

Ensuring sufficient grid capacity for electricity trade

ACER – JRC Webinar

10 July 2024 14:30 – 15:30 CET

Indicative time	Agenda items	
14:15 - 14:30	Webinar open for log-in	Starts promptly at 14:30
14:30 - 14:35	Introductory remarks Christophe GENCE-CREUX, ACER	
14:35 - 14:50	Transmission capacities for cross-zonal trade of electricity and congestion management in the EU Ignacio MUNIOZGUREN GARCIA, ACER	
14:50 - 15:00	Q&A Moderator: Patrick LUICKX, ACER	
15:00 - 15:15	Future-proofing the European electricity market: redispatch and congestion management Georg THOMASSEN, JRC	
15:15 - 15:25	Q&A Moderator: Silvia VITIELLO, JRC	
15:25 - 15:30	Closing remarks Kristine VLAGSMA, JRC	

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Substance-related questions will be addressed during the relevant Q&A session; although they can be posed at any point



Introductory remarks

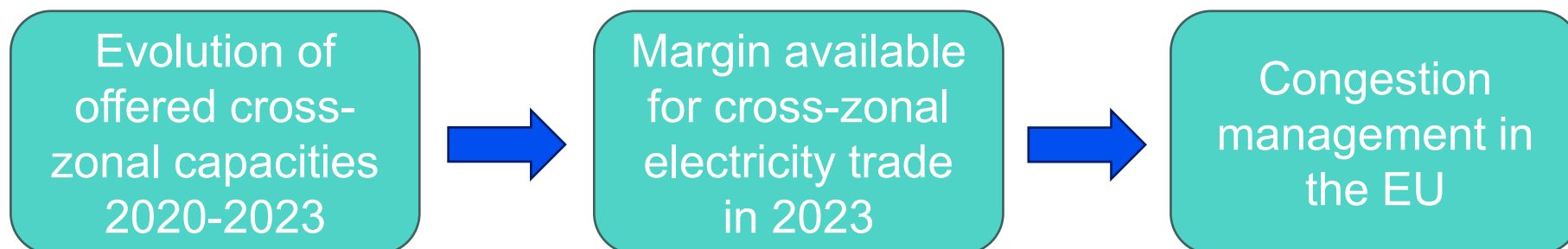
Christophe GENCE-CREUX, ACER

Transmission capacities for cross-zonal trade and congestion management

2024 Market Monitoring Report

Ignacio MUNIOZGUREN GARCIA, ACER

- Continuation in the series of 2024 ACER **Market Monitoring Reports**.
- Assesses the barriers to EU market integration related to the **availability of cross-zonal capacity**:
 - Covering **different market time frames** and across EU regions.
 - Tracks **progress and bottlenecks** in implementing the minimum 70% requirement.
 - Assess the **impact** of the current bidding zone configuration **on market efficiency***.
- Structure and main indicators:



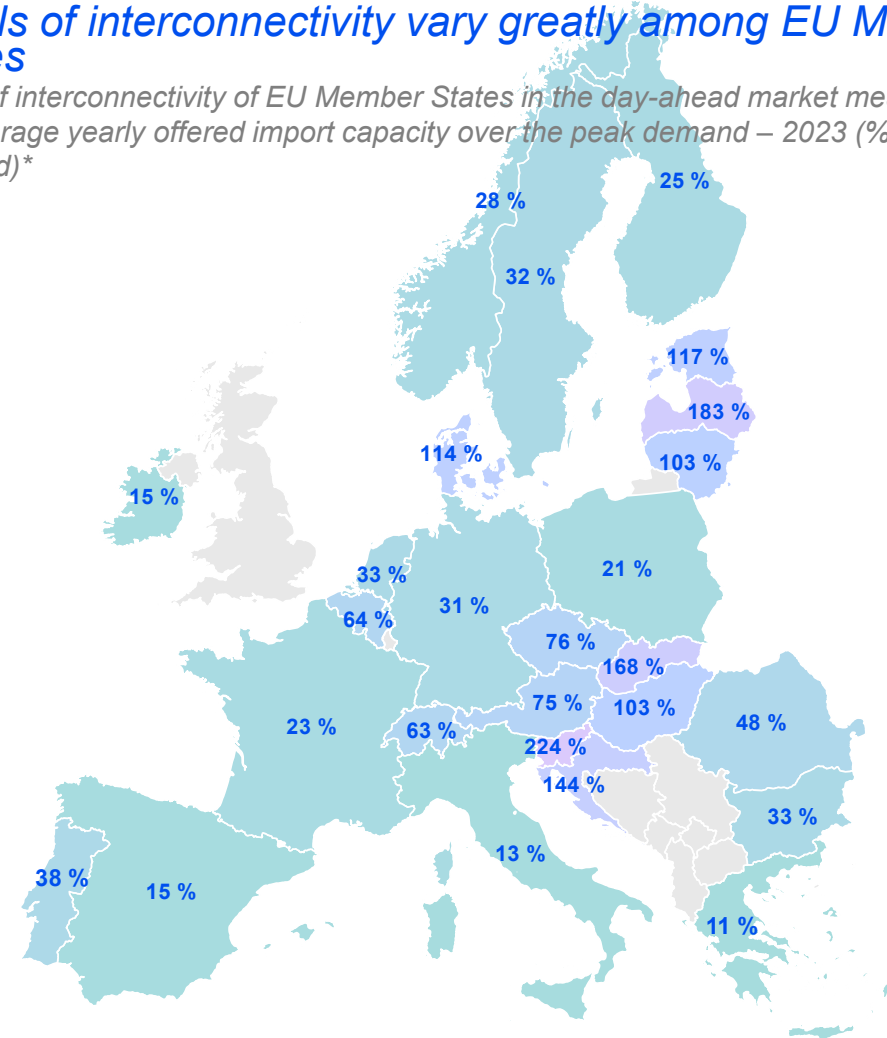
*Article 34 of CACM requires ACER to produce a market report every three years, assessing the impact of the bidding zone configuration in market efficiency.

RES penetration requires (further) integration

- High-RES systems will require maximal access to neighbouring markets, **across all time frames**:
 - Roll-out of **cross-border** electricity infrastructure.
 - **Efficient use** of available infrastructure.
- **Optimization** of cross-zonal **capacity calculation** can boost the EU's interconnectivity.
- The **implementation of the minimum 70% requirement** is a key driver.

Levels of interconnectivity vary greatly among EU Member States

*Level of interconnectivity of EU Member States in the day-ahead market measured as the average yearly offered import capacity over the peak demand – 2023 (% of peak demand)**



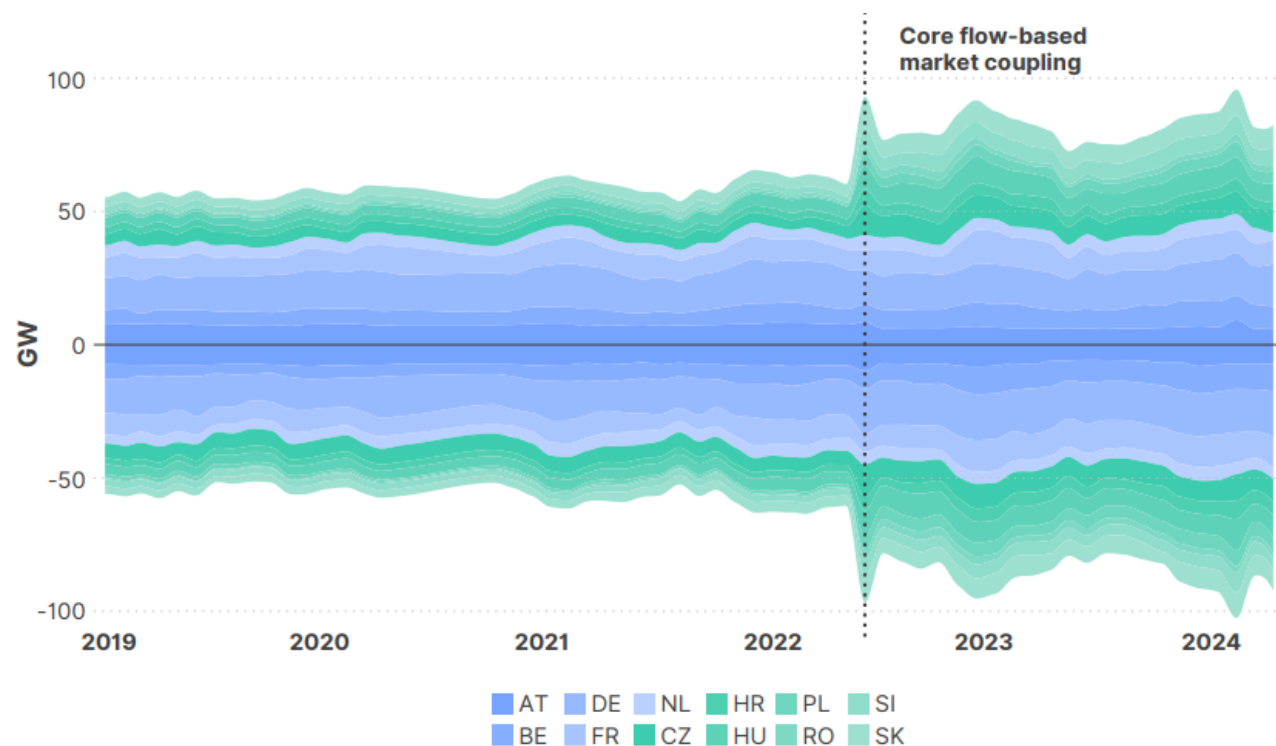
*Internal bidding zone borders are not considered for the purpose of this figure, only interconnectivity at the Member State level is highlighted.

Coordinating capacity calculation brings notable value

- Coordinated capacity calculation processes stem from **CACM** (2015) and **FCA** (2016) Regulations.
- Visible benefits come from **increasing coordination** in capacity calculation.
- Coordinated processes are **not yet fully implemented** in all EU regions.

Flow-based capacity calculation optimizes cross-border trading opportunities across the Core region

Evolution of monthly average import and export possibilities within the Core capacity calculation region – 2019-2023



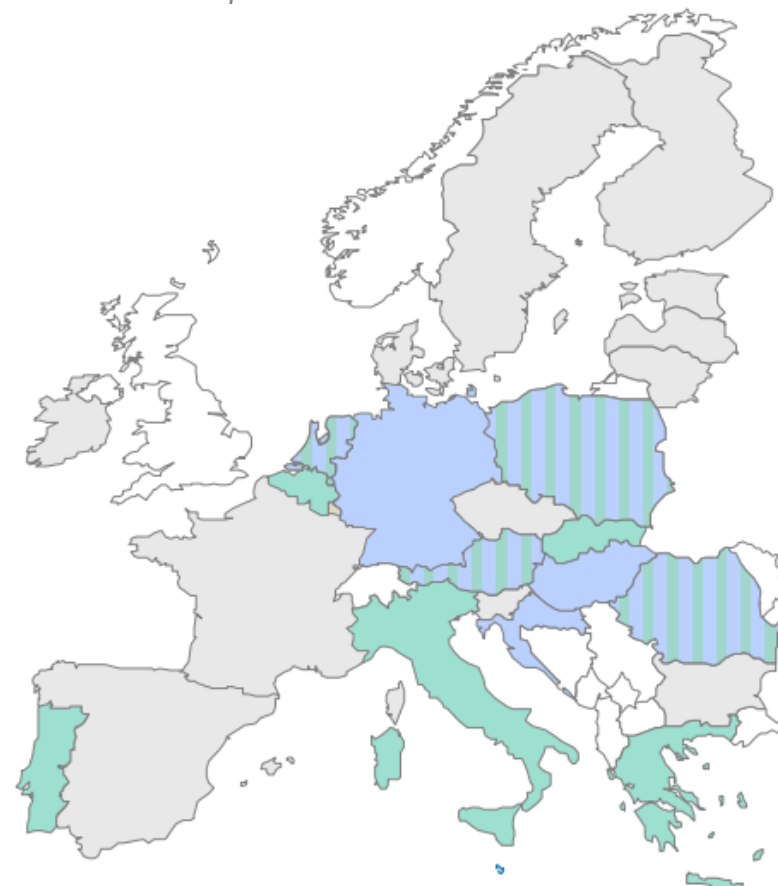
70% requirement to be implemented by end of 2025

- Clean Energy Package introduced the obligation to offer at least **70% of physical capacity** on CNECs*.
- **Derogations and action plans** allow TSOs to progressively implement the requirement up to end of 2025.
- ACER monitors yearly the implementation, in line with **ACER Recommendation 01/2019**.
- Monitoring covers the **day-ahead timeframe**.

Not a compliance assessment of the obligations derived from Electricity Regulation 16(8)

Most Core TSOs had derogations and/or action plans in place in 2023

Overview of the status of implementation of the minimum 70% requirement in the EU per Member State - 2023

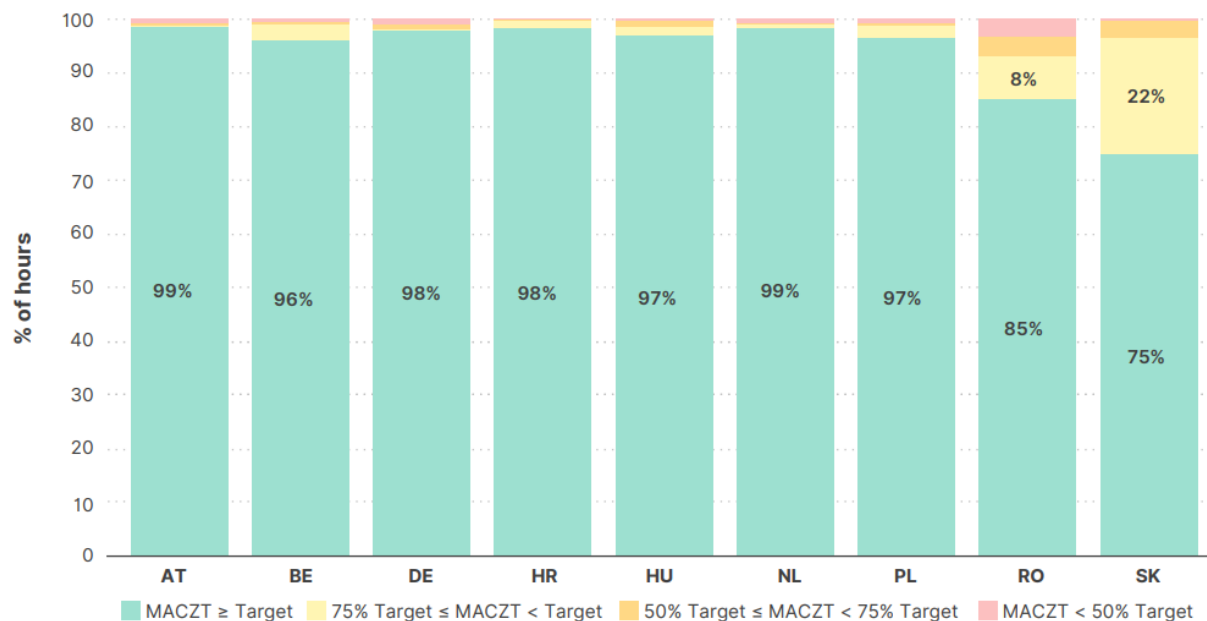


Implementation delays may put the timeline at risk

- In Core, derogations (e.g., due to **loop flows**) significantly reduce the capacity requirements.
- **Implementation delays limit progress** in fulfilling 70%, risking the end of 2025 timeline.

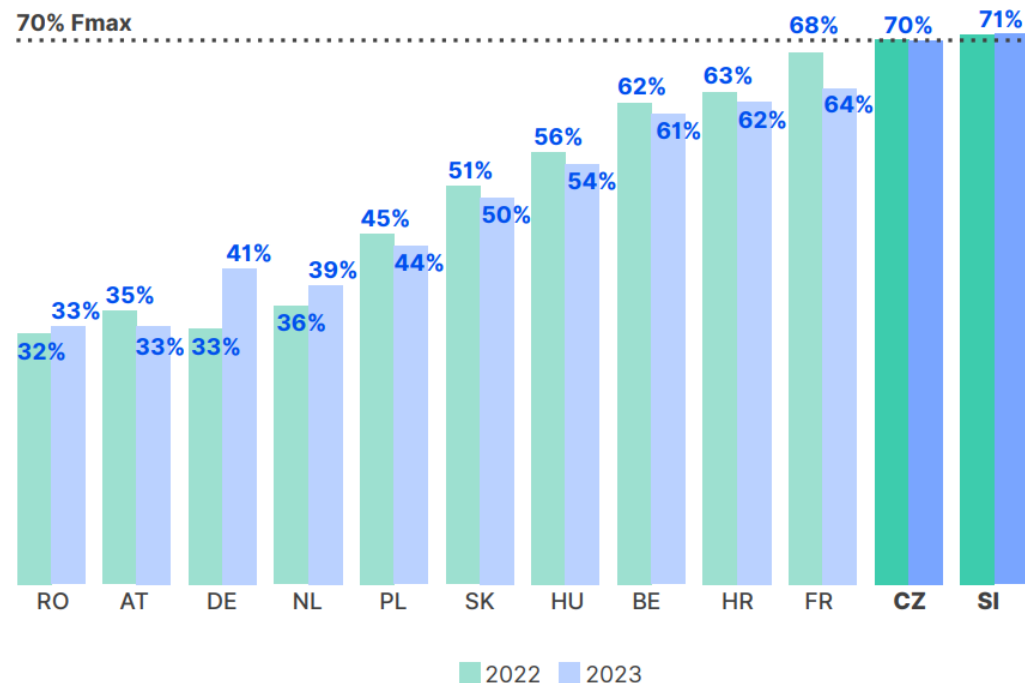
Interim requirements have been generally met...*

Percentage of hours where the interim capacity requirements were met in all CNECs in the Core capacity calculation region per Member State – 2023 (% of hours)



...yet this does not always translate into progress

Average minimum hourly margin available for cross-zonal trade in the Core capacity calculation region per Member State – H2 2022-2023 (% of Fmax)



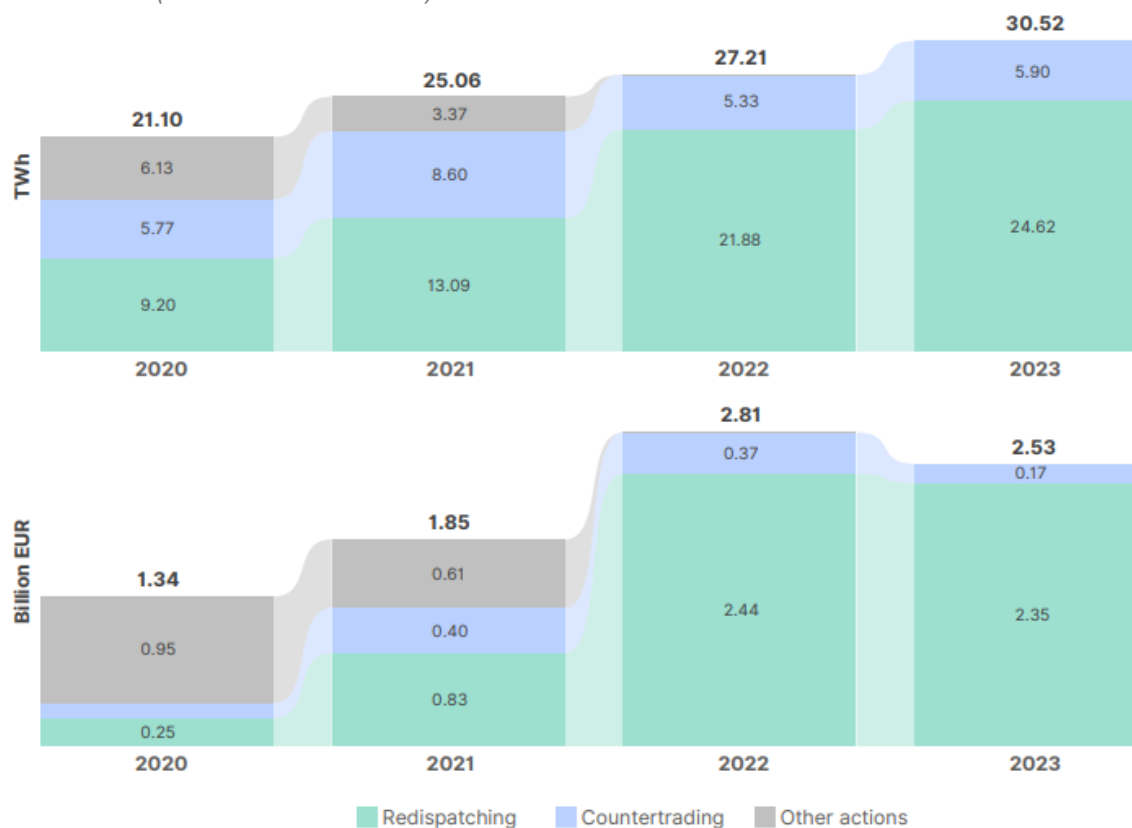
*Only three Member States did not have an action plan nor derogation in the Core region in 2023: Czechia, France and Slovenia.

Increasing power grid congestion in the EU

- Increasing grid **congestion management** in the EU, totaled **57 TWh** and cost **EUR 4.2 billion** in 2023.
- Two elements will further **exacerbate this trend** in the short term...
 - Phase out of action plans and derogations.
 - Increasing penetration of renewables.
- ...unless significant uptake of **grid expansion** and/or **reconfiguration of the bidding zones**.

Upward trend in congestion management needs in Germany

Evolution of volume (top) and cost (bottom) of remedial actions activated in Germany – 2020-2023 (TWh and billion EUR)



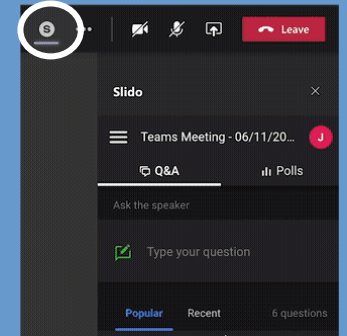
- Availability of cross-zonal capacities is key to the **EU's net-zero ambitions**, enabling further market integration.
- **Significant effort** will be needed to implement of the min. 70% requirement by the end of 2025.
- Maximizing availability of cross-zonal capacity remains a **joint TSO responsibility**:
 - **Swift implementation of coordinated processes**: Capacity calculation and congestion management framework;
 - **Targeted grid investments**: Aimed at reducing the share of loop and internal flows in CNECs;
 - **Improving the bidding zone configuration**: If unable to consistently meet 70% after 2025.
- Going forward, **capacity in the intraday timeframe** will warrant further attention.

Q&A session

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Future-proofing the European electricity market: redispatch and congestion management

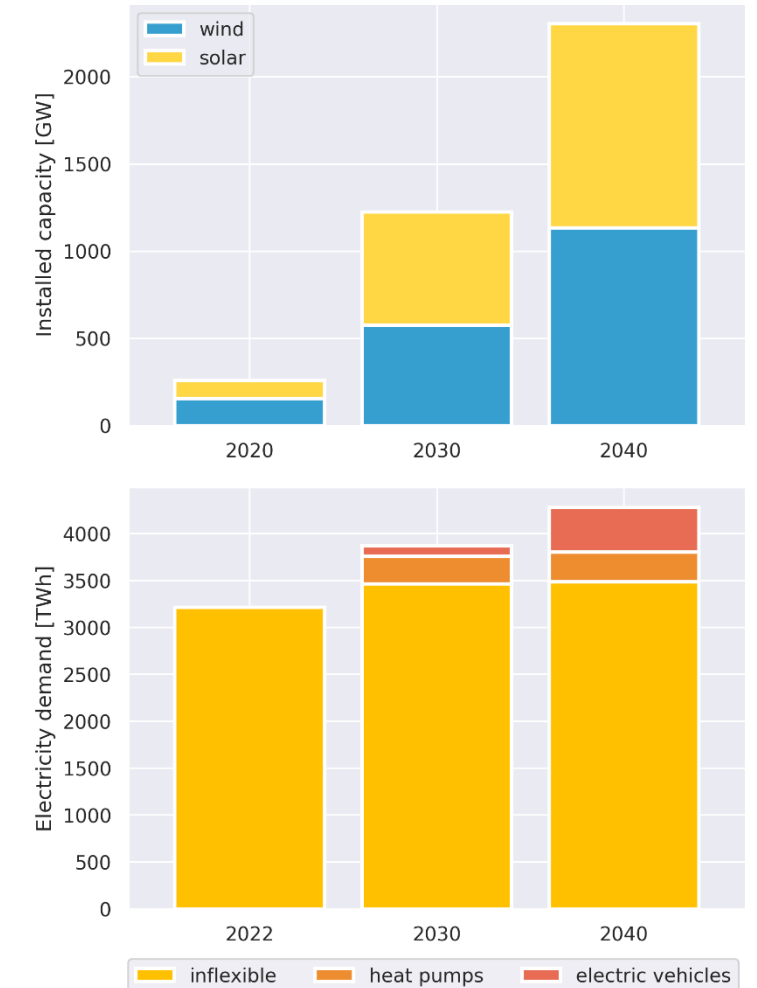
Georg THOMASSEN, JRC

Background

- Renewable deployment is gaining pace in the wake of the European gas crisis of 2022
- EC proposed 90% emissions reduction by 2040 compared to 1990 levels. Target relies largely on the deployment of distributed renewables such as wind and solar PV.
- Increasing redispatch volumes in the European system in the context of renewable deployment.
- Bidding zone review investigates suitable reconfigurations of the European market zones with the aim of reducing structural congestion in the system.
- Research question: *How will redispatch develop in EU in the medium to long-term, and what are implications for decarbonization, as well as the viability of zonal market design?*

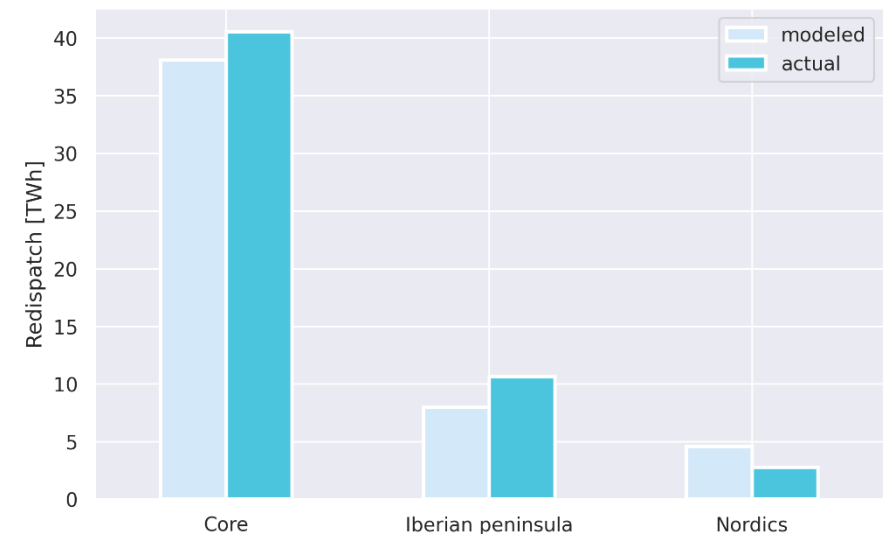
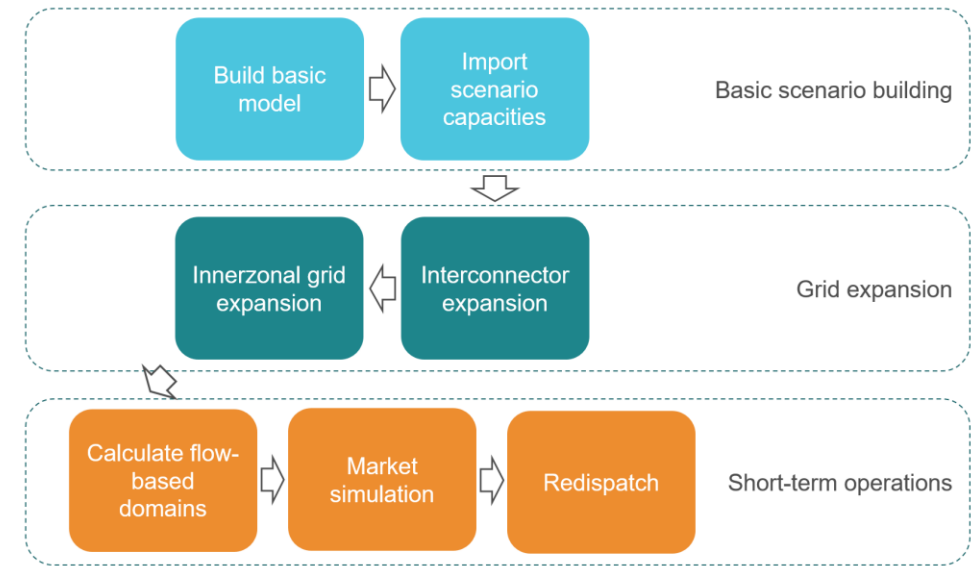
Underlying scenario aligned with the Impact Assessment for the 2040 target

- Aligned with Impact Assessment on essential aspects, such as total installed renewable capacity, total installed electrolysis capacity, as well as electricity demand for all other purposes.
- Assumes *quadrupling* of variable renewable capacity by 2030 and another *doubling* by 2040, compared to 2020 levels.
- Distribution of renewables inside each country is assumed to be proportional to *local generation potential*.
- Heat pumps and EVs with load shifting capability.
- Electrolysis fully price responsive. Geospatial distribution in proportion to *installed* renewables.



Methodology

- Open source model of the European transmission grid *PyPSA-Eur* used as the base model.
- Custom routines developed by the JRC for *grid expansion* at European and national level, *flow-based market coupling* and *redispatch*.
- Validated with *backtesting exercise* replicating 2020 redispatch volumes according to ACER Market Monitoring report.



Three grid expansion scenarios

Scenarios based on German data – as best data basis available to our knowledge.

BAU scenario describes grid expansion based on *current trends*.

XGE scenario based on network development plan (NEP): *35% increase* in total circuit length.

AGE represents *middle-of-the-road scenario* – considerable speed up, yet not NEP level.

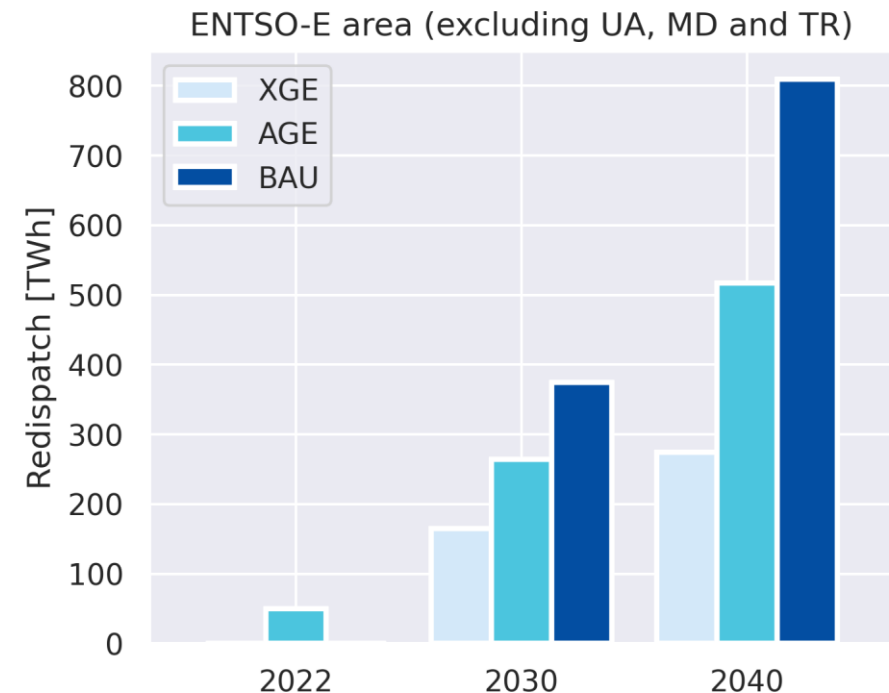
Business as usual (BAU): Current trends lead to a grid expansion of **10%** by 2040 (reinforcements + newly built lines) in each country.

Ambitious grid expansion (AGE): Grid expansion speeds up considerably, so that by 2040 all countries expand their grids by **20%**.

Extreme grid expansion (XGE): Massive expansion effort which leads to expanding total circuit length in each country by **35%**.

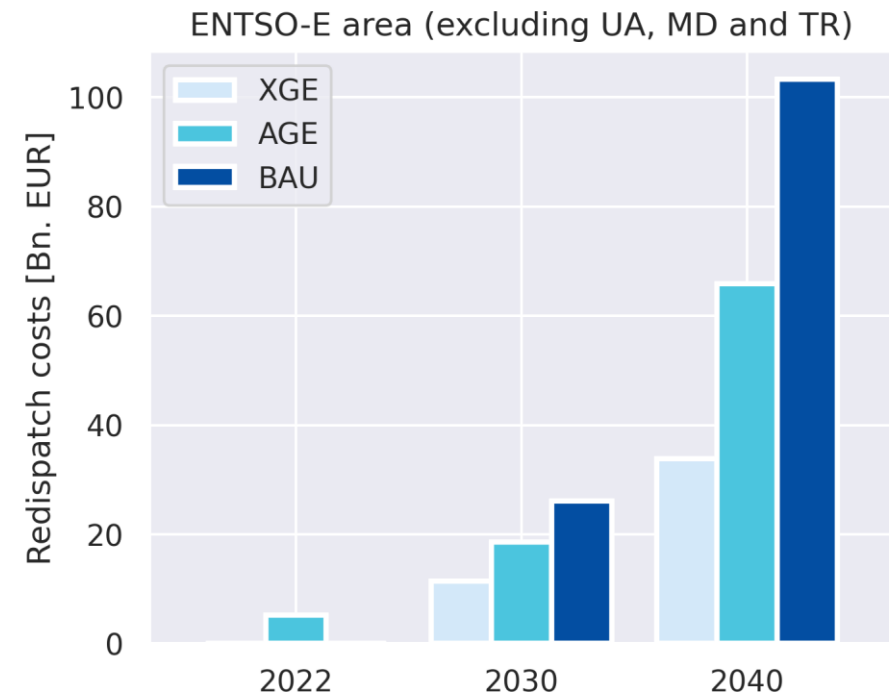
Results of redispatch modelling

- Redispatch volumes increase substantially across *all* investigated scenario.
- Two of the three scenarios result in redispatch volumes in 2040 in the order of magnitude as today's electricity demand in France or Germany.
- Even in XGE scenario, redispatch volumes increase six-fold compared to 2022 levels.



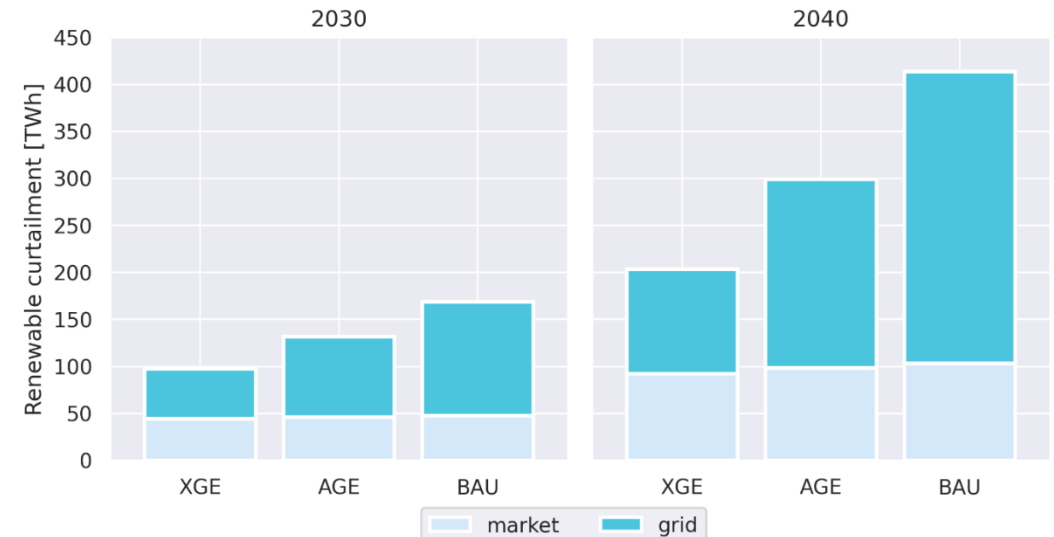
The cost of redispatch

- Costs for redispatch increase to 34 Bn. EUR in 2040 in XGE scenario. With low grid expansion (BAU), they could be as high as 103 Bn. EUR.
- These costs are likely over optimistic: Substantial inc-dec gaming can be expected to increase costs further in market-based settings.
- Questionable whether cost-based arrangements still feasible. Volumes likely too large to be settled efficiently via bilateral contracts.



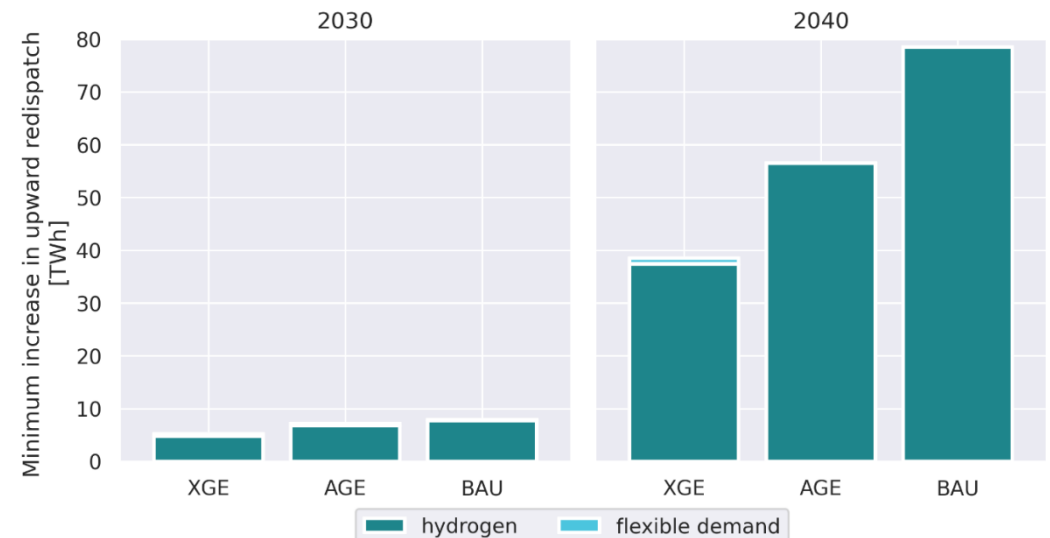
We observe substantial renewable curtailment due to grid congestion

- In XGE scenario, 100 TWh of renewable generation are at risk of being curtailed in 2040 due to bottlenecks in the grid.
- In BAU scenario, 310 TWh of renewable generation gets curtailed due to grid congestion in the same year.
- This indicates we need to steer more actively *where renewables are being deployed* to minimize strain on grid.



Hydrogen production appears to be a significant driver of redispatch

- Only redispatch triggered at node where demand is located is considered (not at neighboring nodes) –*still conservative estimation*.
- Little impact of demand shifting by heat pumps and EVs.
- Hydrogen generation creates significant additional redispatch needs.
- Highlights the importance of steering *where electrolysis plants* are going to be built.



Policy options to address grid congestion

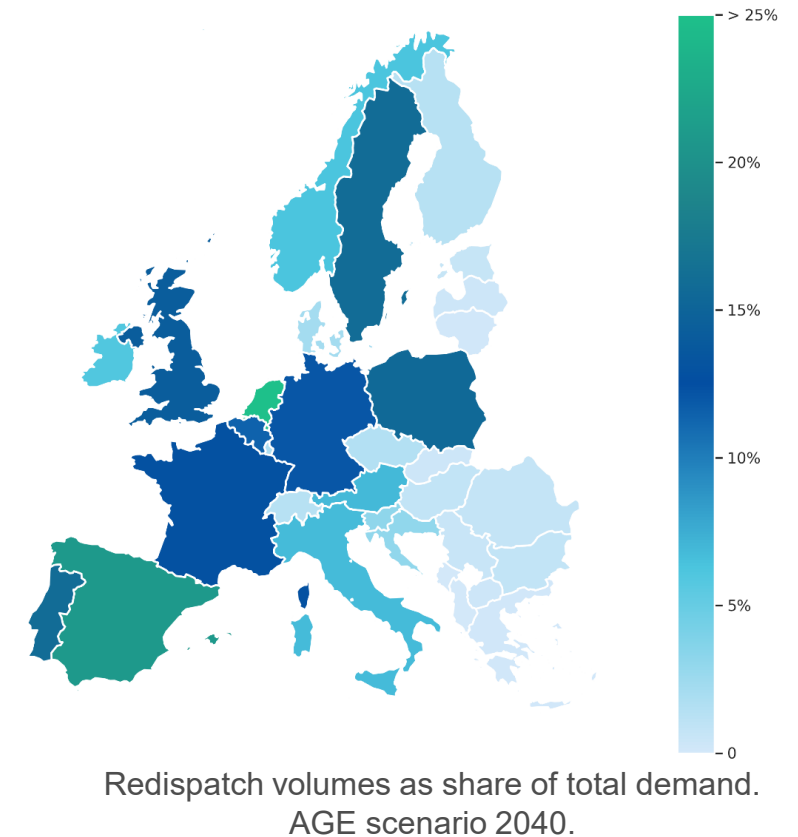
Investment

- Adding locational component to existing and planned auctions (renewables, capacity markets, hydrogen)
- Locational grid charges (deep connection or operational)

Operations

- Bidding zone splits can reduce congestion if they improve representation of bottlenecks in market clearing process.
- Locational marginal pricing can achieve far-reaching alignment between market operations with physical reality.

Investment *and* operational incentives need to be addressed



Key insights and policy recommendations

- **Redispatch volumes in all scenarios increase massively until 2040.** Even with high levels of grid expansion, total redispatch volume increases almost six fold by 2040. At lower rates, redispatch volumes could well match today's electricity consumption in countries like France or Germany.
- **Major volumes of renewable energy are at risk of being curtailed due to grid congestion.** Hydrogen production was identified as redispatch driver across all investigated scenarios and target years.
- Investment incentives should be improved by **adding locational component to existing and planned auction mechanisms** (renewables, capacity markets, hydrogen).
- **Bidding zone splits** that improve the representation of congestion in market clearing should be implemented. We further recommend **cost-benefit analysis** of LMP in a climate neutral electricity system with high shares of variable renewables.
- **It is vital that this issue is addressed as soon as possible, since the period until 2040 is essential to manage where renewables and hydrogen generation are located.**

The study is available here:

Redispatch and Congestion Management

*By Thomassen G., Fuhrmanek A.,
Cadenovic R., Pozo Camara D. and
Vitiello S.*

<https://publications.jrc.ec.europa.eu/repository/handle/JRC137685>

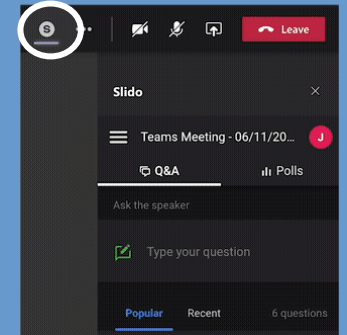


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Closing remarks

Kristine VLAGSMA, ACER