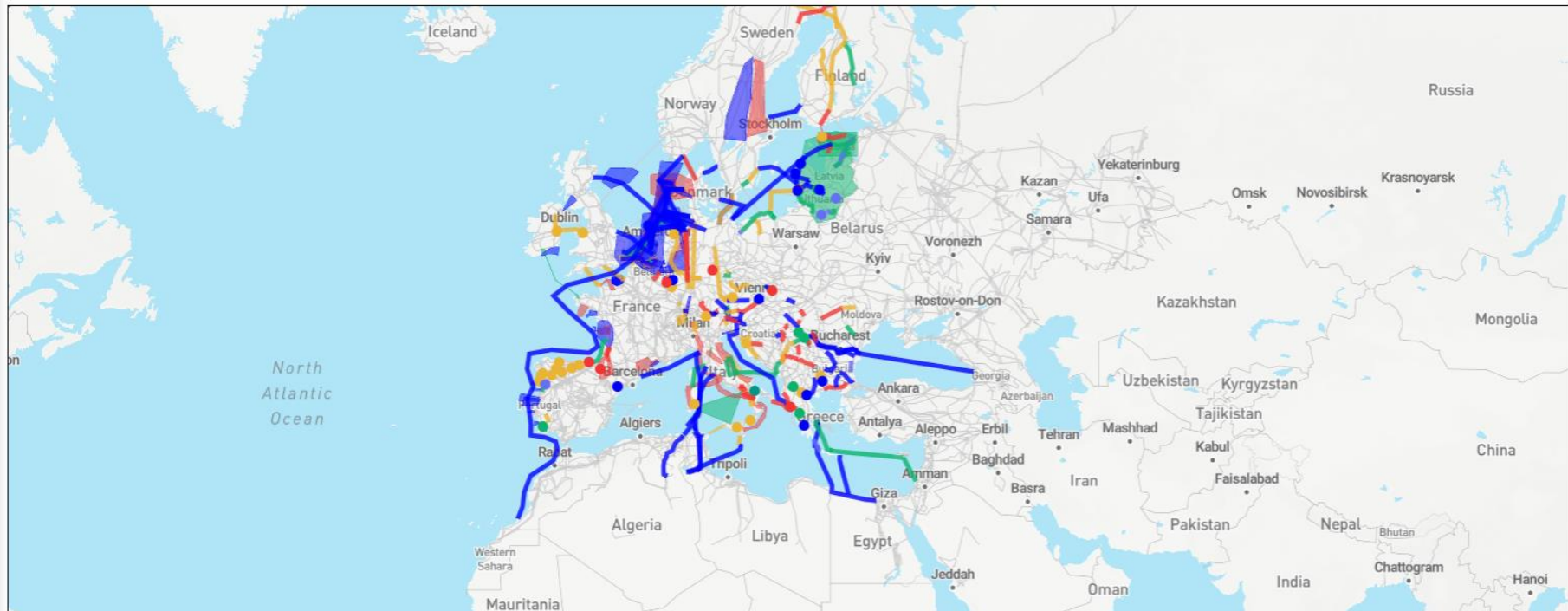
Project/Investment Status

- Commissioned
- In Permitting
- Planned But Not Yet Permitt...
- Under Consideration
- Under Construction

TYNDP 2024 Projects Sheets

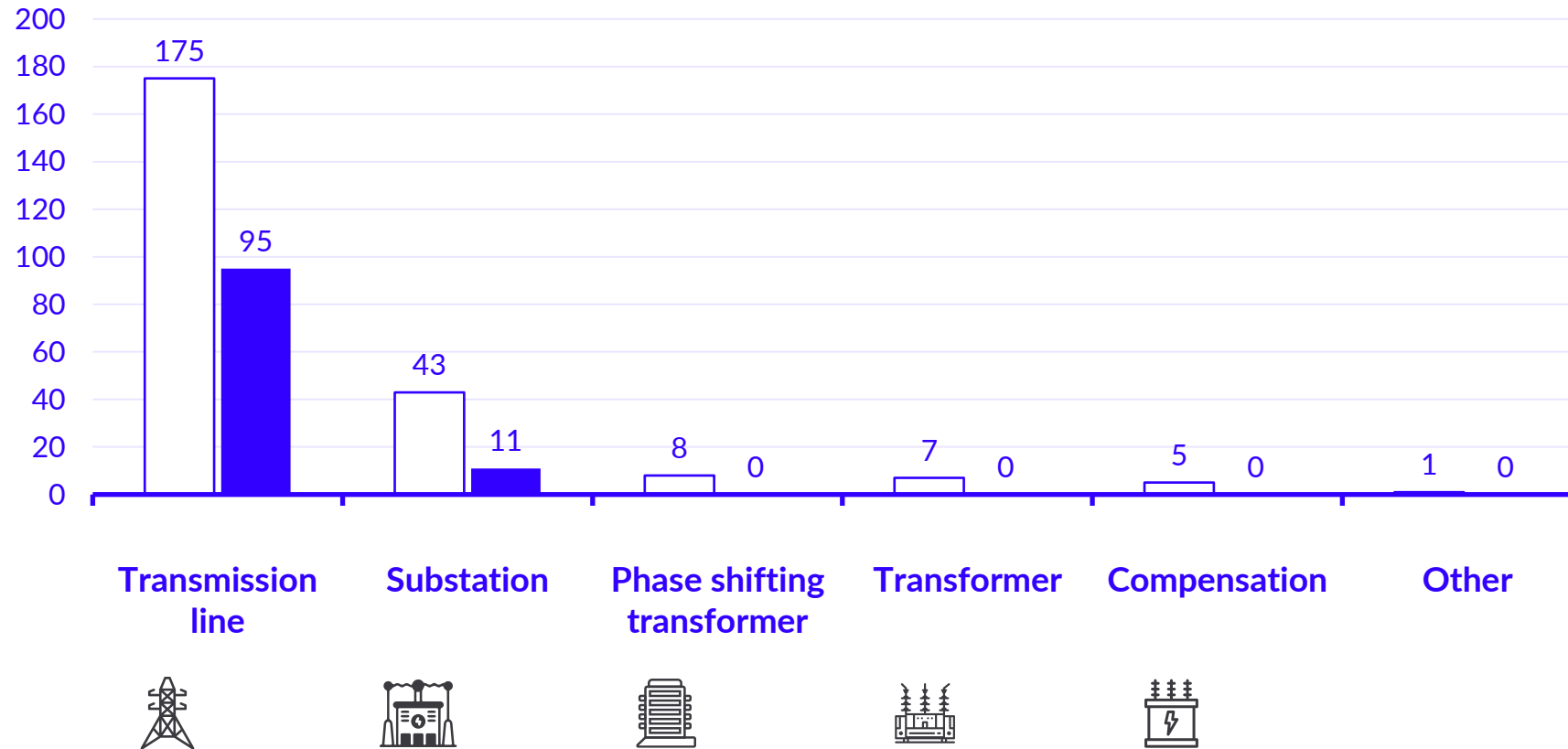
The TYNDP 2024 will assess how 176 transmission and 33 storage projects respond to the TYNDP scenarios. Learn more about the projects by clicking on their location on the map below or filter projects by country, type of infrastructure or status. More information about the projects will become available with the release of TYNDP 2024 for public consultation at the end of 2024.

Toggle filters



Project portfolio: 176 Transmission projects

TYNDP 2024 investments per type of element and technology.



Context

TYNDP 2024 portfolio projects with over 63,400 km of potential additional cables and lines, of which 19,800 km (31%) are AC and 43,600 km (69%) encompasses are DC. The rapid advancement of DC technology has led to improved uptake of this technology and seen its portfolio share grow since TYNDP 2018. The ongoing development of offshore infrastructure is expected to require increased investment in subsea DC cables.

Project portfolio - 33 Storage Projects



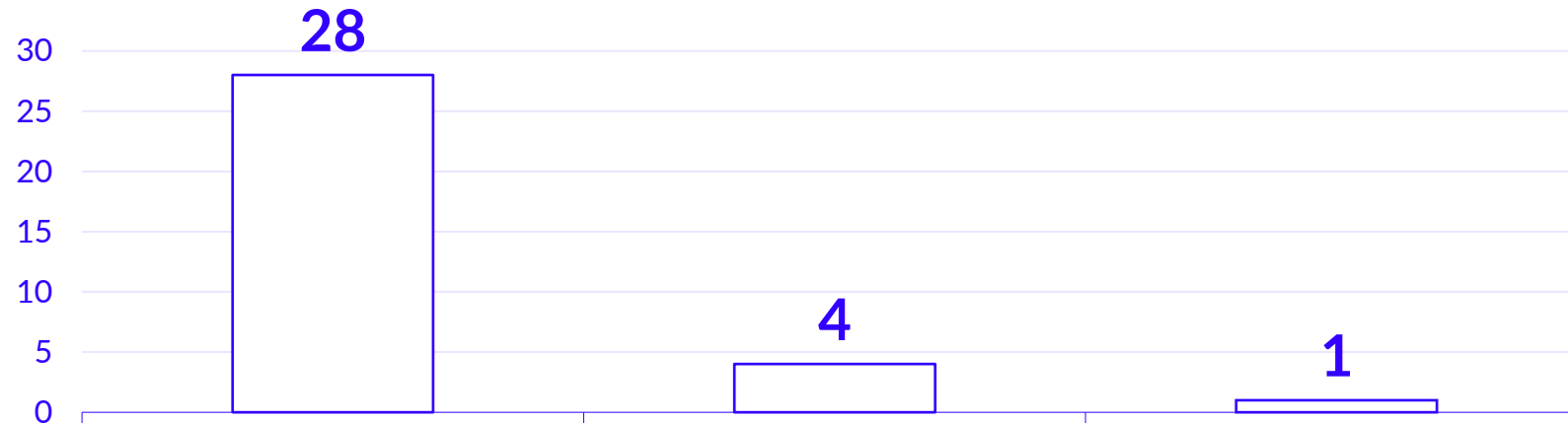
Pump-hydro technology



Compressed-air energy



Electrochemical Storage



Context

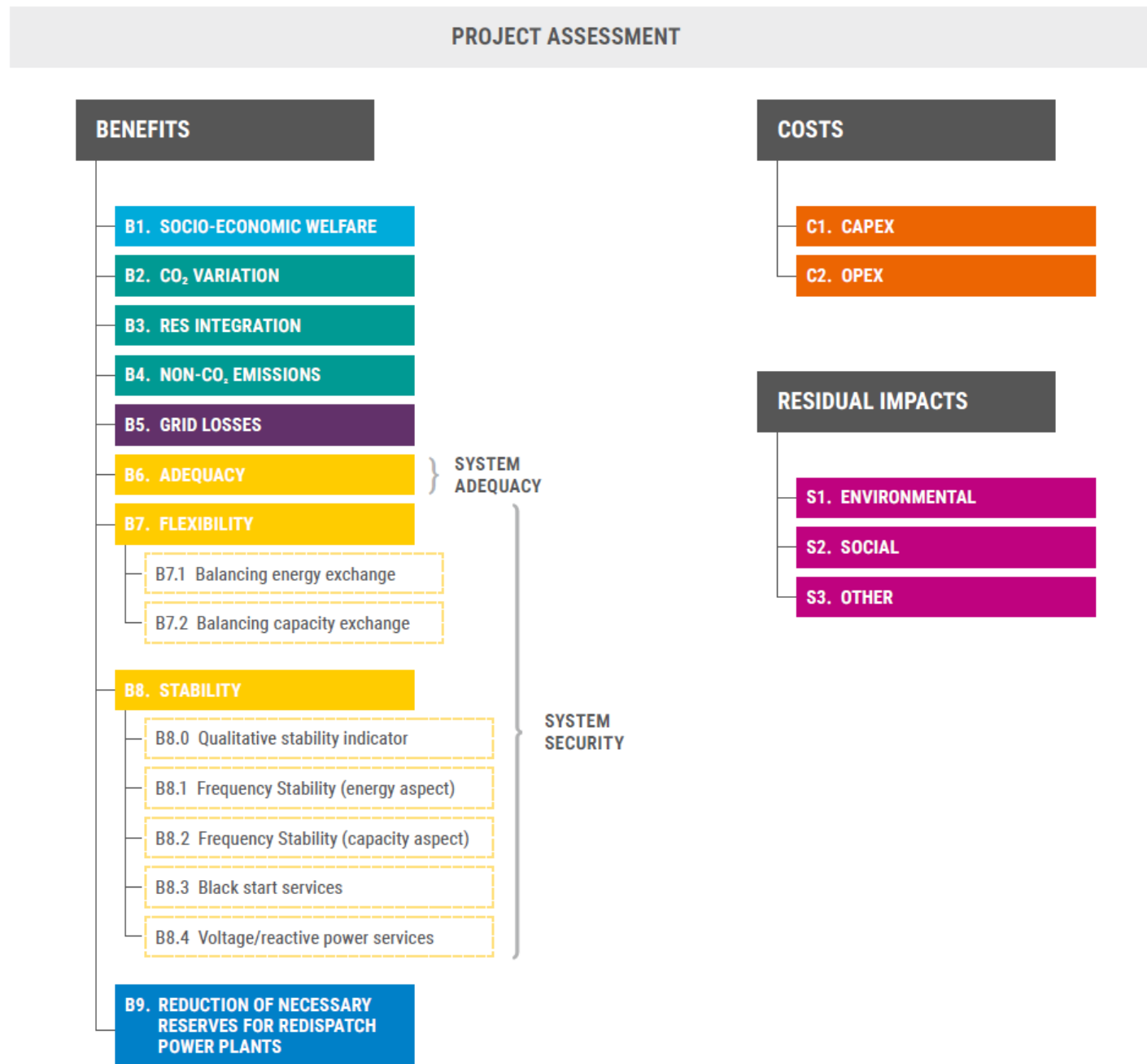
The TYNDP 2024 portfolio includes 33 storage projects, of which 28 use pump-hydro technology. 4 compressed-air energy storage projects and 1 electrochemical storage project complete the portfolio.



Cost-Benefit Analysis

Cost-Benefit Analysis

What are the indicators?



Our values define who we are, what we stand for and how we behave.
We all play a part in bringing them to life.



EXCELLENCE

We deliver to the highest standards.
We provide an environment in which people can develop to their full potential.



TRUST

We trust each other, we are transparent and we empower people.
We respect diversity.



INTEGRITY

We act in the interest of
ENTSO-E



TEAM

We care about people. We work transversal and we support each other.
We celebrate success.



FUTURE THINKING

We are a learning organisation.
We explore new paths and solutions.

We are ENTSO-E