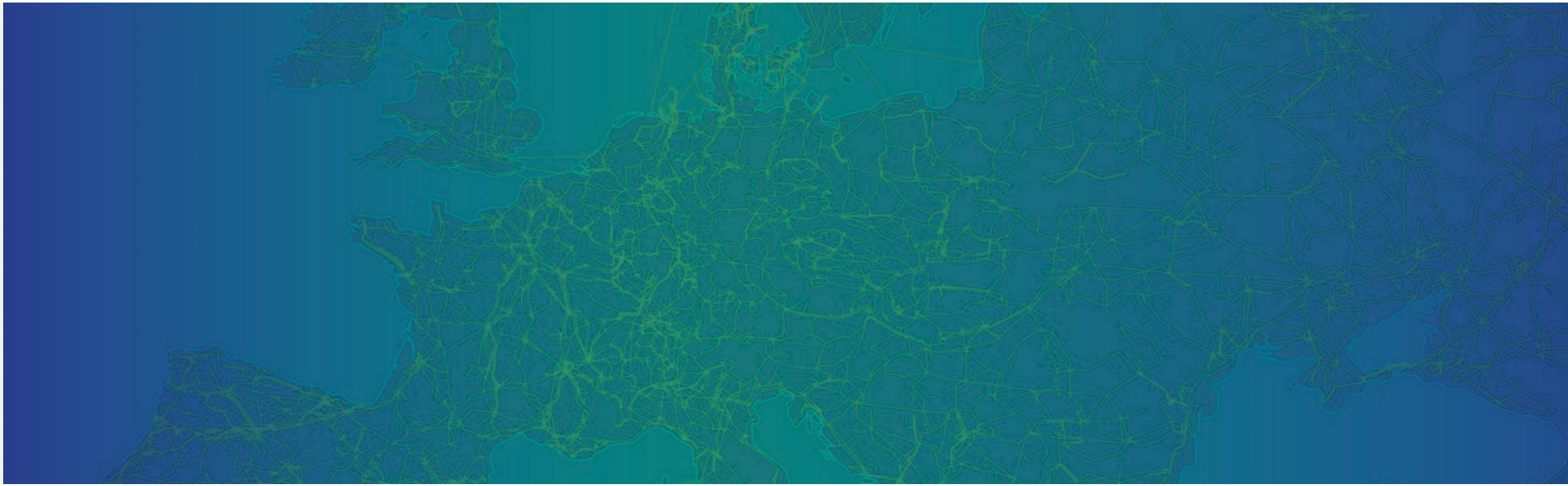
Identification of future energy system needs in TYNDP 2022

Methodology, key assumptions and outputs

Online workshop – 14 October 2021



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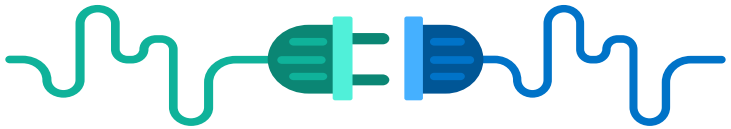
Agenda

Introduction: about power system needs in ENTSO-E's Ten-Year Network Development Plan – Patricia Labra, REE

Identification of system needs in TYNDP 2022: proposed key assumptions and methodology – Mamadou Lo and Arthur Burlin, Rte

Q & A
Moderation: Jean-Baptiste Paquel, ENTSO-E

The Identification of System Needs (*IoSN*) Study



What are power system needs?

System needs show borders / areas where new solutions are needed to reach **decarbonization targets** and **keep security under control**

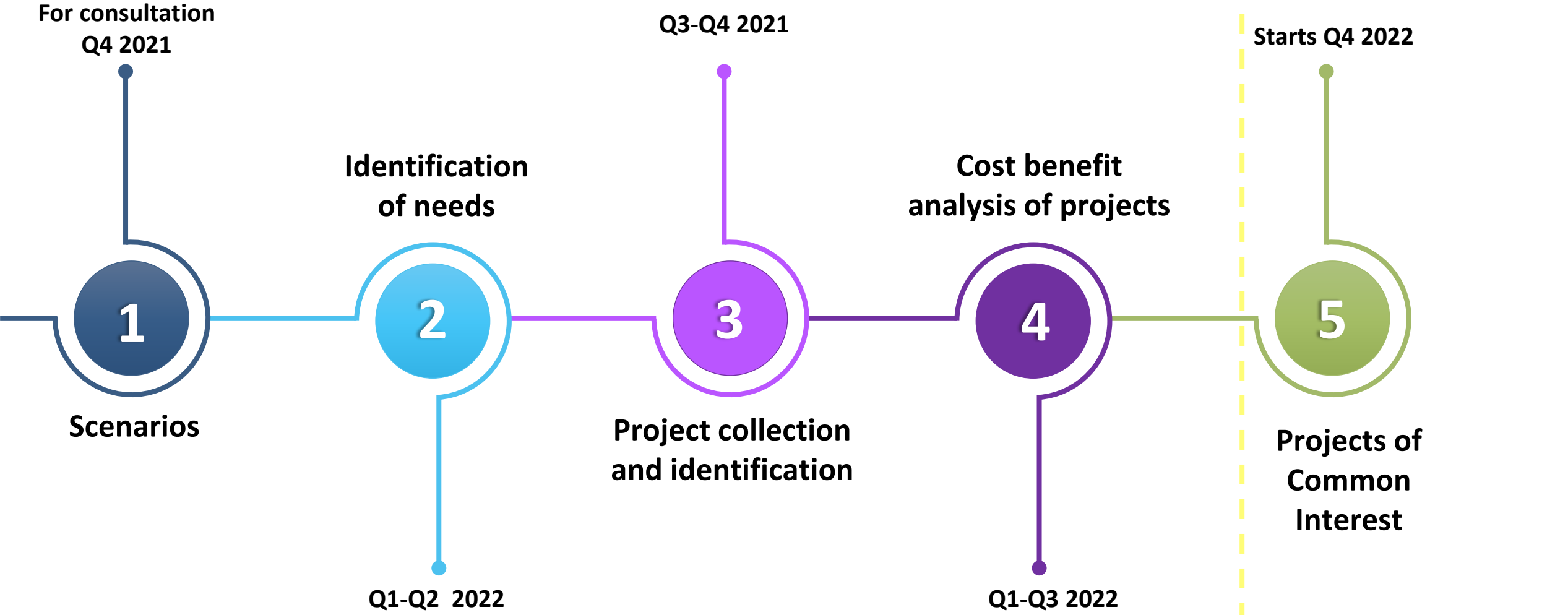
ENTSO-E's system needs study:

- ✓ Investigates where improving the electricity flow throughout Europe would be the most cost-efficient from a pan-European perspective
- ✓ Is carried out by ENTSO-E biannually and forms part of the **TYNDP package**

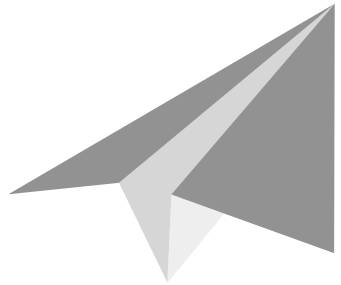
The TYNDP process

TYNDP process

Projects of Common Interest process



From System Needs to solutions



1 Identify **economically viable interconnectors** within a set scenario

2 Viable links prove the existence of at least **one more beneficial configuration**

3 Identified Needs are used by project promoters to **explore, propose and justify solutions**

Increased transmission capacity	**Storage**	**Generation**	**Hybrid offshore projects**	**Smart grids/ sector integration**	**Power to gas**	**?**

System needs in the TYNDP 2020 package

Power system needs

At pan-European level:

- Completing the map report
- At a glance
- System dynamic and operational challenges

At regional level:

- Regional investment plans
- 2030 Needs Briefs per PCI Corridor

At country level:

- Country factsheets

All reports (2020) are available here: System needs - TYNDP (entsoe.eu)

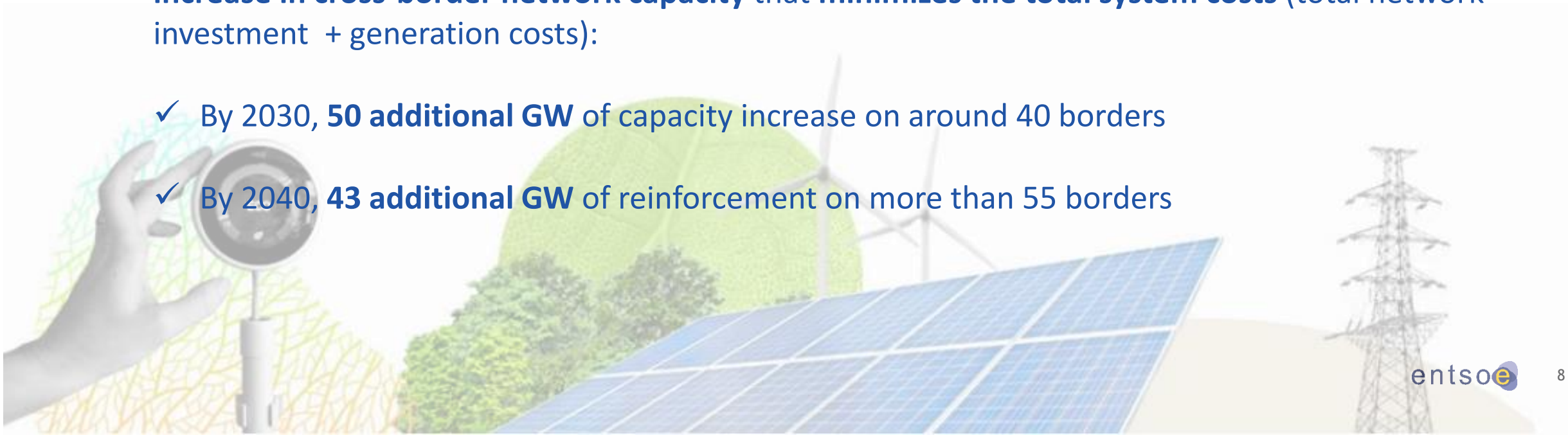
Overview of identified system needs in 2030 and 2040 in TYNDP 2020

The Study finds future needs based on the **National Trends scenario**

To reflect the commitments of Member States to meet the targets set by the European Union in term of efficiency and GHG emissions reduction for the energy sector

To analyze system needs by 2030 and 2040 , ENTSO-E determined the **combination of potential increase in cross-border network capacity** that **minimizes the total system costs** (total network investment + generation costs):

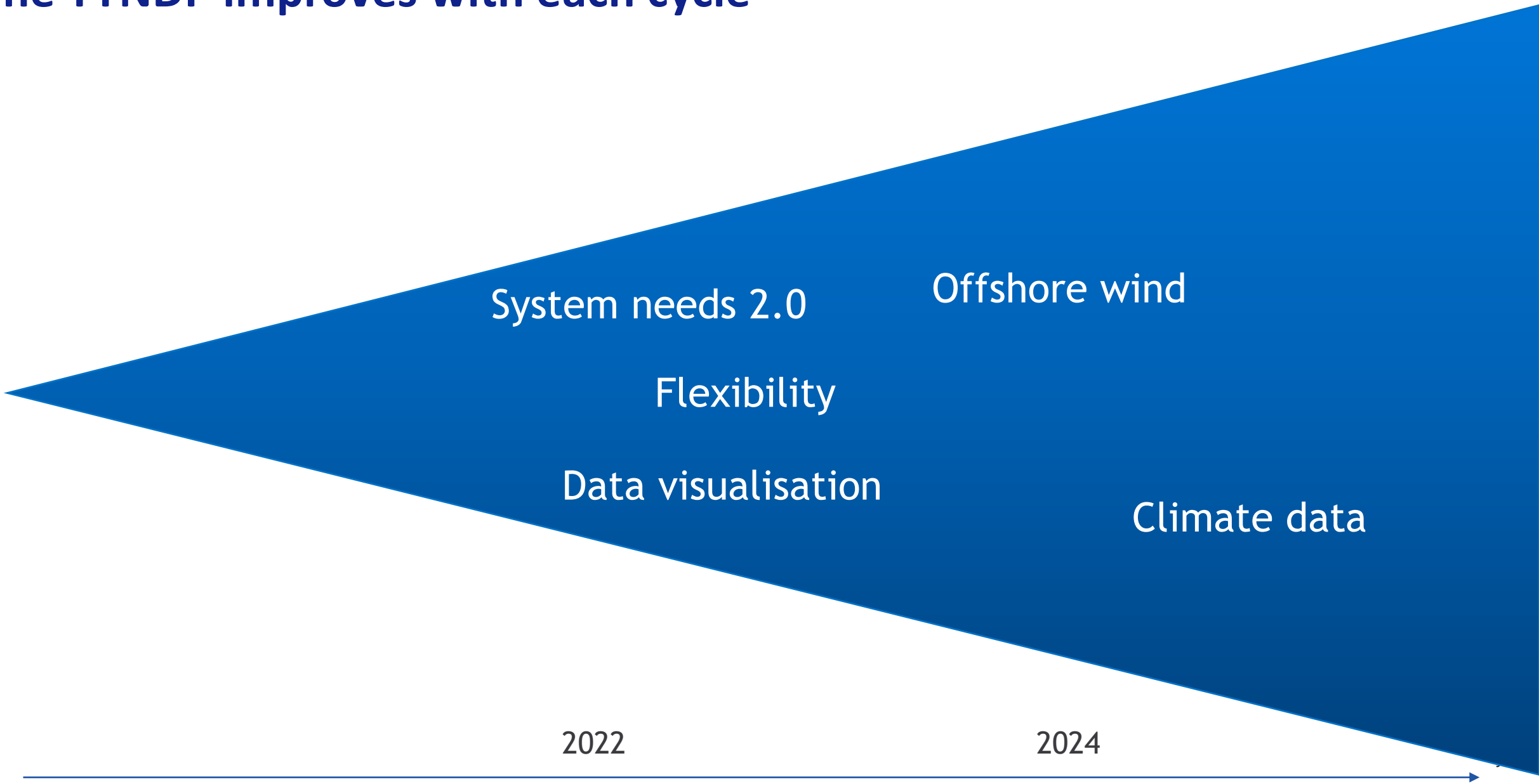
- ✓ By 2030, **50 additional GW** of capacity increase on around 40 borders
- ✓ By 2040, **43 additional GW** of reinforcement on more than 55 borders



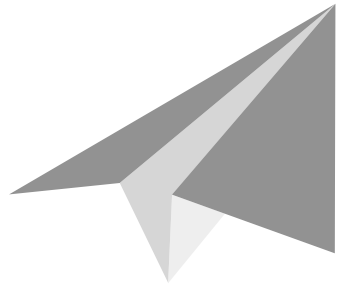
Main stakeholders comments on system needs in TYNDP 2020

- The analysis was performed on only one scenario
- Only one climate year was used (2007, a wet year)
- The methodology failed to capture the full benefits of hybrid offshore infrastructure
- The TYNDP 2020 package contained many reports on system needs, at pan-European, regional and country level, making it difficult for stakeholders to find the information they need

The TYNDP improves with each cycle



What's the purpose of today's Online Workshop?



1. Collect **stakeholders' comments** on the proposed methodology of the IoSN study

2. Improve the IoSN methodology in the **coming TYNDP 2022** and in view of future editions of the study

3. Enable project promoters to use identified needs to **explore, propose and justify solutions**

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Identification of System Needs in TYNDP 2022 – Proposed key assumptions and methodology

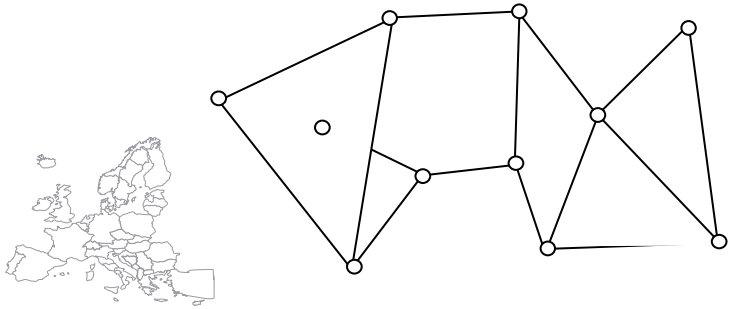
What is meant by ‘identification of system needs’ in the TYNDP?

- Identified system needs are **grid reinforcements and flexibility solutions** which aim at **value maximization**, ensuring **continuous access to electricity** and **deliver on the climate agenda in Europe**.

- System needs give a broad vision of **flexibility development opportunities** for **2030 and 2040 time horizons** by means of co-optimization considering mutual influences between different investment opportunities (transmission, flexibilities).

What is meant by ‘identification of system needs’ in the TYNDP?

Starting point



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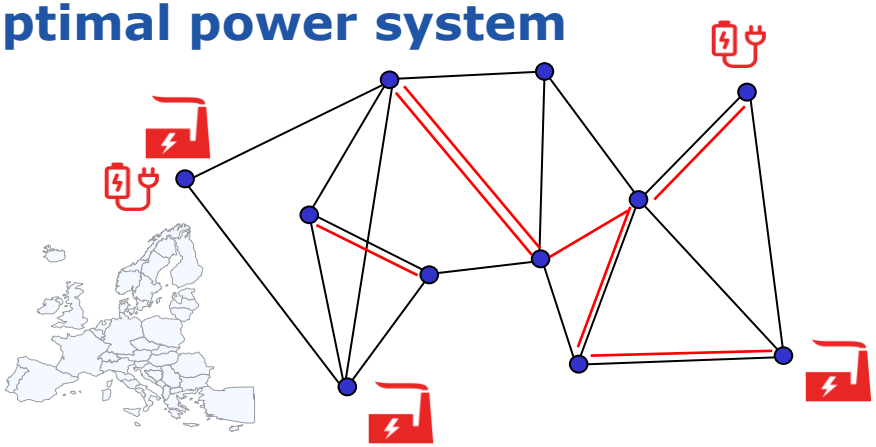
Minimum
[operational costs + investment costs]

Optimal power system



Investment candidates

Cross-border grid 1 : a MW / x M€
Cross-border grid 2 : b MW / y M €
Flexibility 1 : c MW / z M€
Flexibility 2 : d MW / q M €
…
…

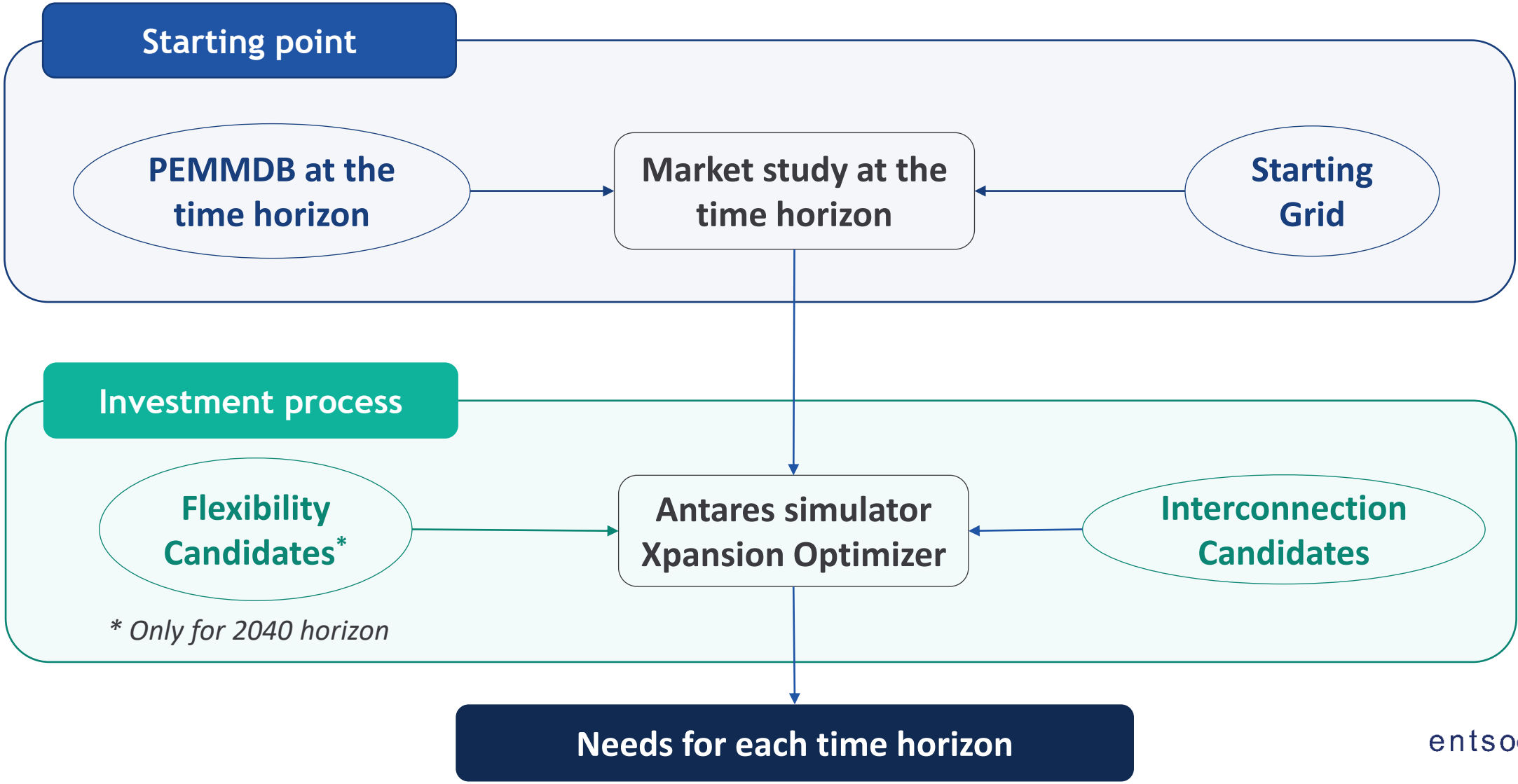
Cross-border grid 1 : invested in
Cross-border grid 2 : not invested in
Flexibility 1 : not invested in
Flexibility 2 : invested in
…

The Investment Optimization Tool

Computes optimal list of investment needs that minimizes the total system cost over a long-term planning horizon

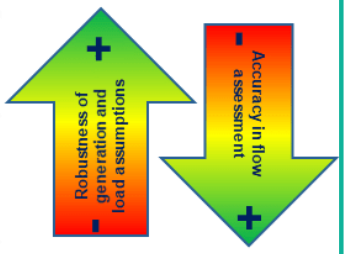
- Antares is a Monte-Carlo software for power systems analysis, **one of 7 software tools used by ENTSO-E in TYNDP CBA process**
- Designed to perform generation / load balance studies (adequacy)
- Can perform economic assessment of generation and transmission projects
- Antares simulates the operation of large interconnected systems, with a time span of one year and time resolution of one hour
- Can survey a large number of possible combinations of load and generations patterns
- Developed by RTE France, open-source
- The Xpansion module to be used in the study
- It minimizes investment and operational costs to suggest an economically optimized portfolio of European projects

Global Identification of System Needs study workflow

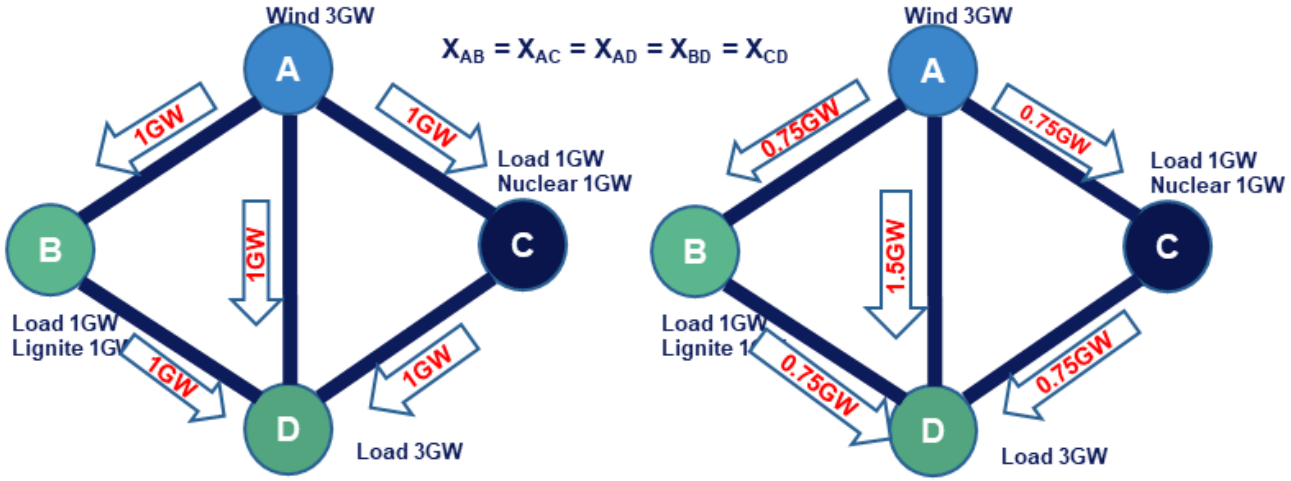


NTC & zonal market models

	Nodes / zones	Capacities	Binding constraints	Results
NTC Model	1 per country	Cross-border	None / specific	Copper plates connected by HVDC's
Zonal Model	N per country	Cross-border	Kirchhoff's mesh rule (+ specific)	Copper plates connected by AC grid → closer to flow-based functioning



Zonal (= Equivalent grid) vs. NTC: Example



$X_{AB} = X_{AC} = X_{AD} = X_{BD} = X_{CD}$

NTC model

$Capa_{AB} = Capa_{AC} = Capa_{AD} = Capa_{BD} = Capa_{CD} = 1GW$

Zonal model

The same generation dispatch would overload link AD → other optimum to be found

In case of NTC and Zonal approach:

- The needs will be identified cross border
- The challenges of the scenarios will be identified with a copperplate simulation → Compliant with each time horizon
- The same methodology/software Tool (except investment candidates types) will be used in the optimization process
- The same interconnection candidates will be used both for 2030 and 2040 horizons

Improvements in TYNDP 2022: Investment candidates

In TYNDP 2020, IoSN process investigated only interconnection candidates. In TYNDP 2022, flexibility candidates are planned to be included in the 2040 horizon.

	Interconnectors	Storage flexibility	Peaking flexibility
IoSN 2030 - Zonal	✓		
IoSN 2040 - NTC	✓	✓	✓

Starting point	2025 grid	National Trends 2030	National Trends 2030

- ✓ For IoSN on 2040 horizon, interconnectors, storage flexibilities and peaking flexibilities will be used as investment candidates.
- ✓ Only 1 type of investment candidates for the 2030 horizon because of the significant complexity to implement additional investment types in the zonal model

In more details – Introduction of flexibilities in IoSN 2040

- ✓ Additional investment candidates in IoSN 2022 are planned to include storage and peaking needs
- ✓ Storage and peaking flexibility assumptions will be aligned with those used to develop TYNDP 2022 draft Scenarios
- ✓ Storage needs will represent hydro pump and battery storage investment candidates
- ✓ Peaking flexibilities are planned to be carbon-free

Expected output: an optimal power system in 2040 with needs for transmission capacity increases on borders, and storage and peaking units needs per country

Improvements in TYNDP 2022: Climatic years

In TYNDP 2020 IoSN process, only 1 climatic year was used in market simulations. In TYNDP 2022 it is planned to use more climatic years.

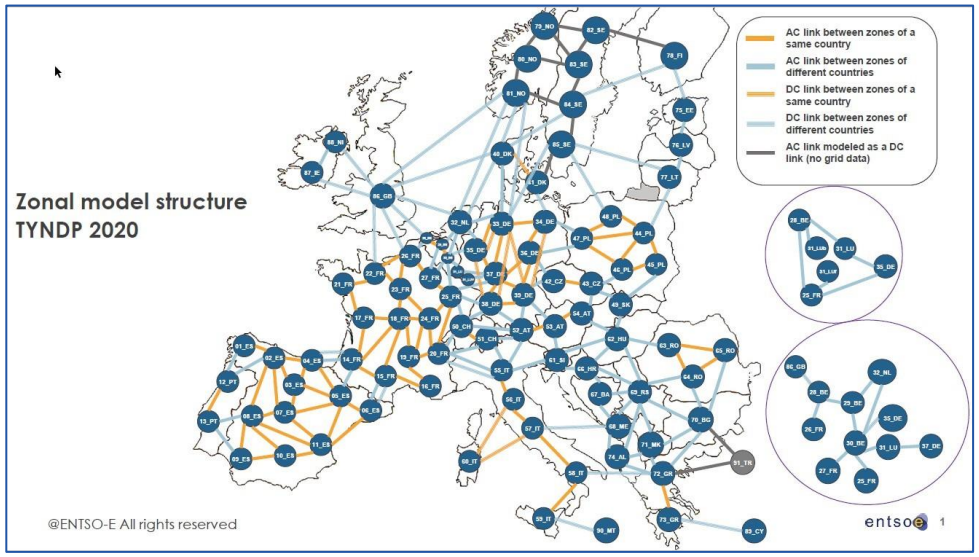
	1 Climatic Year	3 Climatic Years	10 Climatic Years
IoSN 2040 - NTC			✓
IoSN 2030 - Zonal	✓	?	

- ✓ ENTSO-E plans to use 1 climatic year for 2030 Zonal IoSN study, because of the significant increase in modelling and simulation time with each additional climatic year used for the Zonal Model preparation.

- ✓ For the 2040 horizon, ENTSO-E plans to use 10 Climatic Year simulations to address the security of supply needs & comments of stakeholders, ACER and the European Commission on TYNDP 2020 IoSN study methodology.

Improvements in TYNDP 2022: Zonal Clustering Update

- ✓ In TYNDP 2020 the clustering approach used administrative region boundaries as basis
- ✓ Several stakeholders stressed the need to improve the methodology
- ✓ ENTSO-E is working on improving the clustering approach. The plan is to cluster zones based on network contingencies/limiting elements in ENTSO-E network. A test study is in progress.



A two-step optimization process

In TYNDP 2022, a **two-step optimization** is foreseen. Such approach should give a realistic vision of system needs by investing in relevant existing projects (grid & flexibility) likely to be there at the given horizon and completing them with more conceptual ideas to reach the global economic optimum.

TYNDP 2022 IoSN study methodology summary

	Climatic years	Candidates	Steps	Clustering
IoSN 2040 - NTC	10	Interconnectors Storage flexibilities CO_2-free peaking flexibility	2	-
IoSN 2030 -Zonal	1 / (3 ?)	Interconnectors	2	Update by using grid-based clustering

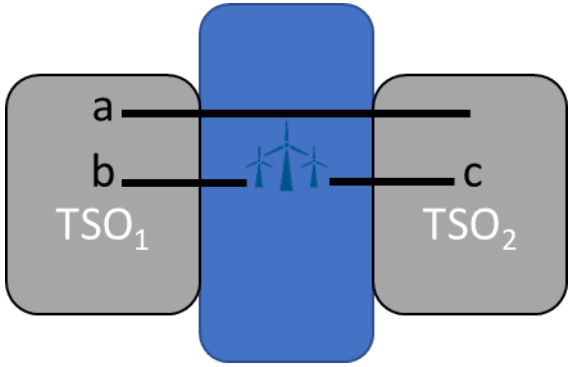
Proposed improvements compared to TYNDP 2020 include :

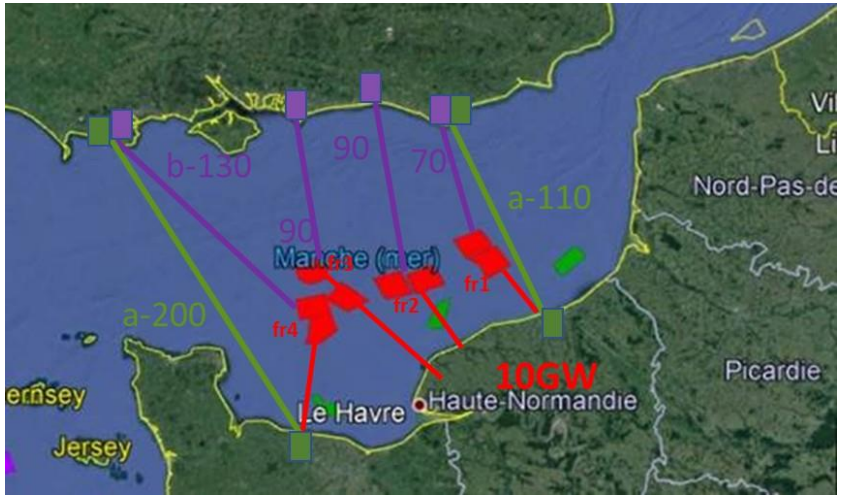
- ✓ More climate years
- ✓ Flexibility candidates included in IoSN 2040
- ✓ Better clustering for zonal model

Warning : This methodology is dependent on computation time for the model. Tests will be performed to confirm operational feasibility.

Identification of hybrid offshore investment needs

- ✓ A hybrid project is an interconnector with a wind offshore farm
- ✓ The methodology employed in TYNDP 2020 failed to recognise the full benefits of hybrid offshore infrastructure
- ✓ A pilot study based on the IoSN study methodology is ongoing, aiming at methodology development to assess hybrid projects and identify needs for such infrastructure
- ✓ If proven, the approach could be implemented in **TYNDP 2024**

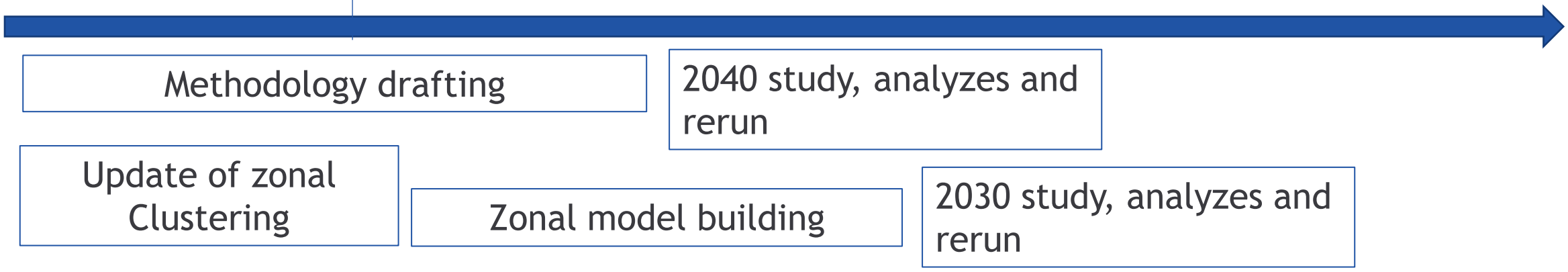




Provisional timeline of the TYNDP 2022 system needs study

October 14th
Public Webinar on the methodology

Q2/Q3 2022
Release of system needs study results



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UPCOMING

20 October 2021

Join ENTSO-E and ENTSOG's Workshop on the TYNDP 2022 draft scenarios

Public consultation open until 18 November