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at the University of Cologne
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enhancing decisions.

THEMA
CONSULTING GROUP

Executive Summary, 15.08.2023

Price impact of a German bidding zone split: Implications for Germany and neighbouring markets

A study conducted by EWI | THEMA Consulting

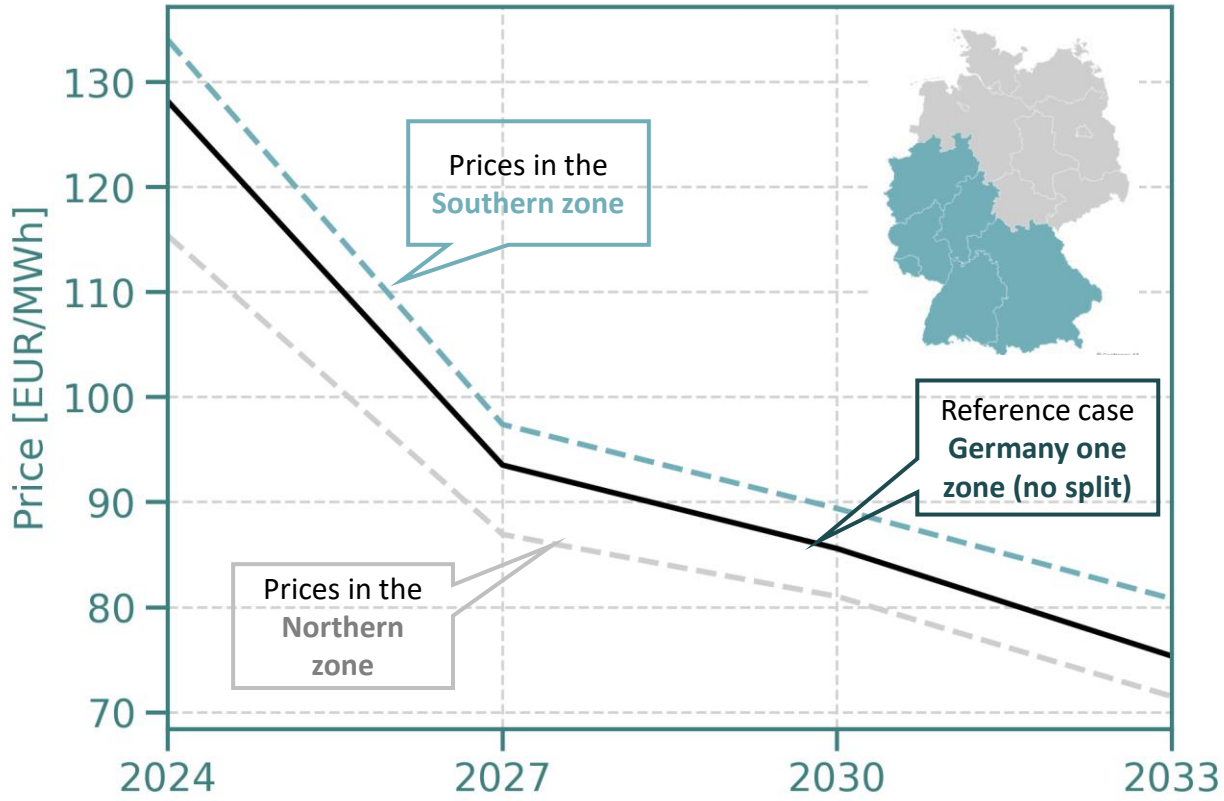
A bidding zone split would cause a significant price spread between North and South Germany - with implications for market values for renewables and neighbouring markets

- THEMA Consulting Group, in collaboration with EWI, conducted a study analysing the impact of a bidding zone split of the German market. The study does not provide any recommendations concerning whether to introduce bidding zones, but merely gives an overview over the potential effects of different split options
- The study focuses on a split of Germany into a Northern and Southern zone, with North-Rhine Westphalia being in the South. This split design is close to Option 2 in the ACER bidding zone review. Such a split makes the current main bottlenecks visible, without fragmenting the market into too many bidding zones. However, the dynamic of the energy transition may lead to new bottlenecks not accounted for by this split
- The split would have a substantial impact on power prices in Germany and would create a significant spread between prices in North and South Germany. While the actual size of the spread differs in THEMA's and EWI's results, the overall tendency is similar across simulations. Such a split would also reduce redispatch volumes
- The key driver for congestion and therefore the price spread is limited transmission capacity, combined with excess power generation in the North of Germany, not so much a lack of capacity in the South.* A clear correlation between hourly wind feed-in in the North and the North-South hourly price spread is observed
- A split would also have significant implications for market value (capture prices) for renewables. In particular, wind in the Northern zone would see much lower market values, driven by an overall lower price level in connection with even higher cannibalisation, which may potentially reduce investment incentives (subject to support scheme)
- Also, neighbouring markets would be affected, with prices declining in the Northern European markets (including the Nordics), and prices increasing in the markets in the South (including France). The German price effect, however, is not passed-through fully to the neighbouring markets
- Without the planned HVDC upgrades, the price split is much more pronounced than in the case where all planned internal HVDC lines in Germany (according to NEP) become operational. Besides HVDC investments, also electrolyser investments in the North of Germany or a shift of renewables from North to South can reduce price differences between North and South
- Liquidity in the forward market may be at risk when the German market is split. ACER has proposed reforms for the forward market which may help to mitigate a potential negative impact on liquidity. However, considerable uncertainty remains as to the future of these proposals and their effectiveness

** The study assumes regional distribution of power generation capacity as outlined in the German grid development plan (NEP). The total German capacities follow the newest government plans and targets.*

Splitting Germany into a Northern and Southern bidding zone creates a significant price spread, implying also a significant impact on RES values in Germany

Power prices in two-zone split, North-Rhine Westphalia in the South (close to ACER Option 2); THEMA results, real 2023 EUR

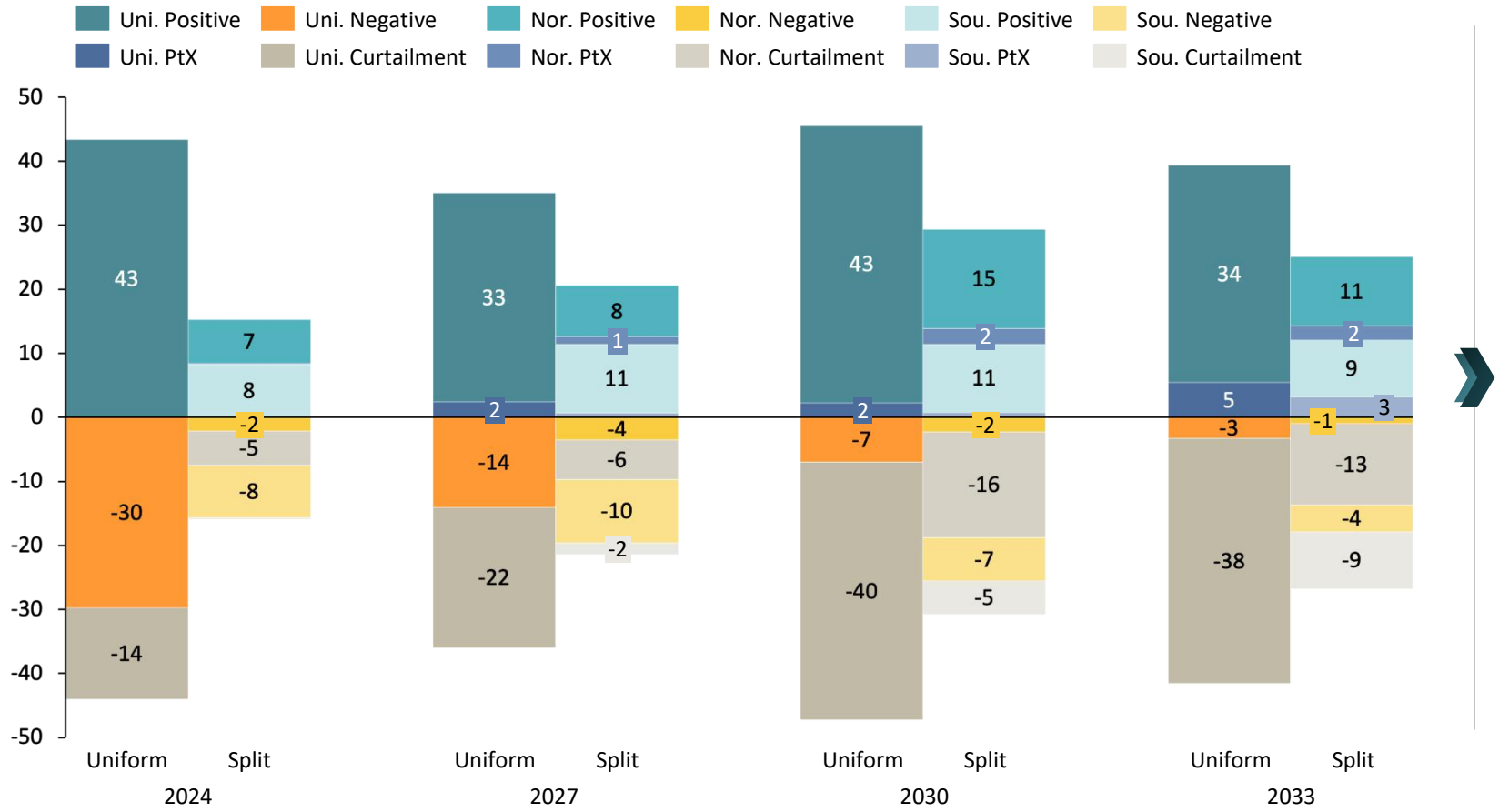


Commentary

- A bidding zone split would have a significant price impact in the respective bidding zones, with prices in the North clearing significantly lower than in the South
- The spread is most pronounced in 2024 and is declining somewhat towards 2030. The reduction in spread is a result of the assumed HVDC upgrades (following the NEP)
- In the hourly simulations behind the results, one can see a clear correlation between hourly wind feed-in in the North and the hourly price spread, which is mostly in the direction of North to South
- Therefore, market values (capture prices) for wind in the North would decline significantly (by ca. 25% in 2024 and 20% in 2027), as wind in the North would be exposed to both a generally lower price level and a higher degree of cannibalisation. Also, the number of hours with zero and negative prices would increase significantly in the North if the market is split (more than quadruple in 2024 and more than double in 2027). This would affect the majority of Germany´s wind power: Besides its offshore capacity, ca. two thirds of 2030´s onshore turbines will likely be in the North according to the current targets and NEP
- The lower prices and increased number of low-price hours, however, may also increase the utilisation of electrolysers in the North of Germany, subject to how electrolysers operate in the future (flexible and price-sensitive versus inflexible base-load H_2 production)

Results show a fairly time-constant redispatch volume for a single price zone. A split would lower redispatch volumes, but the effect shrinking with time

Positive and negative redispatch quantities per year [TWh]; EWI simulations



Commentary

- Redispatch volumes are calculated using a welfare optimal redispatch procedure with limited countertrading. Countertrading explains differences in positive and negative redispatch volumes.
- A zone split leads to a reduction of redispatch volumes of around 35% after 2027. In the assumed 2024 power system, a split would yield a 65% reduction.
- The two-zone split accounts well for the current congestion. Within the chosen capacity expansion scenario, its merits decrease with growing RES installations until 2030 and beyond.
- Electrolysers may participate in redispatch, and their concrete market integration (i.e., whether they provide only positive or bidirectional redispatch) is an important factor to account for. The study assumes only positive redispatch.
- Electrolysers may be turned off in the redispatch simulations, typically due to intra-zonal congestion.

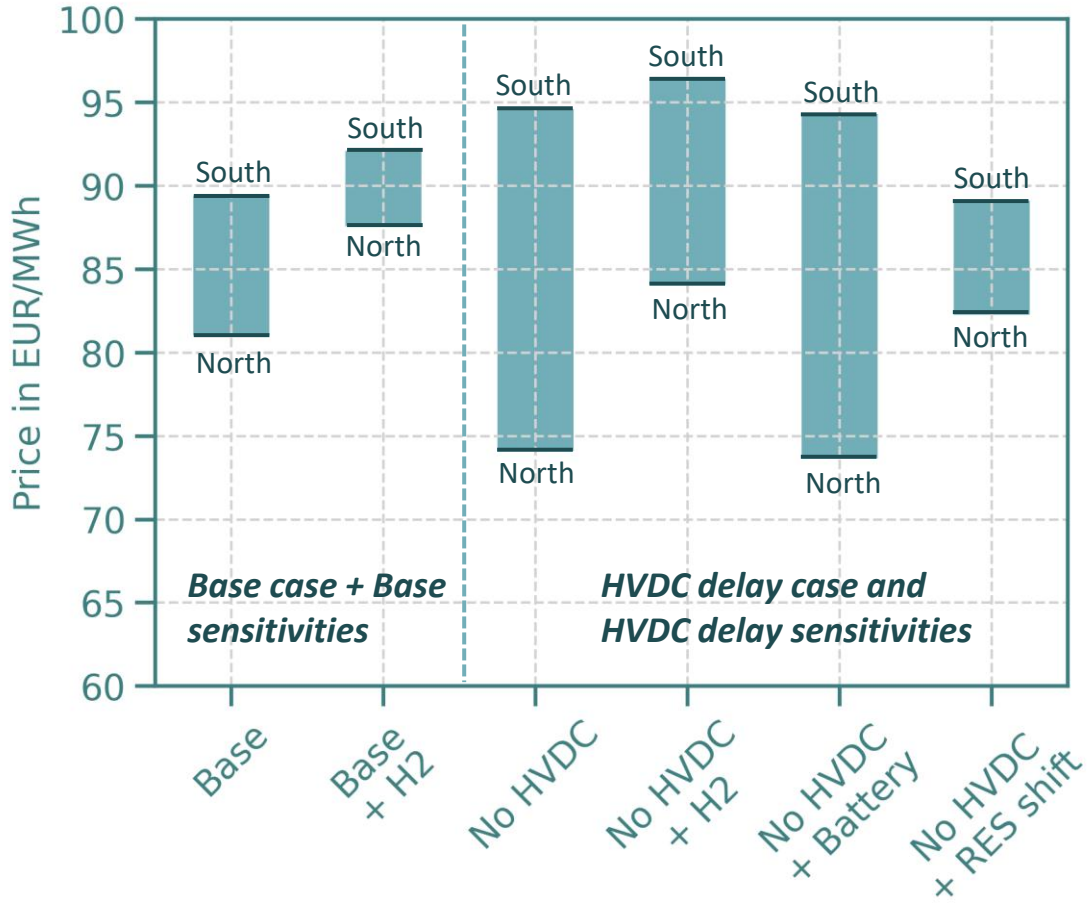
Internal grid developments in Germany are crucial for size of spread. Electrolyser investments or shifting RES from North to South could help reducing congestions

Main drivers and sensitivities modelled in addition*

In order to test the impact of various drivers, the analysis includes a wide range of sensitivities, focussing on the **year 2030**. The main insights are:

- **HVDC lines ["No HVDC"]**: **Without new HVDC** lines from North to South, the price spread would be even more pronounced. We model the case where the new internal HVDC lines in Germany are delayed. Note: In the Base case, we assume that HVDC buildout follows the NEP
- **Electrolysers ["H2"]**: More electrolysers in the North would result in a reduction of the North-South price gap. But as electrolysers imply more demand, electrolysers would increase prices (more in North than in the South). Modelling: Both the **Base case and** the **HVDC delay** case were simulated with **15 GW** of additional **electrolysers in the North.**
- **Batteries ["Battery"]**: Batteries are unlikely to reduce spreads or internal congestions. Markets were modelled with an additional **15 GW of battery capacity in the North.** This showed little impact on prices, as batteries have limited storage capacities
- **RES shift ["RES shift"]**: A shift of RES from North to South can reduce spreads. The study includes simulations where, e.g., **60 TWh of wind in the North is replaced by a mix of PV and wind in the South.** (The original North-South distribution of RES stems from Germany´s NEP which itself projects, not plans, RES capacity)

Price spreads 2030 across sensitivities; THEMA simulations

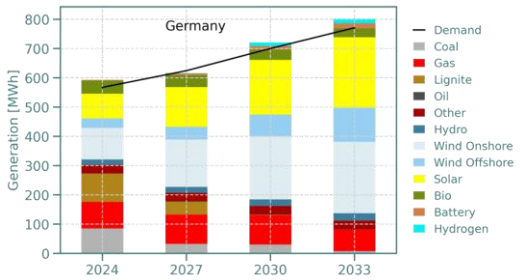


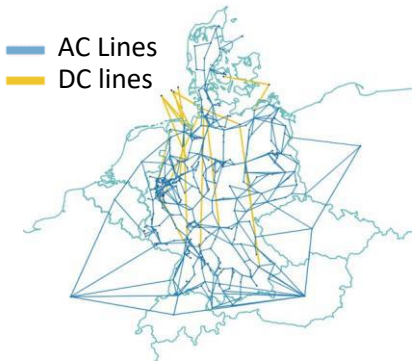
** Name in brackets refer to name in the figure to the right. The full study includes further and more granular sensitivities – available upon request*

The study was conducted by THEMA Consulting Group, in collaboration with EWI, using detailed grid and dispatch simulation models

Key methods and assumptions

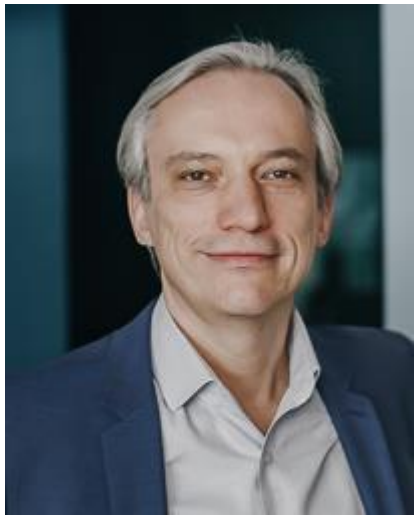
- For the study, THEMA and EWI ran two separate and independent model suits. Both THEMA and EWI used detailed grid data/models and dispatch models to derive results for this study. Running two different and independent models helped to challenge, benchmark and cross-check results





- Both model setups used **similar assumptions** around key drivers to make results comparable. These assumptions include
  - **Power plant capacities and demand** in Germany**,** based on both official targets and the German grid development plan (NEP),
  - **Commodity prices,** based on the IEA World Energy Outlook, and
  - **Grid data,** based on data from the Joint Allocation Office (JAO) and the NEP
- Differences between results are explained by differences in methodologies chosen for FBMC modelling, such as the calculation of Generation Shift Keys (GSK) and more
- For **further information**, please feel free to reach out to Marcus Franken (contact details to the right)

Contact information



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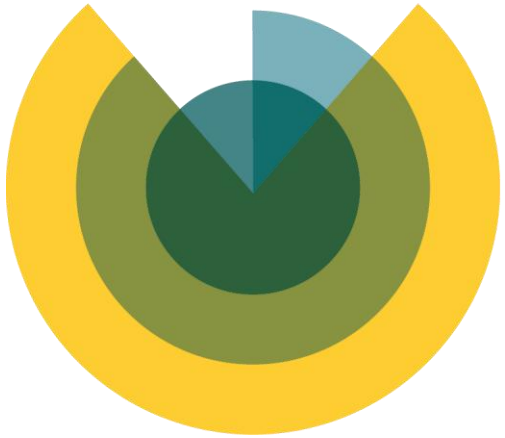

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