Il Ten-Year Network Development Plan di ENTSO-E

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European Network of Transmission System Operators for Electricity - ENTSO-E

- **Association** for the cooperation of the **European transmission system operators (TSOs)**
- 39 member TSOs representing 35 countries
- Established and given legal mandates by the EU's Third Legislative Package for the Internal Energy Market in **2009**
- TSOs are responsible for the **secure and coordinated operation** of Europe's electricity system
  - "the largest interconnected electrical grid in the world"
- Mission:
  - ensuring the **security** of the interconnected power system in all time frames at pan-European level and
  - the optimal functioning and development of the European interconnected **electricity markets**,
  - enabling the **integration** of electricity generated from **renewable energy sources** and of emerging technologies.

I testi e le figure di questa presentazione sono tratti o rielaborati da materiale disponibile sul sito web di ENTSO-E.

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European Network of Transmission System Operators for Electricity - ENTSO-E

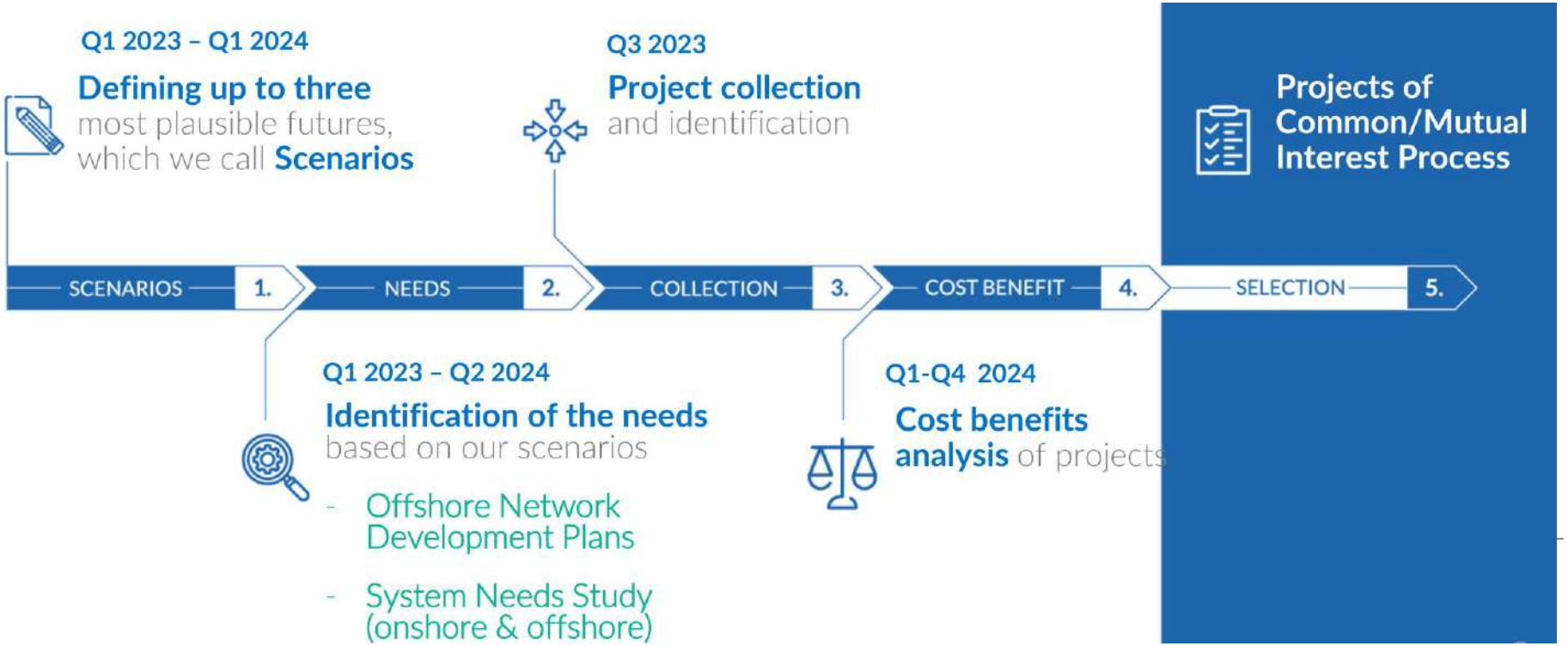
- Key responsibilities include the following:
  - Development and implementation of **standards, network codes, platforms and tools** to ensure **secure system** and **market operation** as well as **integration of renewable** energy;
  - Assessment of the **adequacy** of the system in **different timeframes**;
  - **Coordination of the planning** and development of infrastructures at the European level (**Ten-Year Network Development Plans, TYNDPs**);
  - **Coordination of research**, development and innovation activities of TSOs;
  - Development of **platforms** to enable the transparent sharing of **data** with market participants.

ENTSO-E supports its members in the implementation and monitoring of the agreed common rules.

Ten-Year Network Development Plan (TYNDP)

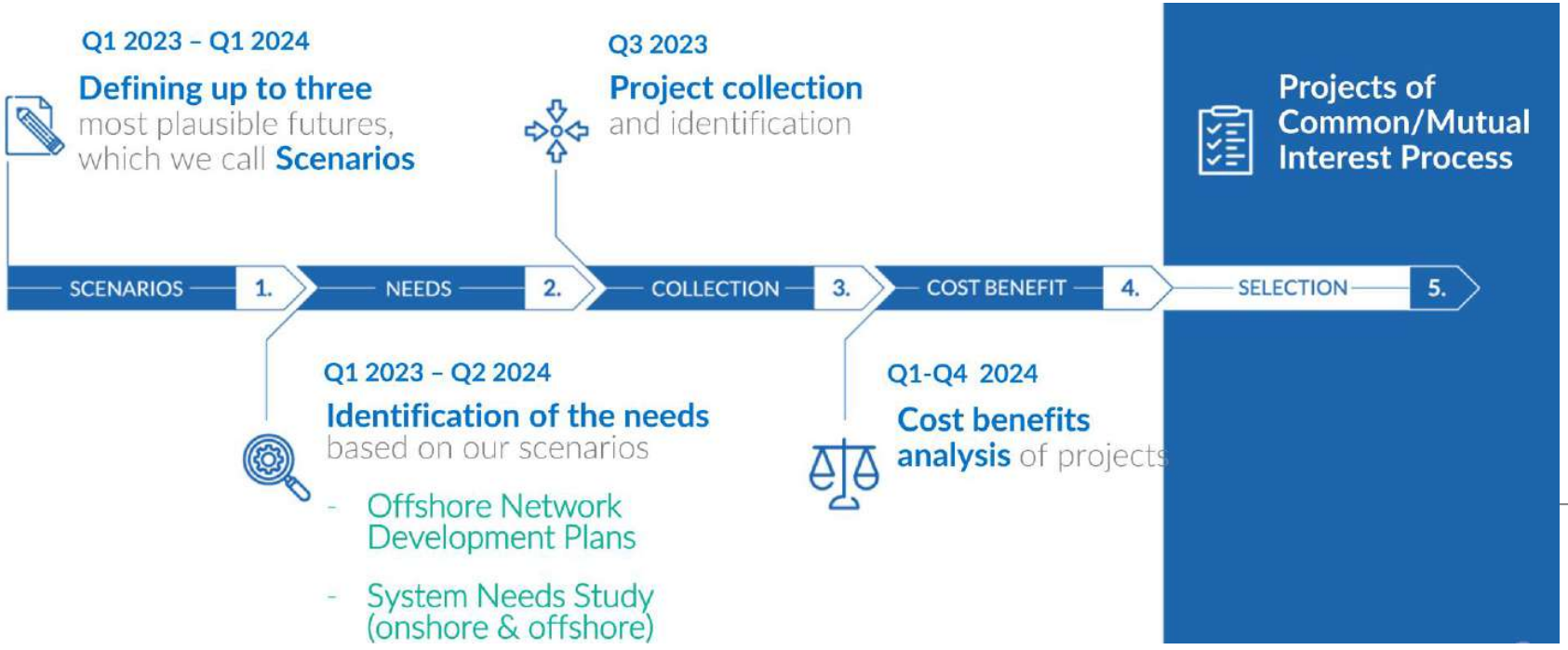
- **European electricity infrastructure development plan**
- **Links, supports and complements national grid development plans**
- Provides a wide **European vision** of the future power system
- Investigates how **power links and storage** can be used to make the energy transition happen in a cost-effective and secure way

- Ogni 2 anni
- Orizzonte di 10-20 anni
- *TYNDP 2024 in preparazione*



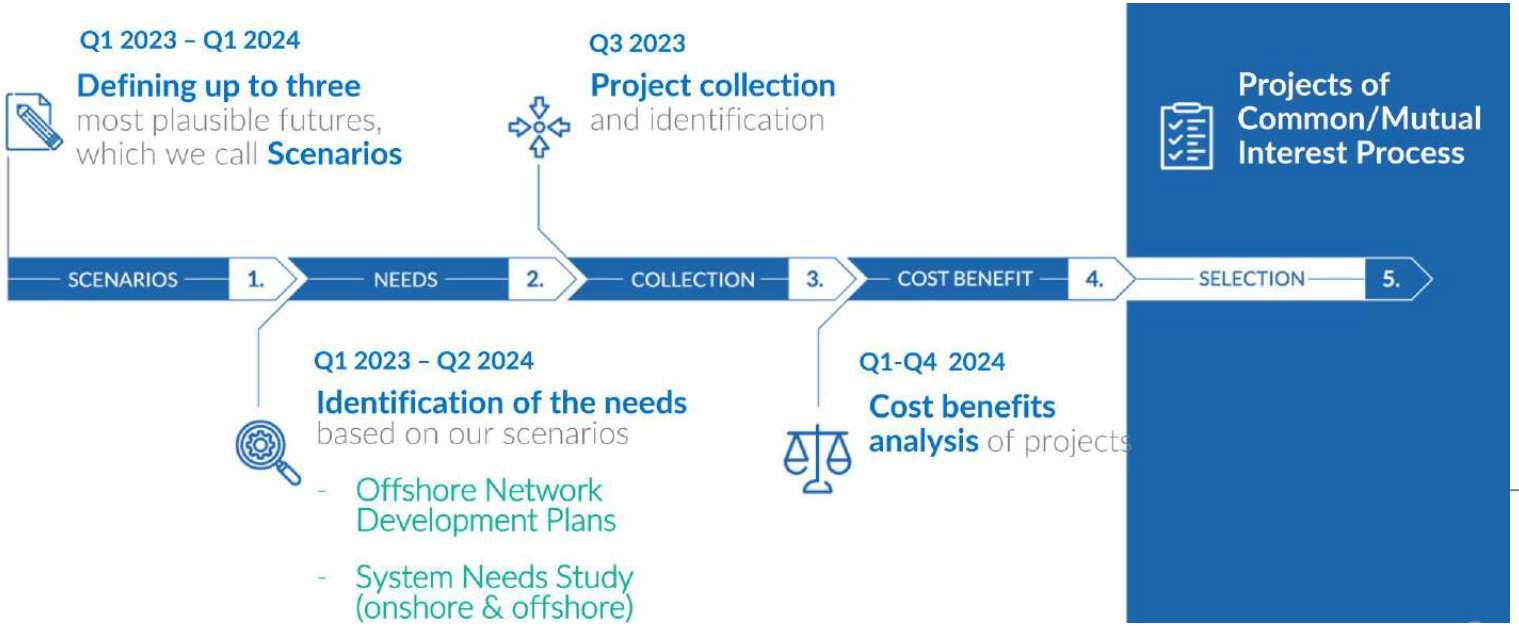
Ten-Year Network Development Plan (TYNDP)

- **Scenari** – ***possibili evoluzioni future del sistema*** – preparati congiuntamente con ENTSO-G
- **Impatti su mercati elettrici e rete: necessità di sviluppo**
  di capacità transfrontaliera, di accumulo o di generazione di picco
- **Raccolta** delle proposte
- **Cost-Benefit Analysis (CBA):** valutazione specifica di ogni progetto considerato nel TYNDP, nei diversi scenari
  - **TYNDP 2022: 141 progetti di trasmissione e 23 progetti di accumulo**



Ten-Year Network Development Plan (TYNDP)

- ENTSOG and ENTSO-E have identified that some projects have a direct impact on both gas and electricity side.
  - This is the case for example of projects integrating electrolysers with other infrastructural projects (e.g. project hubs integrating renewable production with electrolyser(s) + H2 pipeline(s) and/or electricity transmission line(s)).
- The TYNDP, in line with the above-mentioned Regulations, **does not currently include "Power to X"** candidate projects.
  - However, in the revised TEN-E Regulation (2022/869) the new energy infrastructure category 'Electrolysers' has been introduced, and can now apply for PCI/PMI status.

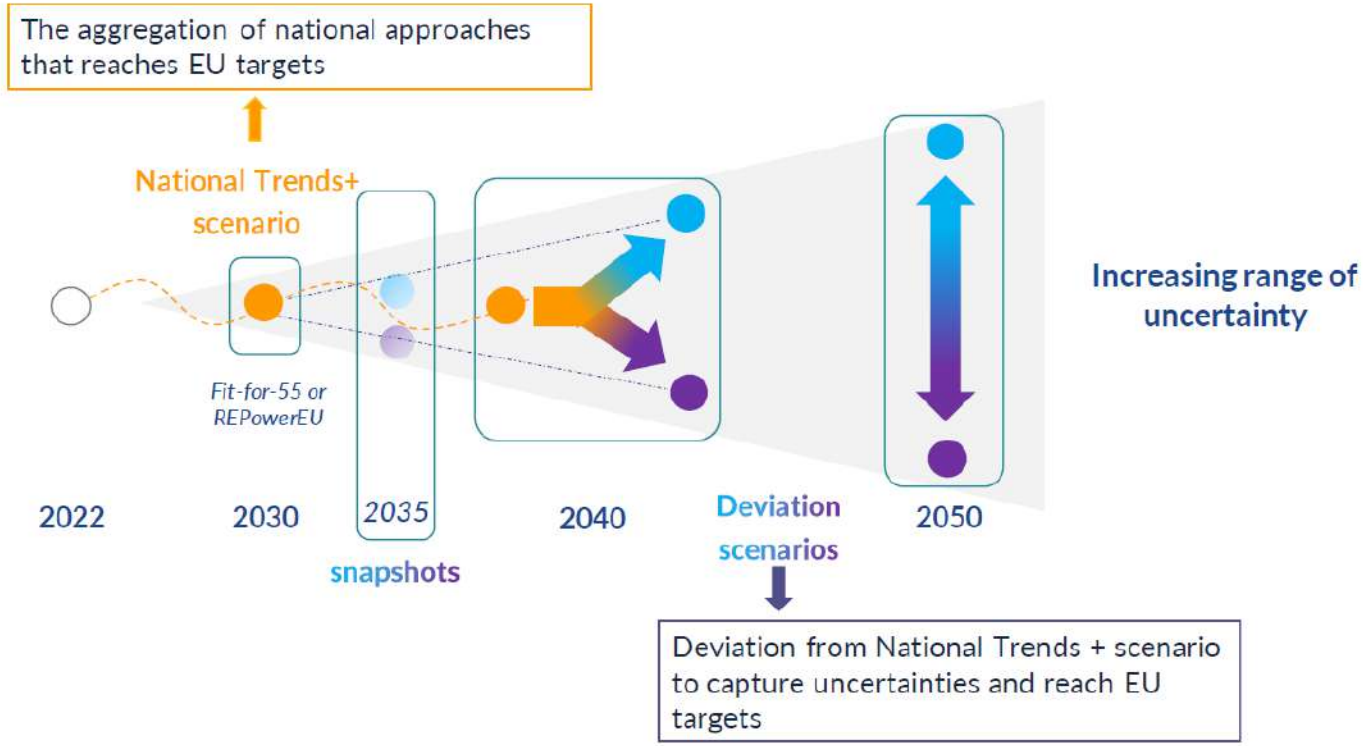


Scenari TYNDP 2024

- Uno scenario coerente con i NECP nazionali: “National Trends+”
  - 2030 e 2040
  - Tutti i vettori energetici
  - Non soggetto a consultazione
- Due scenari di “deviazione” dalle politiche nazionali:

  Distributed Energy (DE),
  Global Ambition (GA)
  - 2030, 2040 e snapshot 2035
  - Tutti i vettori energetici
  - Soggetti a consultazione

Totale
6 scenari



Source: ENTSO-E & ENTSOG Webinar on TYNDP 2024 Scenarios, 20/02/2023
Vd. anche TYNDP 2024 Scenarios Storyline Report

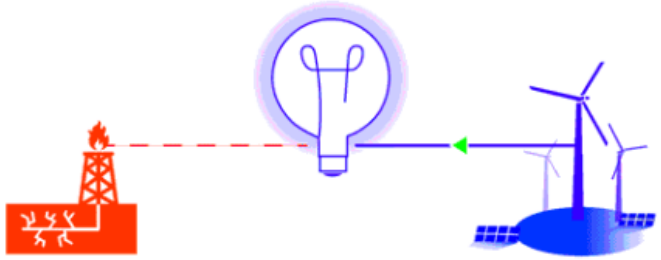
Needs da TYNDP 2022

2030: **64 GW of cross-border capacity increase** on over 50 borders, a 55% increase on the 2025 grid.
2040: **88 GW of cross-border capacity increase** after 2025 on over 65 borders (a 75% increase on the 2025 grid),
41 GW of additional storage in 19 countries and **3 GW of additional CO2-free peaking units** in 4 countries.
The 41 GW of storage capacity add up to the 126 GW of battery storage available in 2030.

All storage technologies combined, the total **storage capacity in 2040 amounts to 174 GW**.

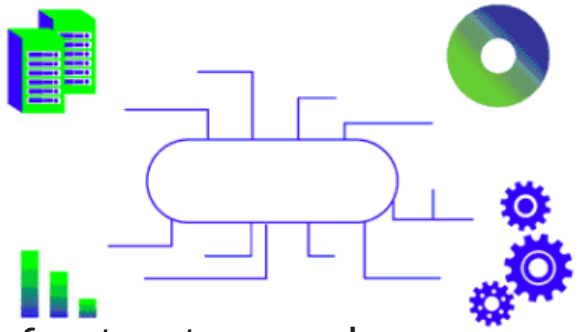
1. Opportunities for improving the power system exist all over Europe.

2. Addressing system needs reduces Europe's dependance on gas-based power generation



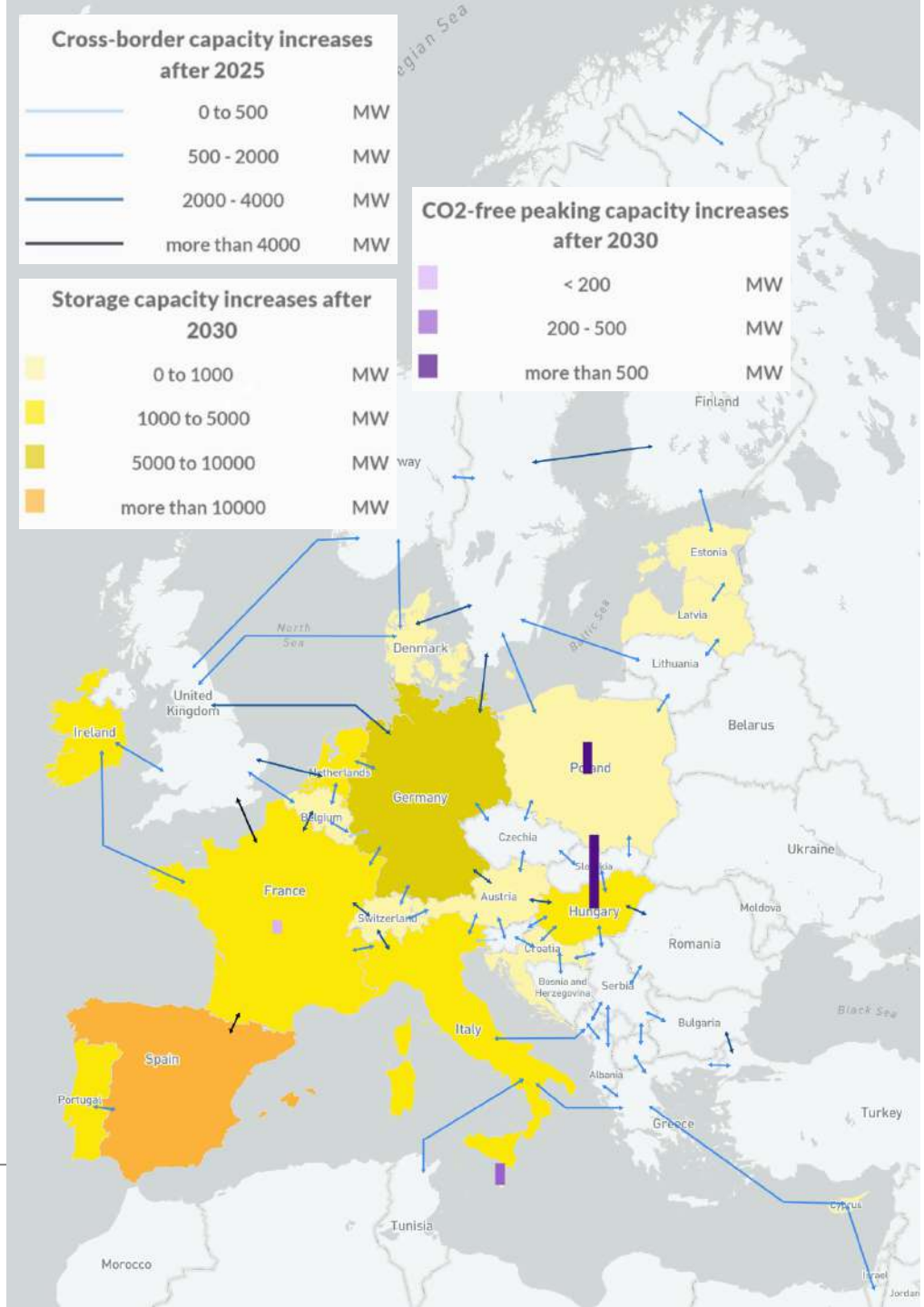
Addressing system needs reduces gas-based generation by 9 TWh by 2030 and 75 TWh in 2040 in the ENTSO-E area.

3. Coordinated planning will be needed across sectors.



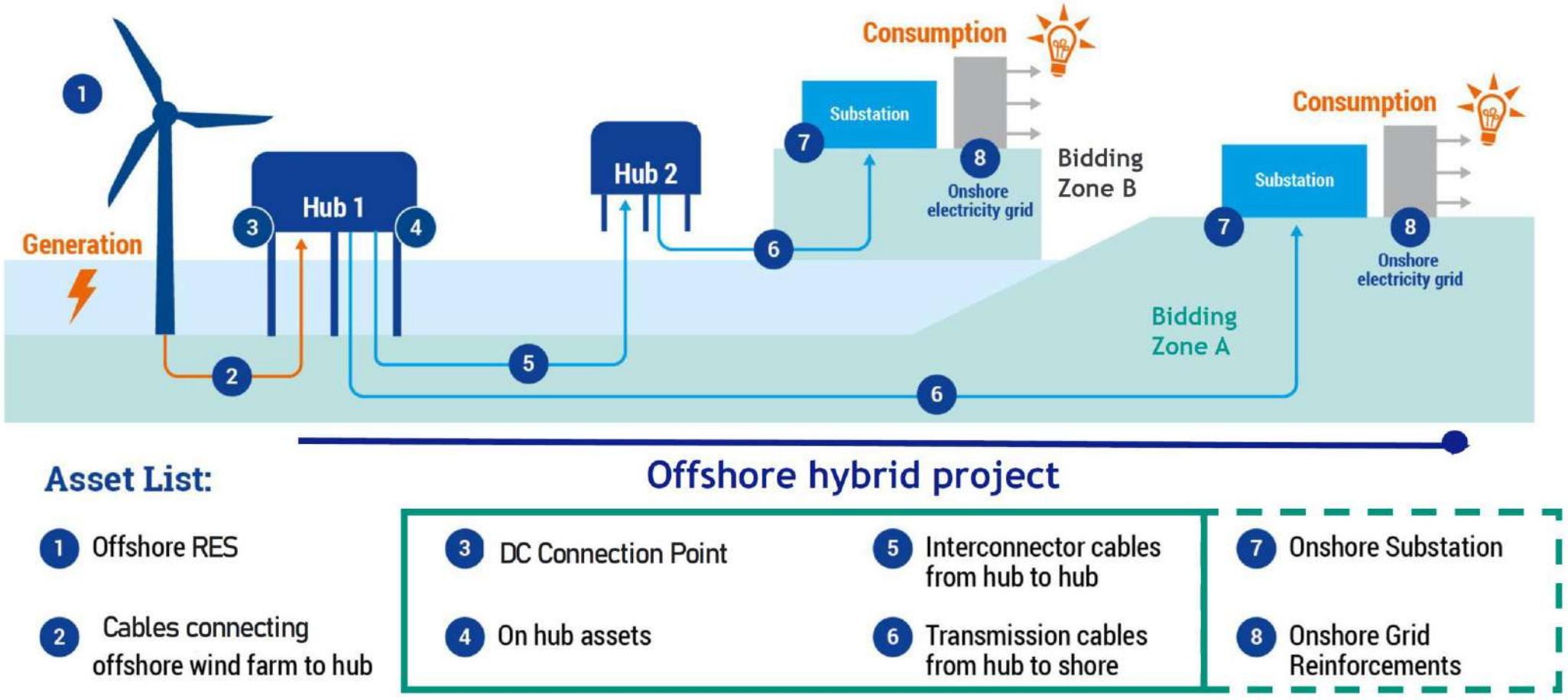
Infrastructure and non-infrastructure solutions such as dynamic line rating.

TYNDP 2022 Needs



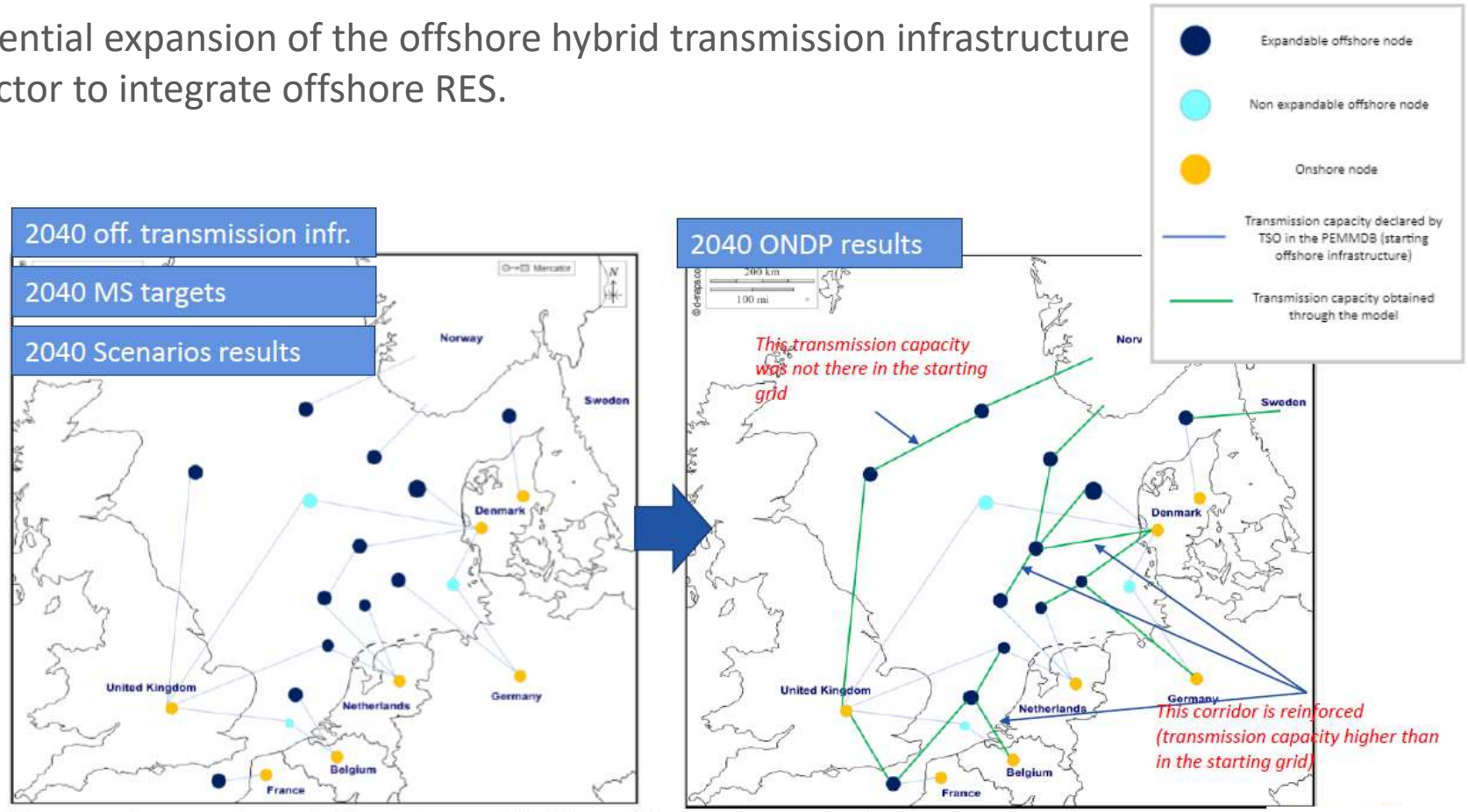
Offshore Network Development Plan (ONDP)

The expression "**offshore hybrid project**" refers specifically to the **transmission infrastructure** connecting **two countries** (or bidding zones) and connecting the Offshore Wind Farms (OWF) to shore.



Offshore Network Development Plan (ONDP)

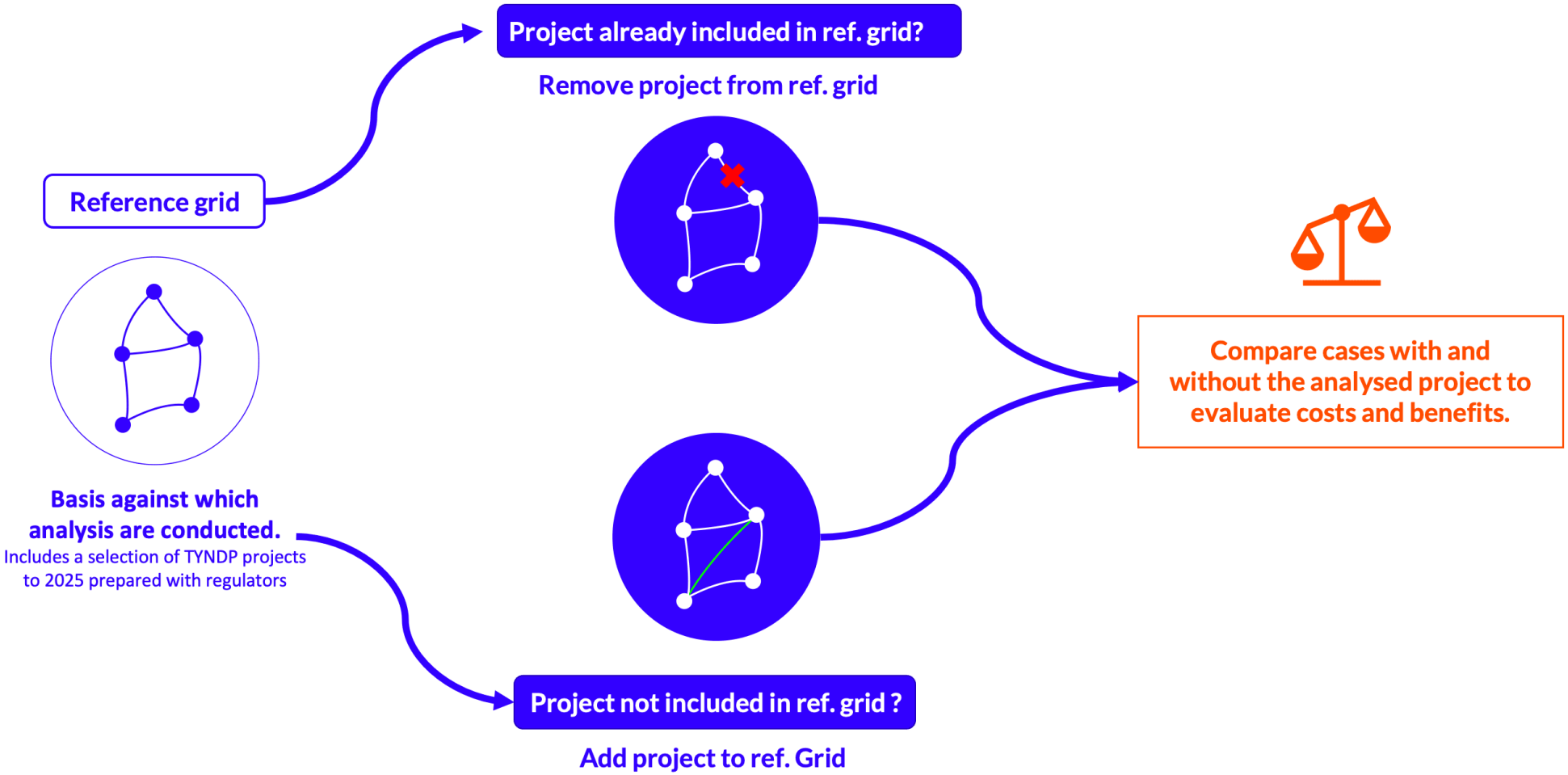
Explore the potential expansion of the offshore hybrid transmission infrastructure and interconnector to integrate offshore RES.



The map is a qualitative representation of the potential structure of the offshore model in the North Sea, not based on the real data under gathering

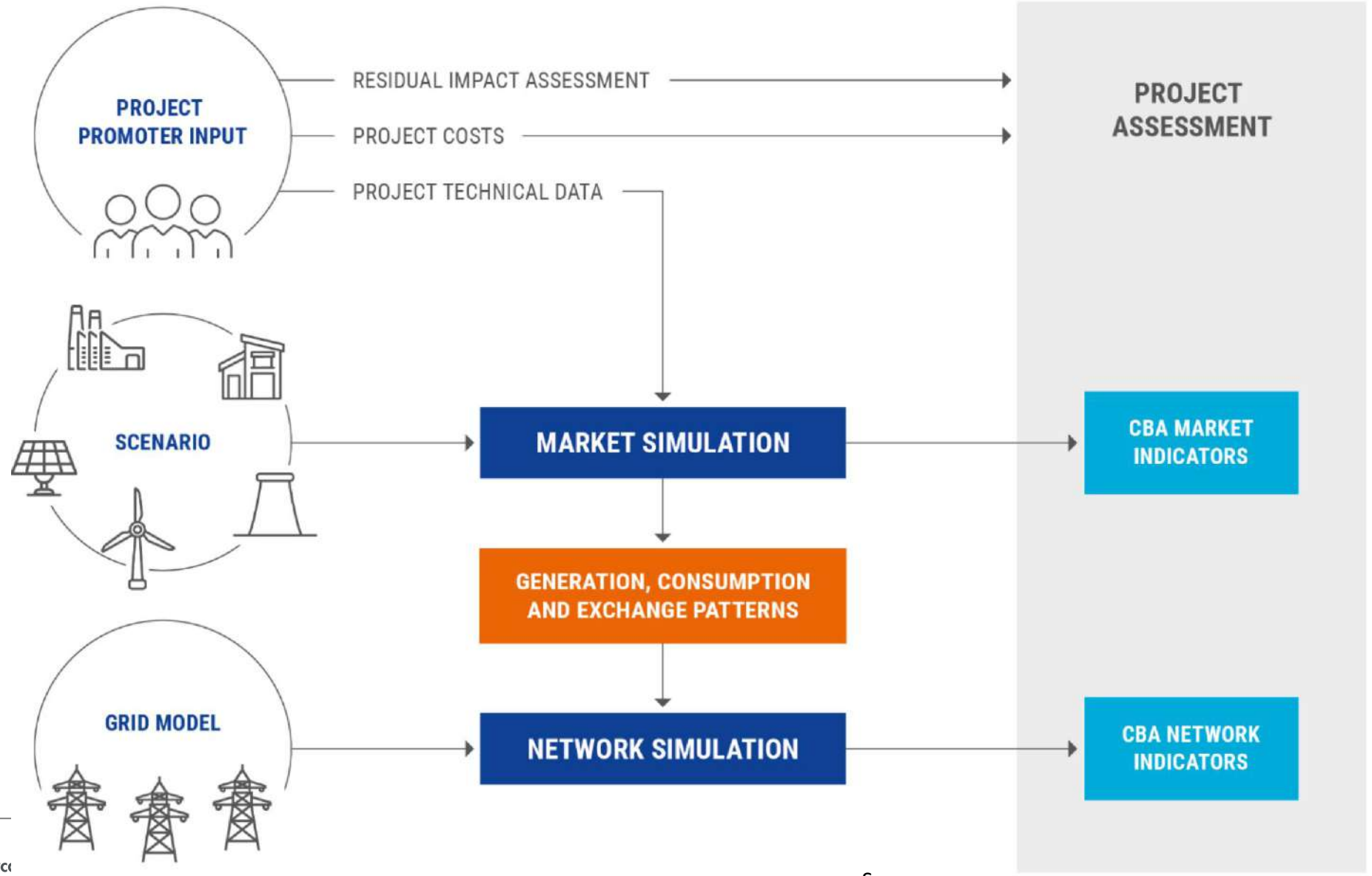
Valutazione dei progetti: Cost-Benefit Analysis (CBA)

Confronto “with and without”



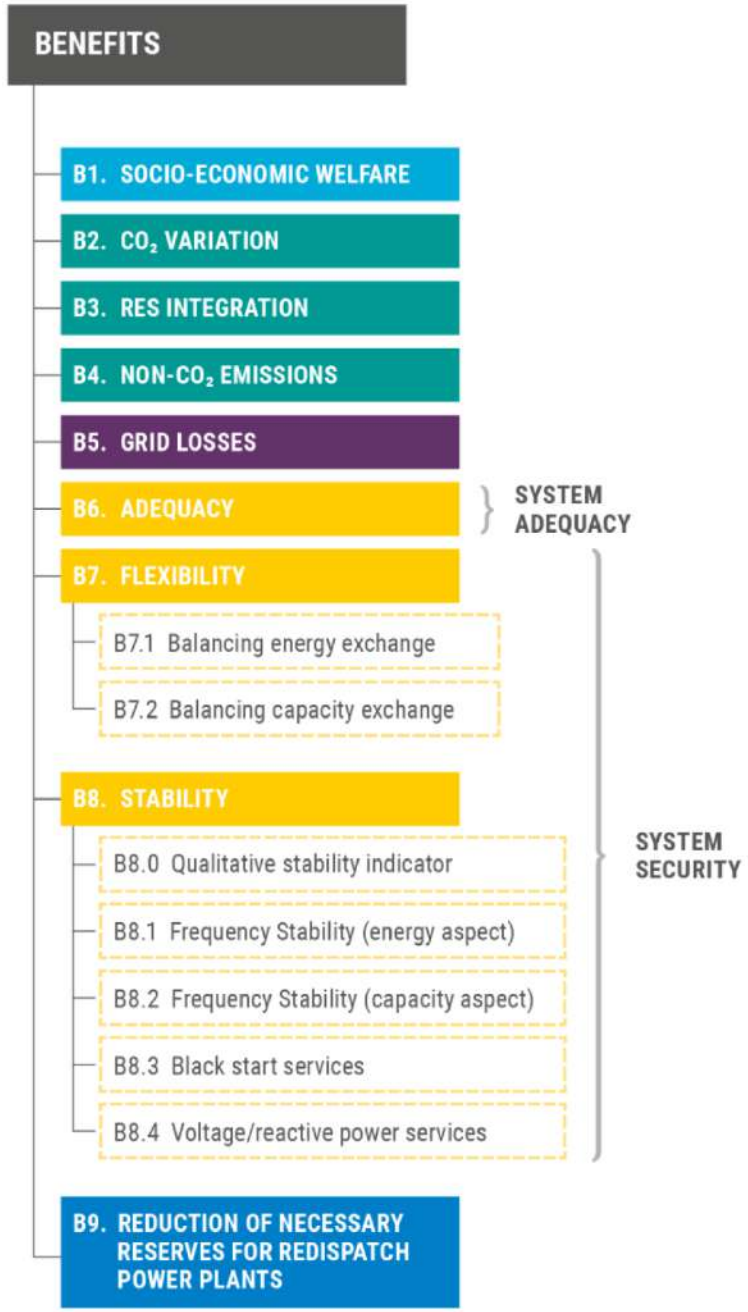
Source:
ENTSO-E IMPLEMENTATION GUIDELINES FOR TYNDP 2024

Valutazione dei progetti: Cost-Benefit Analysis (CBA)



Source:
ENTSO-E IMPLEMENTATION GUIDELINES FOR TYNDP 2024

Project assessment categories

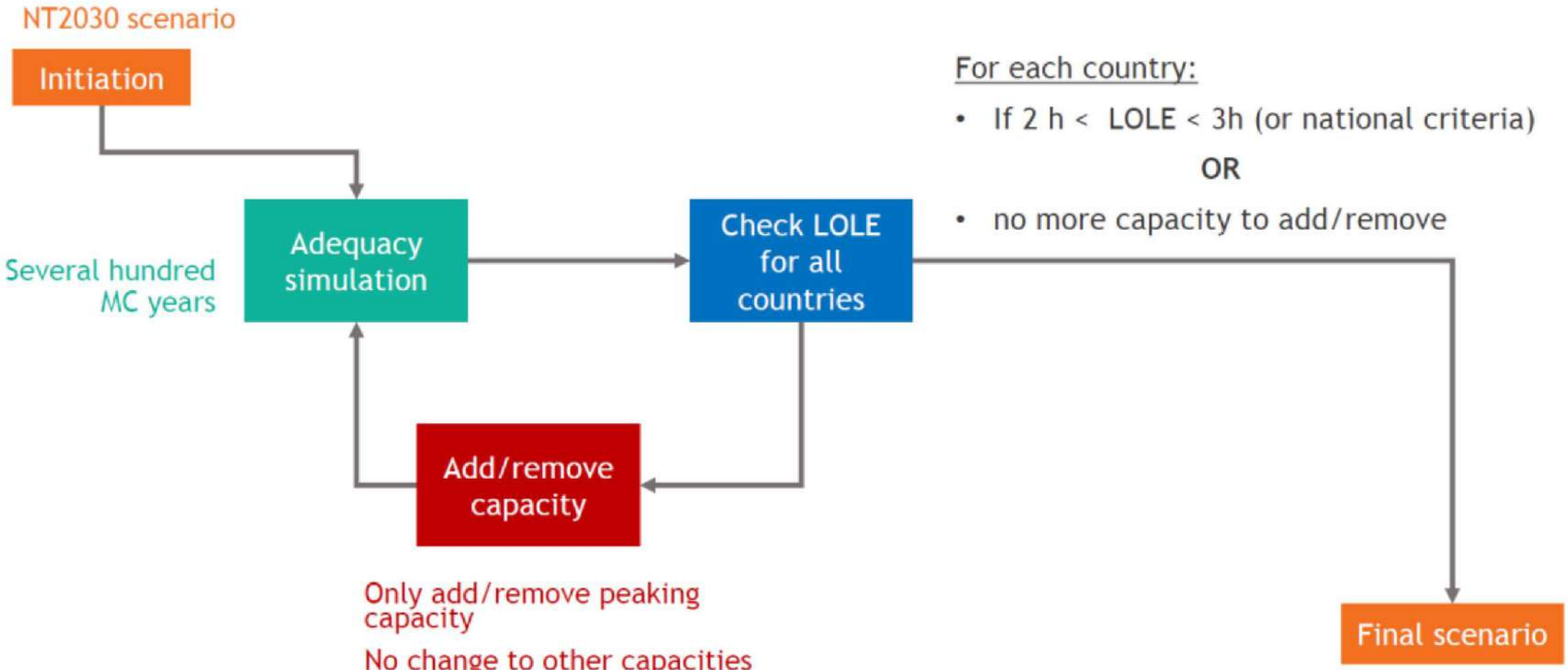


Non-mature

Non-mature

Source:
4th ENTSO-E Guideline for Cost Benefit Analysis of Grid Development Projects
Version 4.1 for ACER/EC/MS opinion
24 April 2023

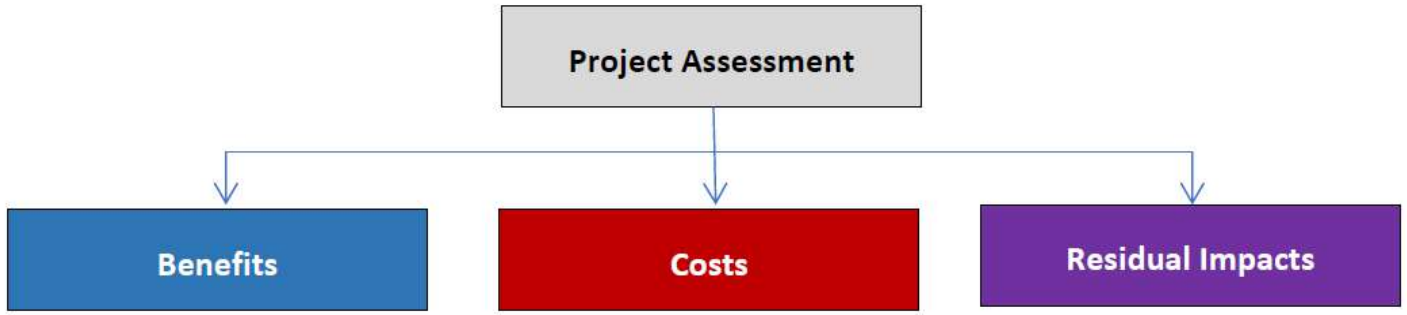
Valutazione dei progetti: obiettivi di adeguatezza



Processo per TYNDP 2022

Source:
ENTSO-E IMPLEMENTATION GUIDELINES FOR TYNDP 2024

Cost-Benefit Analysis (CBA)



Investment value calculation

- Net Present Value (NPV)
  - Must be positive
- Benefit-to-Cost Ratio (BCR)
  - Must be greater than 1

$$NPV = \sum_{t=t0}^{T} \frac{Benefit_t - Cost_t}{(1+r)^t}$$

$$BCR = \frac{\sum_{t=0}^{T} \frac{Benefit_t}{(1+r)^t}}{\sum_{t=0}^{T} \frac{Cost_t}{(1+r)^t}}$$

r = discount rate per annum
T = assessment period

Source:
4th ENTSO-E Guideline for Cost Benefit Analysis of Grid Development Projects
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24 April 2023

Slide addizionali

PCI & PMI

- **Projects of common interest** (PCIs) are key infrastructure projects aimed at **completing the European internal energy market** and help the EU to achieve its energy and climate objectives: delivering affordable, secure and sustainable energy for all Europeans while pursuing a climate-neutral economy by 2050.
- **Projects of Mutual Interest** (PMIs) are key cross-border energy infrastructure projects **between the EU and non-EU countries**, which contribute to the energy and climate policy objectives of the Union. This is a new category of projects that can be supported following the revision of the Trans-European Networks for Energy Regulation (TEN-E) in 2022.

Source: Questions and Answers on the new list of EU energy Projects of Common and Mutual Interest, 28 Nov 2023
https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_6048

PCI & PMI: benefici

1. priority status and streamlined permit granting procedures (a binding three-and-a-half year time limit);
2. improved, faster and better streamlined environmental assessment;
3. a single national competent authority (one-stop-shop) coordinating all permit granting procedures and specific points of contact for offshore grid projects;
4. a procedure enabling allocation of investment (construction) costs among Member States benefiting from a project on the PCI list;
5. eligibility for financial assistance under the Connecting Europe Facility (CEF) in the form of grants.
    - Obtaining the PCI/PMI status is a requirement for eligibility, but not a guarantee for EU funding under the Connecting Europe Facility (CEF).

TYNDP & PCI

- Electricity transmission, storage and hybrid projects shall be part of the latest available TYNDP to be eligible for inclusion in the Union list of PCIs
  - see **Regulation (EU) 2022/869** Annex III 2.(3)
  - *A hybrid project is a project that serves a dual functionality of electricity interconnectors and connecting renewable generation*
- The PCI selection is a process separate from the TYNDP process, under the responsibility of the EC Regional Groups led by the European Commission.
- PCI candidates are evaluated based on the assumptions, analysis and methodology developed in the TYNDP
- Objectives of the verification:
  - Fulfilment of the **eligibility criteria** defined in article 4 of Regulation (EU) 2022/869
  - Assessment of their significant **contribution** to the energy infrastructure priorities of the European Union

Scenari TYNDP 2024

National Trends+ scenario

- The NT+ scenario developed based on the TSOs data in accordance with the anticipated NECPs (as TSOs best estimate), whose draft versions are to be published in summer 2023.
- This scenario will be created for the 2030 and 2040 time horizons, but not for 2050 because datasets for the 2050 time horizons are not available in all countries.
- This scenario should be compliant with the latest EU targets and include the non-binding agreements between EU Member States, and this requires the inclusion of all energy carriers.
- If there is a gap between the EU targets and this scenario, this gap will be transparently presented and closed according to the 'gap filling methodology' under public consultation in July 2023.

The Deviation Scenarios (DE and GA):

- These scenarios are deviations from the NT+ 2030 scenario according to their respective storylines. Therefore, they require a Storyline Update Process.
- These scenarios will be created for the 2040 and 2050 time horizons (2030 NT+ is the starting point). In addition, the 2035-time horizon will be reported as a snapshot.
- These scenarios will be compliant with EU targets. For 2035 and 2040, a meaningful transition from 2030 EU targets is sought, while for 2050 reaching carbon neutrality is mandatory.

Scenari TYNDP 2024

	DISTRIBUTED ENERGY HIGHER EUROPEAN AUTONOMY WITH RENEWABLE AND DECENTRALISED FOCUS	GLOBAL AMBITION GLOBAL ECONOMY WITH CENTRALISED LOW CARBON AND RES OPTIONS
GREEN TRANSITION	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	
DRIVING FORCE OF THE ENERGY TRANSITION	Transition initiated on local/national level (prosumers)	Transition initiated on a European/international level
	Aims for EU energy-independence and strategic independence through maximisation of RES and smart sector integration (P2G/P2L/P2M)	High EU RES development supplemented with low carbon energy and diversified imports
ENERGY INTENSITY	Reduced energy demand through circularity and better energy consumption behaviour	Reduced energy demand with priority is given to decarbonisation and diversification of energy supply.
	Digitalisation driven by prosumer and variable RES management	Digitalisation and automation reinforce competitiveness of EU business.
TECHNOLOGIES	Focus of decentralised technologies (PV, batteries, etc) and smart charging	Focus on large scale technologies (offshore wind, large storage)
	Focus on electric heat pumps and district heating	Focus on a wide range of heating technologies, e.g., hybrid heating technology
	Higher share of EV, with e-liquids and biofuels supplementing for heavy transport	Wide range of technologies and energy carriers across mobility sectors (electricity, hydrogen, e-liquids and biofuels)
	Minimal CCS and nuclear	Integration of nuclear and CCS

Needs vs. CBA

- The **System Needs** study looks at where action is needed: where the flow of electricity could be improved across Europe, to reach decarbonisation targets and keep security and costs under control.
- It consists in an economic optimization exercise, looking at the combination of needs that maximises benefits (in terms of reduced curtailment of renewable energy, improved security of electricity supply…) while minimising system costs.
- The **System Needs study** therefore **considers the European electrical system in its entirety, from a global point of view**, while the **cost-benefit analysis of projects evaluates each project individually** by assessing its specific impact on the overall system.
- Identifying solutions to address the needs is up to project promoters, who may propose their projects for assessment in the TYNDP. ENTSO-E then performs a cost-benefit analysis, looking at how individual projects perform on multiple indicators, including how the project impacts socio-economic welfare, security of supply, impact on reduction of CO2 emissions, integration of renewable energy sources, frequency stability

Optimisation in the Scenarios, ONDP and System Needs aims to answer different questions

TYNDP Scenarios

"What would the European Energy System look like in the storylines "Distributed Energy" or "Global Ambition" in 2040 / 2050 ?"

The optimiser can invest in generation, infrastructure, DSR, flexibility measures etc. All-in-one optimization (however, offshore hybrids were so far not part of the identification process).

TYNDP ONDP

"What does it take to integrate ~360 GW / ~ 480 GW of offshore RES in 2040 and 2050 ?"

-> Distributed Energy 2040&2050

The optimiser is only allowed to invest in offshore infrastructure. All other parameters remain locked in this first edition. Implications on the onshore systems will be part of the TYNDP 2024 System needs study.

TYNDP System Needs

"Where could the onshore and offshore energy system be made more economically efficient ?"

-> National Trends 2030&2040, Distributed Energy 2050

The optimiser can invest in transmission, storage, peaking capacity and offshore hybrid (ONDP output).

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Residual impact

Residual impact indicators refer to the impacts that remain after impact mitigation measures have been taken. Hence, impacts mitigated by additional measures should no longer be listed in this category. The indicators are defined as follows:

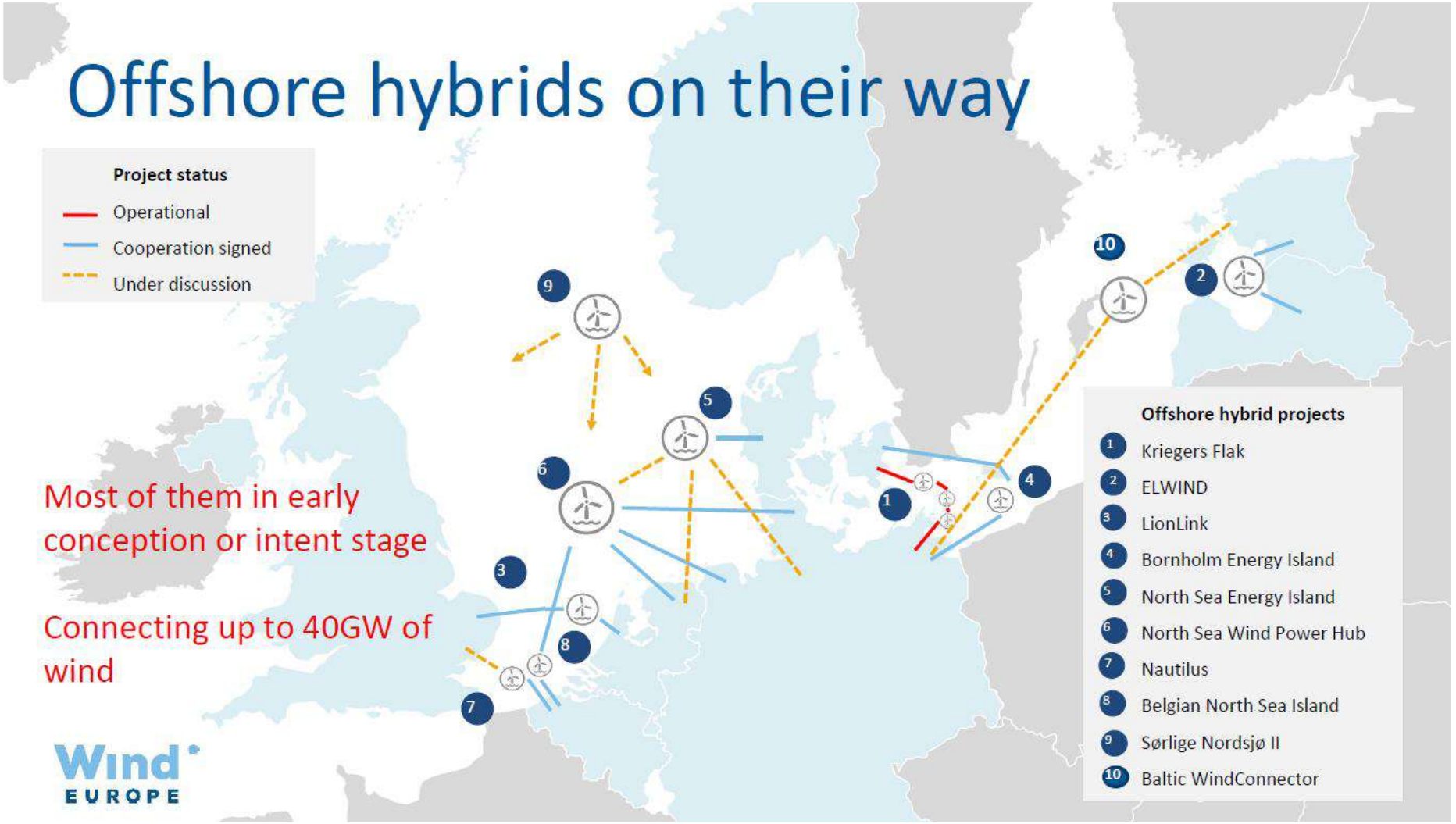
- **S1. Residual Environmental impact** characterises the (residual) project impact on the environment, as assessed through preliminary studies, and aims to provide a measure of the environmental sensitivity associated with the project.
- **S2. Residual Social impact** characterises the (residual) project impact on the (local) population affected by the project, as assessed through preliminary studies, and aims to provide a measure of the social sensitivity associated with the project.

As it is not always possible to (fully) mitigate certain negative effects, the indicators 'social impact' and 'environmental impact' are used to:

• Indicate where potential impacts have not yet been internalised, i.e. where additional expenditures may be necessary to avoid, mitigate and/or compensate for impacts, but where these cannot yet be estimated with sufficient accuracy for the costs to be included in indicator C1; and

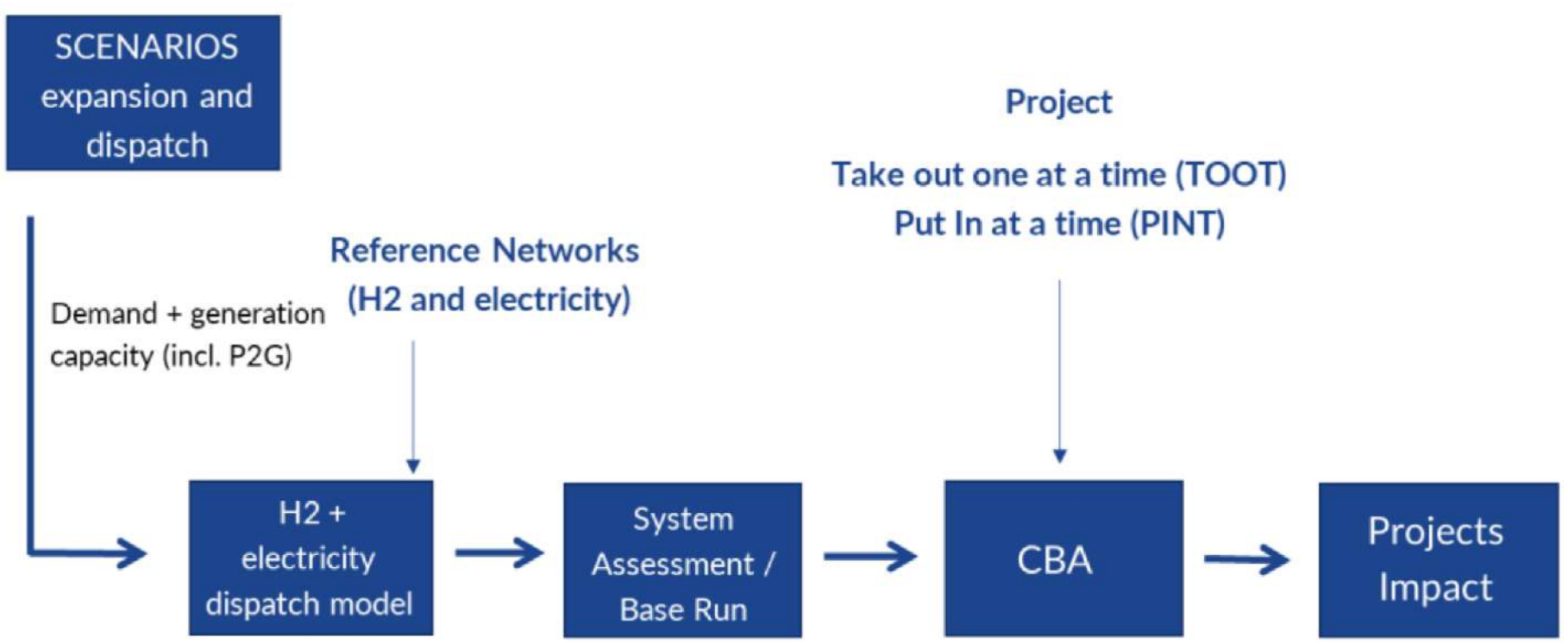
• Indicate the *residual* social and environmental effects of projects, i.e. effects that may not be fully mitigated in the final project design and cannot be objectively monetised.

Source: ENTSOE CBA 4.0 Guideline



Source: ENTSOE, Delivering the European Offshore Electricity System, Public workshop | 06 June 2023 | Brussels

Valutazione dei progetti



Sector Specific Indicators

- B3: RES Integration
- B4: Non-CO2 Emissions
- B5: Grid Losses
- B6: Adequacy
- B7: Flexibility
- B8: Stabiliity
- B9: Redispatch Reserves

Energy System-Wide Indicators

- B1: Global socio-economic welfare
- B2: CO2 Variation

Source:
ENTSO-E IMPLEMENTATION GUIDELINES FOR TYNDP 2024