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ENERGY RESEARCH

Negative Preisstundenentwicklung und die Auswirkung der 1h-Regel für Bestandsanlagen

Windenergietage, 12 November 2025

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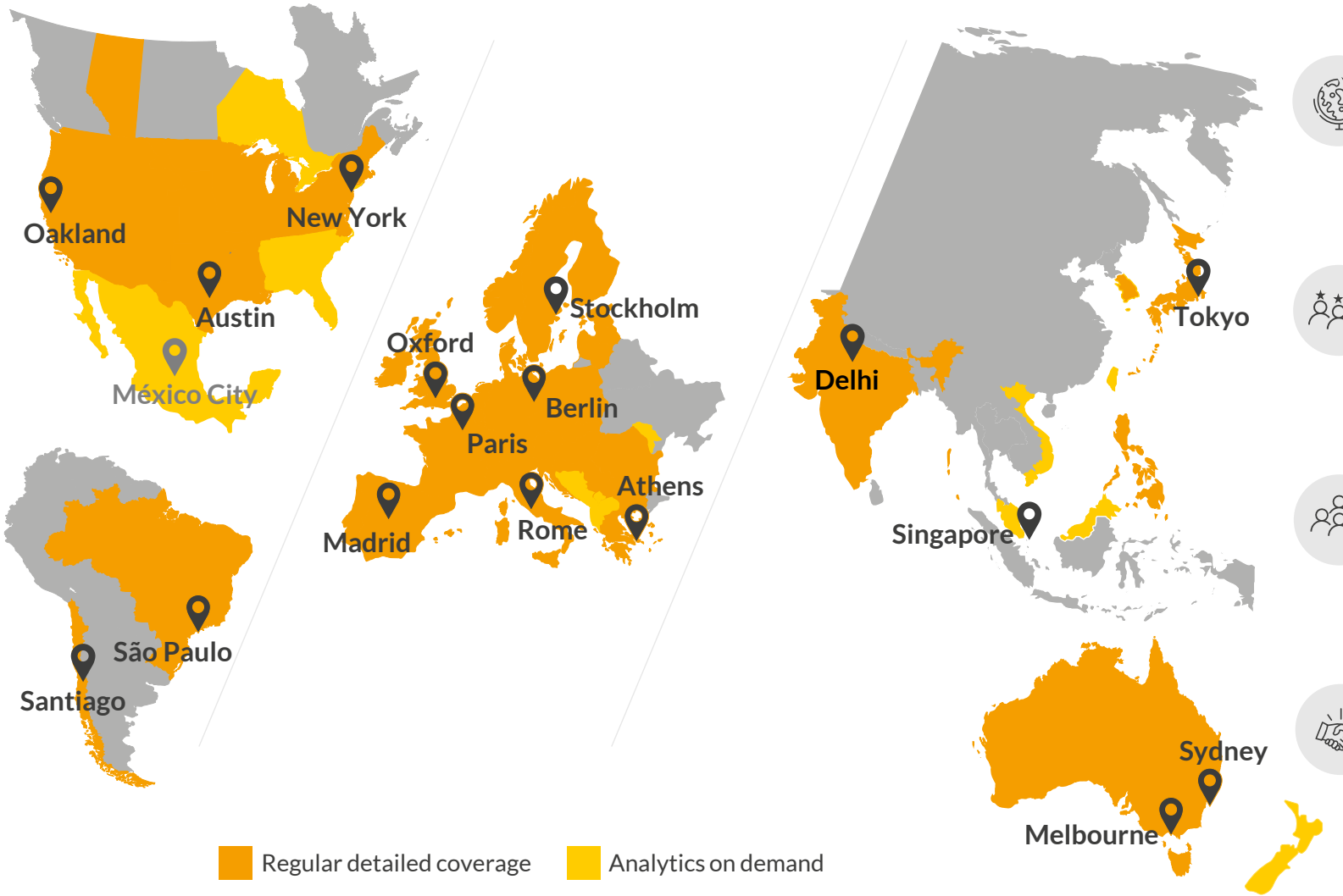

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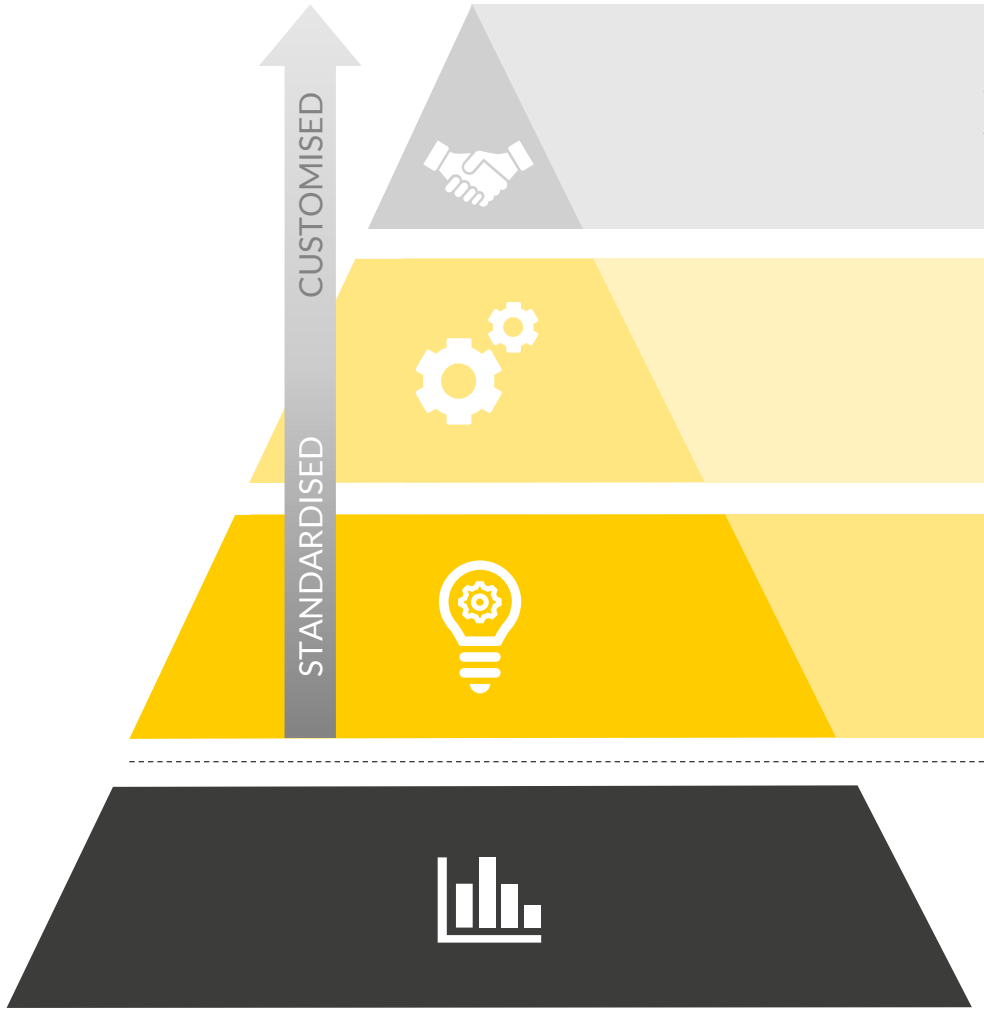

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Source: Aurora Energy Research

Agenda

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I. Development of negative prices in Europe

II. Drivers for negative prices in Germany

III. The impact of EEG reforms for existing assets

IV. Outlook and key takeaways

In recent months, there has been an increasing trend in negative price hours in Europe and already exceed 2024 instances in all regions

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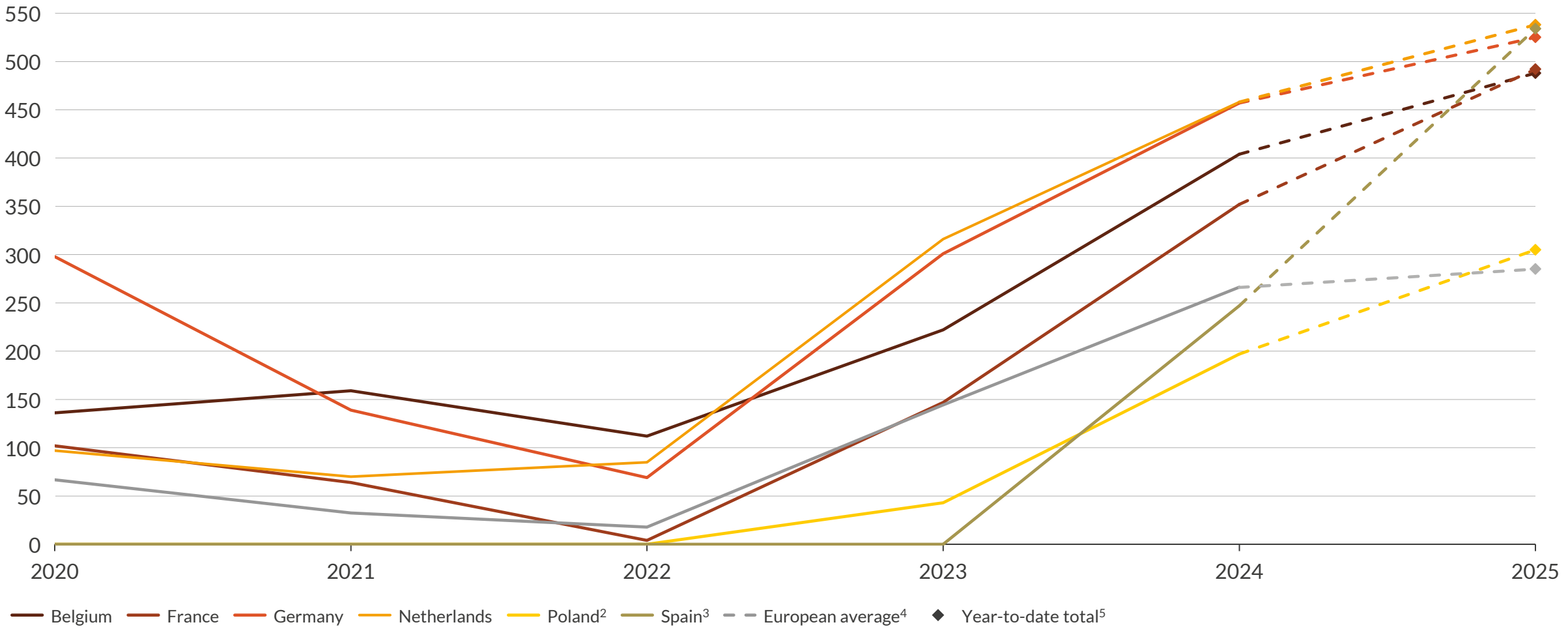
Number of instances with negative Day-Ahead prices per year[1]

Hours per year



1) Data extracted from ENTSO-E and CAISO on the 19/08/2025; 2) Poland did not allow negative prices until 2023; 3) Spain did not allow negative prices until 2024; 4) Include EU members, Great Britain and Norway. Excludes Malta and Cyprus; 5) Day-Ahead Market, 2025 values are until the 30/09/2025.
Sources: Aurora Energy Research, ENTSO-E, CAISO

In addition, the magnitude of negative prices has increased, with lowest prices seen in Belgium and Netherlands

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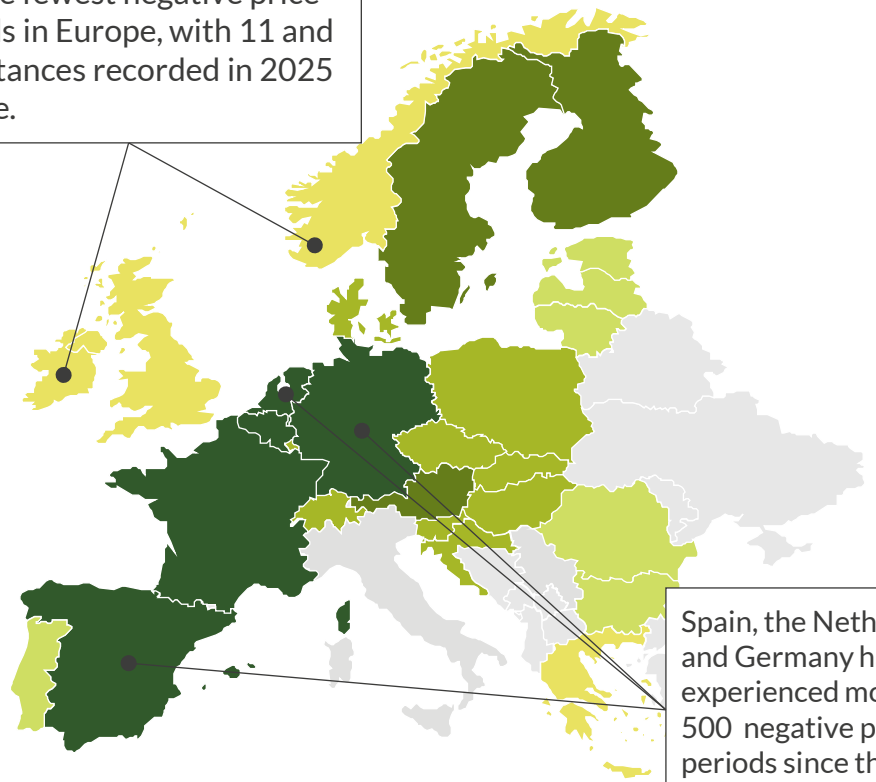
Number of negative price hours on the Day Ahead market[1,2]

Number of negative price hours

Norway (NO4) and I-SEM have had the fewest negative price periods in Europe, with 11 and 26 instances recorded in 2025 to date.



Spain, the Netherlands and Germany have experienced more than 500 negative price hour periods since the beginning of 2025.

0-125 126-250 251-375 376-450 >450

1) According to data extracted from ENTSO-E on the 01/10/2025; 2) Italy's current regulation prevents power prices from falling below zero; 3) Day Ahead market; 4) Regions include Hungary, Austria, Czechia, Belgium, Poland, Netherlands, Germany, Bulgaria, Greece, I-SEM, Great Britain, Norway, Denmark, Sweden, Spain, Finland and Portugal; 5) An average of lowest prices for each zones is used for countries with multiple price zones.

Source: Aurora Energy Research, ENTSO-E

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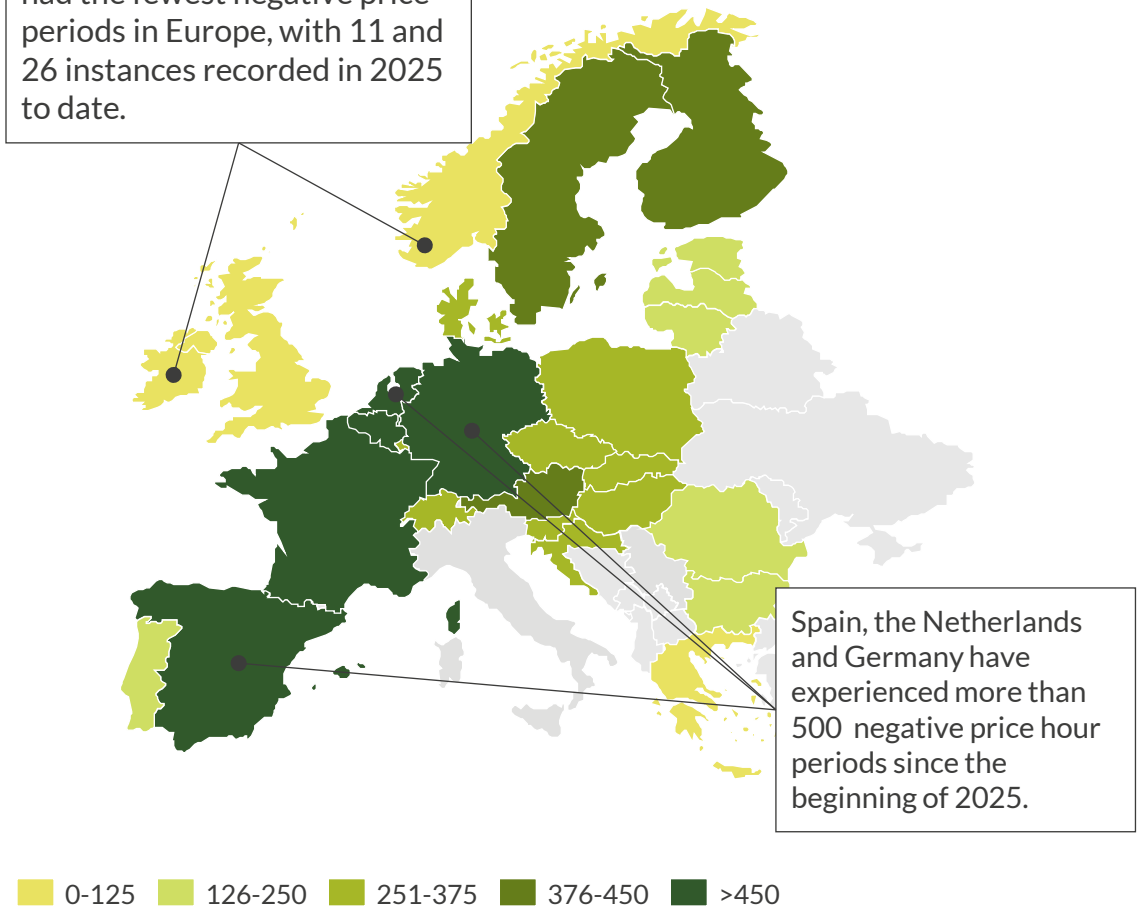

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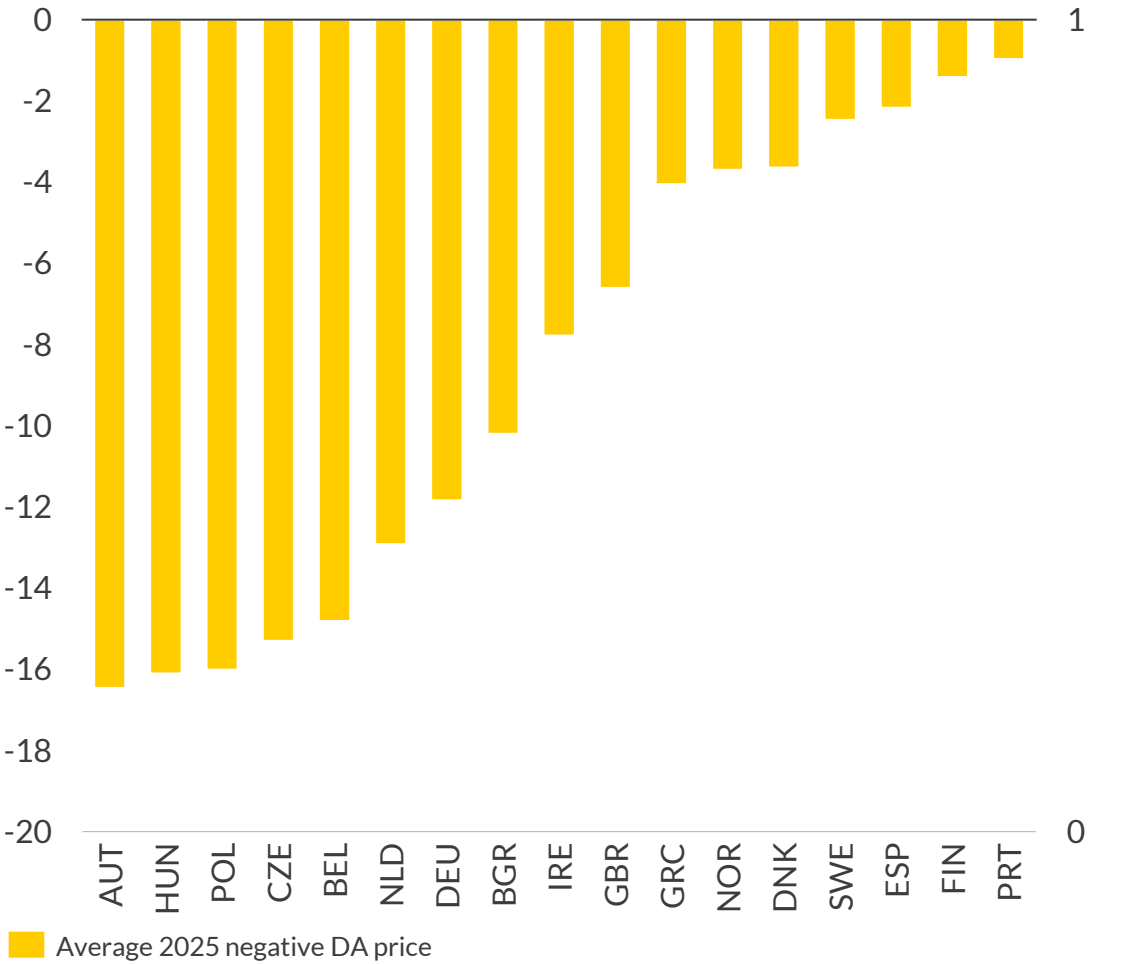
Average DA[3] price during negative price hours[1,2]

€/MWh (nominal)



Lowest negative price[1,2]

€/MWh (nominal)

1

0

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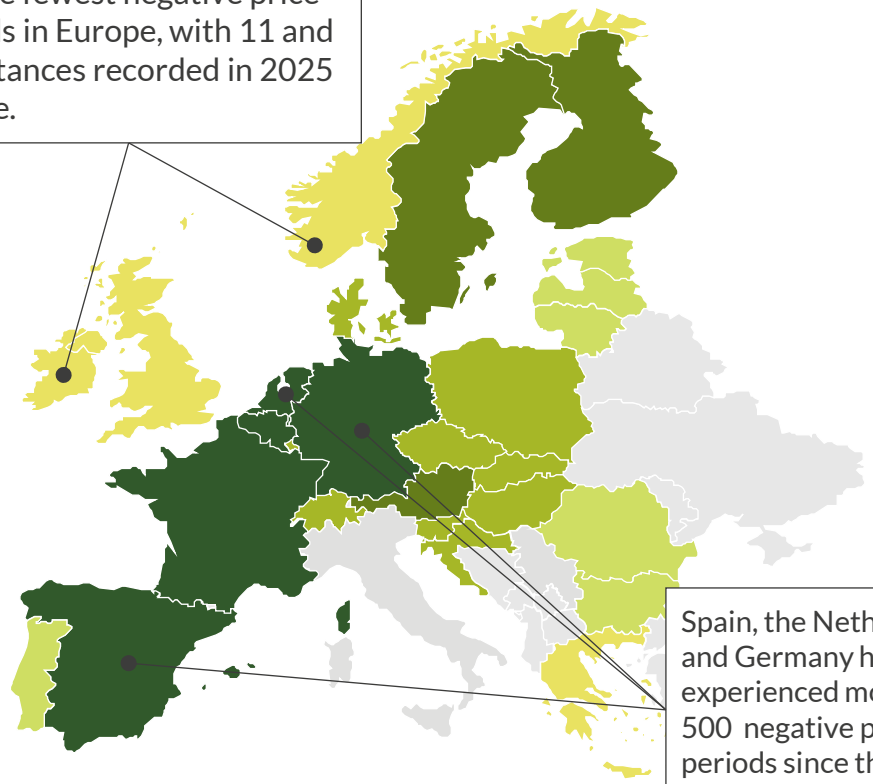

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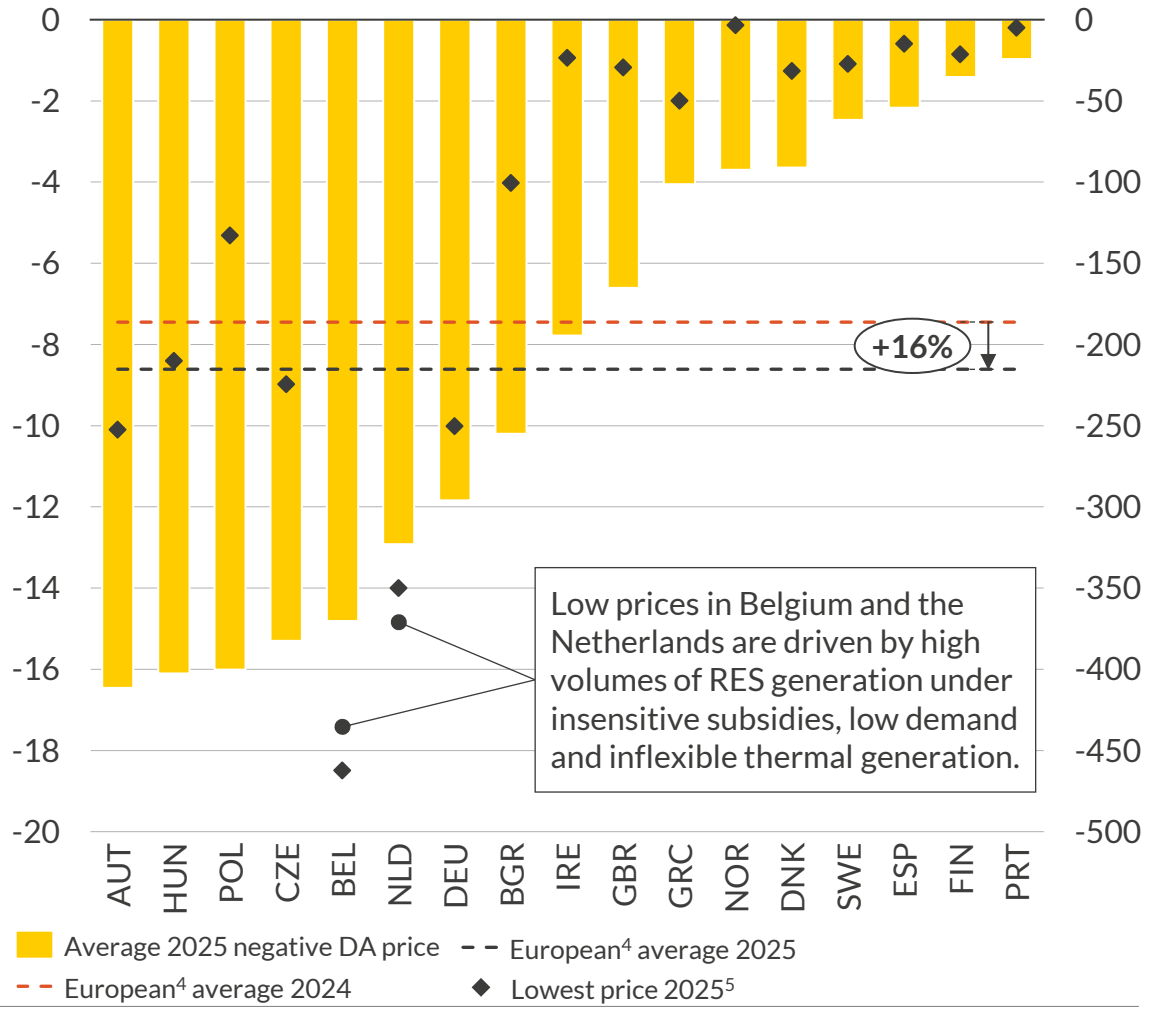

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Source: Aurora Energy Research, ENTSO-E

The drivers, for the magnitude and frequency of negative prices, typically fall into one of five categories, often acting at the same time

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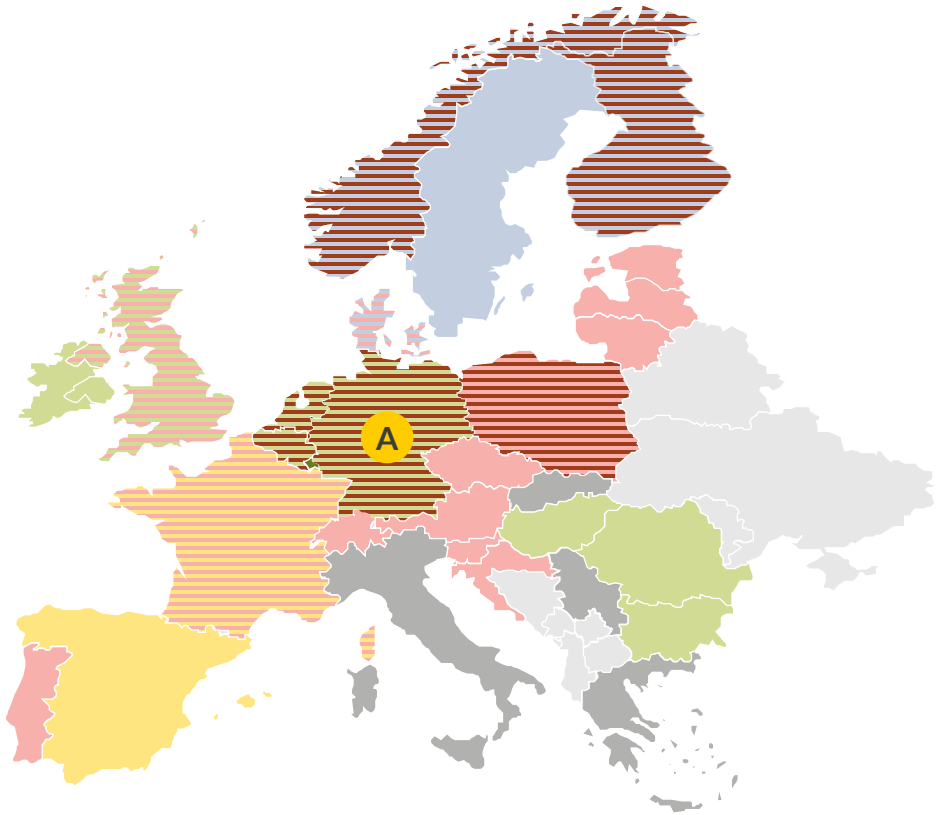
Key drivers for negative prices per market[1]



1. **Production from RES under (negative) price insensitive subsidies –** mainly occurs in central Europe, where renewables keep generating during negative price periods. In 2024, negative prices fell below -10 €/MWh[2].
2. **GoO and REGO certificates –** Technologies receiving Guarantees of Origin often bid lower, by the GoO value, leading to frequent small negative price hours, usually up to -5 €/MWh, in countries with high renewable capacity.
3. **Imported –** Negative price hours are imported from a neighbouring country rather than being driven by domestic factors. For example, Czechia imports large negative prices from Germany.
4. **Inflexible Plants –** Inflexible plants such as coal or nuclear power plants continue operating regardless of market price, amplifying the impact of other drivers for negative prices.
5. **Strategic Bidding –** Renewables bidding strategy pushes prices slightly below zero to ensure participation in the merit order. Bids often come in just below zero to avoid paying imbalance costs or satisfy contractual obligations under PPAs.

Deep dive A

1) Italy's current regulation prevents power prices from falling below zero; 2) Average negative prices in GB, Ireland and Bulgaria were more moderate.

Source: Aurora Energy Research

In Germany, negative prices are primarily driven by inflexible plants and production from RES under price insensitive subsidies

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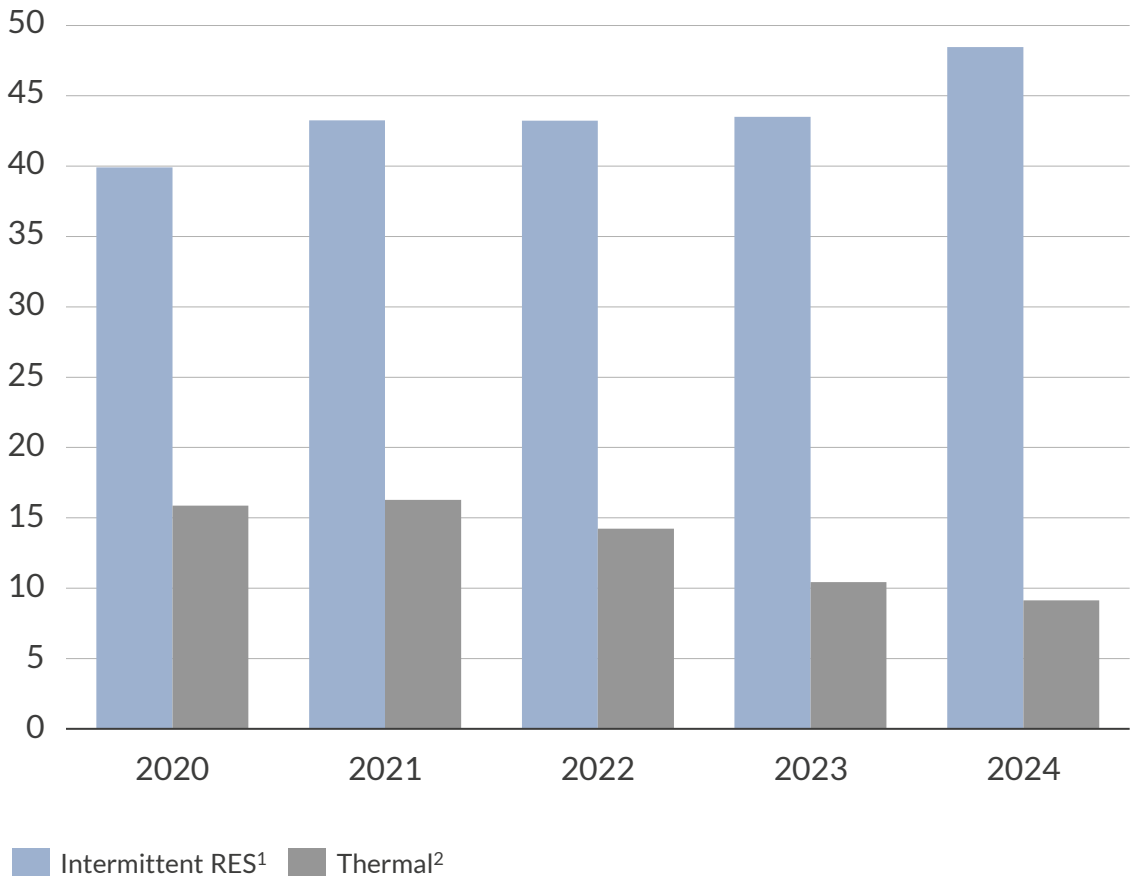
Deep dive A

1 Negative prices mostly occurred in hours of high generation from German renewable and thermal fleets.

Average domestic generation at hours of negative German day-ahead prices

GWh



1) Includes solar PV, onshore wind, and offshore wind; 2) Includes hard coal, lignite, gas CCGT, nuclear (until 2023) gas and oil peakers, wastes; 3) Guarantees of Origin.

Sources: Aurora Energy Research

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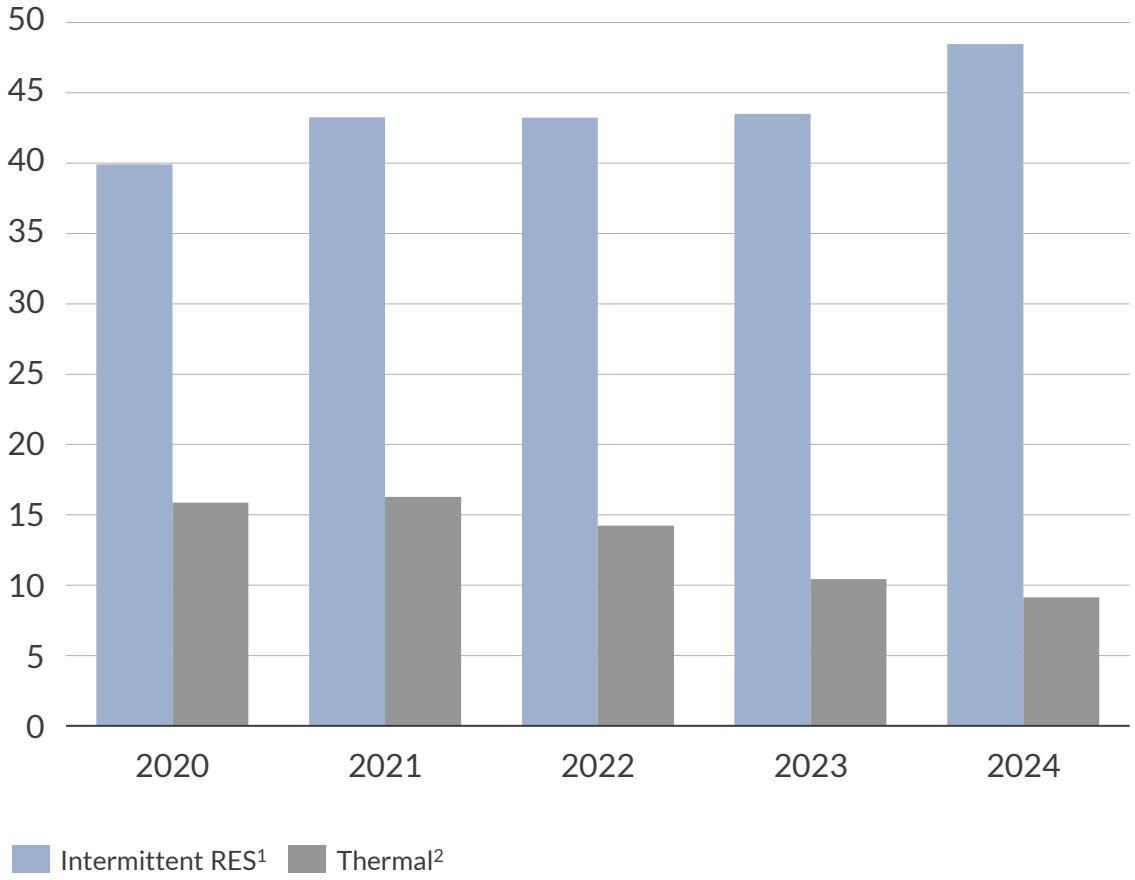
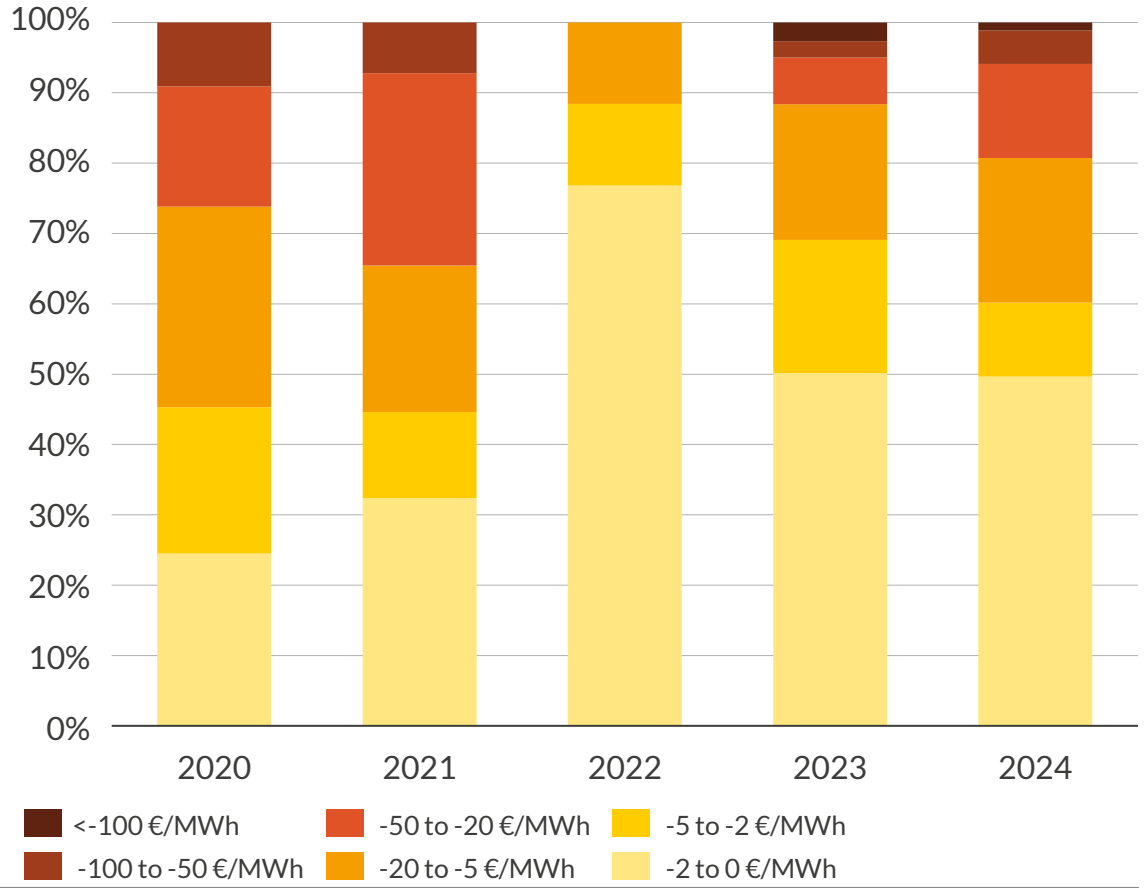


2 Renewables might bid just below 0 when considering revenues from subsidies, GOs[3], or penalties for failed delivery for PPAs.

Distribution of negative prices by price intervals
Total % of negative price hours



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Sources: Aurora Energy Research

Most European markets are reducing subsidy protection to 1 hour of negative prices, increasing risk exposure for renewables

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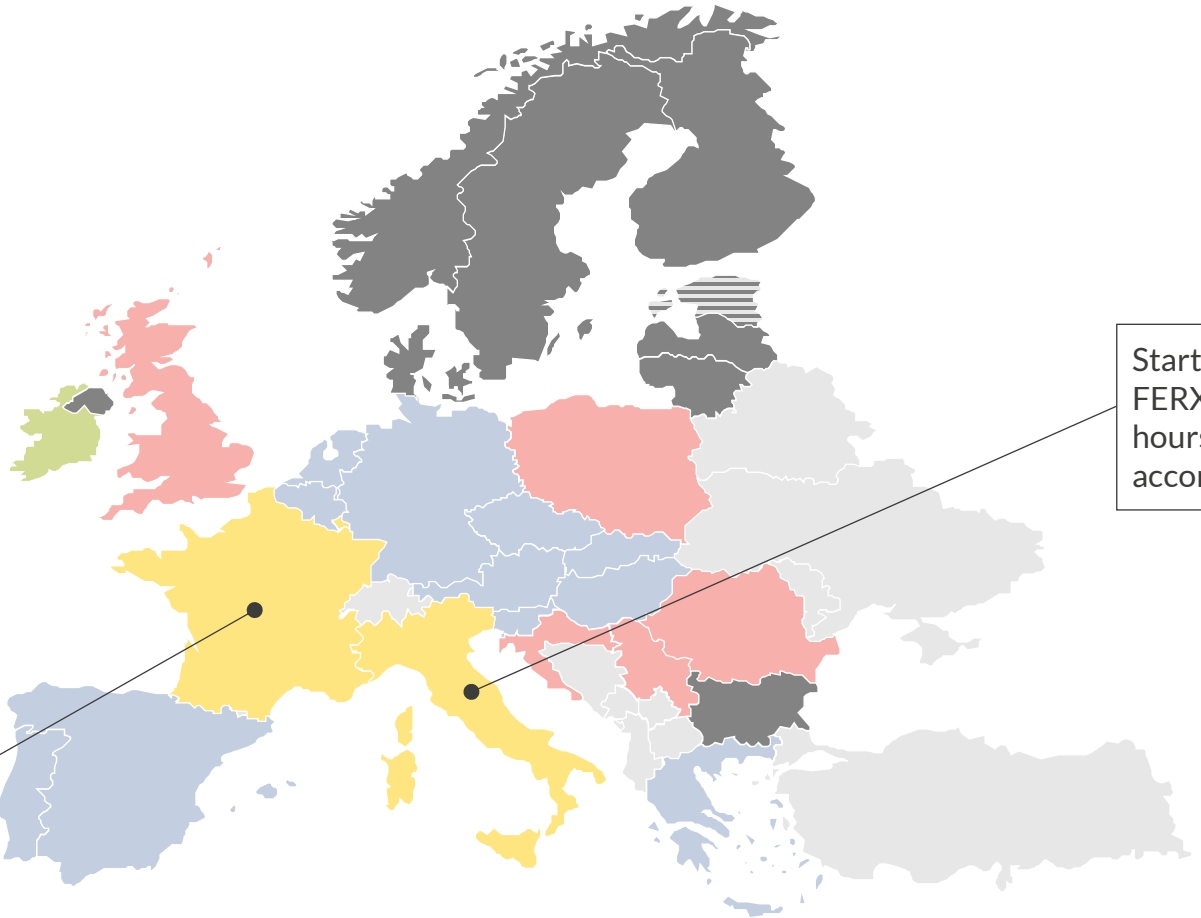
Protection of solar PV and onshore wind assets from negative market prices in national subsidy schemes



Starting from 2025, the new subsidy scheme FERX suspends payment in negative price hours and extends the contract duration accordingly.

Full exposure for first 15h (solar PV) or 20h (onshore wind), after which a premium is paid per hour, though this does not fully offset the losses.

No exposure | Some exposure | Full exposure | No subsidies, full exposure | No information | Some exposure (x-hour rule variation)

Source: Aurora Energy Research

Returns of many RES assets are affected by the x-hour rules, under which subsidies are suspended in periods with negative power prices

Background

- German legislation defines that large-scale renewables assets do not receive subsidies when Day-Ahead power prices are negative during a certain period.
- The length of this period was first defined as 6 hours (so-called "6-hour rule" → no subsidies are paid if the period is 6 hours or longer) but was tightened with several Renewable Energy Act ("EEG") revisions to now zero hours/15min.

The x-hour rules help **system stability and efficiency** as they **incentivise curtailment** in times of excess renewable generation

BUT

as **generated volumes are "lost"** during negative price hours, they **can pose a threat to the business case.**

Overview of the rules

Rule	Legislation	Plants Subject To Rule
6h-rule	§24 EEG 2014, §51 EEG 2017	▪ Awarded between **01/01/2016 and 31/12/2020**
4h-rule	§51 EEG 2021	▪ Awarded between **01/01/2021 and 31/12/2022**
1h-rule	§9 InnAusV[1]	▪ For **co-located assets** since 2020
EEG 2023 rule[2]	§51 EEG 2023	▪ Awarded between **01/01/2023 and 28/02/2025**
No subsidies during negative price periods	§51 EEG 2023[2]	▪ Awarded after **01/03/2025**

Amendment passed in the *Energy Package ("Energiepaket")* in February 2025

1) *Verordnung zu den Innovationsausschreibungen* (Innovation Auction Ordinance). 2) Amendment to EEG 2023 of 25 February 2025.

Sources: Aurora Energy Research, EEG 2014, EEG 2017, EEG 2021, EEG 2023

Switching to the 1h-rule may be viable for solar PV assets but is risky given uncertainties in negative price hours, while it is uneconomical for onshore wind

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1 The 2025 Energiepaket[1] incentivises existing EEG renewable assets to behave more flexibly.

- § 100 Abs. 47 EEG allows for switch to 1-hour rule for existing assets

Existing assets under 4h- or 6h- rule

↓

1h- rule (or 15min-rule)

- + 0.6 ct/kWh bonus
- + smart metering requirement
- + EEG extension

1) AKA "Solarspitzengesetz". 2) EEG subsidy period 2020-2039 + extension under the 1h-rule. 3) North Germany, assuming 30% load factor and EEG strike price reflecting the average award value of the 2018 tender, plus a 125% correction factor. 6) Applicable after the subsidy period ends. 7) Includes a 125% correction factor for onshore wind.
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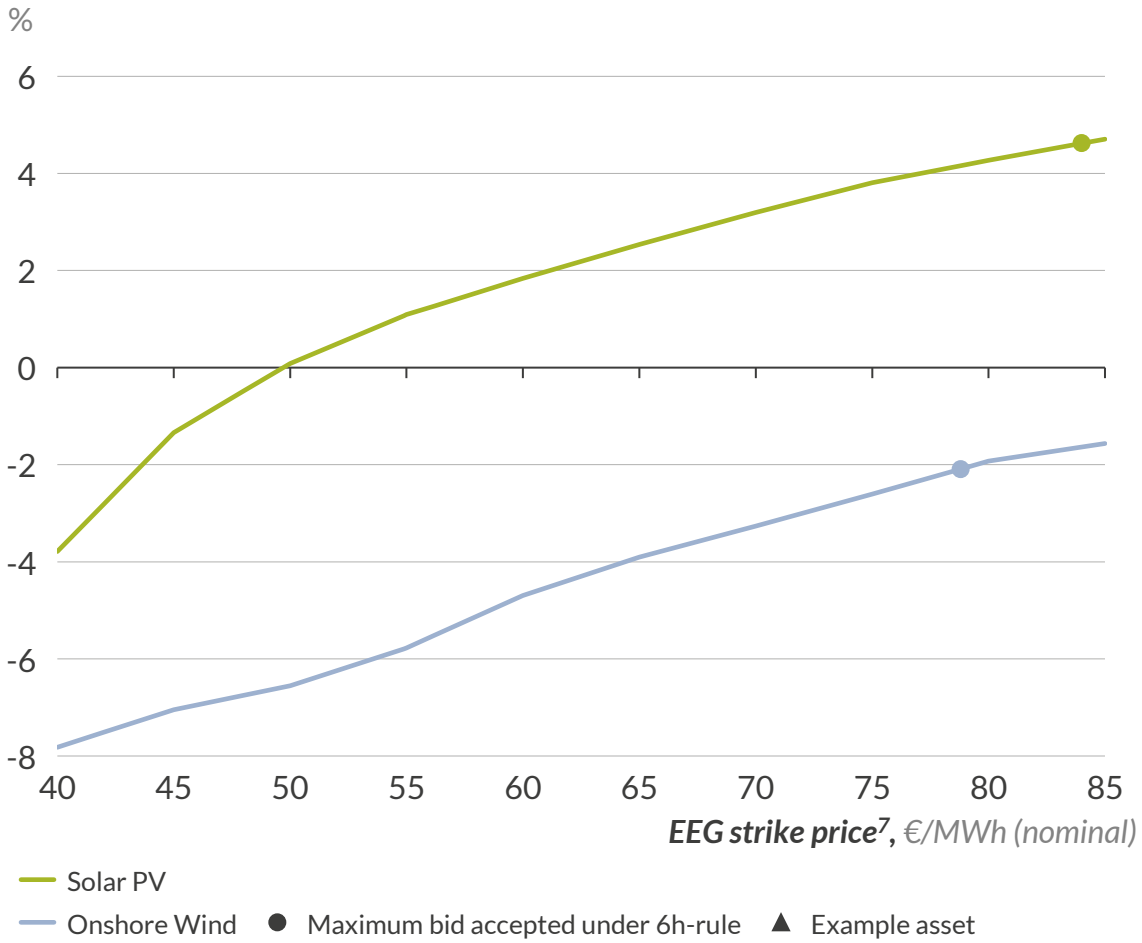
3 0.6 ct/kWh is insufficient to incentivise existing 6h-rule onshore wind assets to switch rules.

Potential revenue upside opting from 6h- to 1h-rule, 2026-2042, COD 2020



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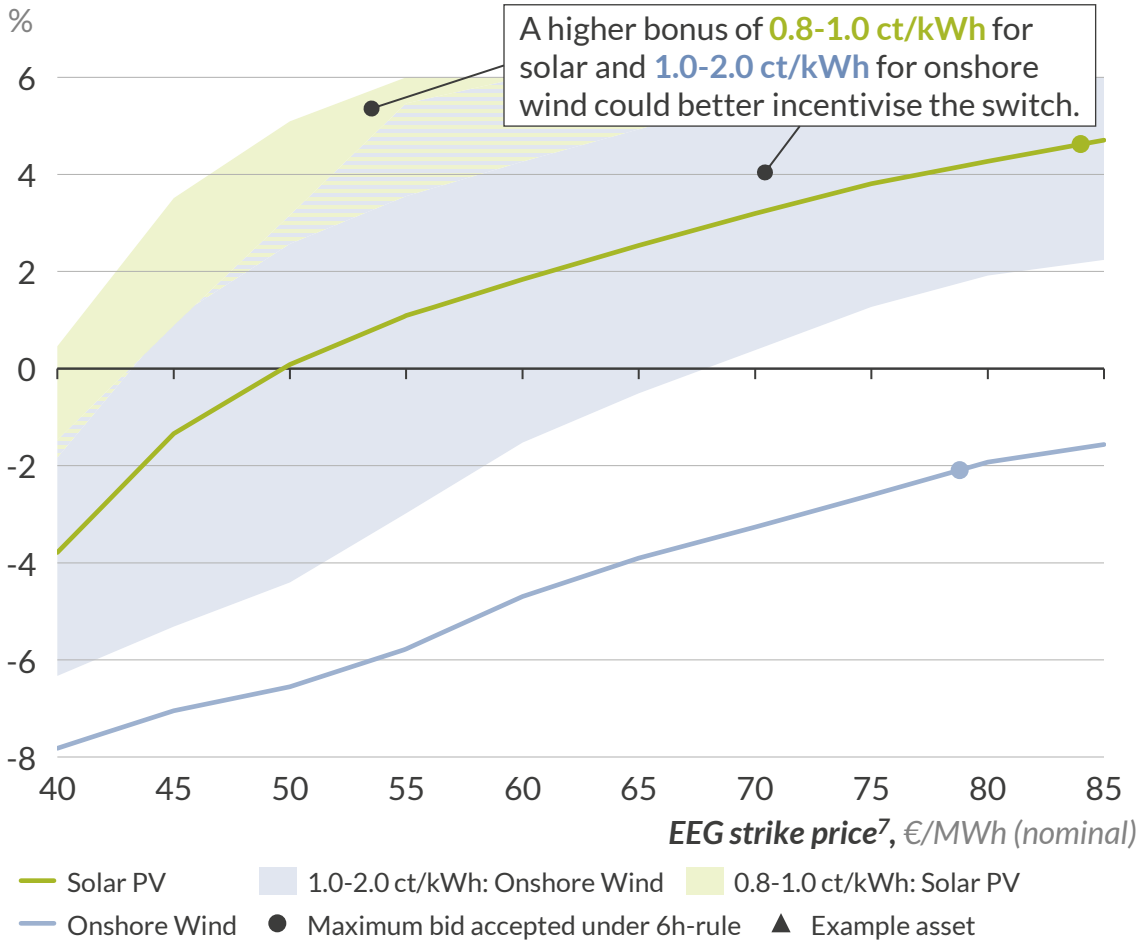

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The frequency of negative prices is expected to decline by 2035 as power demand increases and flexibility grows on the generation and demand side

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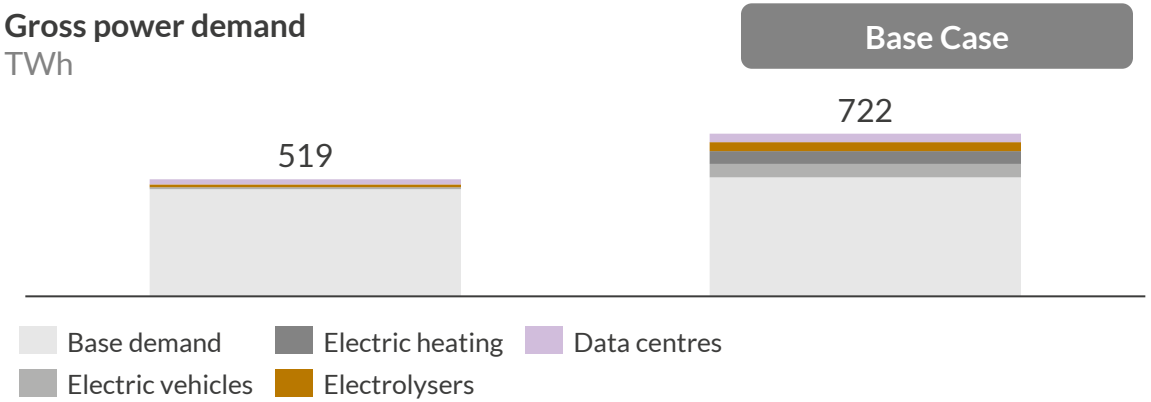
Gross power demand
TWh



Share of inflexible renewables out of total renewables capacity[1]
%

BESS capacity
GW

1) Includes subsidised solar PV, onshore wind, and offshore wind plants under feed-in tariff or 4-hour / 6-hour rule (i.e., subsidies are exempted when negative prices last 4 / 6 hours or more). In addition, there might be more renewable assets that are incentivised to bid below 0 to satisfy contractual obligations under Power Purchase Agreements.

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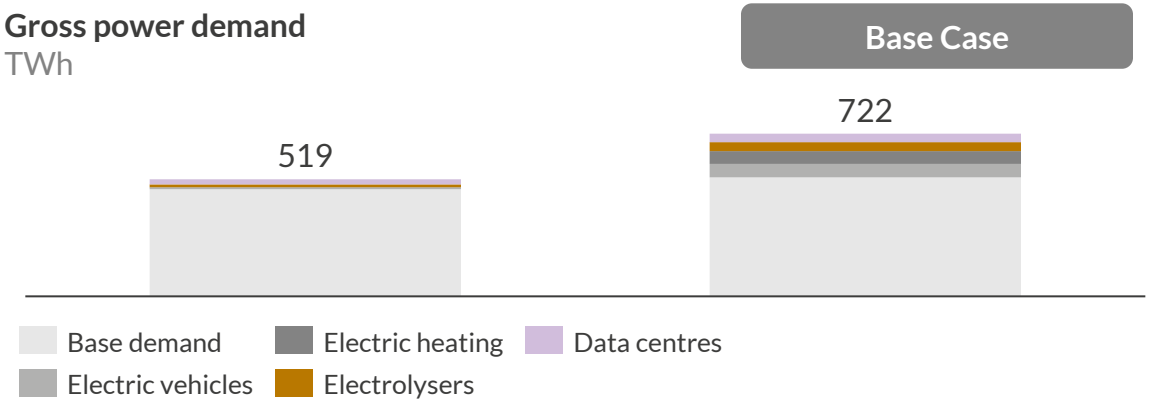

Share of inflexible renewables out of total renewables capacity[1]
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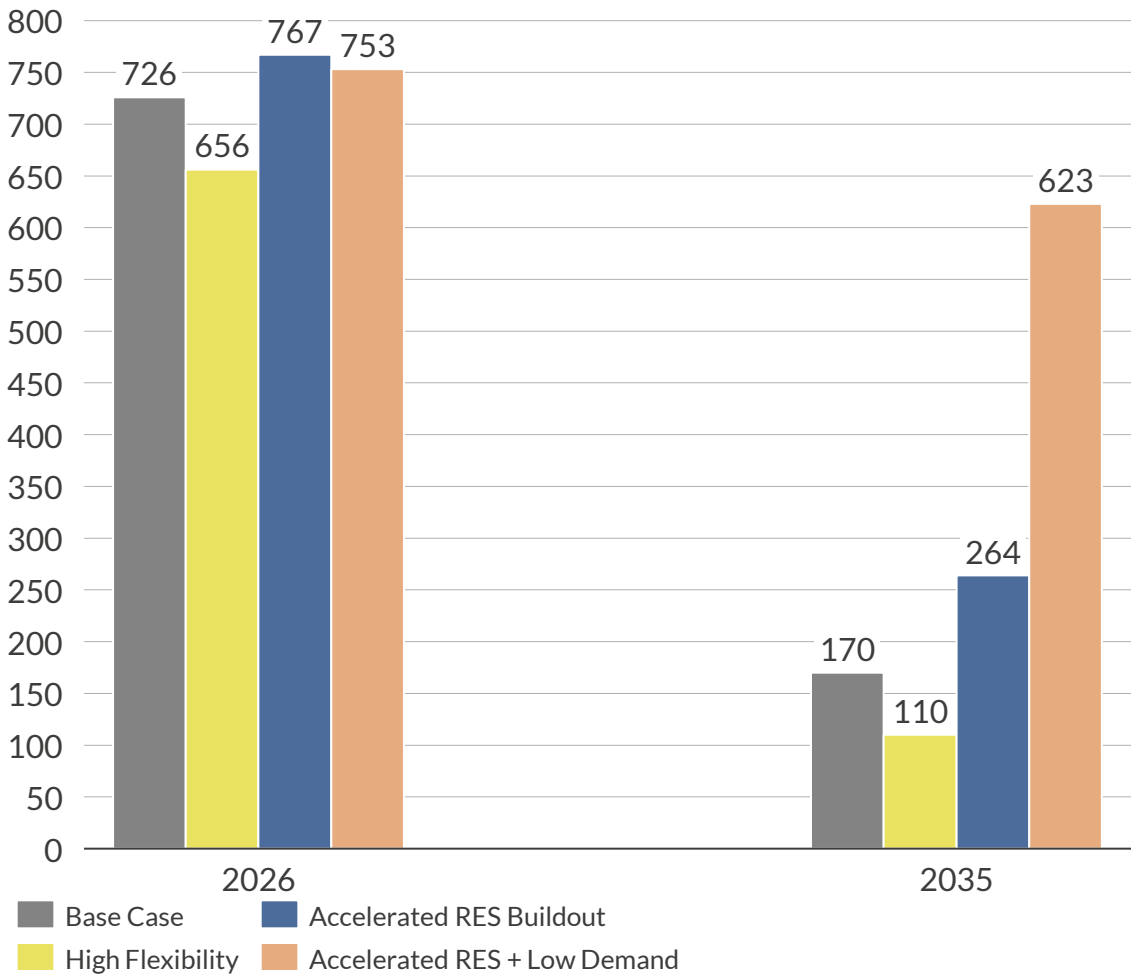
BESS capacity
GW

Total number of negative price hours
Hours p.a.



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Key takeaways

1 **Negative price risk is increasing:** Increasing renewables deployment leads to increasing moments of oversupply that drive prices into the negative. At the same time, many countries exclude negative price periods from subsidy regimes such that the negative price risk is increasing even for subsidised newbuilds.

2 **Negative price exposure is not worth the risk:** A 0.6ct/kWh upside provides little incentive to bear the negative price risk in the current market environment, especially for onshore wind. The upside for onshore wind assets would need to increase significantly for a switch to the 1h-rule to be viable.

3 **Batteries and demand drive uncertainty around negative prices:** Negative prices are expected to decline by 2035 as power demand increases, and system flexibility grows. In the short-term, deployment strategies like battery co-location or ancillary markets participation for renewables could further hedge the negative price risk.

Source: Aurora Energy Research

Thank you for your attention

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Date
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