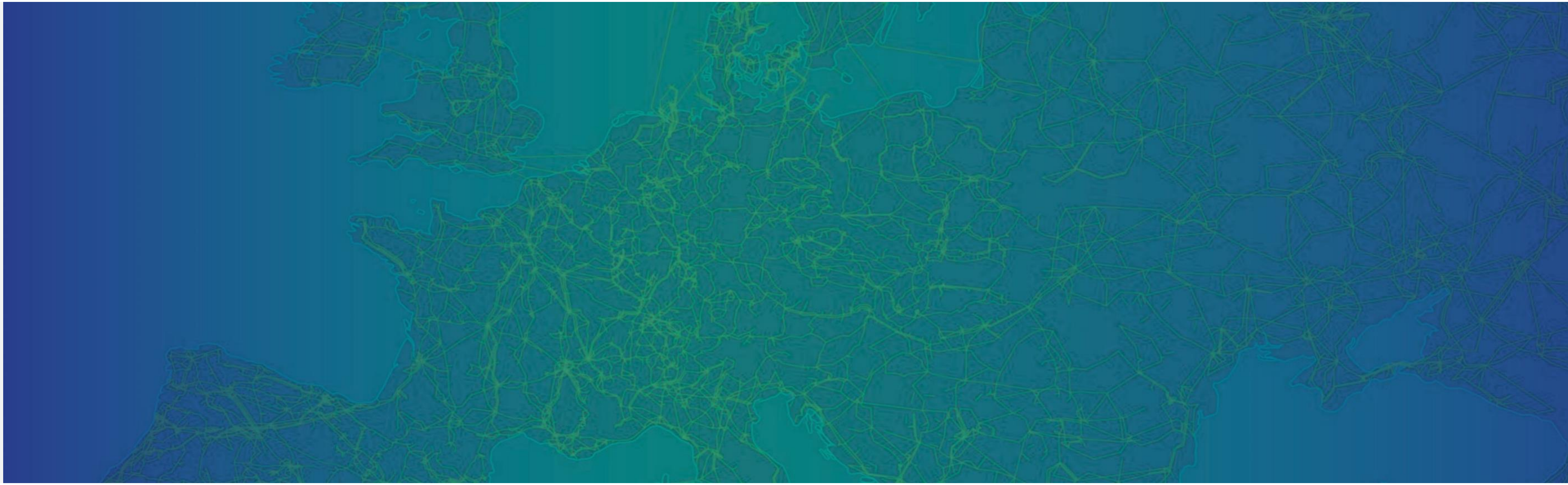
Power System Needs in 2030 and 2040

ENTSO-E webinar, 28 September 2020



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Agenda

Welcome

Setting the scene: Why does ENTSO-E identify system needs?
Jean-Baptiste Paquel, ENTSO-E

Pan-European system needs in 2030 and 2040
Patricia Labra Francos, REE

Identification of system needs methodology
Andriy Vovk, ENTSO-E

Q&A

Deep dive: Needs at regional level
Antje Gesa Orths, Michael Heit, Fernando Batista, Vladan Ristic, Lubos Samsely, Antonio Conserva

Q&A

Conclusion
Dimitrios Chaniotis, RTE

Setting the scene: Why does ENTSO-E identify system needs?

Jean-Baptiste Paquel, ENTSO-E

System needs: why looking for system needs?

Where is action needed
to ensure continuous access to electricity in Europe
and deliver on the climate agenda ?

2030

Most relevant for investors, policy makers, regulators, smart grids or storage promoters

2040

Most relevant for project promoters (transmission, generation, storage), TSOs

Looking for needs, not solutions

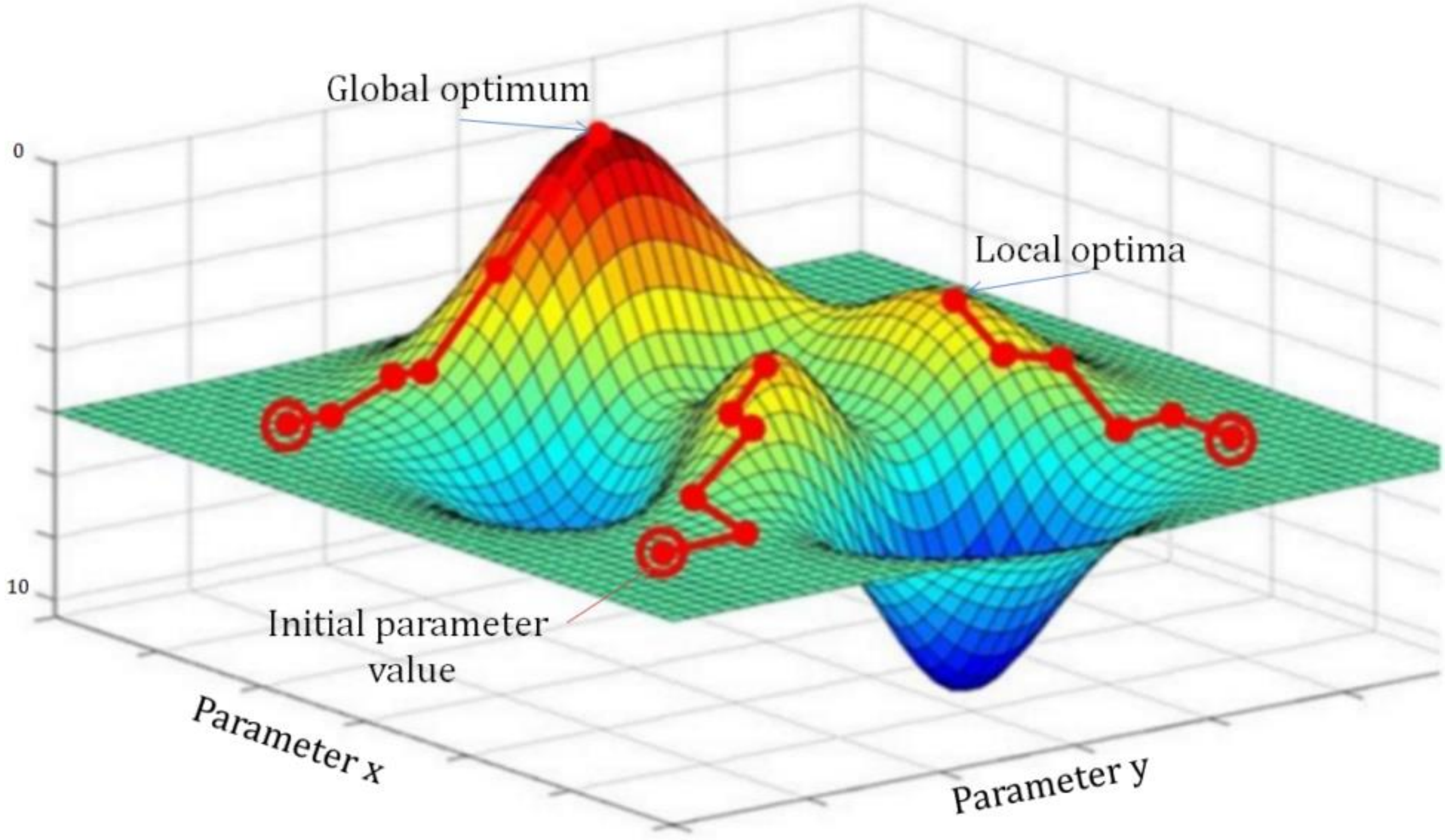
The system needs study looks for
economically viable interconnectors within a set scenario

These viable links prove **that**
at least a configuration exists
which would deliver more benefits to Europeans

Project promoters use the needs identified to
explore, propose and justify solutions

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

Needs beyond the starting point
Why do we need a starting point?



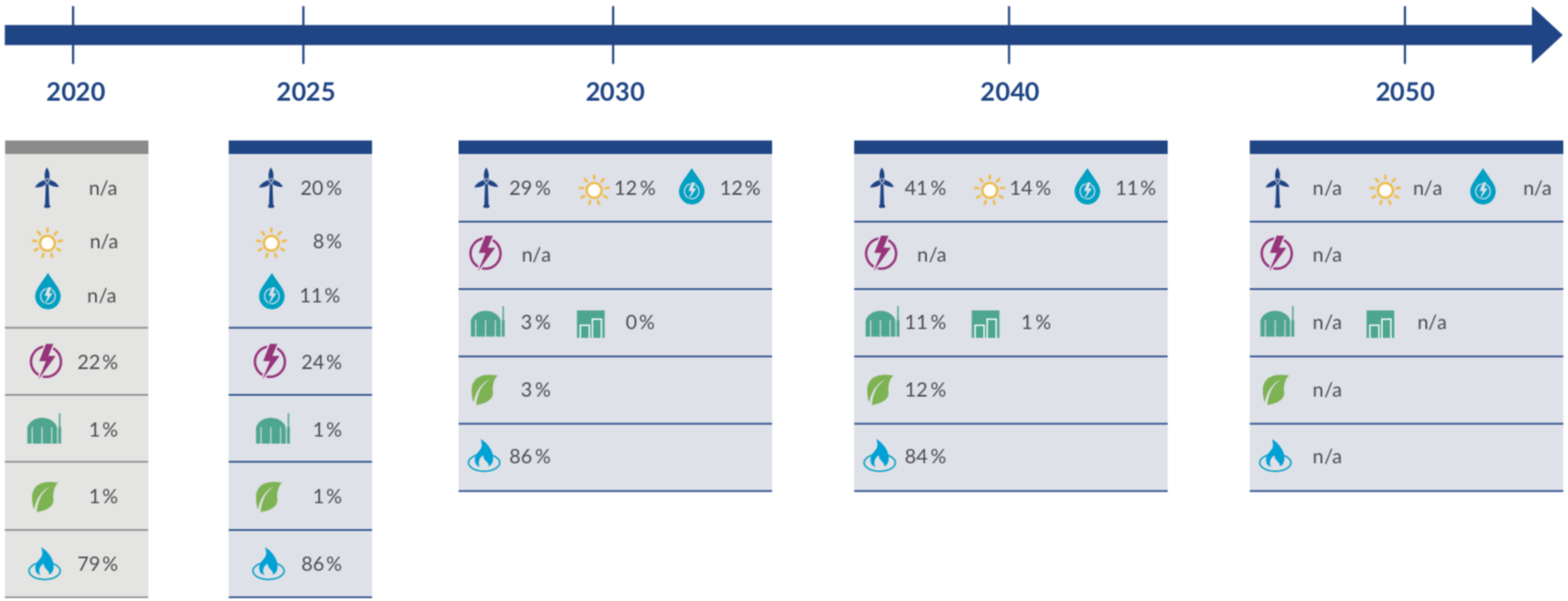
Needs beyond the starting point: National Trends Scenario

TYNDP central scenario

Aligned with NECPs

Compliant with EU 2030 Climate and Energy framework

Compliant with EC 2050 long term strategy



All needs identified are beyond developments mentioned in the scenarios (including storage, demand response, etc)

3 key findings from the 2020 European identification of system needs

1 **New solutions are needed all across Europe**

CO_2
Deliver on climate agenda

€
Lower energy costs for Europeans

Respond to new RES flexibility challenges

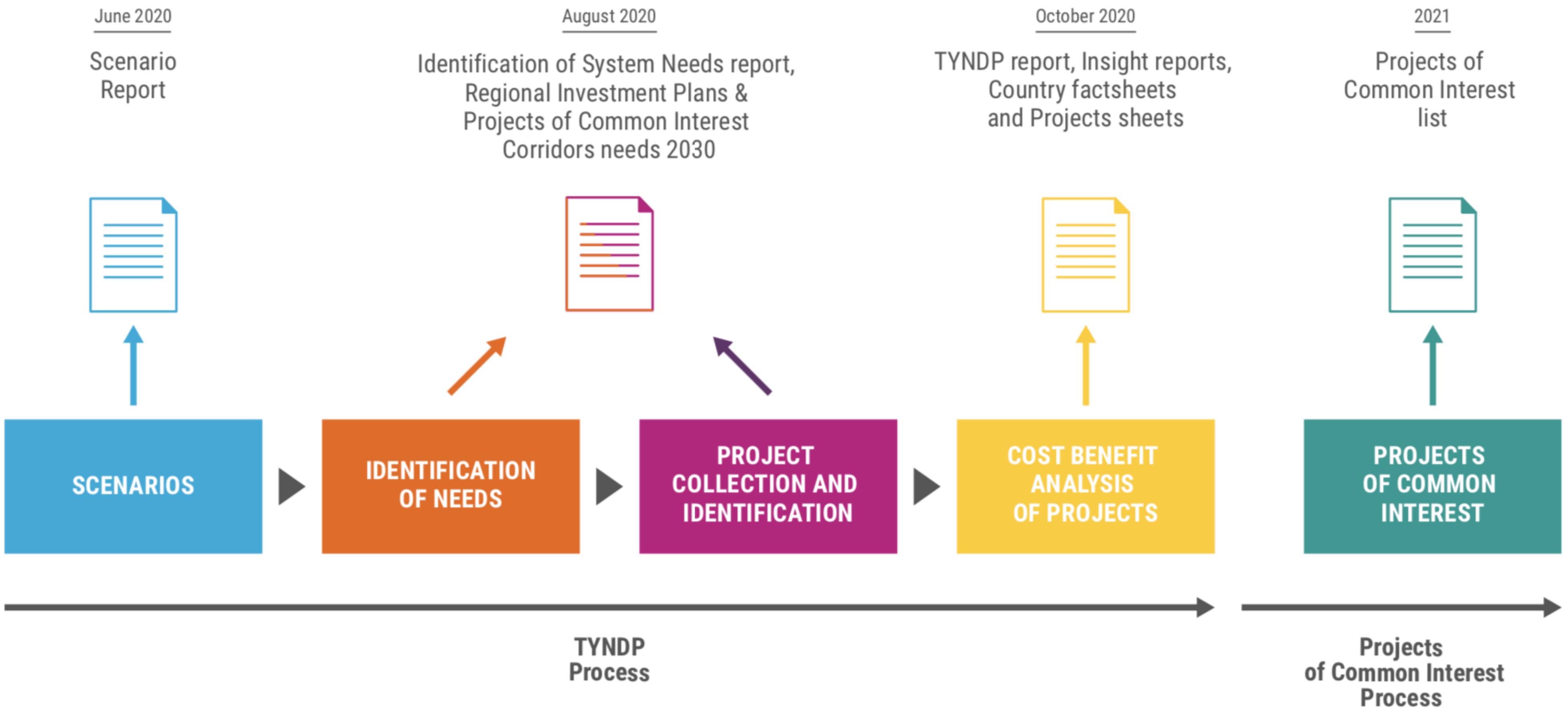
Realize the **Paris Agreement**

2 **New cross-border flows trigger new internal network and new system flexibility needs**

3 **Taking offshore wind to the next level will require smart planning**

The simple solutions considered for the study beyond 2025 show no economic justification

2020 Europen planning cycle



A real European product

Pan-European system needs in 2030 and 2040

Patricia Labra Francos, REE

New solutions are needed across Europe

The system in 2040: generation costs savings

+93GW of transmission
3,4 b€/year investment

No action scenario

2040 generation and demand with the grid of **2025**

Economic needs grid 2040

The 2040 grid identified in ENTSO-E's **socio-economic based needs** study

Copper plate

Infinite transmission across Europe

- 9,6 b€/year

- 4,1 b€/year

Savings in generation costs using the same 2030 scenarios ENTSO-E perimeter

The system in 2030: generation costs savings

+85GW of transmission
1,3 b€/year investment

No action scenario

2030 generation and demand with the grid of **2020**

Economic needs grid 2030

The 2030 grid identified in ENTSO-E's **socio-economic based needs** study

Copper plate

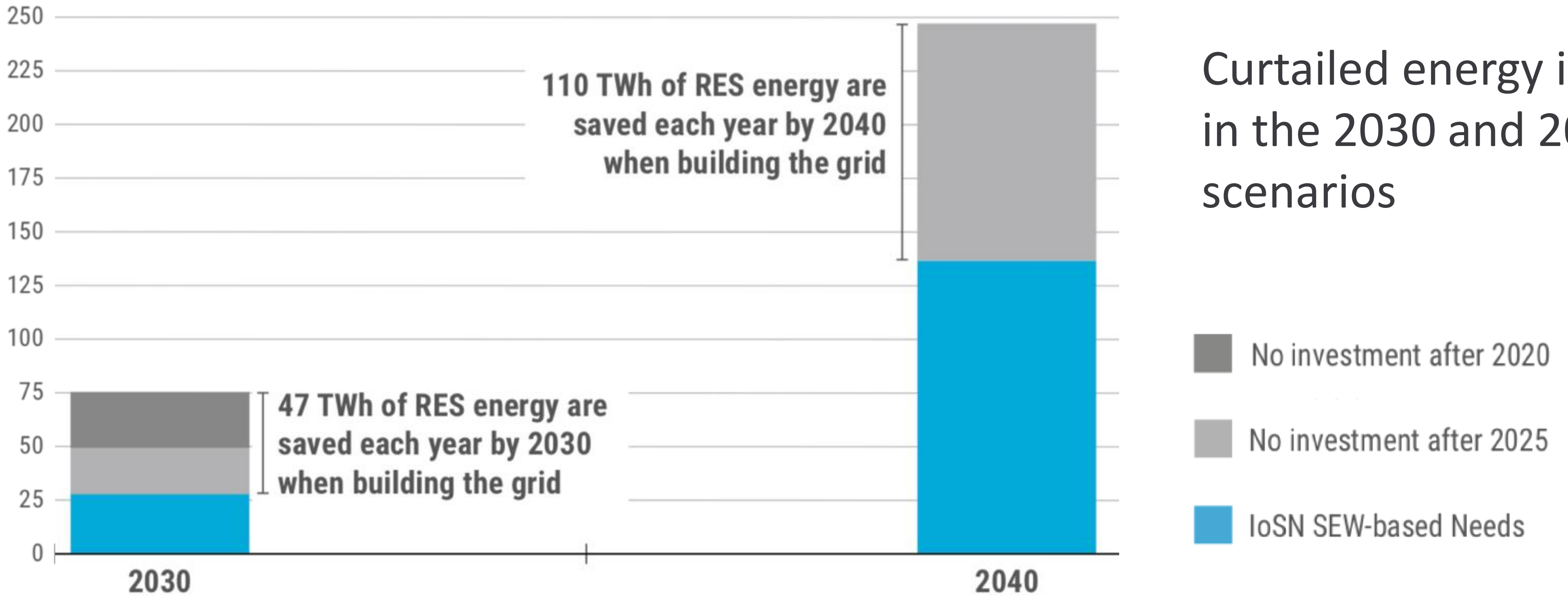
Infinite transmission across Europe

- 4,9 b€/year

- 2,2 b€/year

Savings in generation costs using the same 2030 scenarios
ENTSO-E perimeter

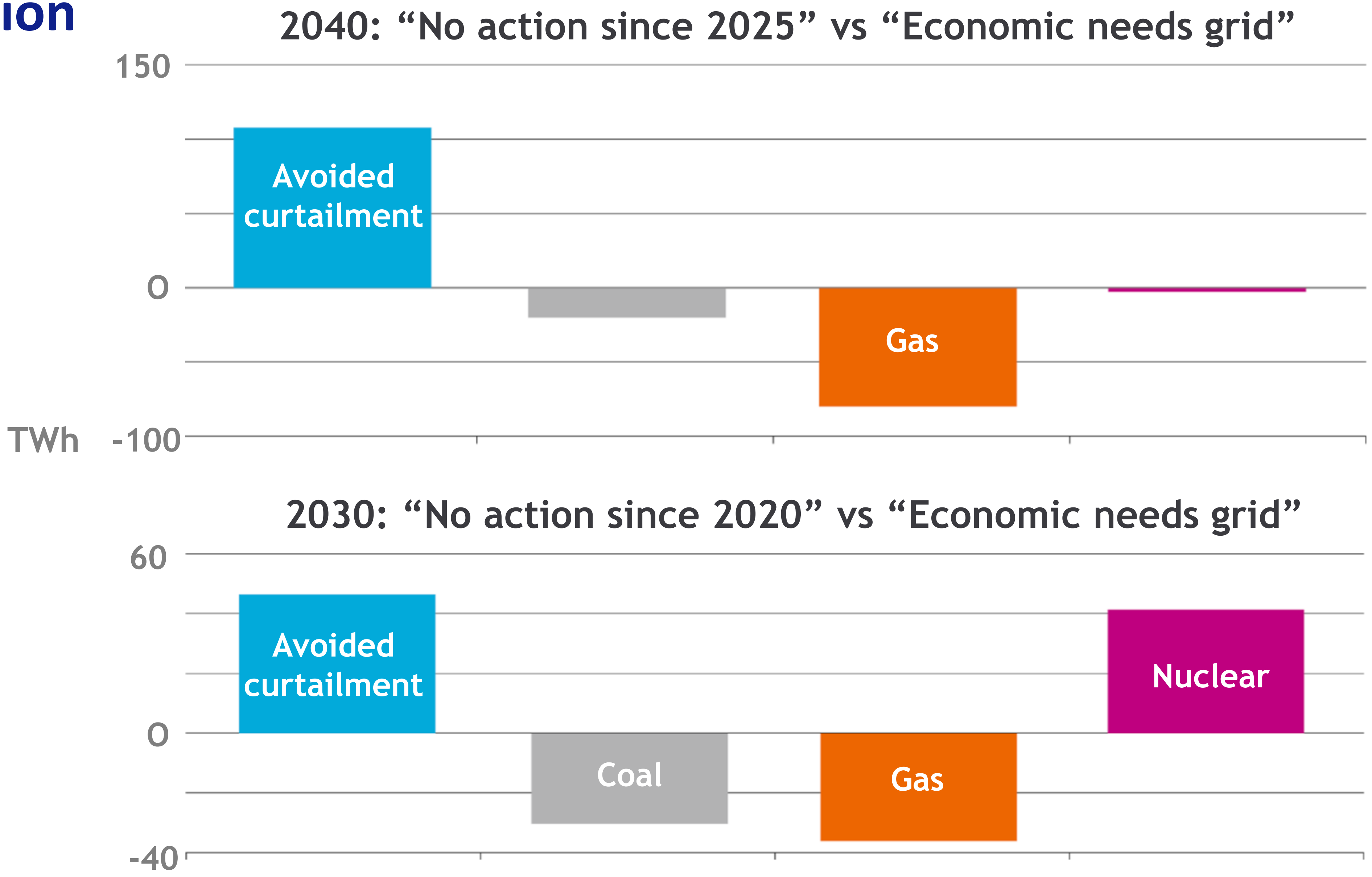
The system in 2030 and 2040: curtailments



Curtailed energy in TWh in the 2030 and 2040 scenarios

In reality, mainy renewable or storage investments foreseen in the scenarios will not happen if access to higher price market is not possible, further slowing down the energy transition

Generation mix



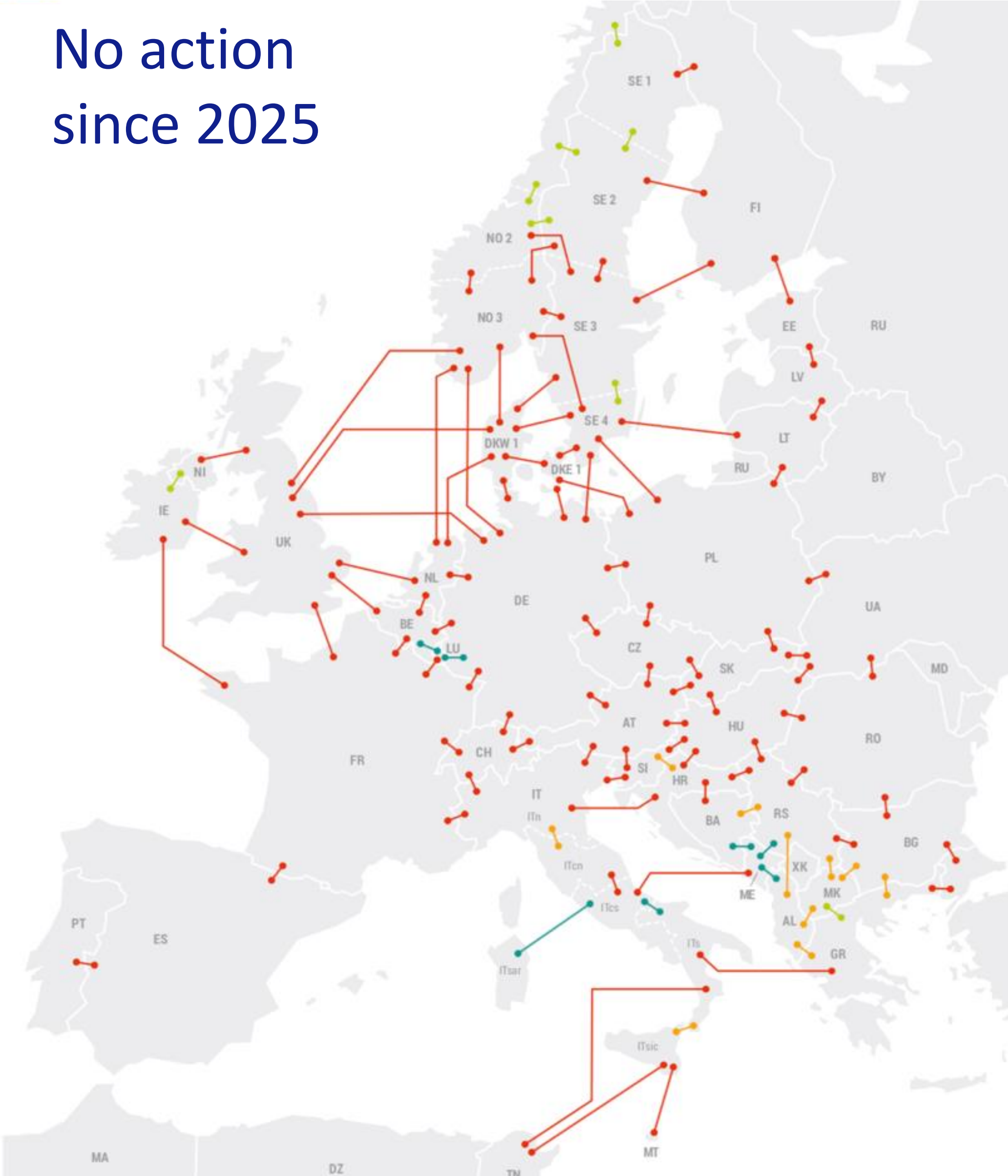
C02 price sensitivity

	'No investment after 2025' with the current ETS CO_2 price of 28 €/ton	SEW-based Needs 2030 with the current ETS CO_2 price of 28 €/ton	'No investment after 2025' with a CO_2 price of 100 €/ton	SEW-based Needs 2030 with a CO_2 price of 100 €/ton
Increased capacity in GW	–	50	–	74
Curtailed energy in TWh/year	49	28	49	23
CO_2 emissions in Mton/year	618	576	508	452

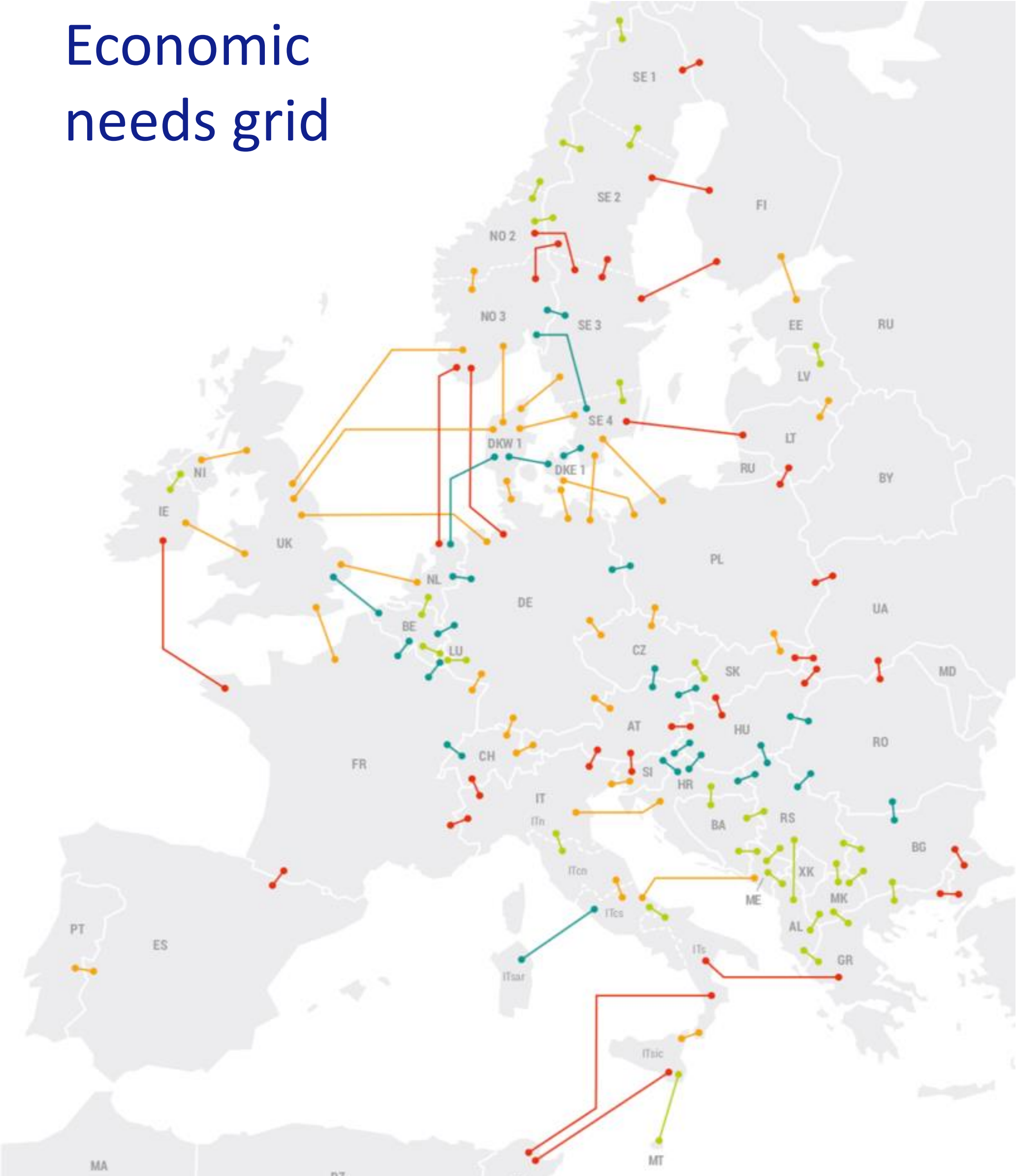
The ETS CO2 prices are not sufficient to decrease CO2 emissions to an extent compatible with EU climate ambitions

Price convergence between countries - 2040

No action
since 2025



Economic
needs grid

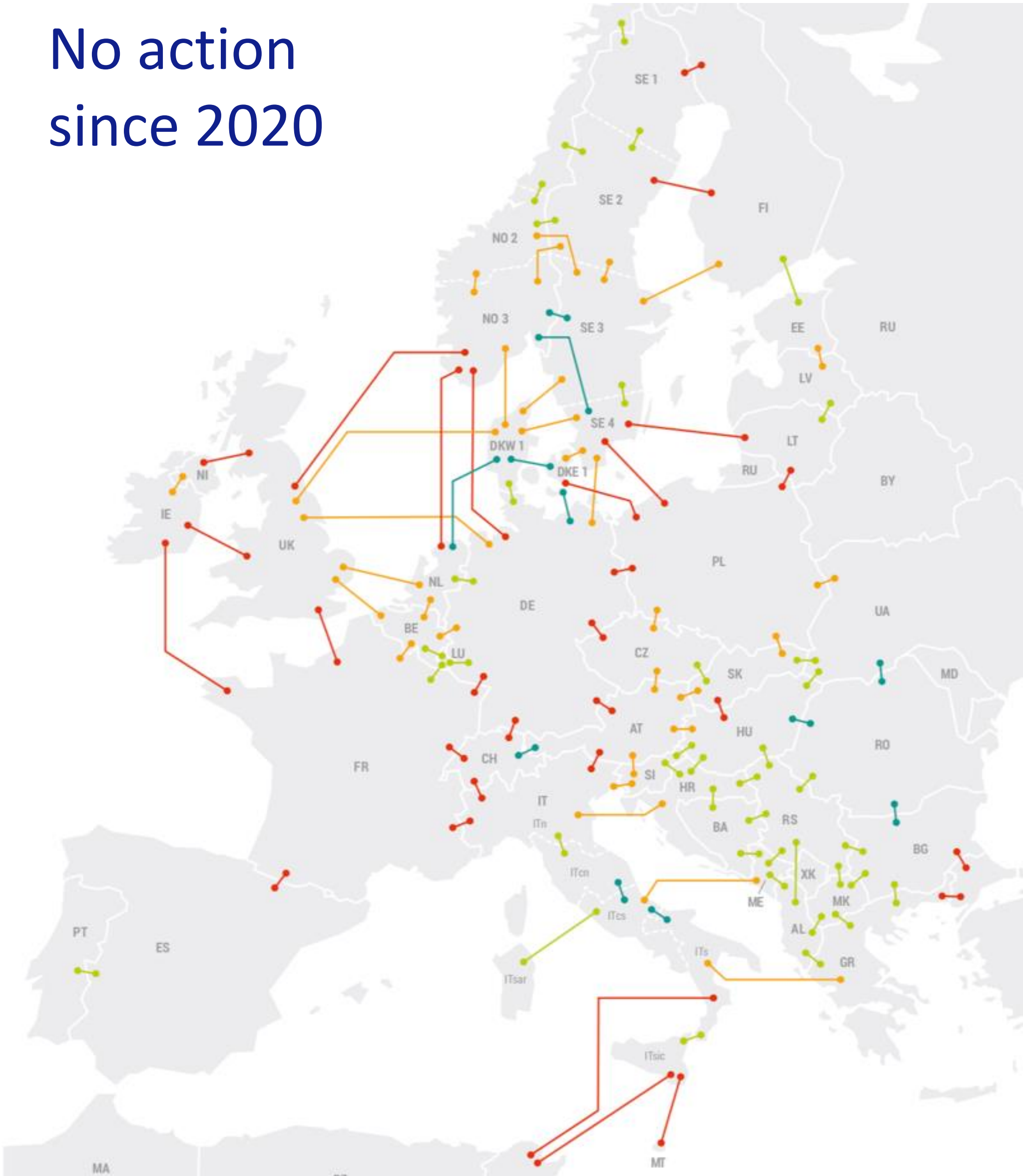


- < 2.00 €/MWh
- 2.00–5.00 €/MWh
- 5.00–10.00 €/MWh
- > 10.00 €/MWh

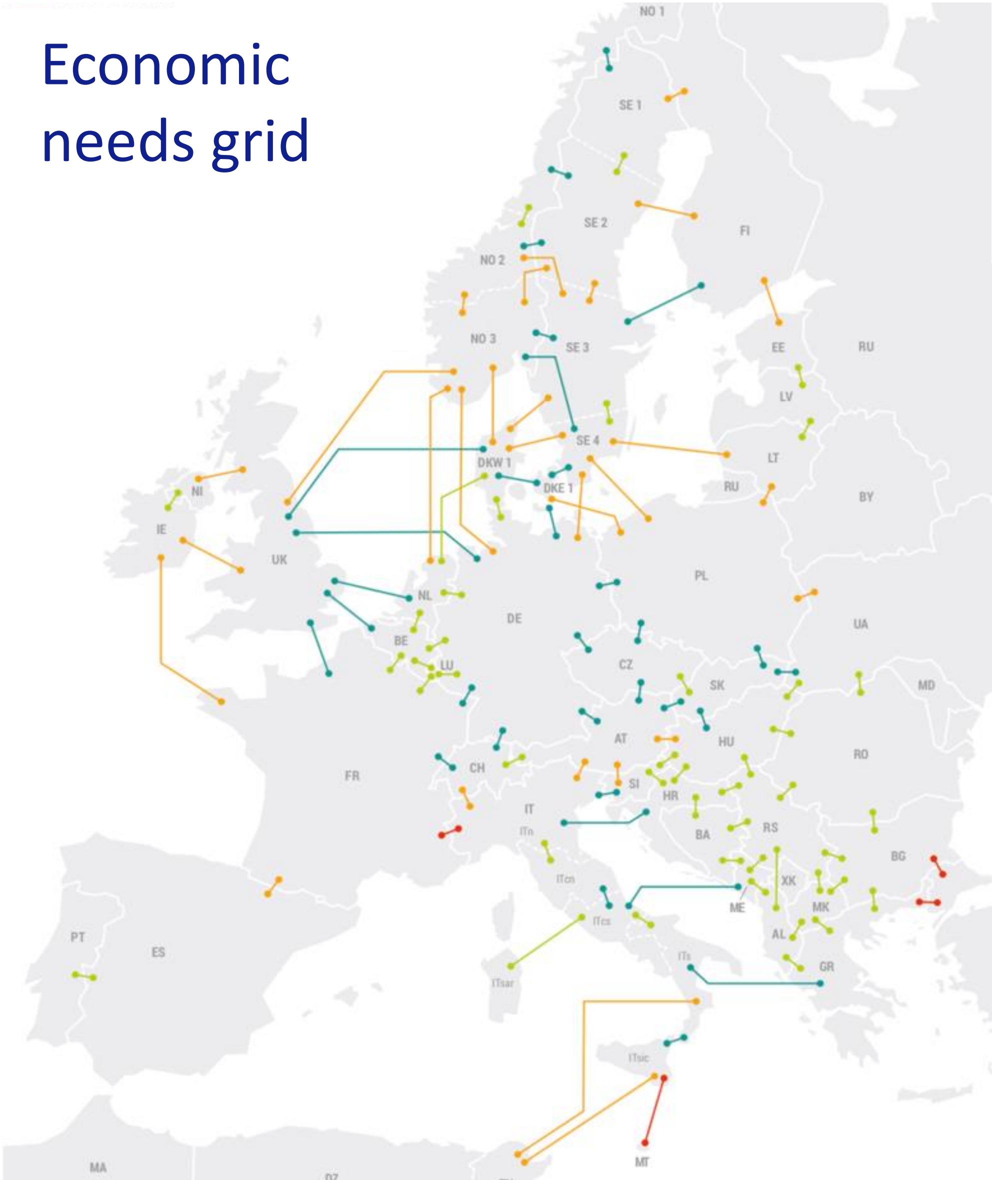
Marginal cost difference between zones in 2040 scenarios

Price convergence between countries - 2030

No action since 2020



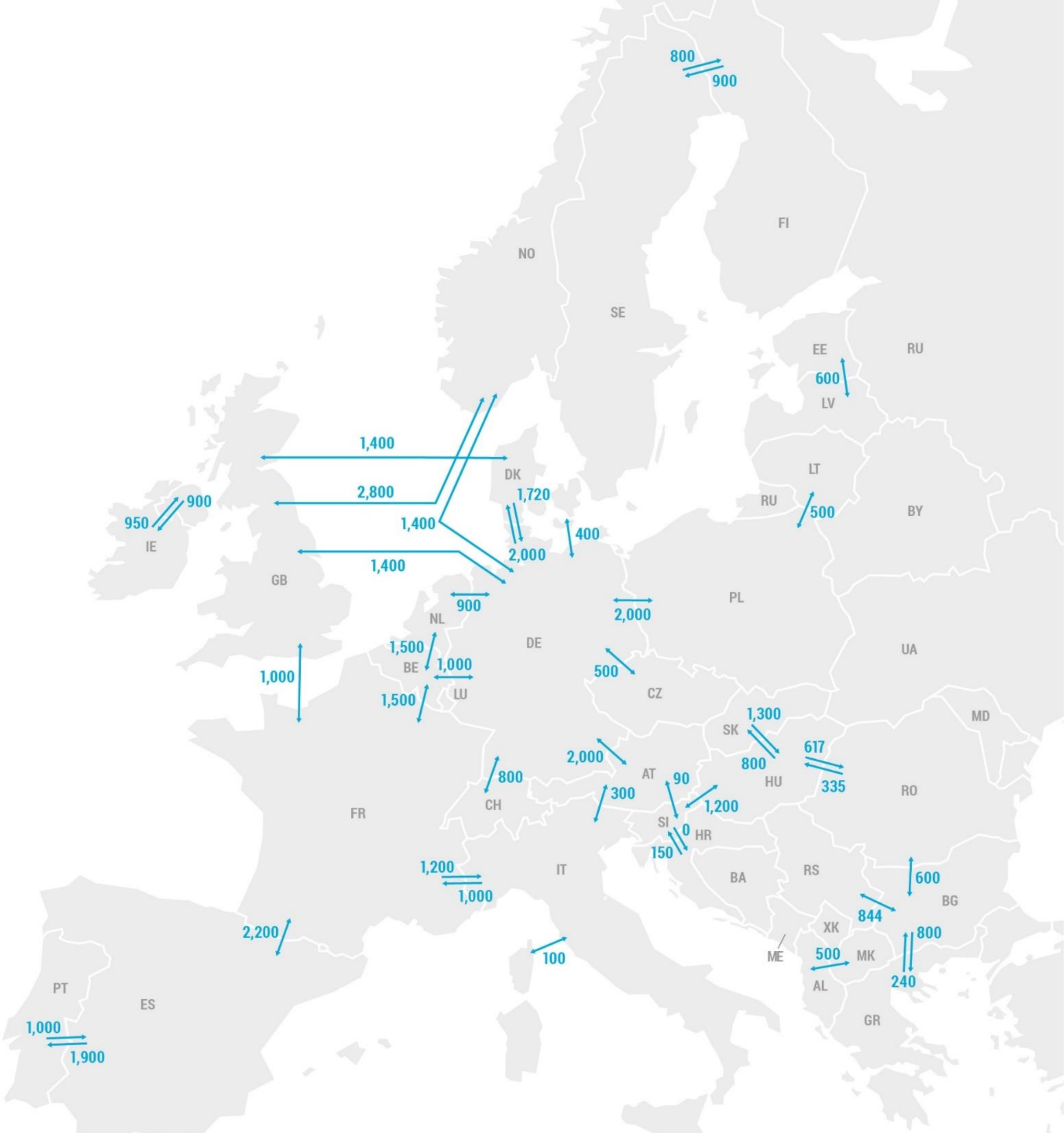
Economic needs grid



< 2.00 €/MWh
2.00–5.00 €/MWh
5.00–10.00 €/MWh
> 10.00 €/MWh

Marginal cost difference between zones in 2030 scenarios

Cross border capacity increases expected to be commissioned by 2025



Economic needs grid 2040

Capacity increases found :

- looking at minimising generation costs (socio-economic wellfare)
- beyond 2025 expected investments
- with ENTSO-E 2040 scenario for generation and demand

Needs < 700 MW

Needs 700 - 2000 MW

Needs > 2000 MW

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Economic needs grid 2030

Capacity increases found :

- looking at minimising generation costs (socio-economic wellfare)
- beyond 2025 expected investments
- with ENTSO-E 2030 scenario for generation and demand

Needs < 700 MW

Needs 700 - 2000 MW

Needs > 2000 MW

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Economic needs grid 2030

Economic needs grid:
one of many solutions

- Needs < 700 MW
- Needs 700 - 2000 MW
- Needs > 2000 MW
- Additional capacity increases that when added one at a time to the economic needs deliver similar overall benefits

How to increase the benefits captured?: there is room for all technologies

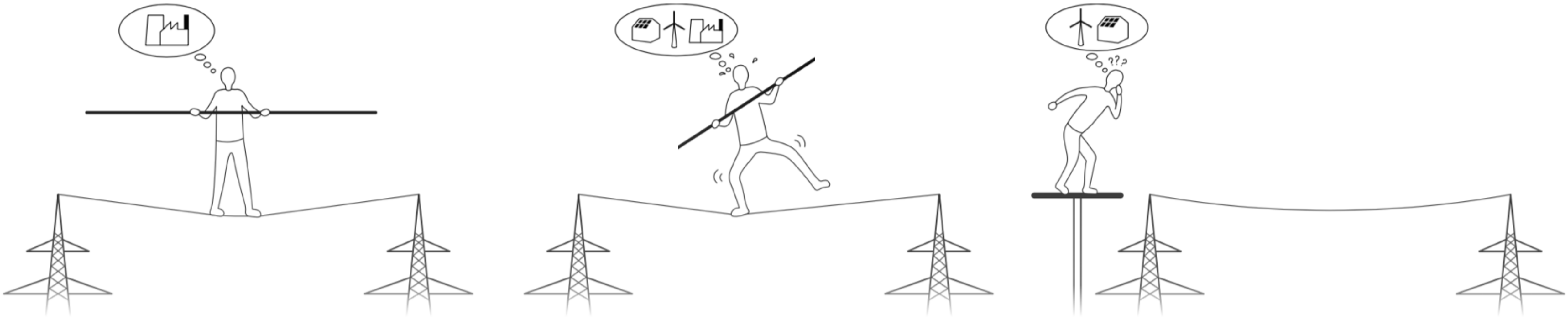
Transmission projects with lower costs, a different location, new technologies or with addtional benefits could contribute

Other solutions combined with network increases could take Europe even further: **Storage, power-to-gas, hybrid offshore infrastructures, etc..**

Remaining curtailment

New cross-border flows trigger new internal network and new system flexibility needs

New system stability challenges
trigger new needs



Previously

Inertia of the large rotating generators immediately contained deviations

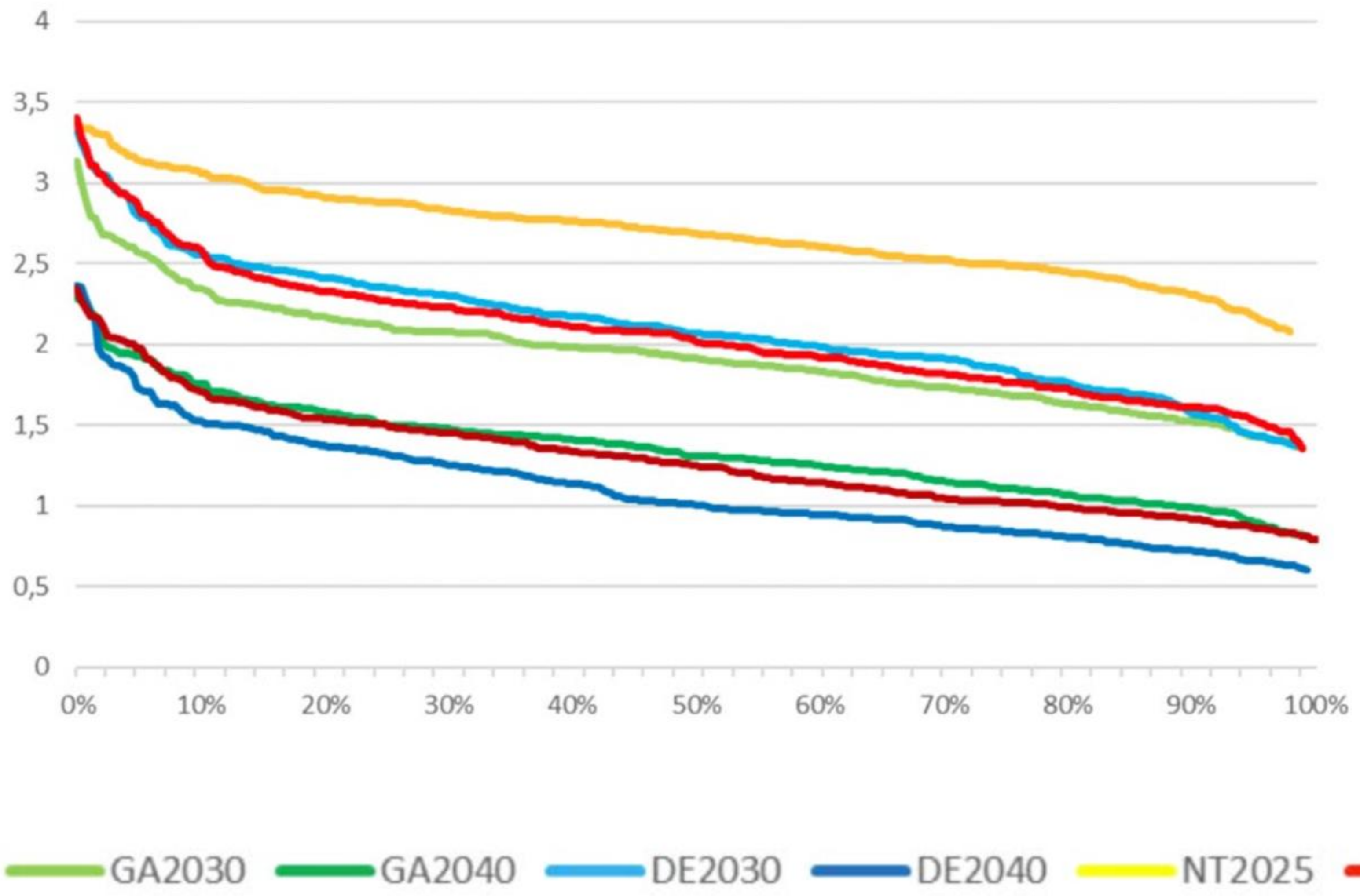
Today

Variable RES do not provide Inertia. Share of thermal generators decreases.
Inertia decreases.

Tomorrow

Very low levels of inertia available

Frequency management: system inertia trends



Duration curves of system inertia for the Continental Europe synchronous area in ENTSO-E's 2025, 2040 and 2040 scenarios

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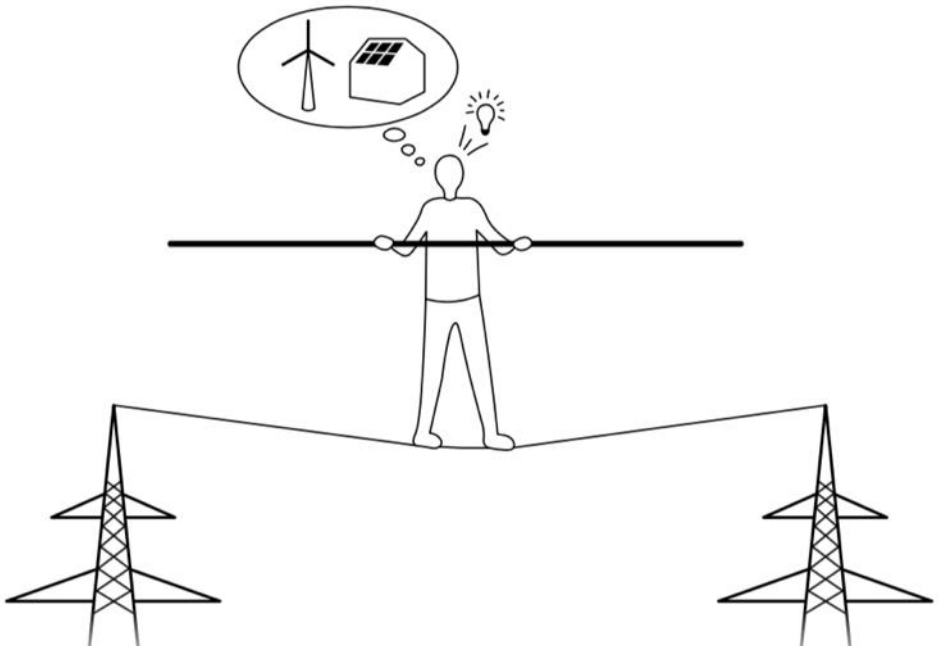
Other system operations challenges
in an increasingly variable system

- **Flexibility aspects**
  - New flexibility sources will be needed to accomodate for higher generation variation

- **Transient and voltage stability related aspects**
  - Short-circuit power
  - Reactive power fluctuations

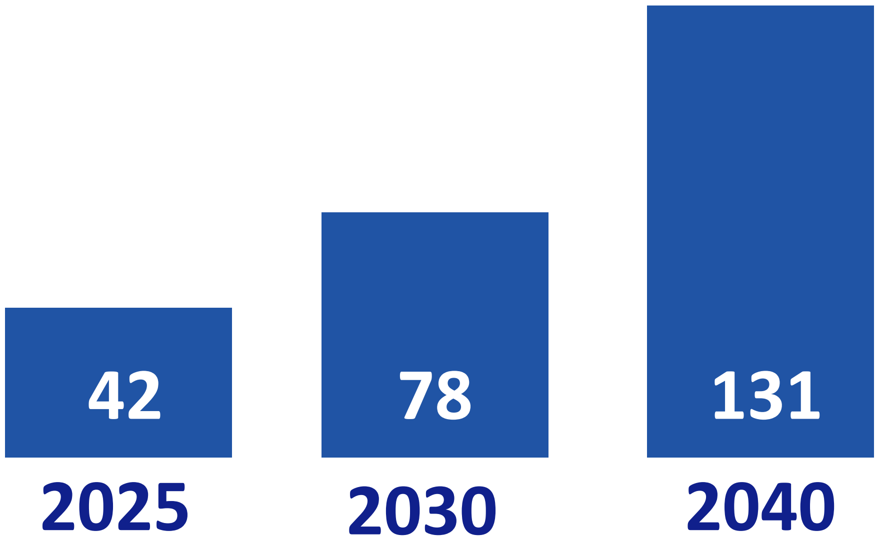
New system stability challenges: how to adapt?



- **Connection codes**
- **Coordinated R&D**
  - Coordinated efforts of TSOs, DSOs, industr research and policy makers
  - Grid-forming converters
- **New fast frequency response sources**
  - Converted connected RES, storage, demand response, etc
- **New roles for existing generators**
- **Network investments**
  - Voltage supporting units
  - Interconnectors
  - Internal reinforcements

Taking offshore wind to the next level will require smart planning

Offshore wind: large scale developments ahead



Installed capacity (GW)
in the ENTSO-E National Trends Scenarios

High price differences in the regions should lead to high infrastructure needs

Marginal cost difference
between zones in 2040
with the Economic needs grid

< 2.00 €/MWh
2.00–5.00 €/MWh
5.00–10.00 €/MWh
> 10.00 €/MWh

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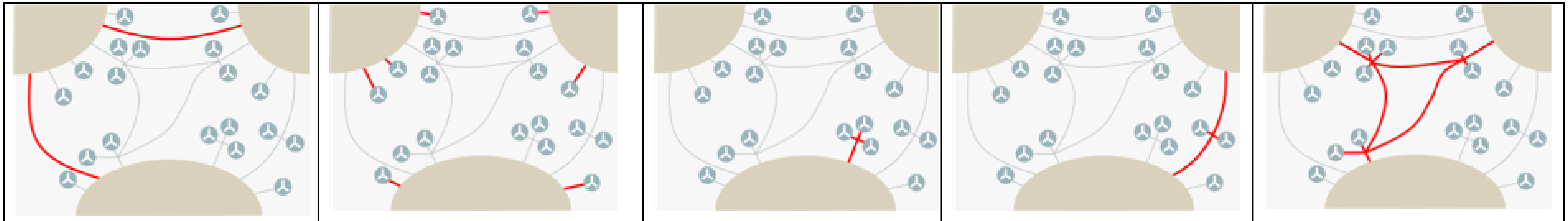
Offshore wind: only one configuration considered in the study

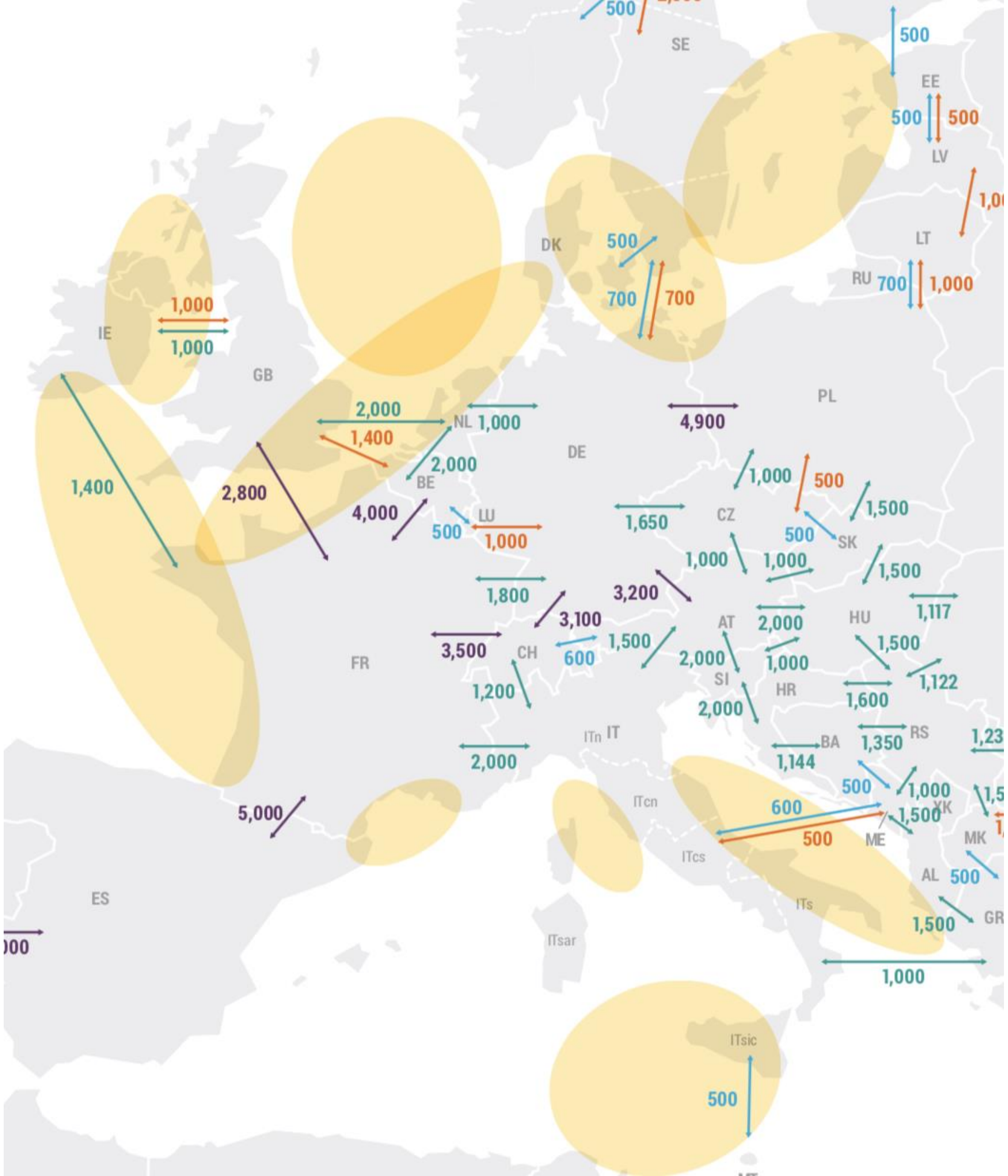


i) Point-to-point IC	ii) Radial offshore park to shore	iii) Radial hub-to-shore	iv) Hybrid project	v) Multi-terminal offshore hubs

c.f. NSCOGI study 2012

In this study offshore wind is treated as a part of the scenarios. **Connection costs to the shore are considered an externality**, they are not the subject of the study

Only the ”radial connection to shore with interconnectors” configuration is therefore considered



High reference costs for interconnectors:

low needs identified beyond 2025 ongoing projects

The simple solutions explored in the study show no economic justification

Need for holistic planning?

Make the TYNDP evolve?

Economic needs grid 2040
(from 2025 expected developments)

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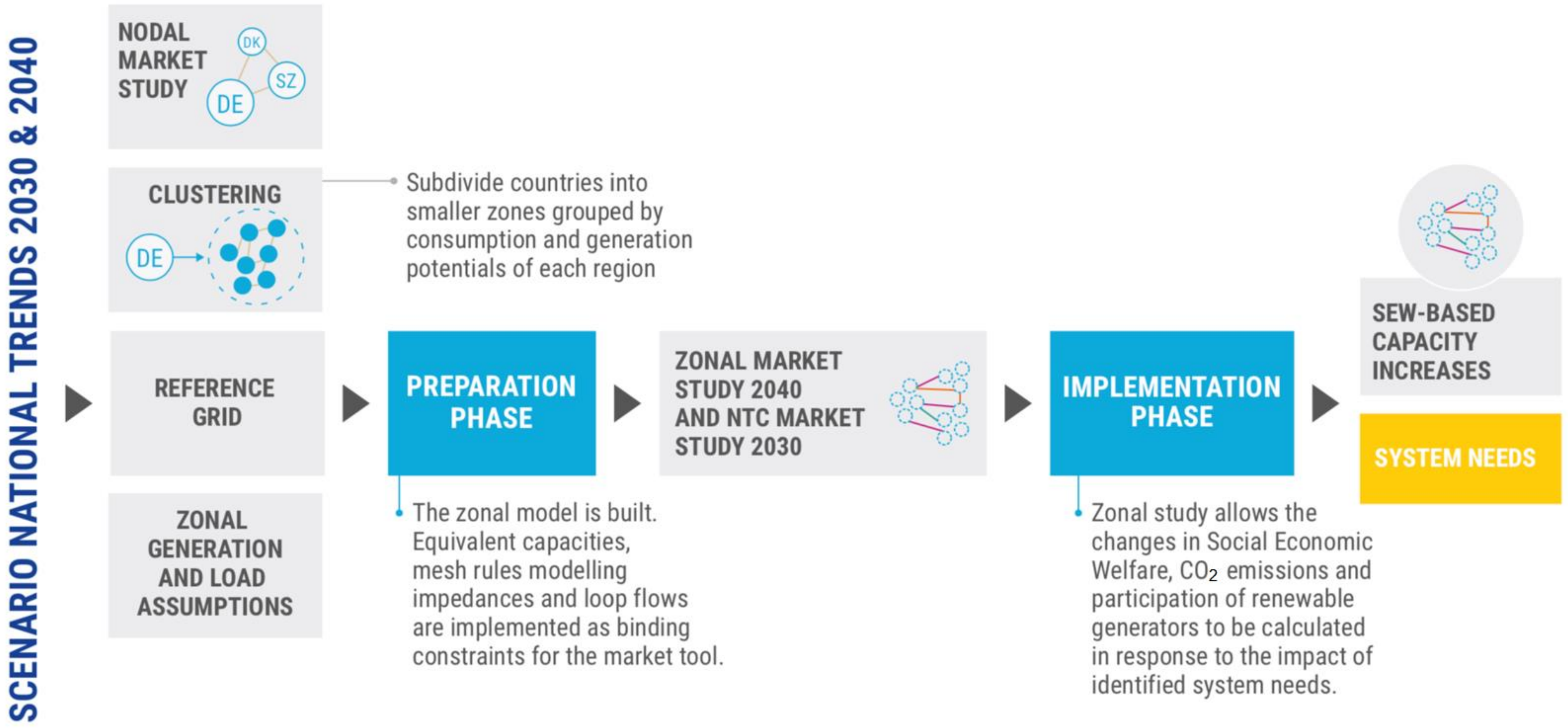
Identification of system needs methodology

Andriy Vovk, ENTSO-E

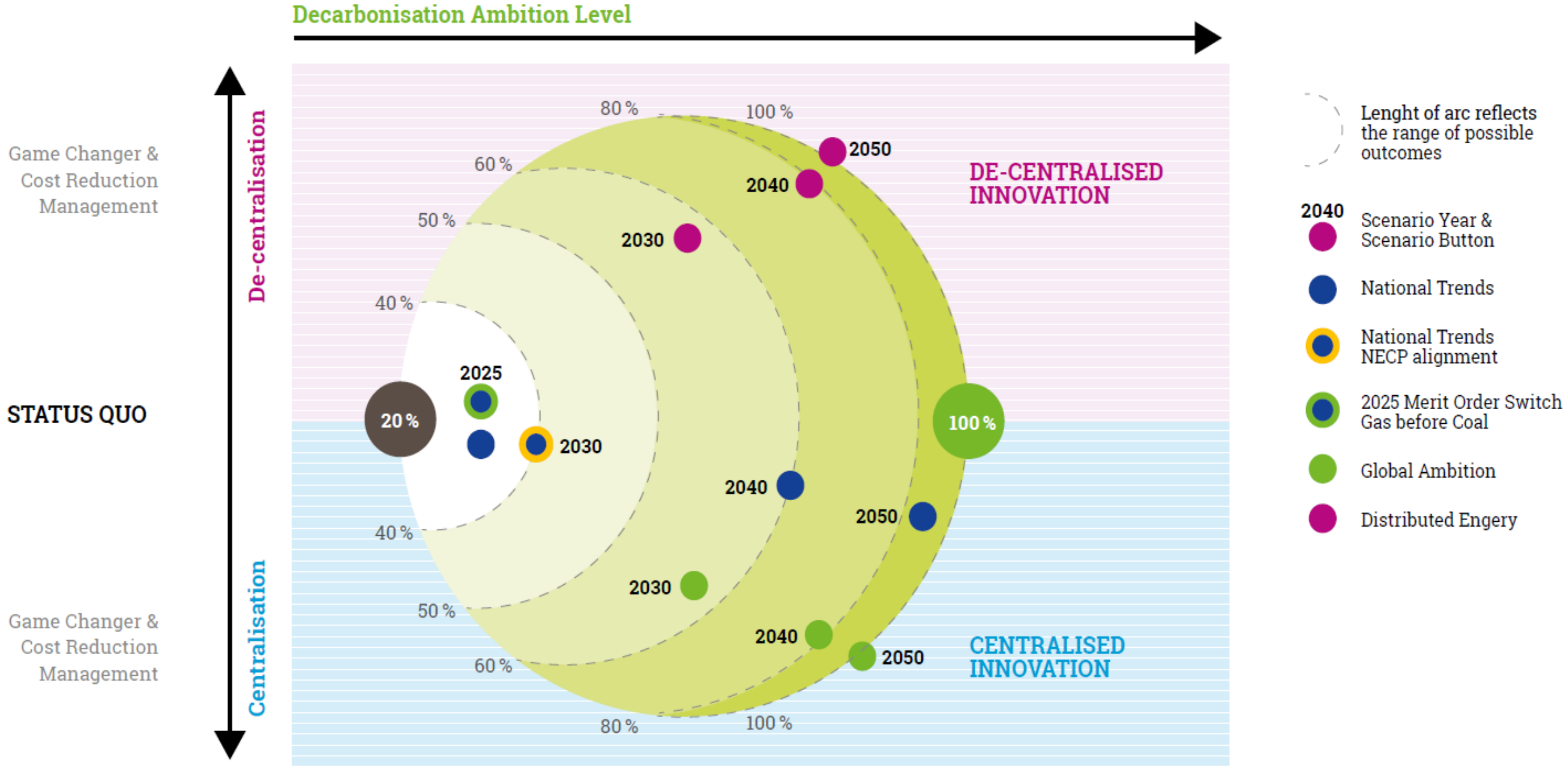
Studies performed

	2030	2040
TYNDP 2018		**"Expert base" European expansion study** *NTC model*
	Additional studies: SEW vs GTC; No grid; System stability; Experts analysis Regional studies	
TYNDP 2020	**Automated European expansion study** *NTC model*	**Automated European expansion study** *Zonal model*
	Additional studies: SEW vs GTC; No grid; System stability; Experts analysis Regional studies	

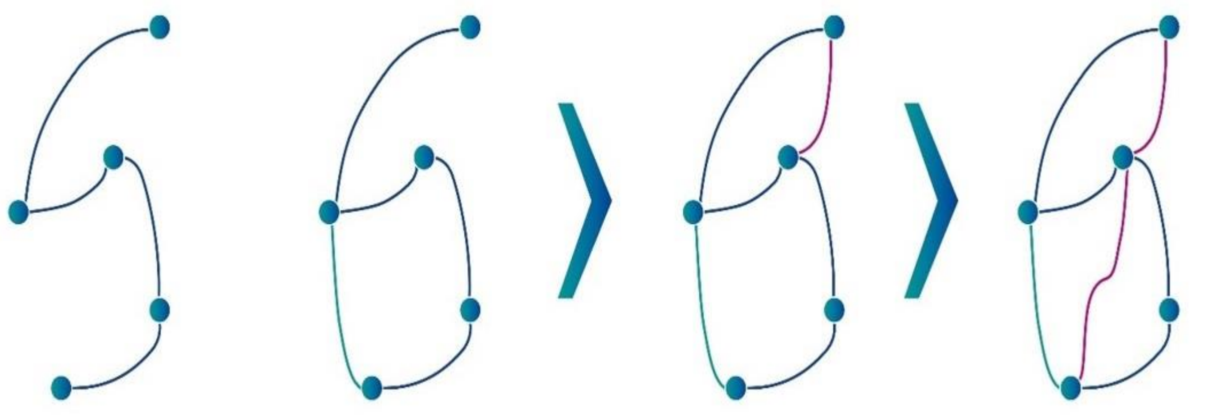
Process overview



Starting points: National Trends Scenarios and the Reference Grid

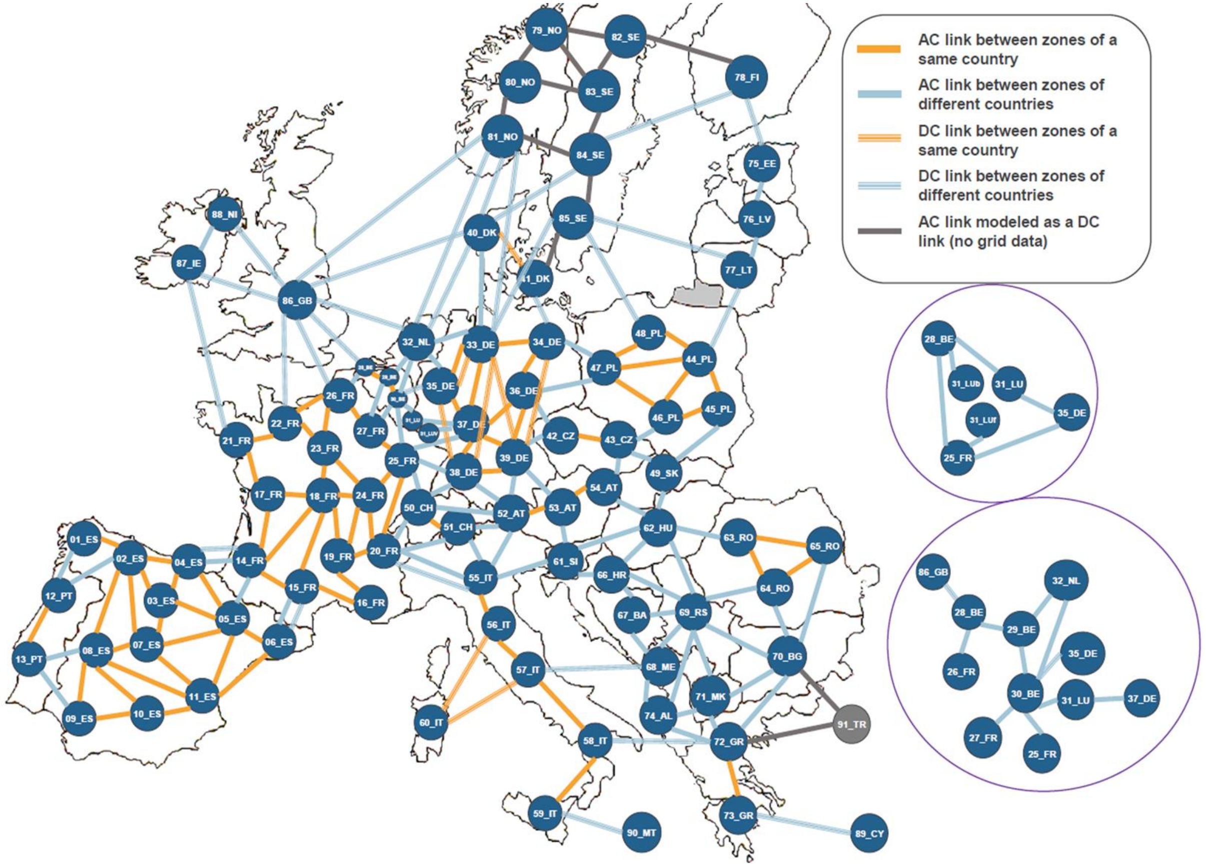


Starting points: National Trends Scenarios and the Reference Grid

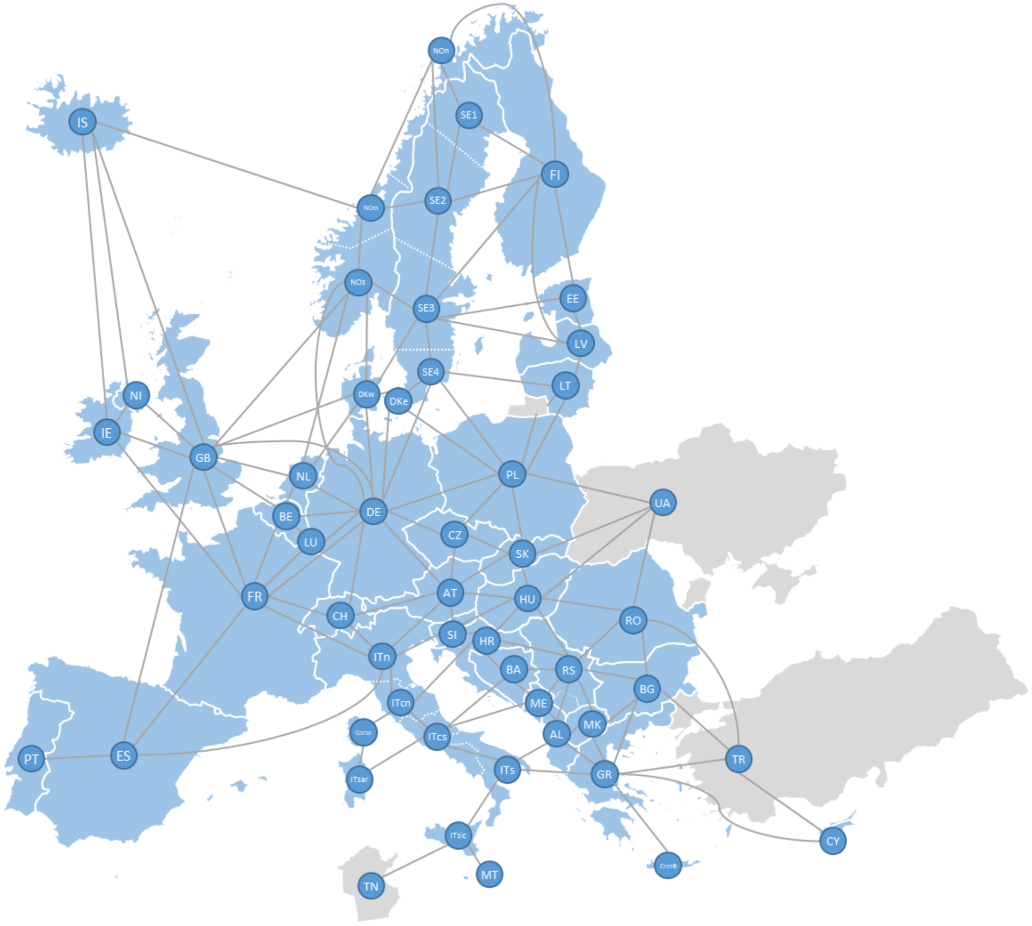


- A realistic and technically sound starting point is necessary
- An infinity of solutions exist for the power system. The closer the starting point is to a realistic configuration, the more realistic the results are
- ENTSO-E chose the Mid-term Adequacy 2025 grid as a starting point
- Experts and regulators were formally involved to review the reference grid proposed

First zonal model used in a European planning study



Model for the 2040 needs study



Model for the 2030 needs study and all previous TYNDPs

The expansion tool

Assesses the potential optimal interconnection level between the zones considered

- Antares is a Monte-Carlo software for power systems analysis, **one of 7 tools used for the TYNDP CBA**
- 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 great number of possible combinations of Load curves and Generations curves
- Developed by RTE, commercially available

The expansion tool: how does it work?

The Antares Xpansion algorithm is based on the **Benders Decomposition** technique

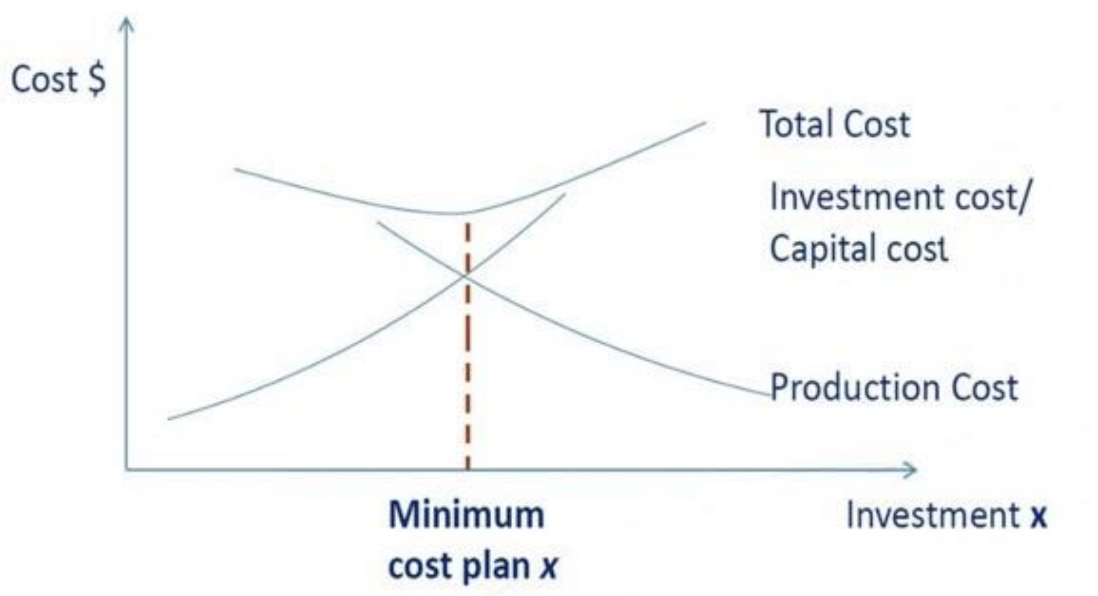
- ANTARES simulation constitutes a sub problem
- The master problem is an Mixed Integer Programming Problem, which should be solved by Expansion tool
- The algorithm is done **iteratively**

Focus on Benders algorithm:

Benders decomposition is a solution method for solving certain large-scale optimization problems. Instead of considering all decision variables and constraints of a large-scale problem simultaneously, Benders decomposition partitions the problem into multiple smaller sub-problems. Since the computational difficulty of optimization problems increases significantly with the number of variables and constraints, solving these sub-problems iteratively can be more efficient than solving a single large problem.

The expansion tool: how does it work?

The ultimate goal of the capacity expansion problem is to minimize total operational and capital cost of system while solving simultaneously dispatch and line reinforcement problems:



Optimal list of reinforcements (from a larger pool of input candidates) that minimizes the total system cost over a long-term planning horizon.

Q&A

Deep dive: Needs at regional level

Regional System Needs – Northern Seas

Antje Orths, Convenor of the Regional Group Northern Seas

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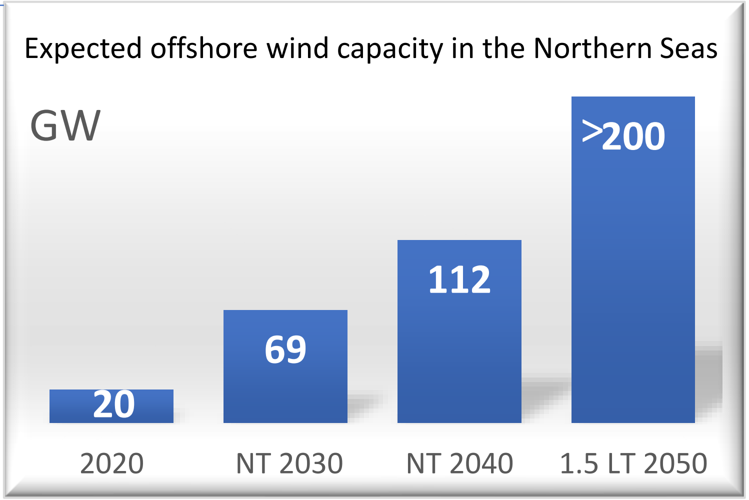
The Region's key messages for its evolution are…

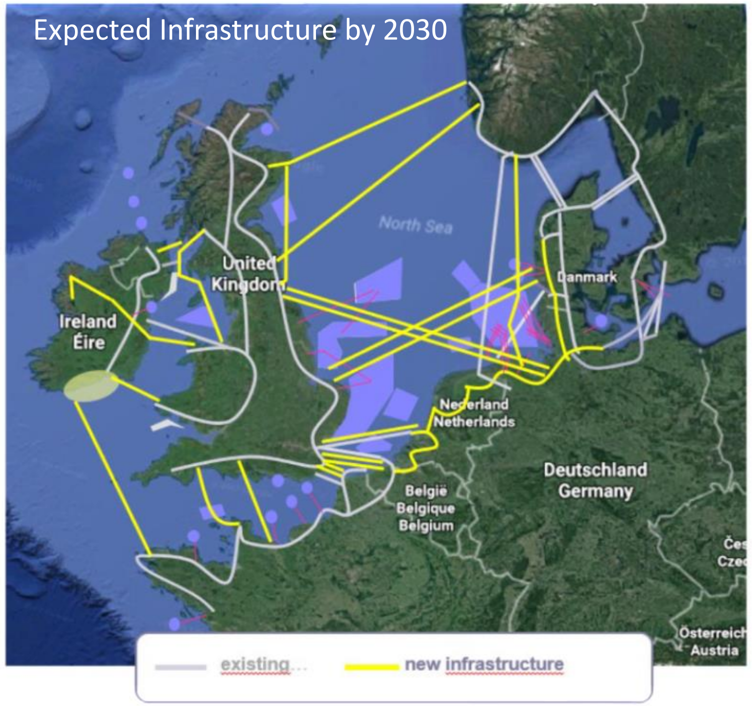
- **Climate goals & decarbonization requirements**
  => fundamental change of energy generation and demand,
  => changed power flows across the region
  Regional RES abundance available

- **Offshore wind expansion triggers related off- and onshore infrastructure needs.**

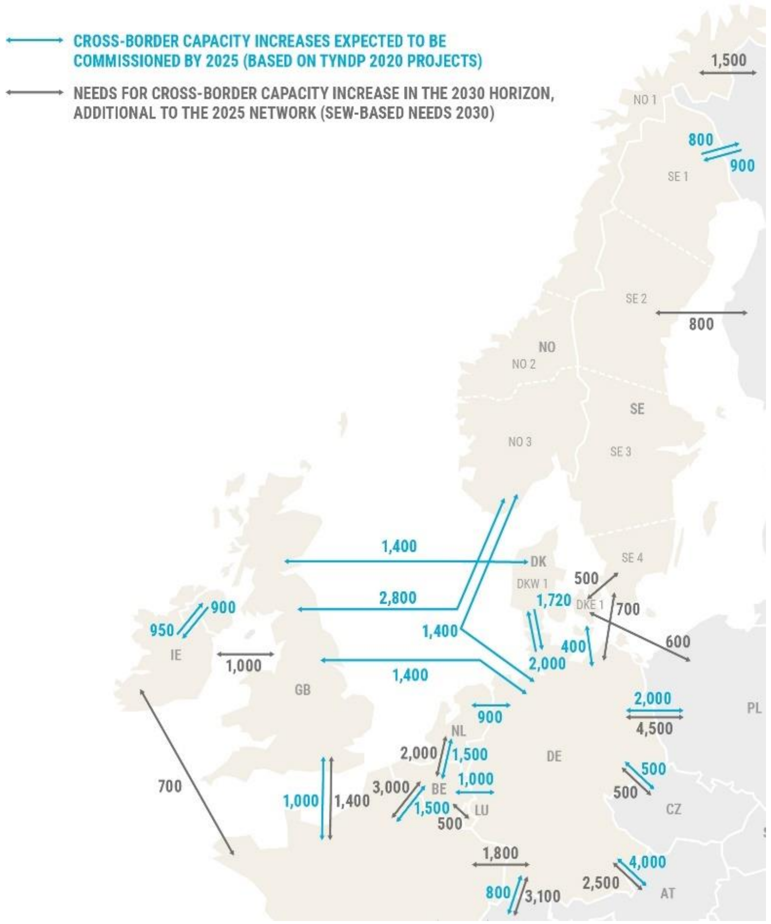
- **Flexibility is challenged**; however **Smart Sector Integration** will be part of the solution. Activities have started already.

- The above requires **new interconnectors**, especially between the four synchronous areas and will as well support market integration, security of supply and RES integration.





The Regions’ Capacity Needs



Projects by 2025 and
Economic needs 2030

Economic Needs 2030

Economic Needs 2040

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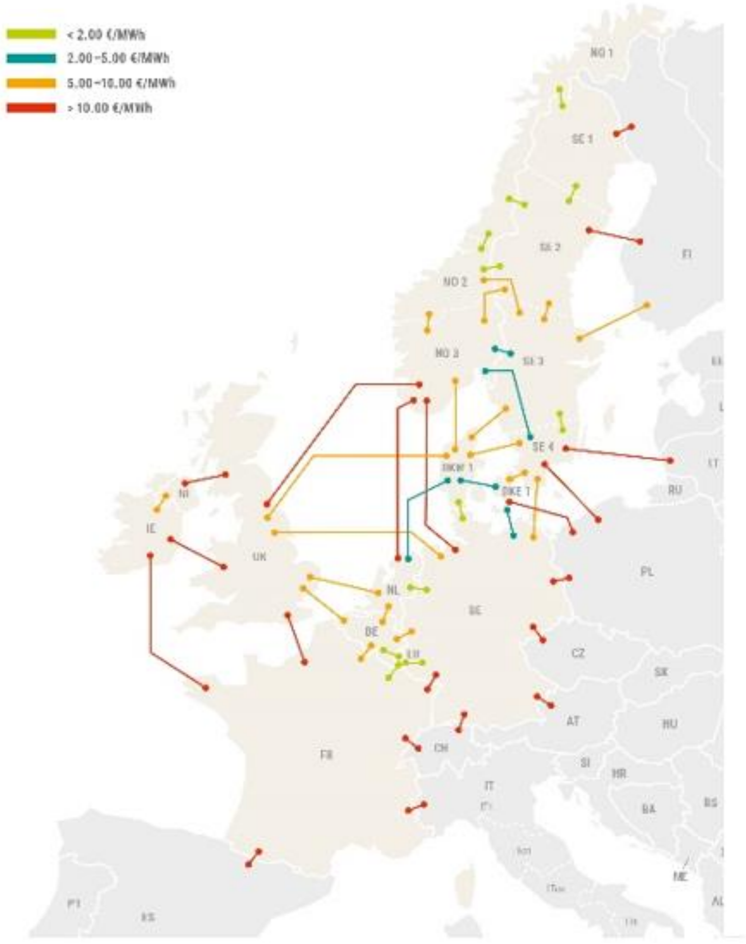
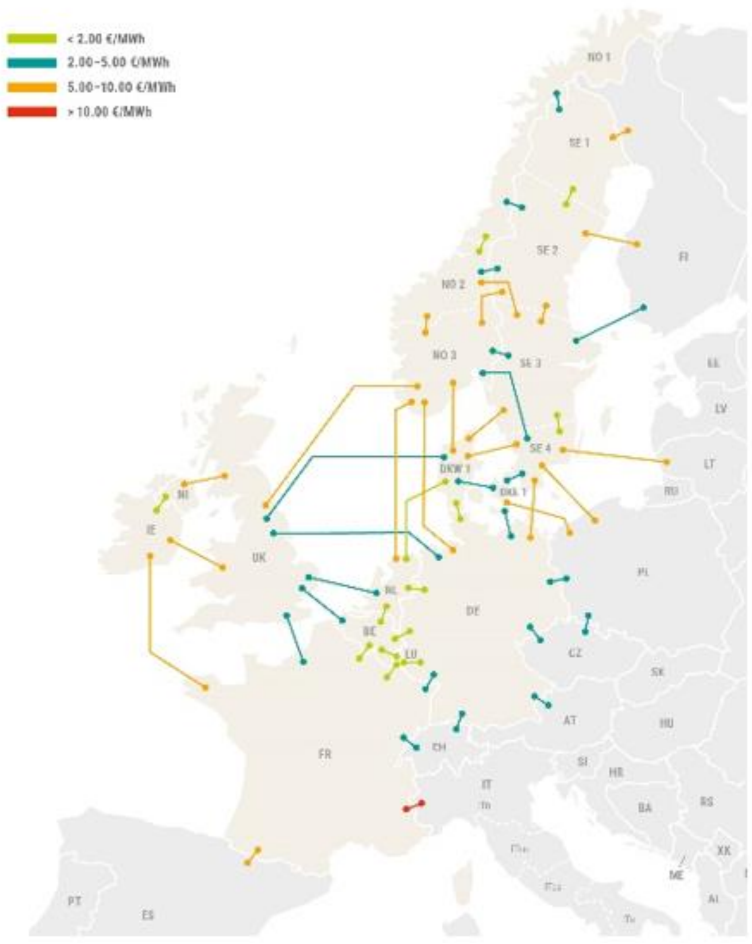
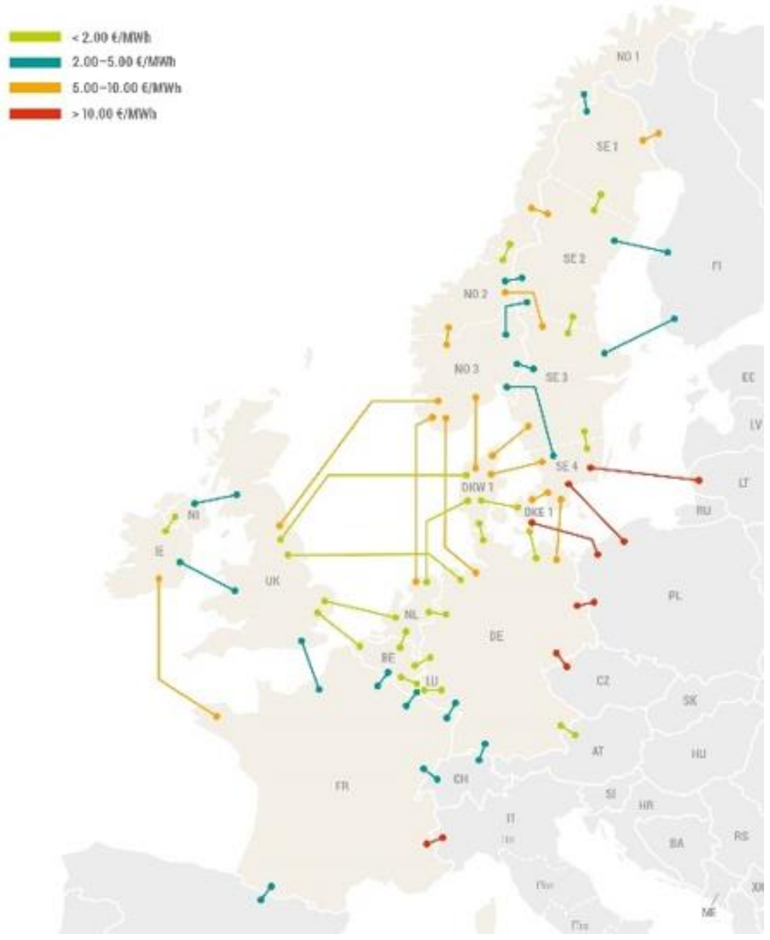
Difference in Marginal Cost of Electricity 2030 [€/MWh]



'No Action since 2020'- Scenario



Economic Needs 2030



Portfolio 2030

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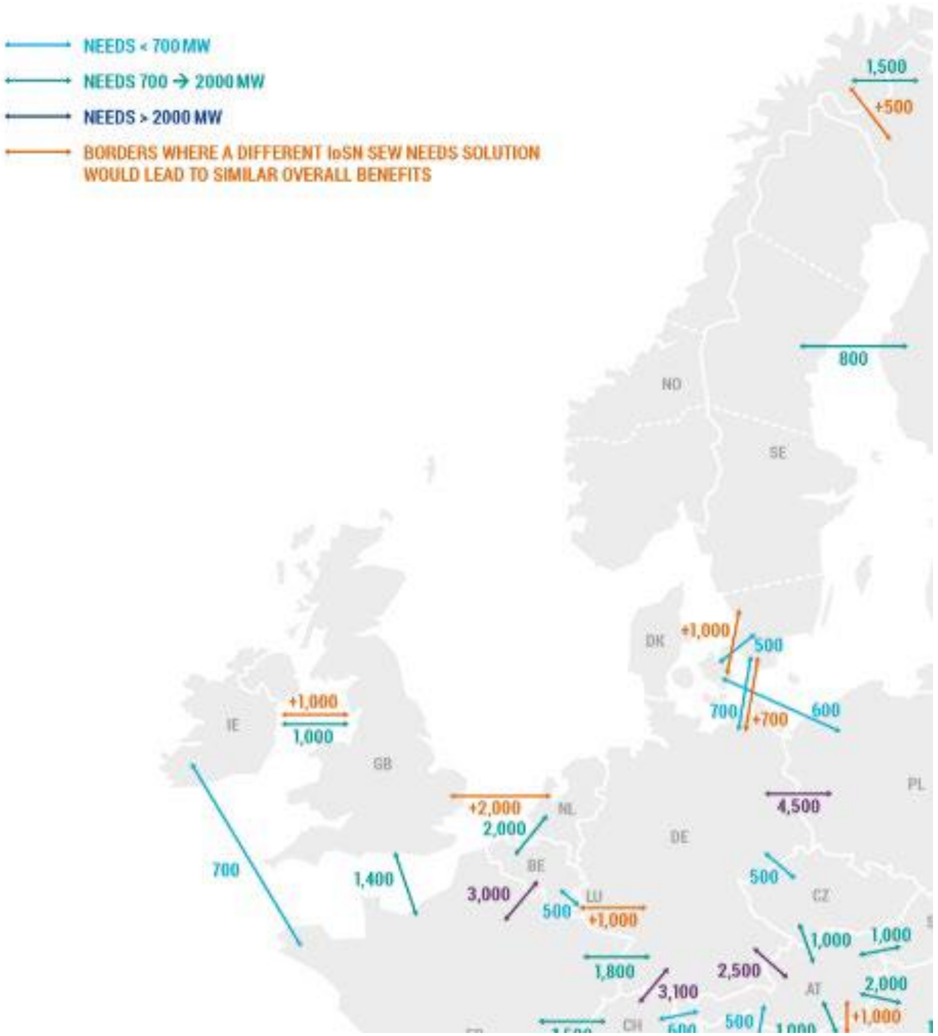
The Regions’ Capacity Needs 2030

Benefits

If 2030 needs would be satisfied, compared to the ‘No-Action since 2020’ situation, the related benefits would be

- **> 70 TWh net export** to other European regions
- **5 €/ MWh** increase of the regional average marginal price for electricity generation
- **Up to 8 €/MWh and 4 €/MWh on average** reduction of marginal cost spread, more aligned costs
- **60 Mton CO2 savings** for the whole of Europe, which however may lead to a slight **increase of regional CO2 emissions** compared to a ‘No-Action’ solution. The NS-Region is likely displacing more polluting & expensive thermal generation from other RGs, sending energy from RES and more efficient thermal generation..

This decade until 2030 prepares benefits to be captured in the following decade up to 2040, and assists other European RGs in decarbonising



Economic Needs 2030

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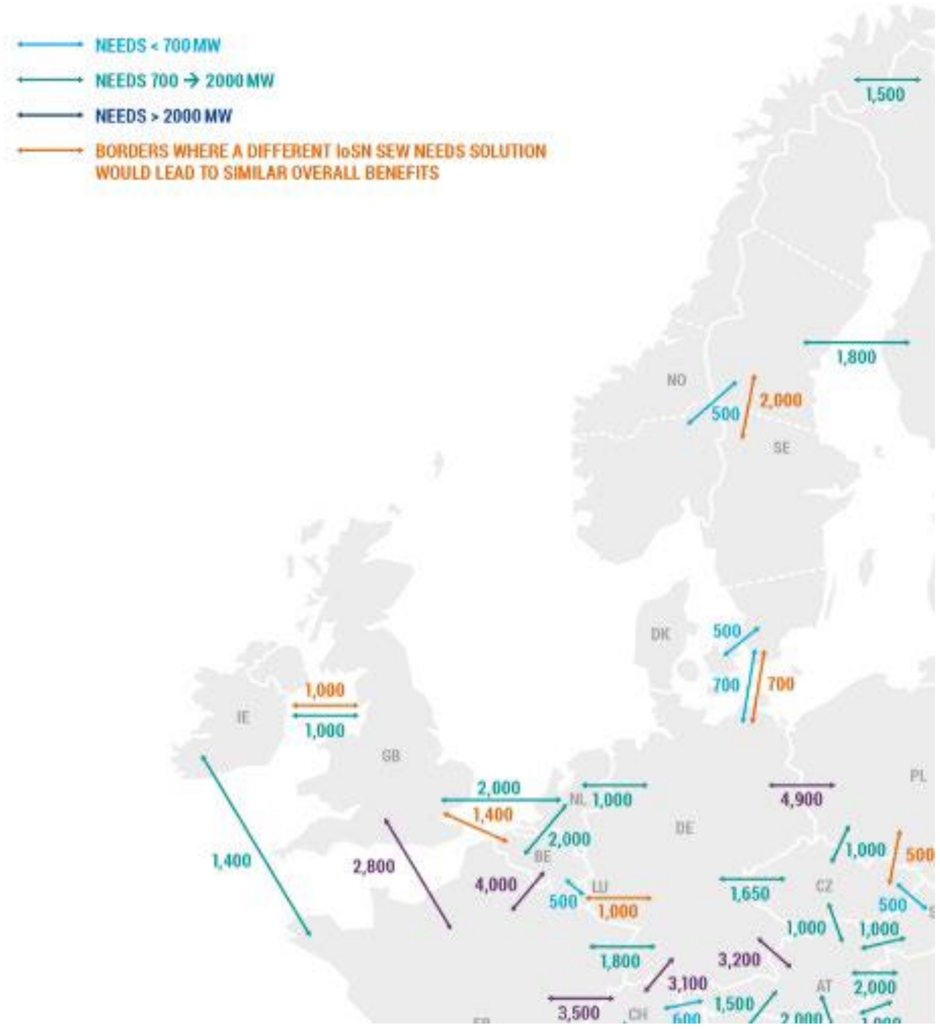
The Regions' Capacity Needs 2040

Benefits

If 2030 needs would be satisfied, compared to the 'No-Action since 2025' situation, the related benefits would be

- **44 TWh** net export to other European regions
- **17 €/ MWh** reduction of the regional average marginal price for electricity generation
- **Up to 63 €/MWh and 28 €/MWh on average** reduction of marginal cost spread between the Region's countries; more aligned costs
- **55 TWh** less curtailed variable RES
- **4.2 Mton** reduced CO_2 emissions in the RG

Investments done before 2025 benefit the region, as shown in previous TYNDPs.



Economic Needs 2040

The Regions' Project Portfolio

These projects will be analysed with the CBA methodology in TYNDP20

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Thank you!

Antje Orths
Convenor Regional Group Northern Seas
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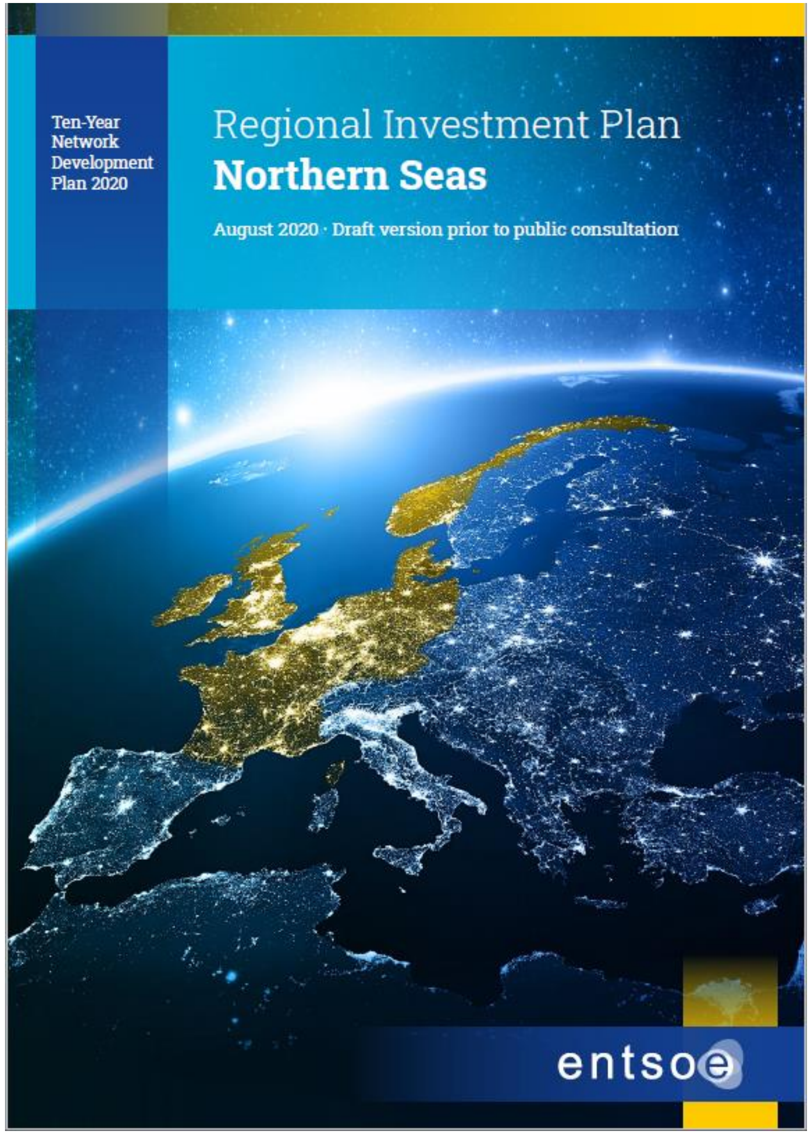

Regional System Needs – Baltic Sea

Michael Heit, Convenor of the Regional Group Baltic Sea

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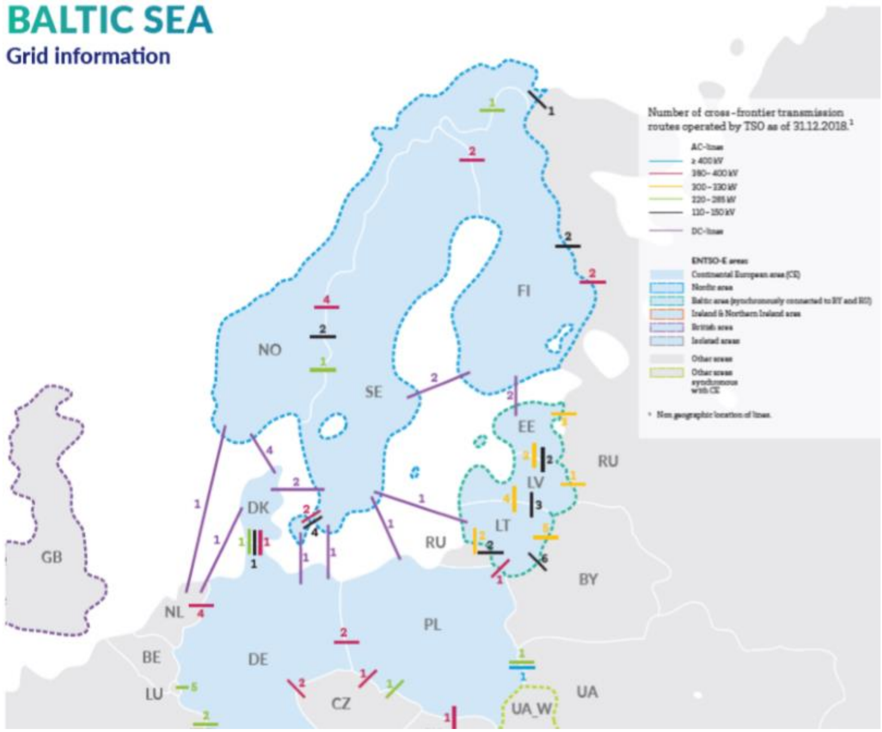
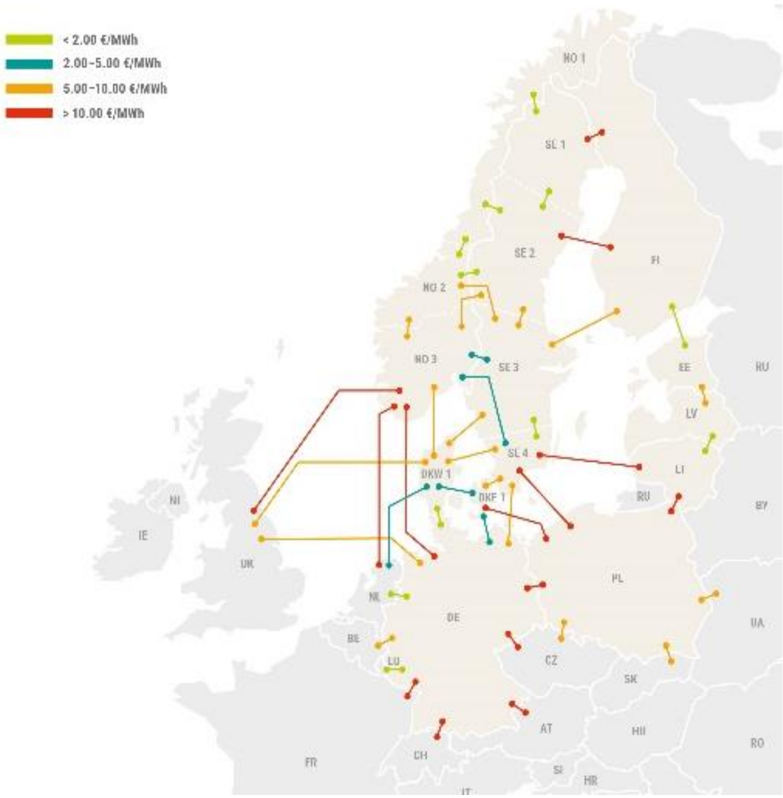
The Region's key messages for its evolution are…

- **Climate goals and requirement for decarbonization** lead to fundamental change of generation and demand, which triggers changed power flows across the region and drives the development of a electricity grid infra-structure. Dominant **power flow direction will go from North to South.**
- Rapid **expansion of both onshore and offshore renewables** and decom-missioning of nuclear generation in Germany (2023), potentially in Sweden (2040), and German coal phase-out (2028) triggers offshore- and onshore infrastructure needs.
- **Flexibility is challenged**, however Smart Sector Integration will be part of the solutions in the BEMIP PCI Corridor. Hydro resources could be made better use of as flexibility sources.
- The above **trends require new interconnectors**, some of them are already under construction (NO-DE, SE-FI …) and will help market integration, security of supply and integration of renewable energy sources.
- **Baltic countries** will be **synchronized with Continental Europe** by 2025, but security of supply will need to be further enhanced.

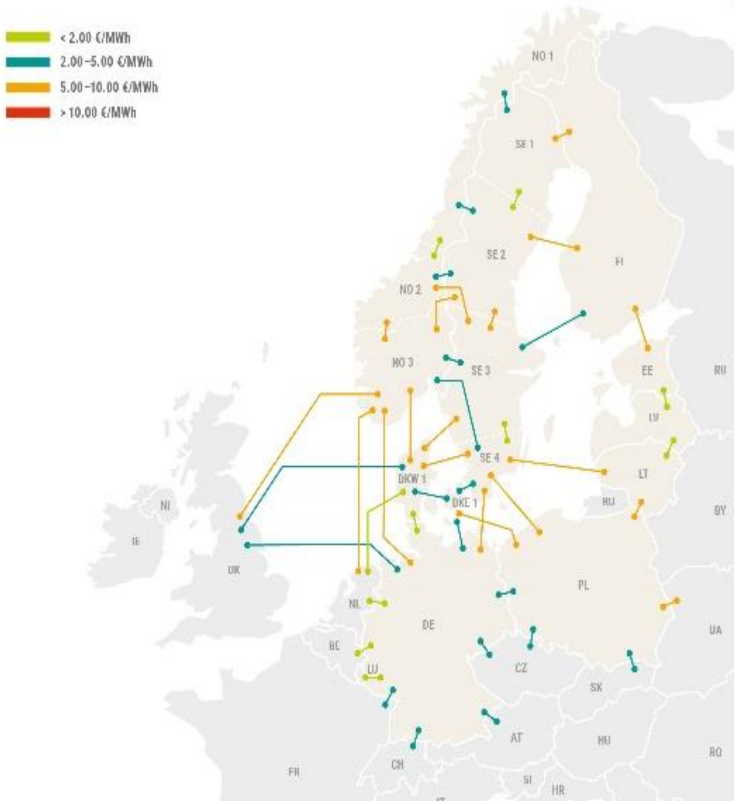


Synchronous areas and existing interconnections
in the Baltic Sea region

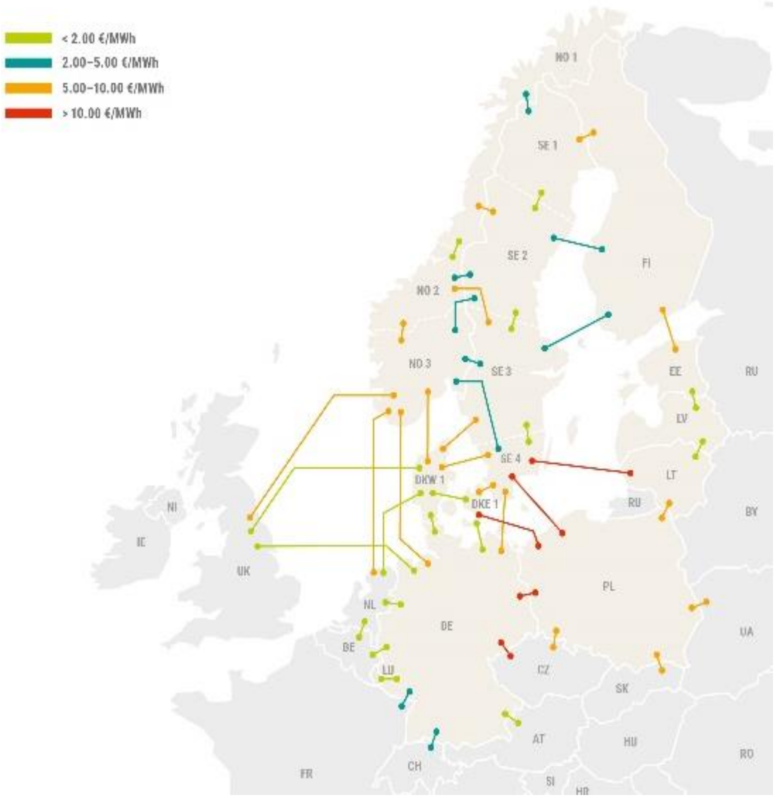
Difference in Marginal Cost of Electricity 2030 [€/MWh]



No investment after 2020



Economic Needs 2030



Portfolio 2030

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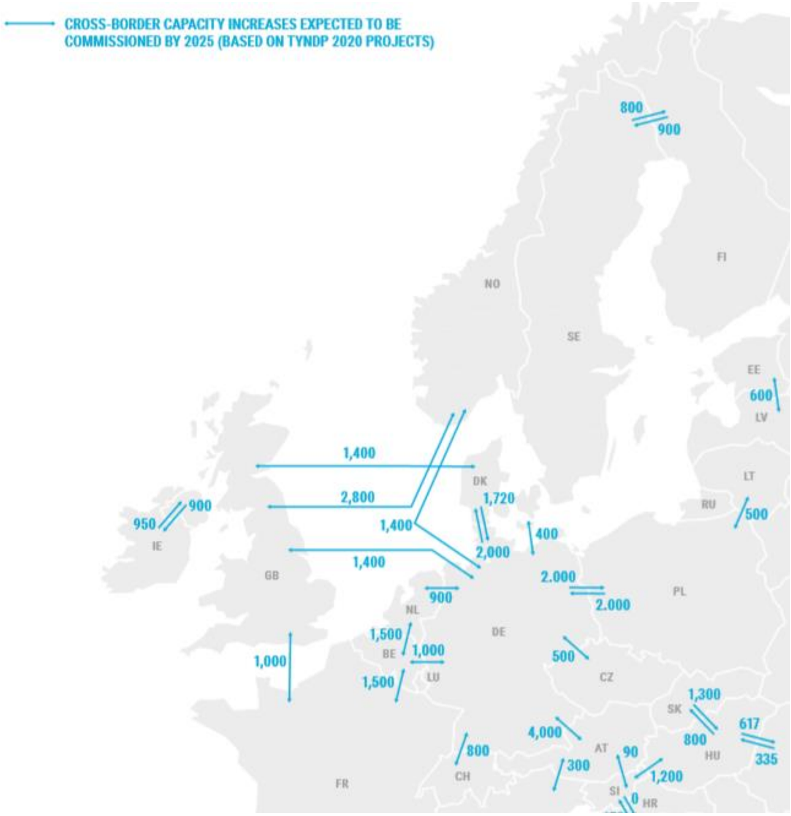
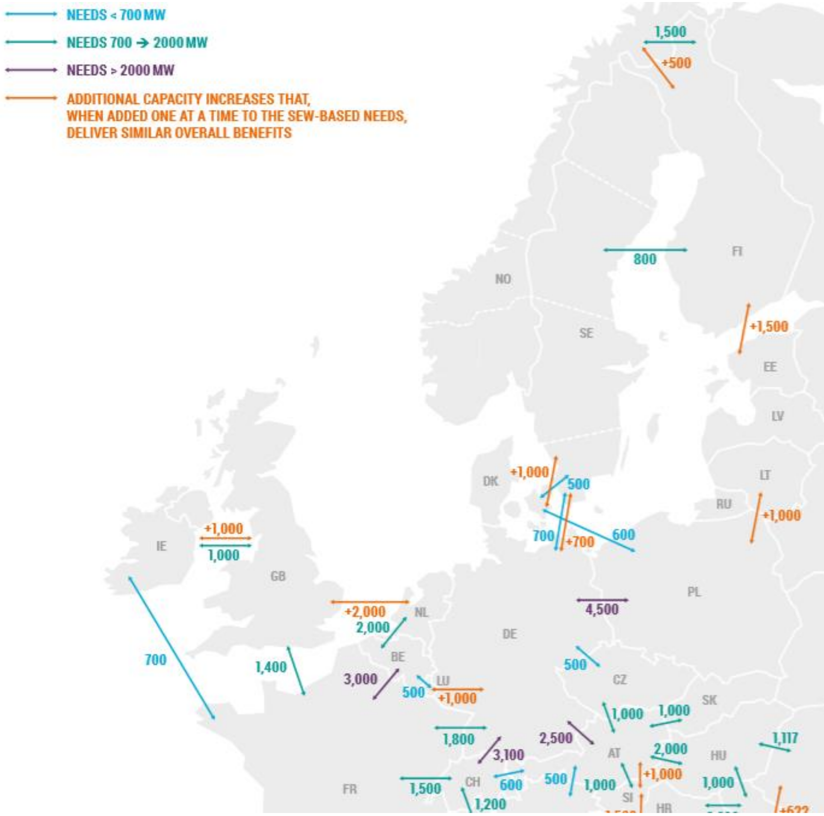
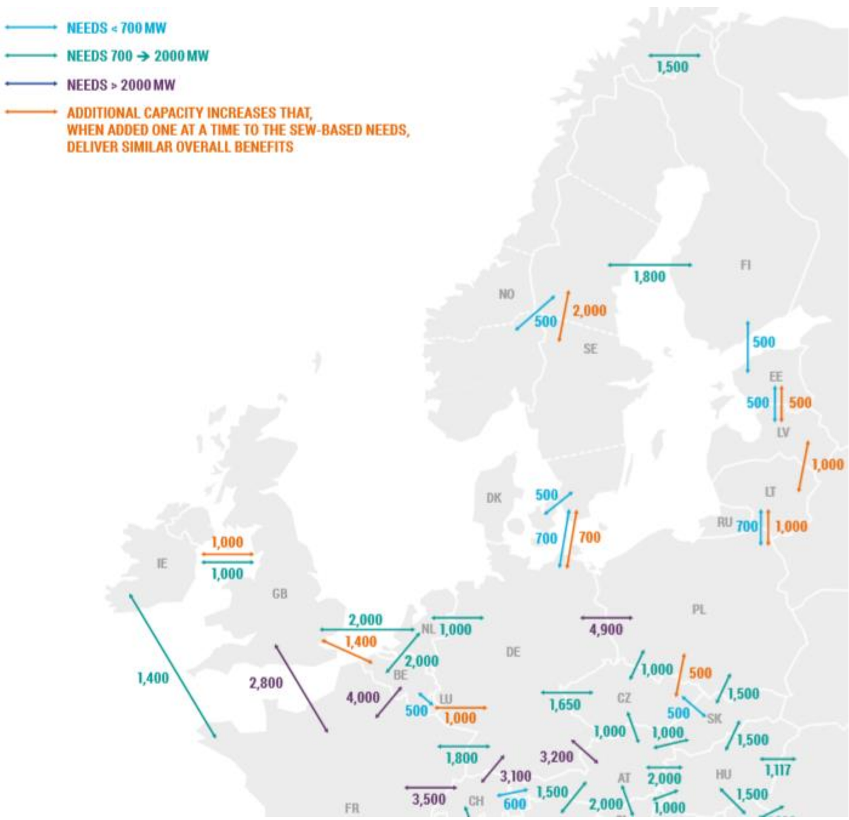
The Regions Capacity Needs



Capacity increases assumed in Reference Grid 2025



Capacity increase between 2025 and 2030*



Capacity increase between 2025 and 2040*

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* Border PL-LT: Potential of 1000 MW on LitPol link will be used for technical exchange in conditions of synchronous operation of the Baltic States.

The BS Regions’ Capacity Needs (2040)

Benefits

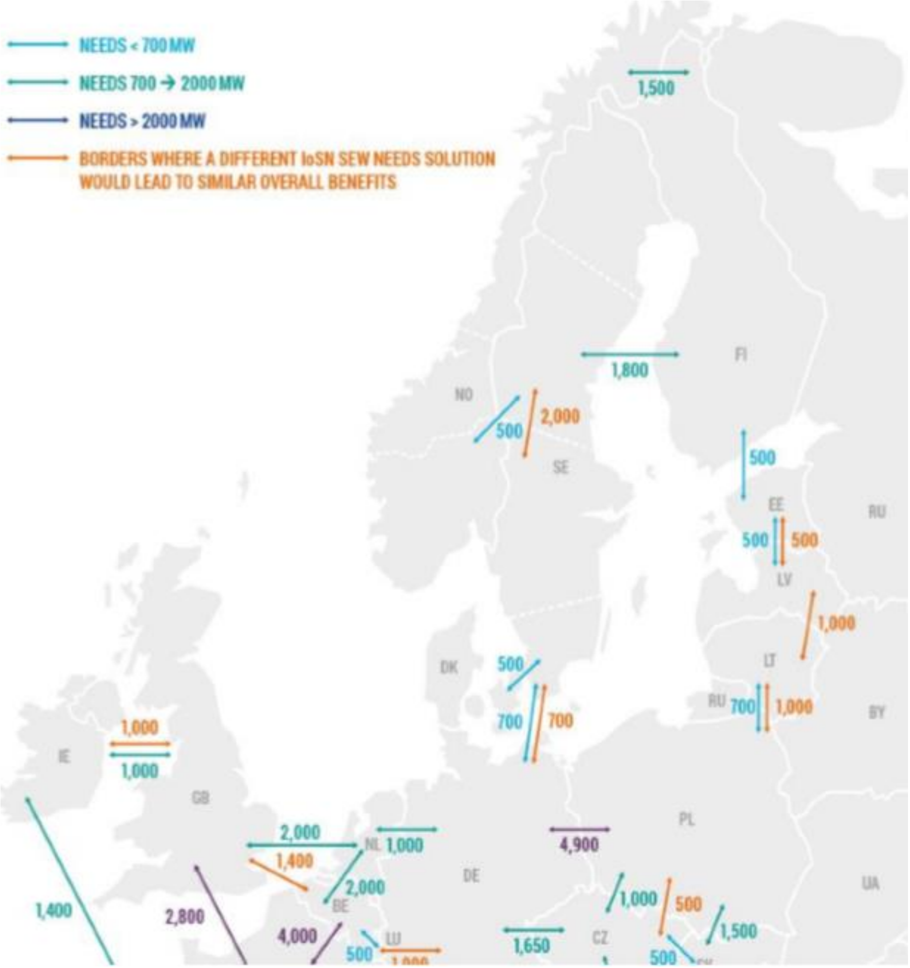
The main benefits of satisfying the identified capacity needs (2040) are:

✓ **Up to 50 € per MWh reduction in marginal costs**

✓ **From 46 to 80 TWh less curtailed energy**

✓ **A 10 MT reduction in CO_2 emissions**

Increasing the capacities at the borders, would have a significant impact on both the electrical system and on the society.



Economic Needs 2040

The BS Regions' Portfolio

Projects which will be analysed with the CBA methodology in TYNDP2020

Projects in TYNDP 2020 project list

Thank you!

Michael Heit
Convenor Regional Group Baltic See

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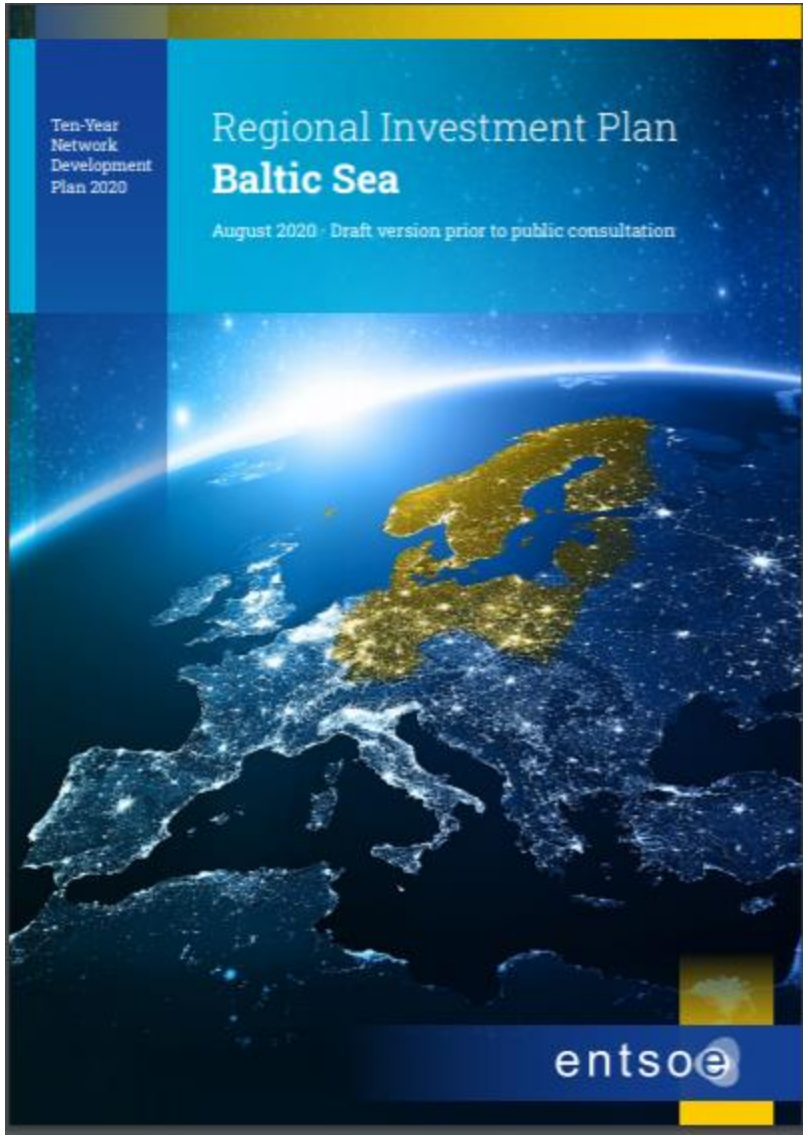

Regional System Needs – Continental South West

Fernando Batista, Convenor of the Regional Group Continental South West

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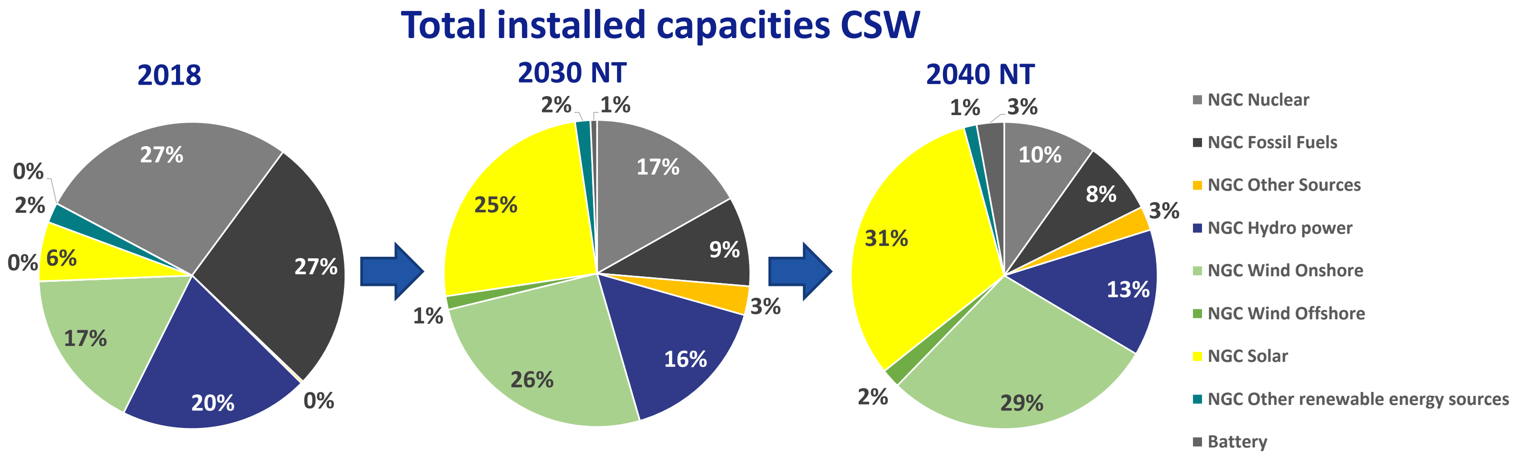
What are the RG’s main challenges / key messages?

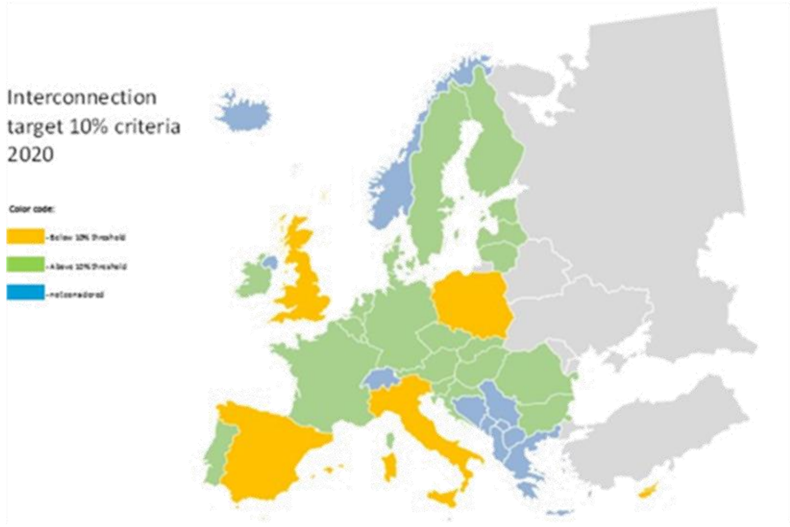
- **Change in the generation portfolio towards a more carbon-free system:**

The 2030 and 2040 scenarios already show a **transition from thermal to renewable generation**.



- **Need for a further market integration in the region, with special focus on the isolation of the Iberian Peninsula:**

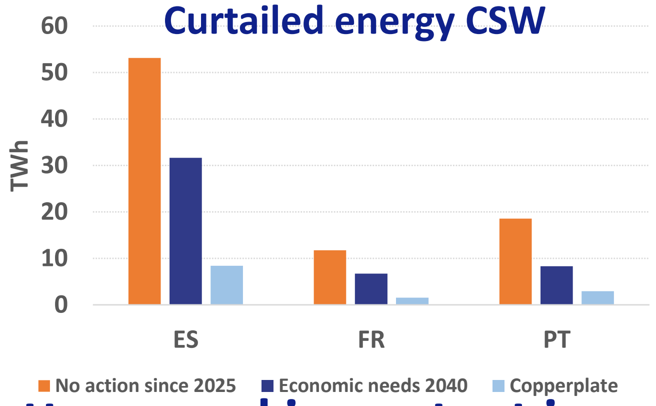
Spain will not yet fulfill the 10% objective for 2020. Moreover, **needs for cross-border development will also be attached to the 15% 2030 objectives**.



What are the RG’s main challenges / key messages?

- ## The RES integration will pose a challenge, and it will not have a unique solution:

The market analysis of 2040 NT scenario reveals a **high amount of curtailed energy in the region** with both 2025 reference grid and 2040 grid.



- ## The system will experience new power flow patterns and important investment needs:

Higher flows and new flow patterns, especially in the South-North direction for which the grid was not designed.

“no action since 2025”

“Economic needs 2040”

- ## The security of supply will have a new dimension:

Security of supply in the future will not only be a matter of checking **conventional system adequacy**, but it will **go beyond these issues**. For instance, **flexibility, dynamic issues and system inertia and demand-side response** will gain importance in the security of supply.

Which future capacity needs have been identified (2030 and 2040)?

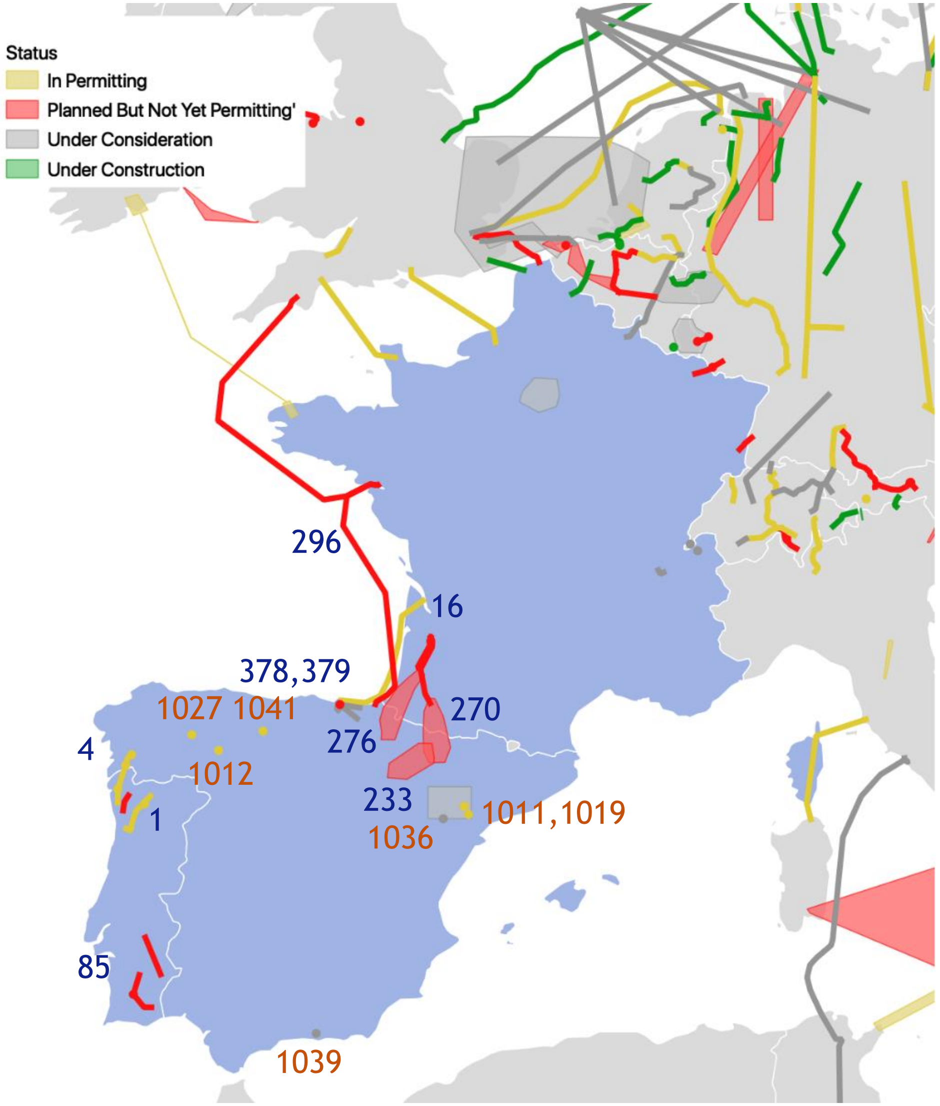
2030 2040

what's the RG benefit ?

The **needs for transmission capacity increases id**entified across Europe in such scenarios from **2025 onwards would have a significant impact** on the electrical system and on society as a whole in **2040**:

- **reduction** of the **generation costs** in the CSW region by **510 M€/year**
- **cost spread reduction** between France and Spain by around **15 €/MWh** and between Portugal and Spain by around **10€/MWh**.
- **integrating 36,6 TWh/year** of **renewable energy** in the CSW region; would otherwise be curtailed.
- **reduction** up to **2,5 Mtons/year** of **CO2 emissions** in CSW emissions.

Which projects will be CBA investigated?



Projects in the CSW region

	Transmission
Project n°	**Project Name**
1	RES in north of Portugal
4	Interconnection Portugal-Spain
16	Biscay Gulf
85	Integration of RES in Alentejo
233	Connection of Aragon Pumping hydro
270	FR-ES project -Aragón-Atlantic Pyrenees
276	FR-ES project -Navarra-Landes
296	Britib
378	Transformer Gatica
379	Uprate Gatica lines

	Storage
Project n°	**Project Name**
1011	Reversible Pumped-Storage Hydroelectric Exploitation, “Mont-Negre”
1012	Purifying Pumped Hydroelectric Energy Storage (P-PHES), Navaleo
1019	Two reversible hydroelectric plants, Gironés and Raimats
1027	Purifying Pumped Hydroelectric Energy Storage (P-PHES), Cúa
1036	SR Mar de Aragon
1039	Reversible Hydraulic Power Plant “Los Guajares”
1041	Purifying – Pumped Hydroelectric Energy Storage “Velilla del Río Carrión” (P-PHES VELILLA)

Thank you!

Fernando Batista
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Fernando.batista@ren.pt

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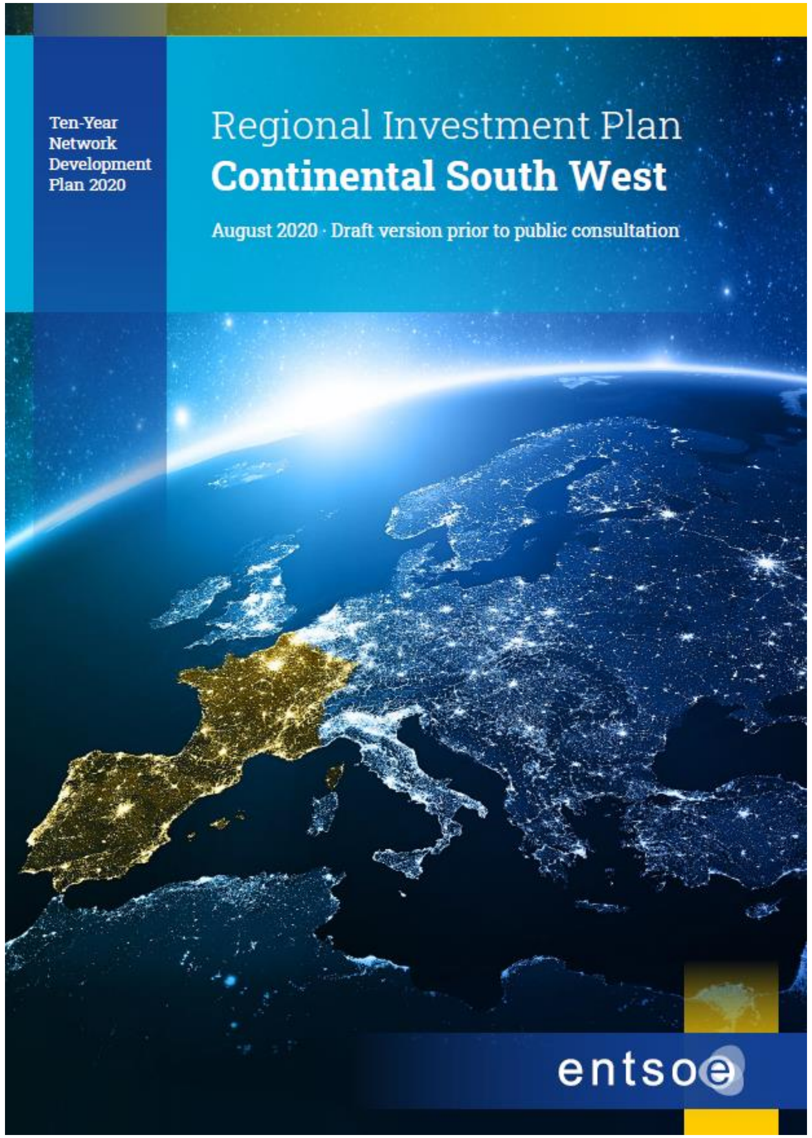

Regional System Needs – Continental South East

Vladan Ristic, Regional Group Continental South East

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Key messages of the region

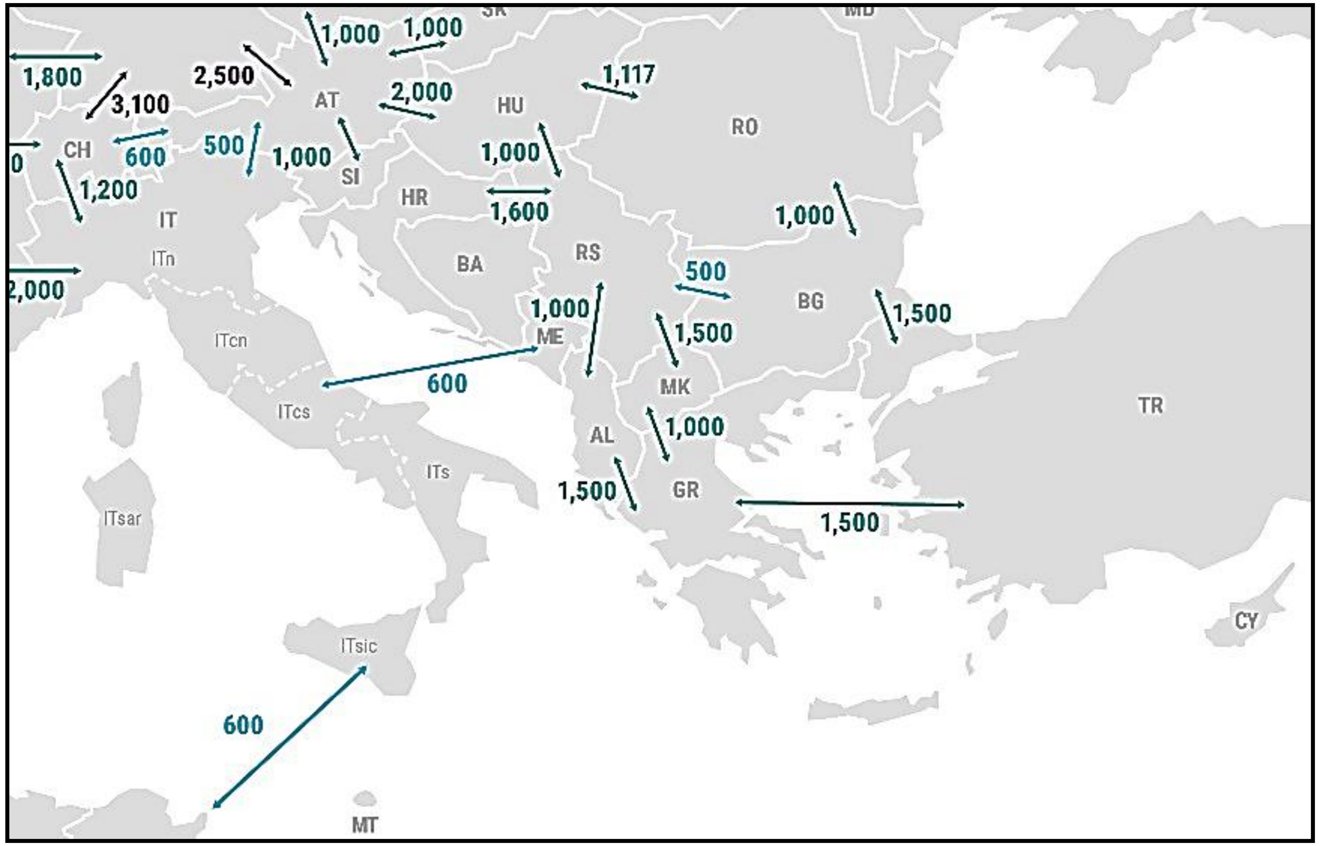
- Increase of transfer capacities and market integration facilitation
- Massive renewable energy source integration
- Generation paradigm shift
- Necessity of stronger connection between EU countries and West Balkan countries
- Increase of the transmission capacity between Turkey and the rest of the region
- Connection of the neighboring systems to the region

IoSN established needs – 2030 time-horizon

- The entire region shows the needs for massive strengthening of interconnections before 2030.

- Special attention should be paid to the border between Bulgaria and Turkey and the border between Greece and Turkey.

- The proposed solutions should contribute to the reduction of the CO_2 emission and the amount of curtailed energy in the region.

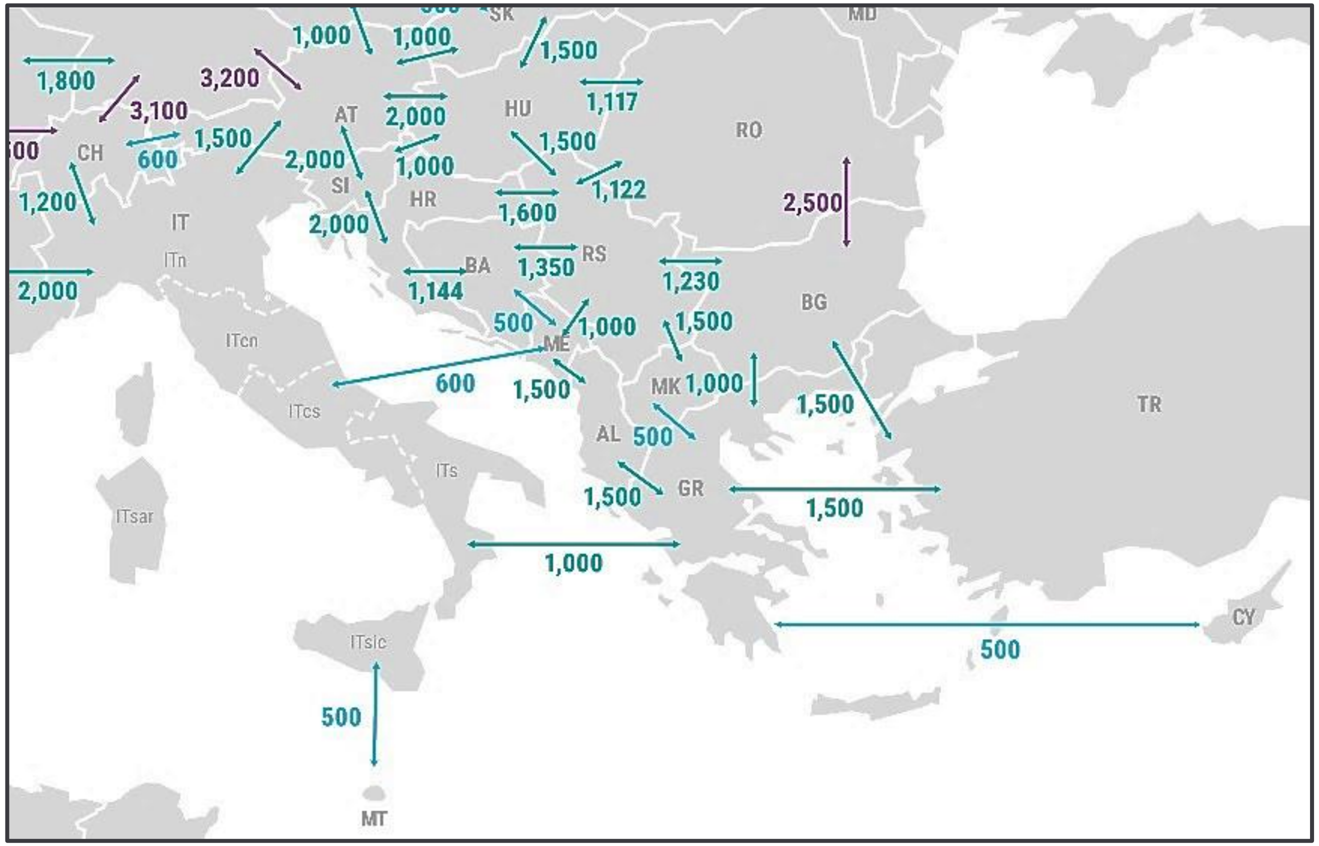


IoSN established needs – 2040 time-horizon

- The strong market integration trend is expected to continue in the period between 2030 and 2040.

- Other than the already mentioned needs, there are numerous suggestions for the optimal development, some more ambitious than the rest.

- The grid reinforced in a proper way would guarantee the enhancement of the values of several indicators (CO_2 emissions, curtailed energy, marginal price unification etc.).



Thank you!

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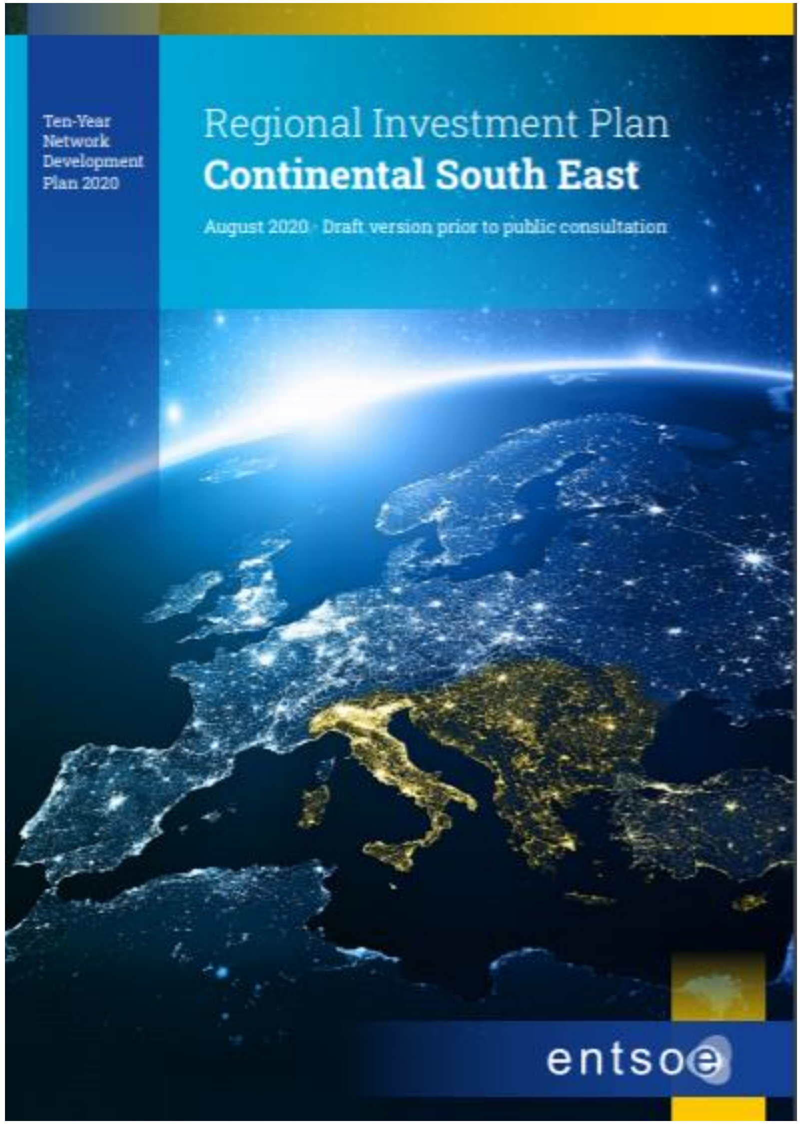

Regional System Needs – Continental Central East

Lubos Samsely, Convenor of Regional Group Continental Central East

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Content

1. Main drivers for the CCE grid development
   a) Generation mix change
   b) Enlarging synchronously connected Europe

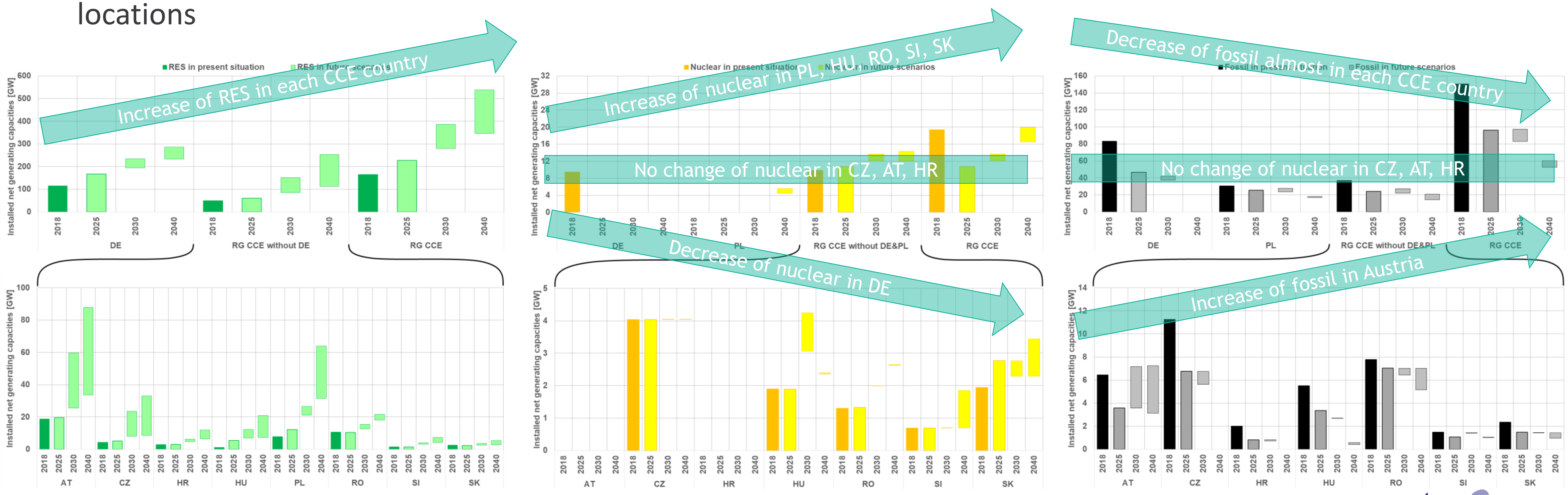
2. Identified system needs

3. Future capacity needs

4. CCE Project portfolio in TYNDP2020

Generation mix change

- Fulfilling the EU climate goals by setting Integrated National Energy and Climate Plans by 2030
  - Massive RES integration – dispersed or concentrated generation parks
- Different national energy policies of the CCE countries
  - Nuclear and fossil
- Change of the generation location – decommissioning of existing a building the types of generation in different locations

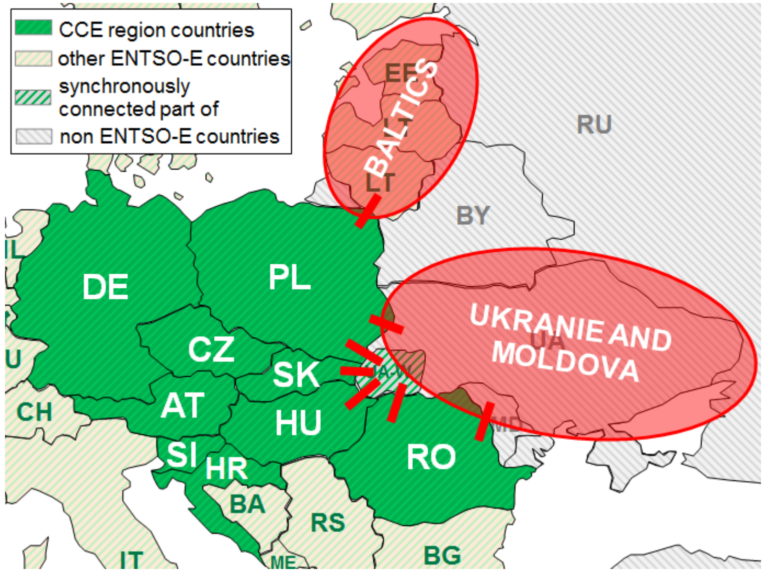


Enlarging synchronously connected Europe

- Enlarging the synchronously connected Europe
  - Ukrainian and Moldavian synchronous interconnection to Continental Europe Power System
  - Baltics power systems synchronous connection to Continental Europe Power System
- Change of the energy flow patterns (additional exports or imports)

- Not included in the TYNDP2020 scenarios nor in System Needs study results

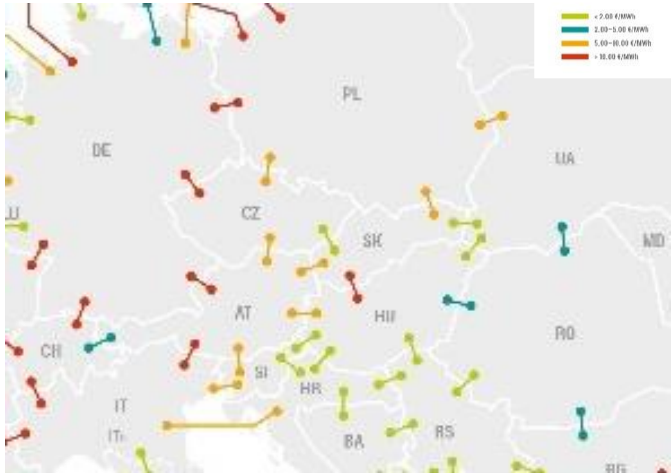
- Challenge to be incorporated in future TYNDPs



Identified system needs

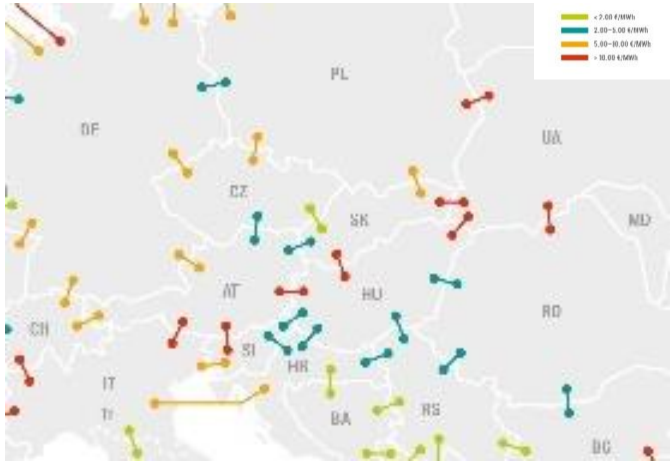
- Insufficient integration of RES – high curtailed energy;
- Insufficient market integration - high system costs in market areas and high price differences between the market areas;
- Insufficient decarbonisation - high CO_2 emissions;
- Change of the net annual balances and load flow pattern in the region causing then possible cross-border and internal bottlenecks.

Price differences in 2030 - “No investments after 2025”



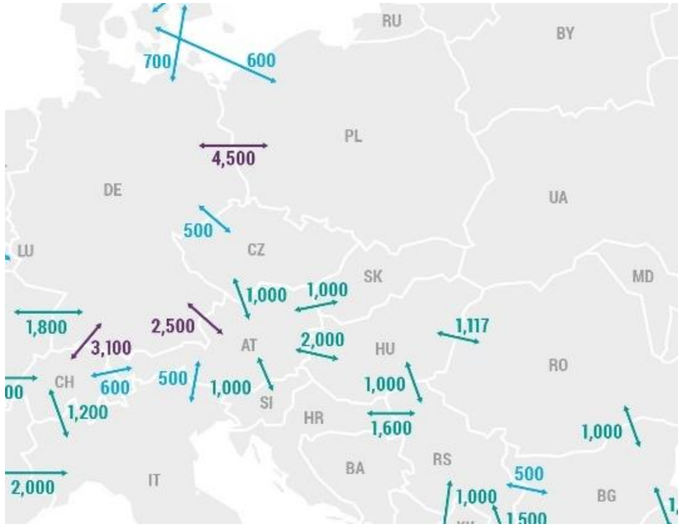
Price differences in 2030 - “Economic needs capacity increases in 2030”

Price differences in 2040 - “Economic needs capacity increases in 2040”



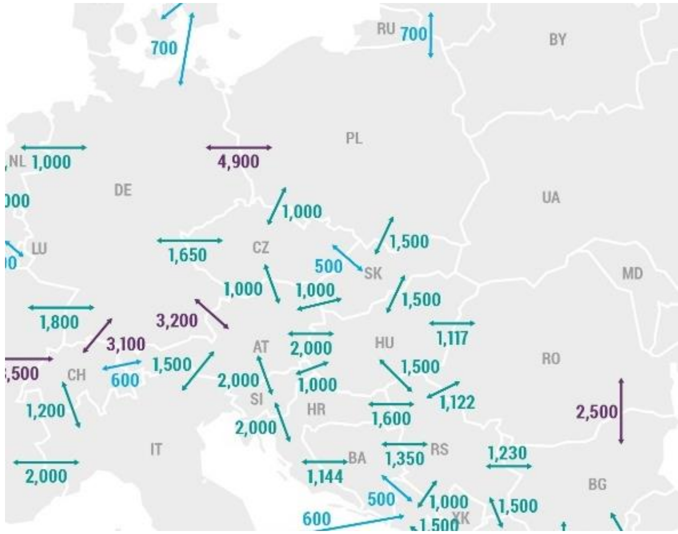
To solve the identified system needs, the future capacity increases have been designed.

Identified system needs



Improvement in satisfying the identified needs in 2030 considering identified capacity increases (comparison “no investments after 2025” and “2030 economic needs”):

- **2 € per MWh in average reduction in marginal costs**
- **10 TWh less curtailed energy**
- **16 MT reduction in CO2 emissions**



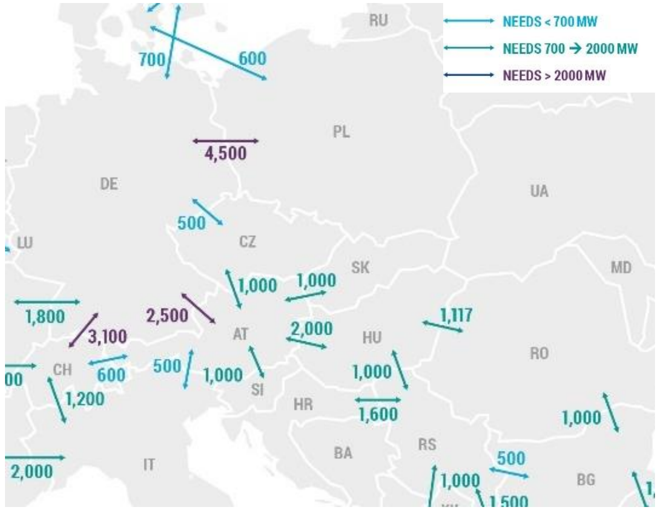
Improvement in satisfying the identified needs in 2040 considering identified capacity increases (comparison “no investments after 2025” and “2040 economic needs”):

- **30 € per MWh in average reduction in marginal costs**
- **40 TWh less curtailed energy**
- **9 MT reduction in CO2 emissions**

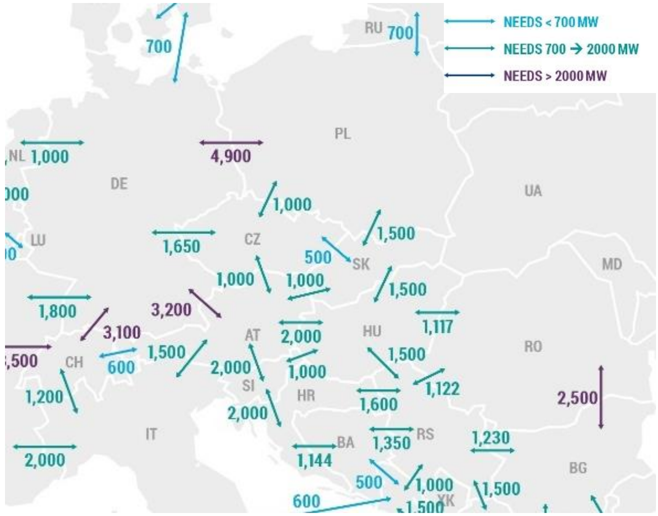
Future capacity increases

Capacity increases in the reference grid 2025

Capacity increases in 2030 – Economic needs grid



Capacity increases in 2040 – Economic needs grid



Cross-border capacity increases will not solve all the needs. Need to apply measures from different energy sectors.

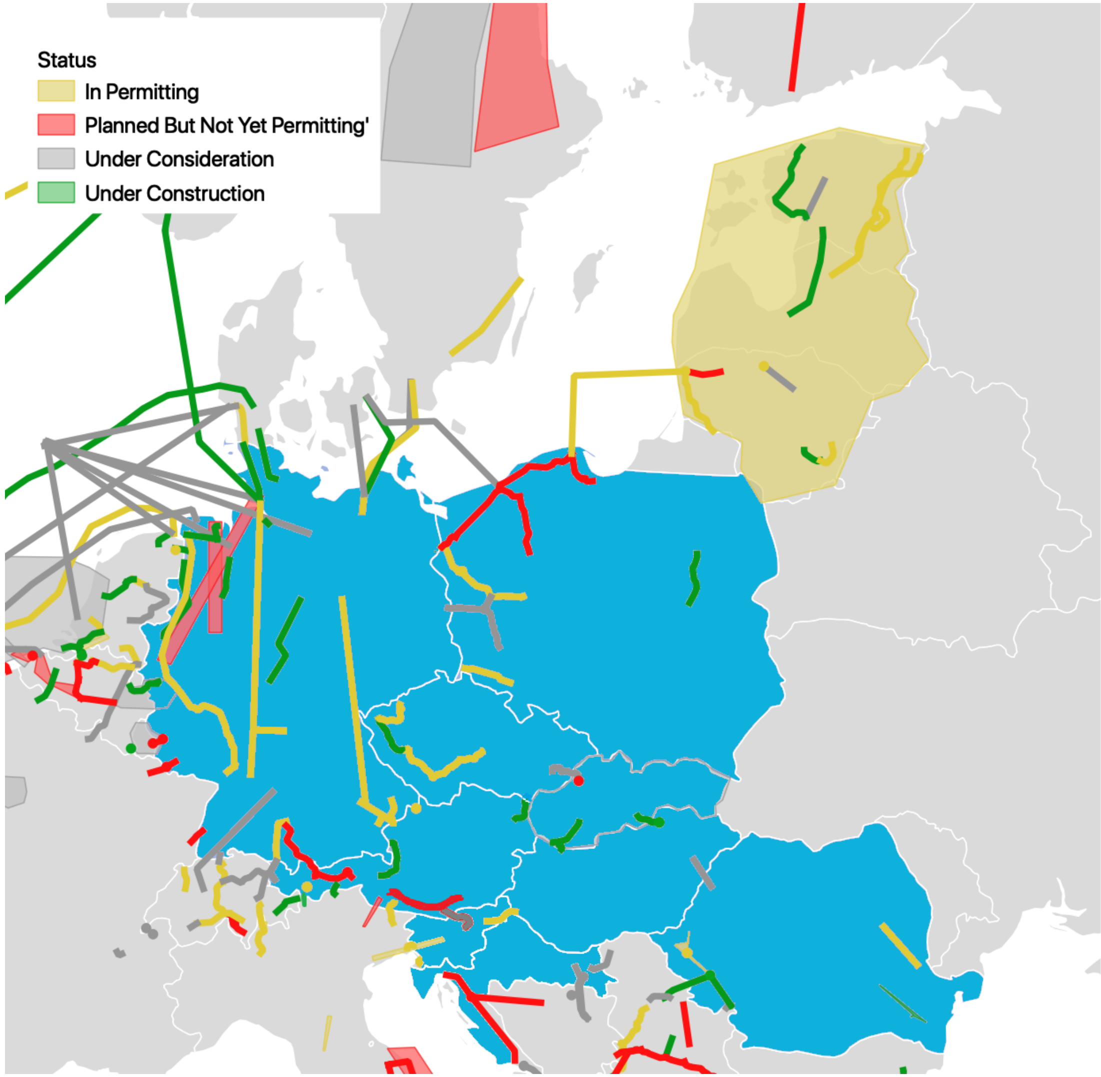
ENTSO-E already started – Multi Sector Planning.

Identified future capacity increases **partially or fully covered by projects in the TYNDP2020**:

- Poland – Germany (2030 and 2040)
- Czech – Slovakia (2040)
- Hungary – Romania (2030 and 2040)
- Slovenia – Austria (2030 and 2040)
- Austria – Germany (2030 and 2040)
- Czech – Germany (2030 and 2040)

CCE Project portfolio in TYNDP2020

Projects to be assessed by the Multi-criteria Cost Benefit Analysis methodology in TYNDP2020 process



Thank you!

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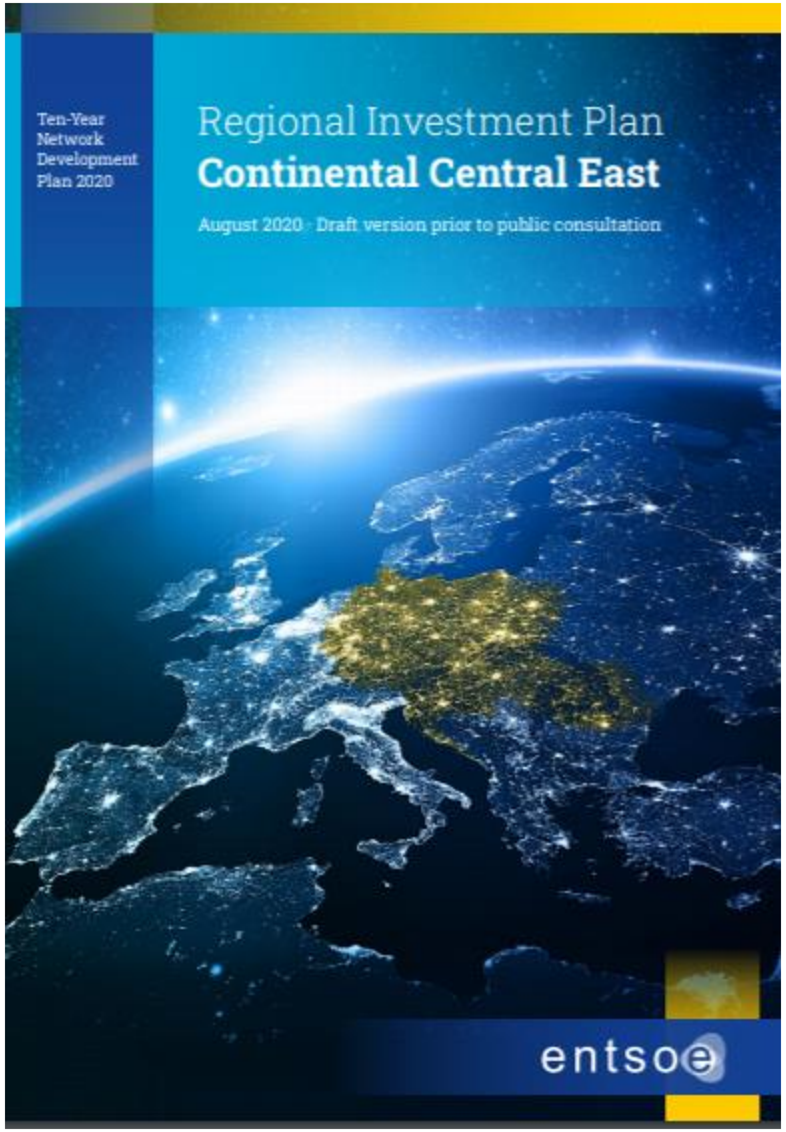


Regional System Needs – Continental Central South

Antonio Conserva, Regional Group Continental Central South

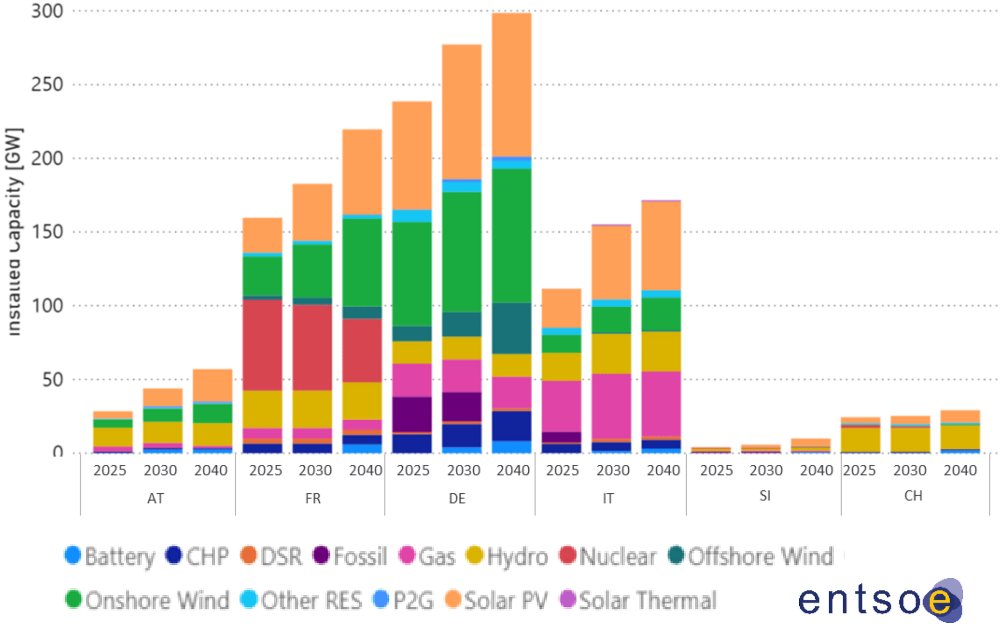
The Region's key messages for its evolution are..

Large developments of variable wind and photovoltaic power, especially at the corners of the CCS region, the nuclear phase-out, mainly gas-based thermal generation, and the pump storage potentials in the Alps are some of the outstanding characteristics of the region that will challenge the whole future electricity system and especially the transmission system.

Main drivers for power system evolution:

- Massive RES integration
- Nuclear phase-out and existing thermal capacity dismissing or mothballing
- Efficient integration of storage plants in order to facilitate the full exploitation of RES
- coal phase-out
- Gas dependence of thermal generation
- Wide area power flows
- System stability and security of supply

National Trend scenario



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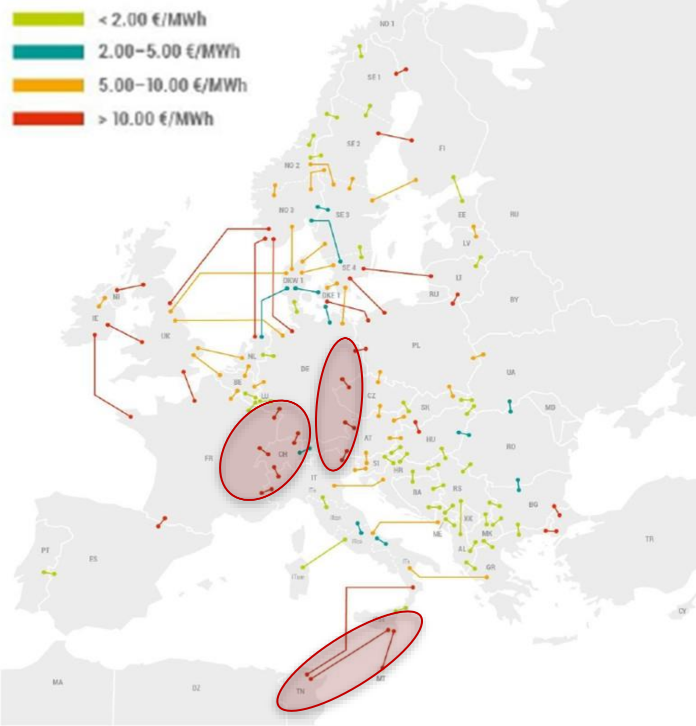
System Challenges to be faced…
2030 scenarios with current grid 2020

Results from analysis on all **2030** scenarios (National Trend, Distributed Energy, Global Ambition) confirmed expected needs that the power system will have to face if the grid does not evolve beyond 2020, such as:

1. Very high price differences between market areas

Average hourly price differences in CCS Region – 2030 scenarios vs 2020 grid

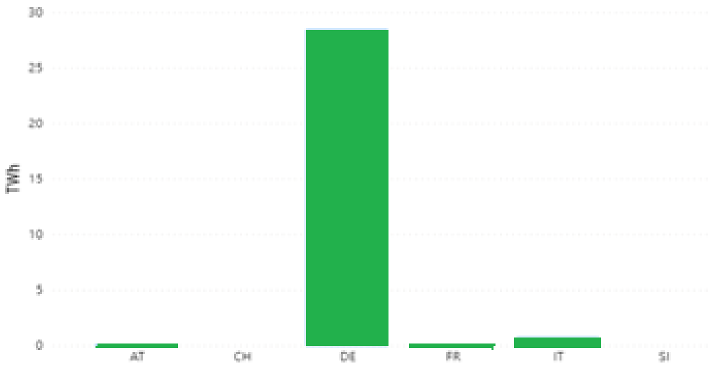


2.bottlenecks between market areas and inside these areas

Main boundaries of the CCS Region

3. insufficient RES integration (high amounts of curtailed energy)

Curtailed energy in CCS Region - 2030 scenarios vs 2020 grid

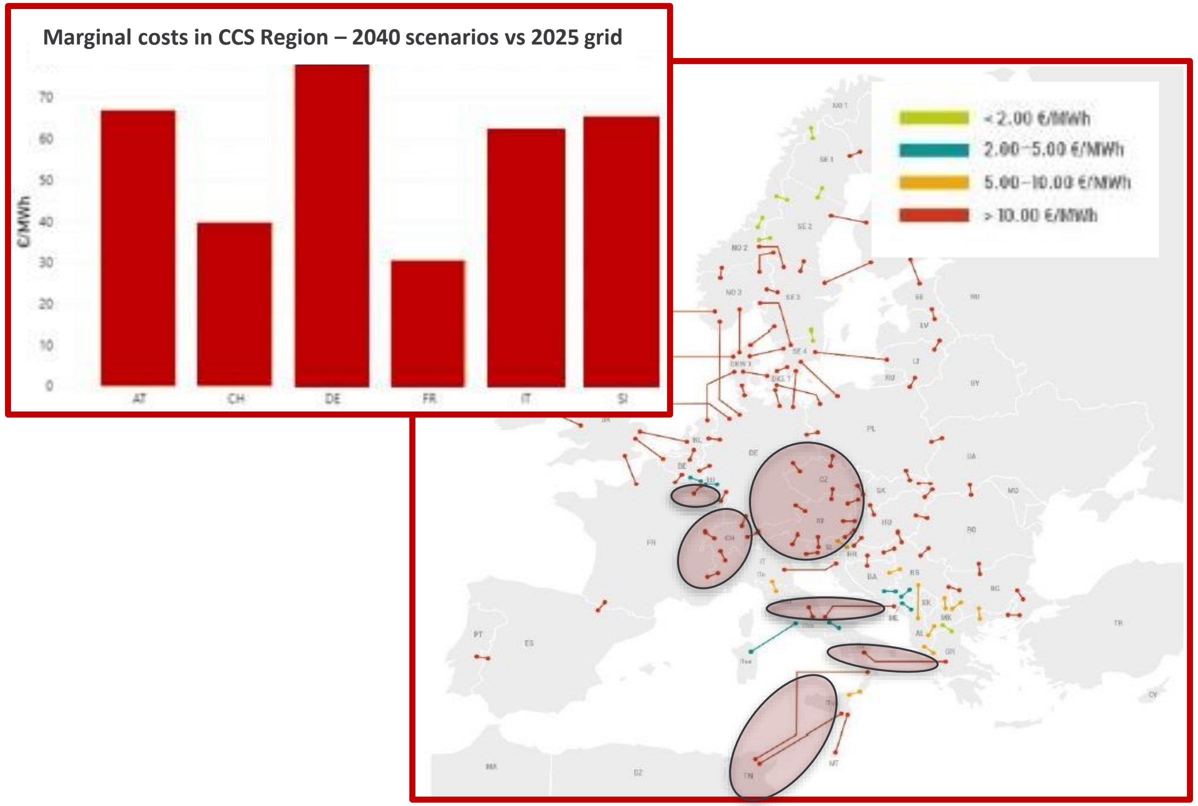


System Challenges to be faced…

2040 scenarios with current grid 2025

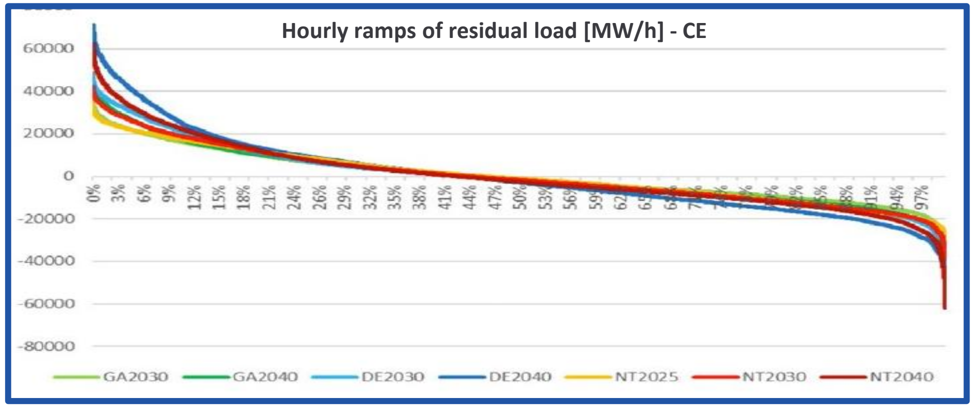
Looking at very long term **2040** scenarios, if the grid does not evolve beyond 2025, the system issues increase remarkably

1) Higher price spreads and more bottlenecks between market areas and inside these areas

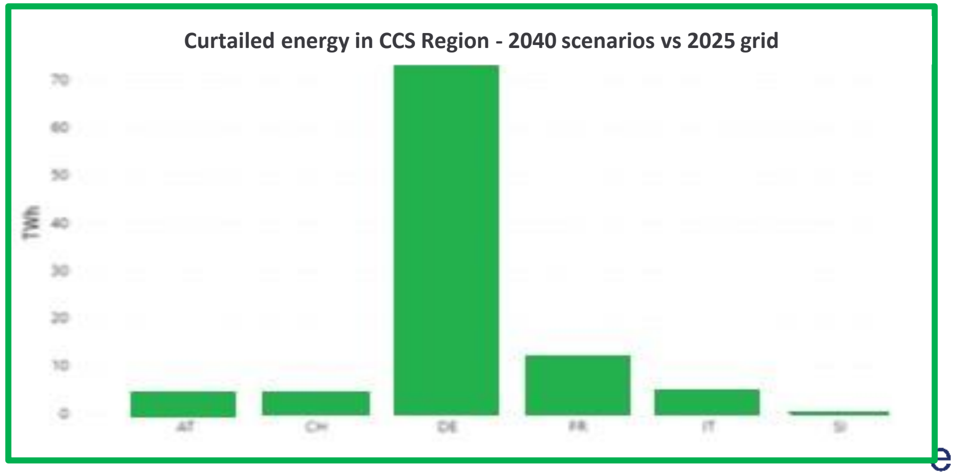


Average hourly price differences in CCS Region – 2040 scenarios vs 2025 grid

2) Systems flexibility issue



3) Bigger amounts of curtailed energy



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Which future transmission capacity needs have been identified by 2030?

2030 scenarios with current grid 2020

- The outcomes of the market and network investigations confirm in general the necessity of the projects already planned in TYNDP, in order to meet market integration challenges, to increase the sustainably of the transmission system by integrating more RES generation and to improve the security of supply

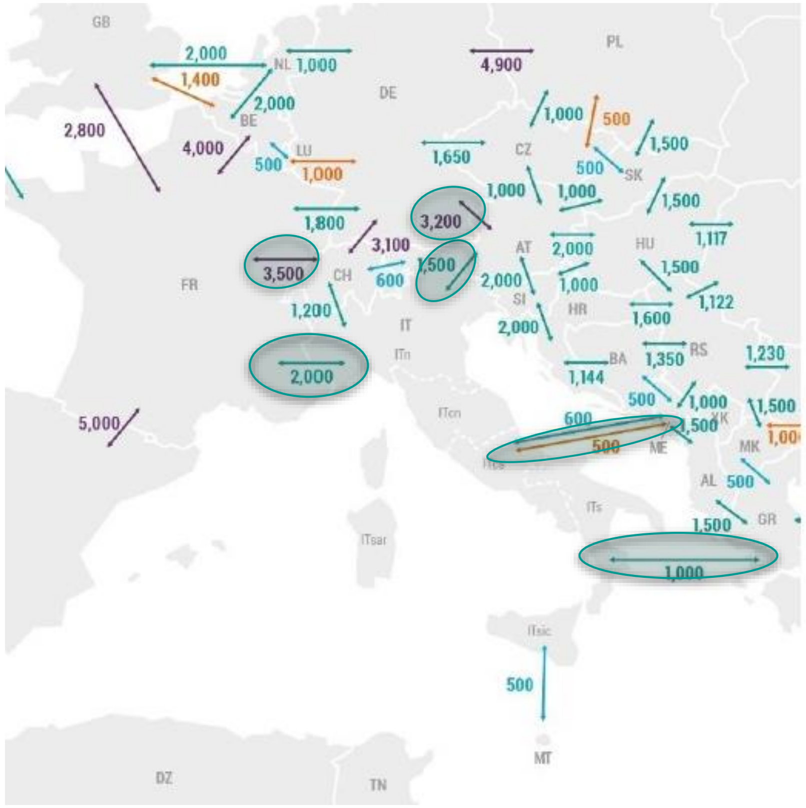
- Needs for transmission capacity increase are highlighted on the main boundaries of the CCS Region, including
  - Northern Italian boundary
  - Italy – Balkans
  - Italy – North Africa
  - France – Germany
  - France - Switzerland

Increase in capacity from 2025 to 2030

Which future transmission capacity needs have been identified by 2040?

2040 scenarios with reference grid 2025

- In addition to 2030 studies, the results of market and network simulations in 2040 scenarios show additional needs till 2040 that could be investigated more in detail in the present and/or future TYNDPs
- For instance, the borders where it could be interesting to investigate further transmission capacity increases are:
  - Italy – Austria
  - Italy-Greece
  - Italy – France
  - Italy – Montenegro
  - France – Switzerland



Increase in capacity from 2025 to 2040

From needs to Projects

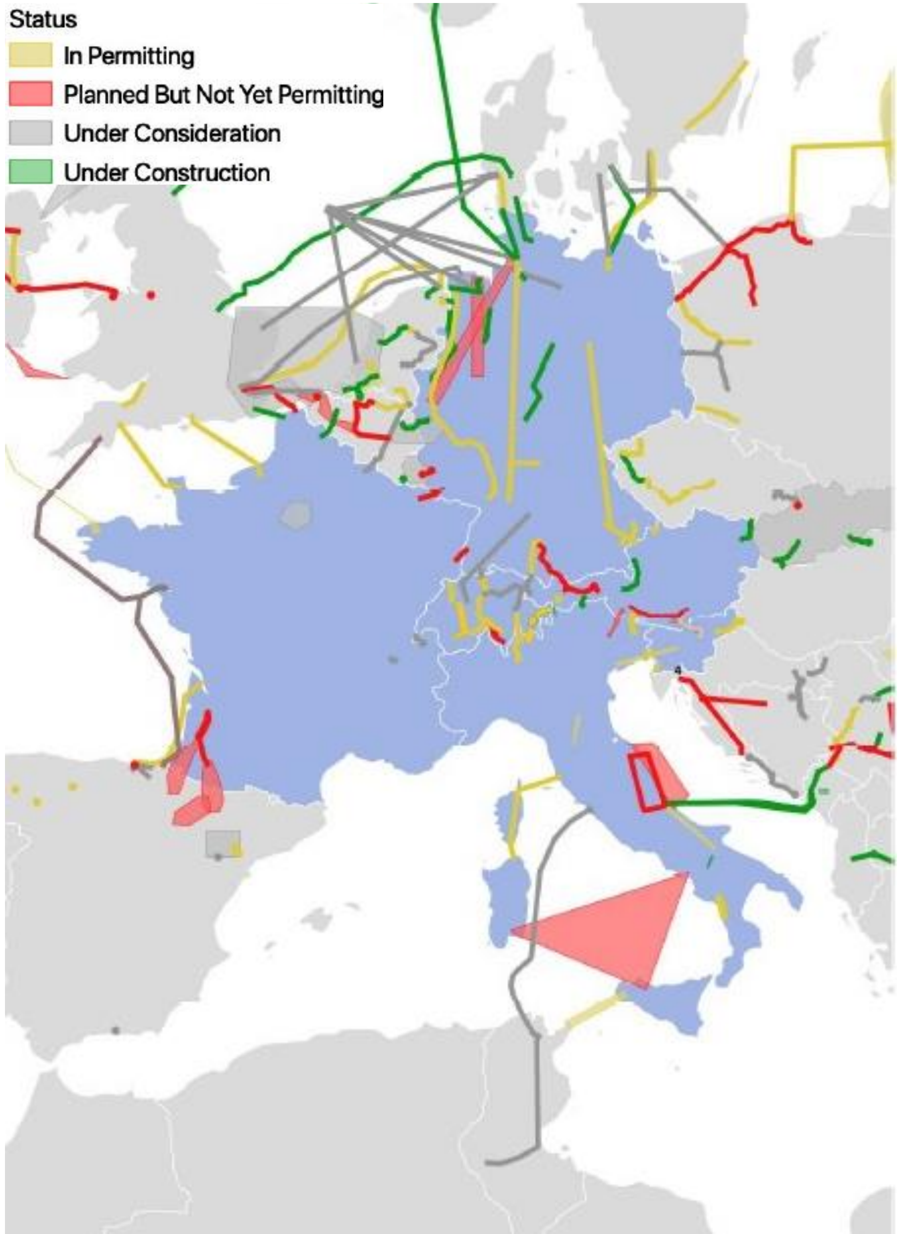
CCS TYNDP projects

TYNDP projects will contribute to achieving **by 2030** at least the following **benefits at pan-European level*…**

47 TWh
less curtailed renewable energy

61 Mton
reduction in CO_2

4870 M€
reduction of system costs



** Referred to IoSN 2030 capacities compared to the 2020 grid.* To be assessed more in detail with CBA methodology in TYNDP 2020

Thank you!

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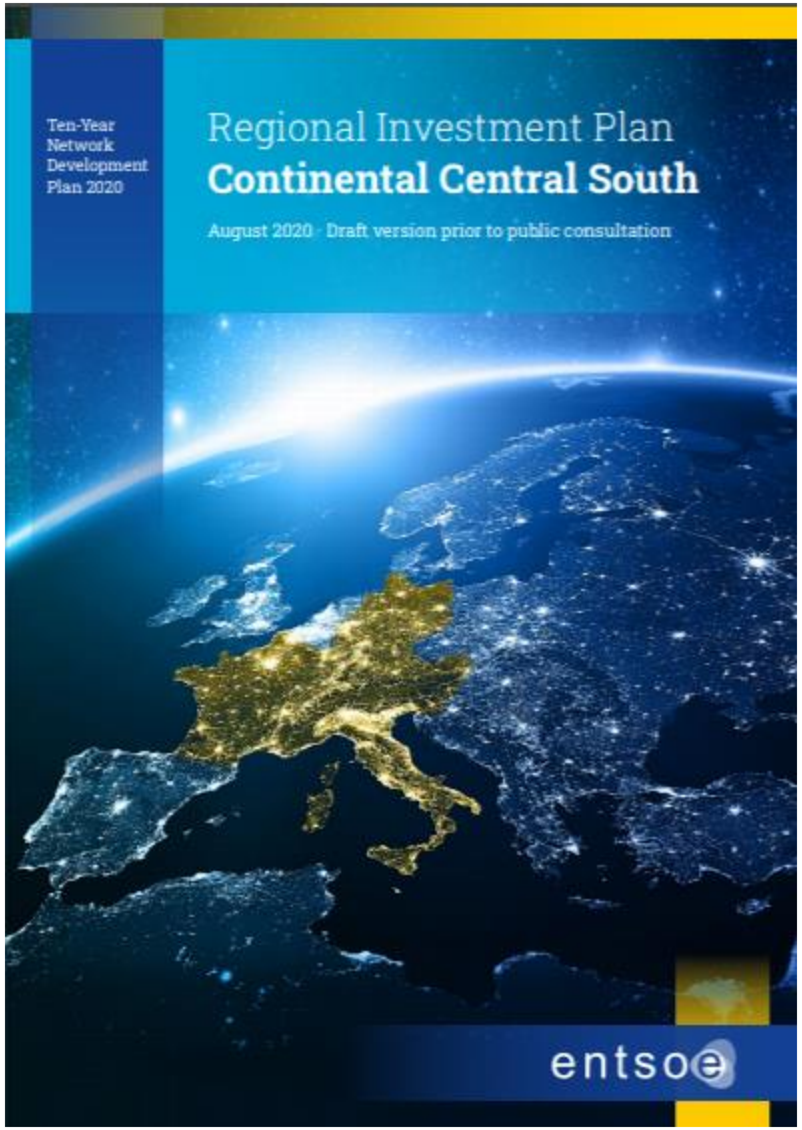

Q&A

Conclusion
Dimitrios Chaniotis, Rte

Thank you for your attention.

Slides and recording soon available at tyndp.entsoe.eu

To contact ENTSO-E's TYNDP team: tyndp@entsoe.eu