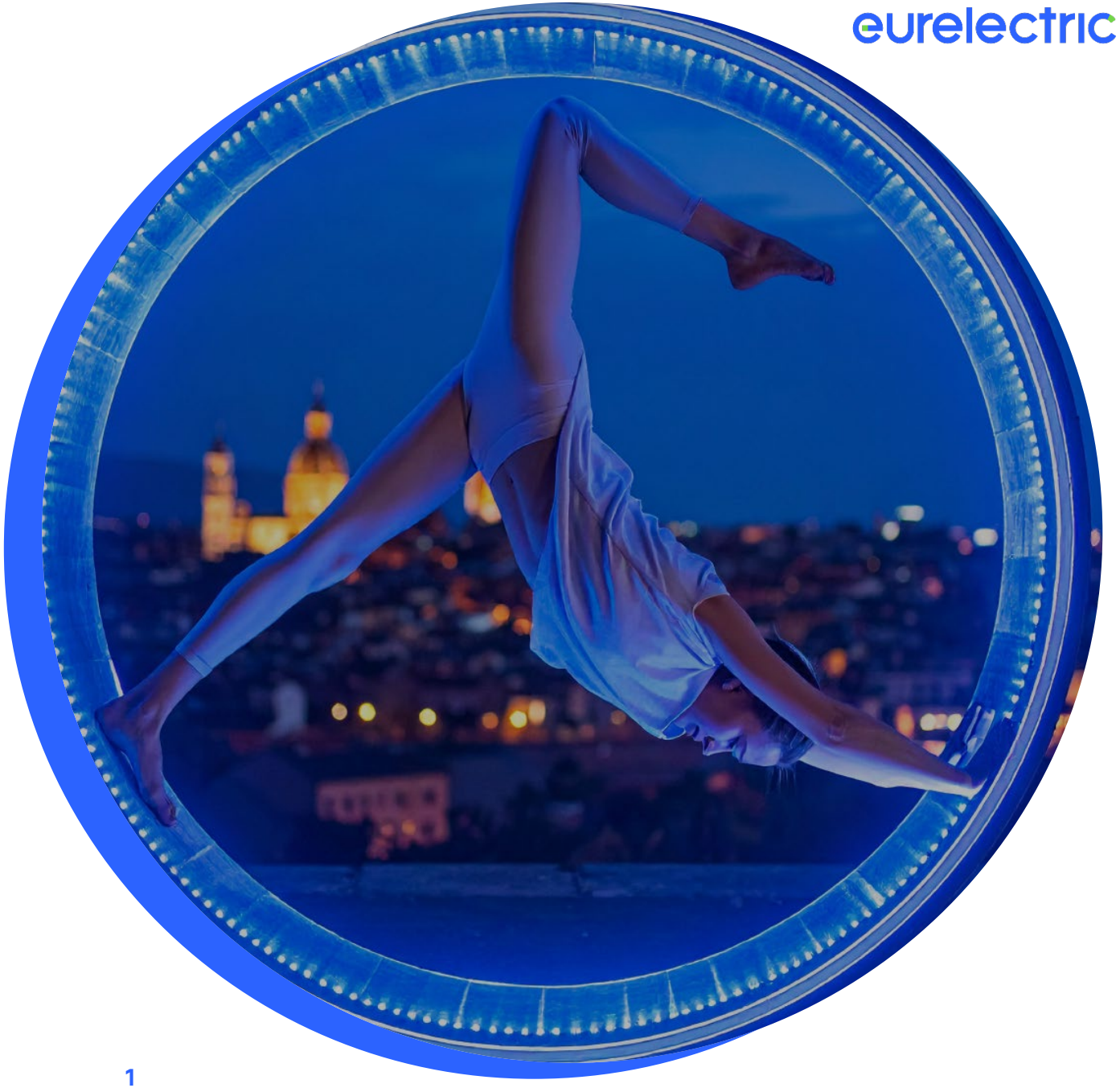
Power Barometer 2025

In shape for the future

Extensive analysis



Foreword

In 2025, the European Union finds itself at a critical juncture. The geopolitical landscape is marked by growing uncertainty, with conflicts escalating and spreading into new regions, while trade frictions and global competition intensify. Within this volatile context, energy has re-emerged as a strategic instrument - not only as a cornerstone of economic resilience, but increasingly as a pillar of national security across Europe.

Electricity stands out as a key enabler of Europe's long-term energy security and decarbonisation - offering a path away from imported fossil fuels and toward greater energy independence. Electrification is widely acknowledged as the foundation of Europe's competitiveness and climate neutrality, yet its progress remains slow due to structural barriers, policy gaps, and weak investment signals.

Geopolitical tensions and high energy prices have strained energy-intensive sectors, especially those lacking viable electrification alternatives. Meanwhile, electricity demand has stagnated - driven less by efficiency gains and more by weakening industrial output and slow uptake of EVs and heat pumps. Still, structural drivers like the rapid growth of data centres are expected to positively impact demand, while electrification is gaining ground as a competitive alternative to fossil fuels in industry.
Momentum in the power sector is building. Solar installations reached record highs over the past year, while investors are increasingly backing battery storage, flexibility assets, and distribution grids — vital steps for integrating renewables and managing demand-side flexibility.

To ensure resilience and strategic autonomy, Europe must accelerate investment not only in clean electricity but also in the flexible infrastructure that will support it. The **Power Barometer 2025** captures these pivotal developments, offering a data-driven view of where Europe stands today — and what is needed to secure a sustainable, reliable, and competitive energy future.

Kristian Ruby
Secretary General Eurelectric

About

Eurelectric's Power Barometer is the annual flagship data report offering a fact-based assessment of the European power sector and its links to broader energy and climate challenges. It tracks the sector's transformation by highlighting progress in decarbonisation, electrification, renewable integration, and grid development, while also exploring how electricity is increasingly powering transport, industry, and other parts of the economy.

Beyond the power sector itself, the report addresses wider issues such as security of supply, competitiveness, and climate impacts – underlining the central role of electrification in Europe's path to net zero. It also sheds light on market dynamics and investment signals that shape the sector's ability to deliver on Europe's energy ambitions.

Unlike reports bound by a fixed set of indicators, the Power Barometer evolves year on year, focusing on the most relevant trends and developments in the energy landscape. This flexible approach ensures timely insights and keeps the analysis aligned with today's rapidly changing context.

The **2025 Power Barometer** reviews the key developments of 2024 and 2025 at a decisive moment for the European Union. Against the backdrop of geopolitical tensions, shifting trade dynamics, and the arrival of a new European Commission, it provides policymakers and stakeholders with clear insights into Europe's progress on the energy transition – and the challenges that still lie ahead.

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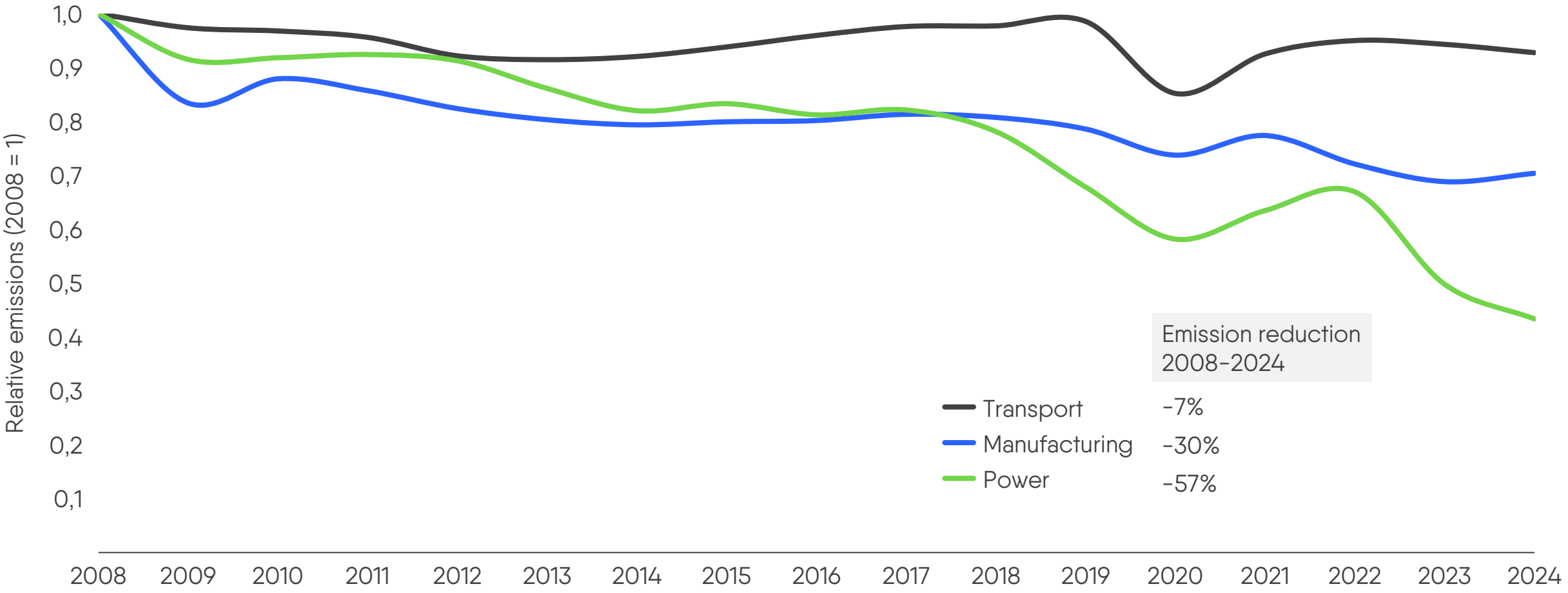
The power sector continues leading the charge in emission reduction

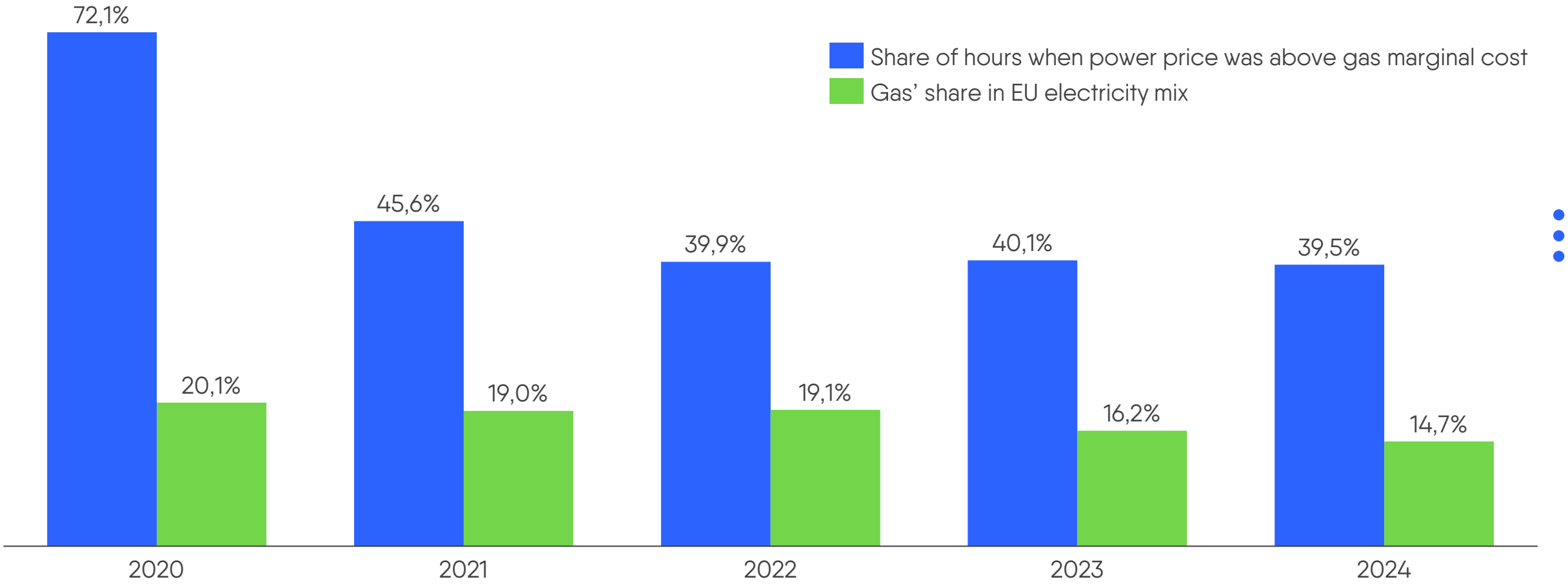
Emission reductions of power, manufacturing and transport sectors of the EU27 since 2008[1]



Notes: 1) 2024 emissions of manufacturing sector is estimated based on 2024 Q1-Q3 data from quartely dataset of Eurostat. For transport, estimates from EEA were used for 2023 and 2024. For power sector, Elda, Eurostat and Ember are used. Sources: Elda, Eurostat, EEA, Ember.

Gas is setting electricity price less frequently

- While electricity prices[1] were equal or higher than cost of electricity production by gas power plants during 72 % in 2020 this has come down to 39.5 % in 2024. This means gas' role in setting electricity price is declining as the renewable penetration is rising.



Notes: 1) The share of hours were calculated for each individual bidding zones. These zone-level results were then averaged to obtain the EU-wide value. Sources: ACER, Elda.

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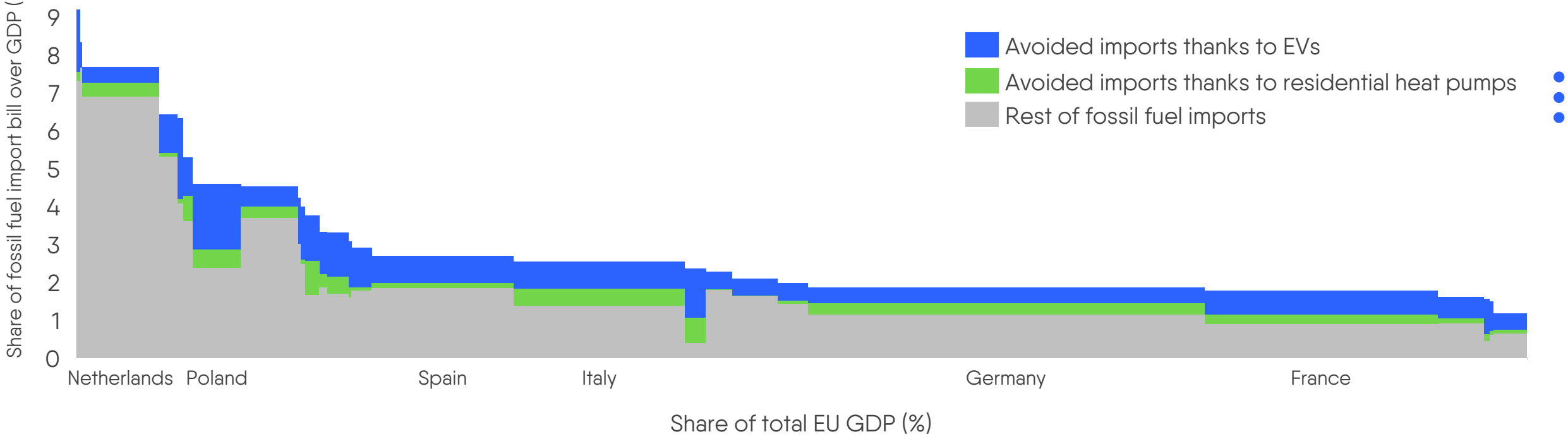
Out of the €450 billion of fossil fuel imports, €150 billion could have been saved by electrifying transport and residential heating

Cost savings from avoided fossil fuel imports[1] thanks to EV and heat pumps[2]

- In 2023, the EU27's total fossil fuel import bill reached €451 billion. Although it declined slightly in 2024, it still exceeds €400 billion.
- Most of these imports were oil and petroleum products, totalling 785 million tonnes[1], followed by 478 bcm of natural gas[1].
- Transitioning the entire EU car fleet to electric vehicles could save around €100 billion in oil and petroleum import costs.
- Similarly, installing heat pumps in all homes and businesses across Europe could reduce natural gas imports by just over €40 billion.

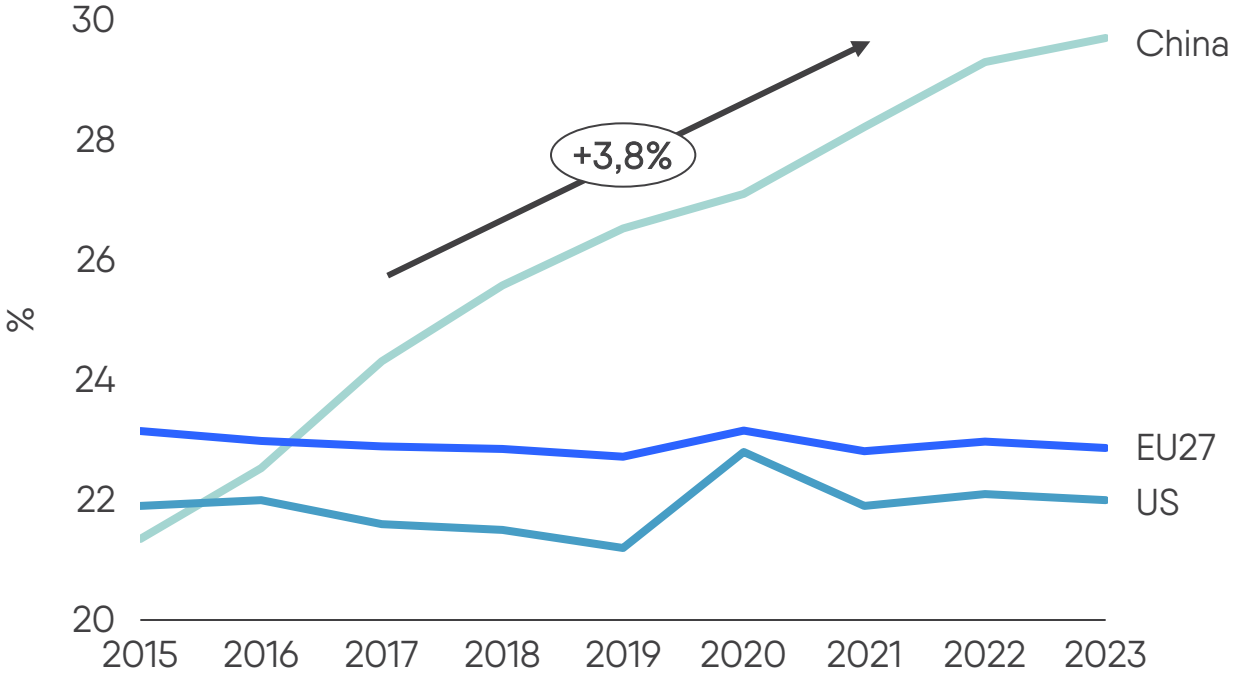


Notes: 1) Data refers to 2023. 2) All financial figures in USD. EVs are assumed to replace all oil and petroleum products consumption for road transport. Heat pumps are assumed to replace natural gas use for residential and commercial sectors. Natural gas is converted to mtoe through its calorific values. Sources: Eurostat, WB.

China's electrification growth keeps gaining momentum, while the EU and the US lag behind

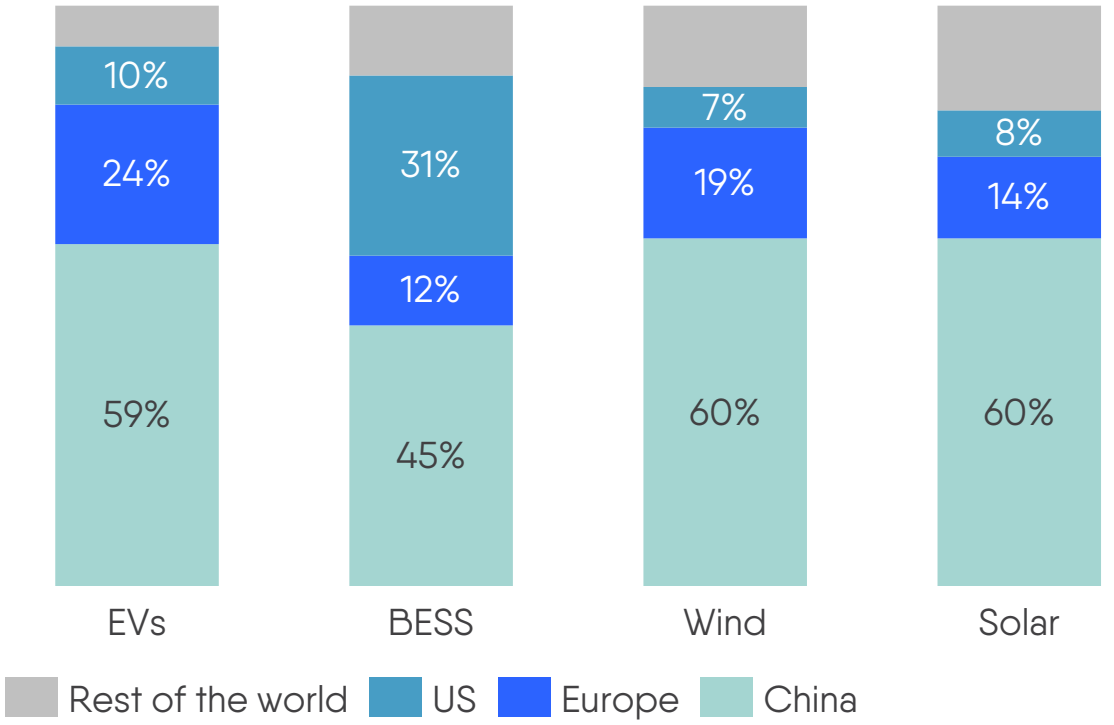
Share of electricity in total final energy consumption

- China surpassed the US and the EU in electrification rate in 2015. Since then, its electrification rate has steadily increased by nearly 4 percentage points per year, while the rates in the US and EU have remained largely unchanged.



Share of global clean technological sales in 2023

- China's high electrification share is driven by strong investments in renewable energy, with the country accounting for over 50% of global wind and solar purchases. Europe falls behind particularly in battery purchases, where it is overtaken by the United States.

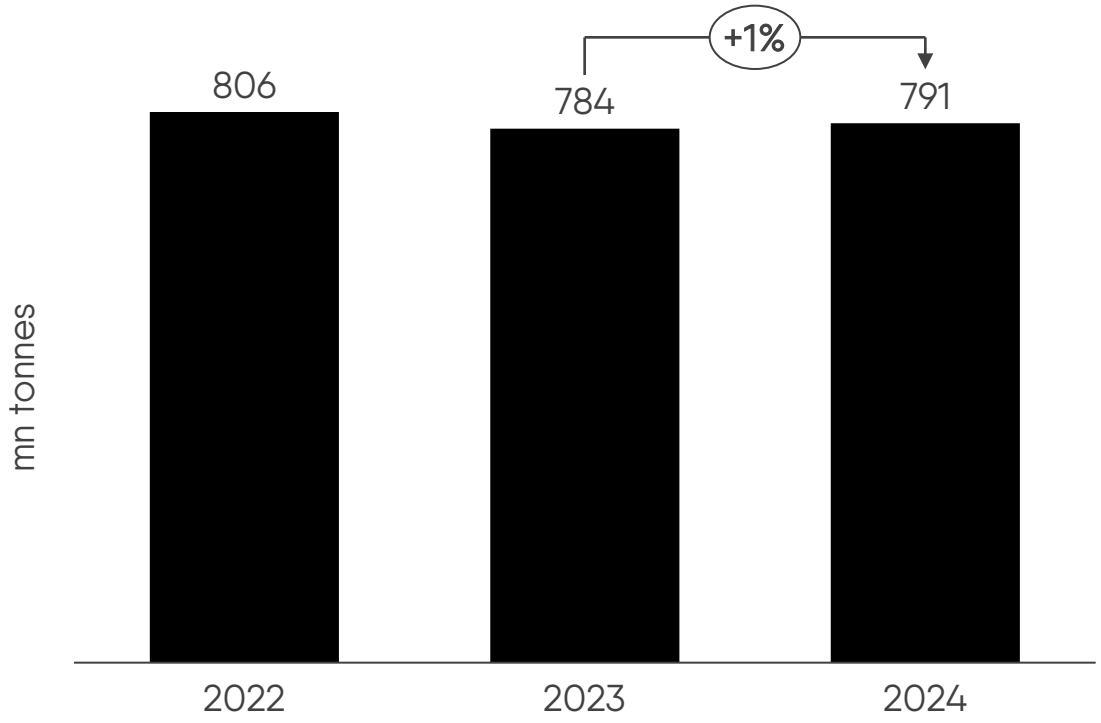


Sources: IEA, Enerdata, RMI, BNEF.

While natural gas imports continue to decline each year, oil imports to the EU increased in 2024

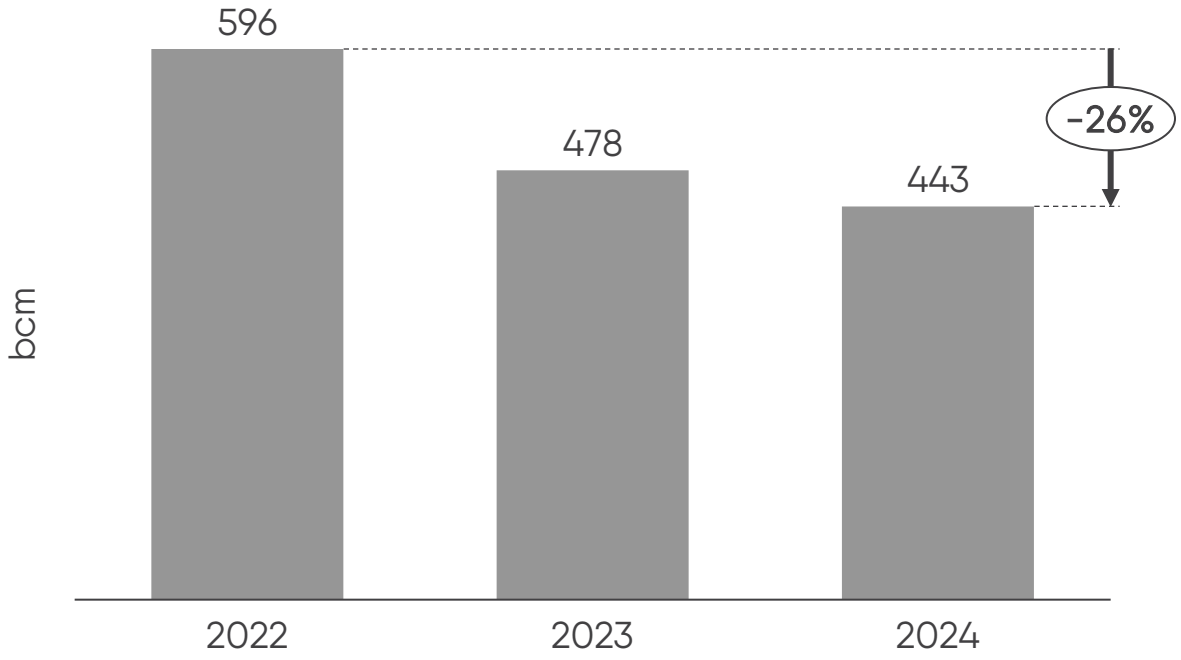
EU27 imports of oil and petroleum

- Oil and petroleum product imports to the EU rose by 8 million tonnes in 2024 compared to 2023, reaching a total of 791 million tonnes. The annual increase was especially noticeable in the second quarter of 2024 and in November.



EU27 imports of natural gas

- Natural gas imports to the EU decreased by 36 billion cubic meters in 2024 compared to 2023, reaching a total of 442 bcm. The annual drop was especially noticeable in the second and last quarter of 2024.



Source: Eurostat.

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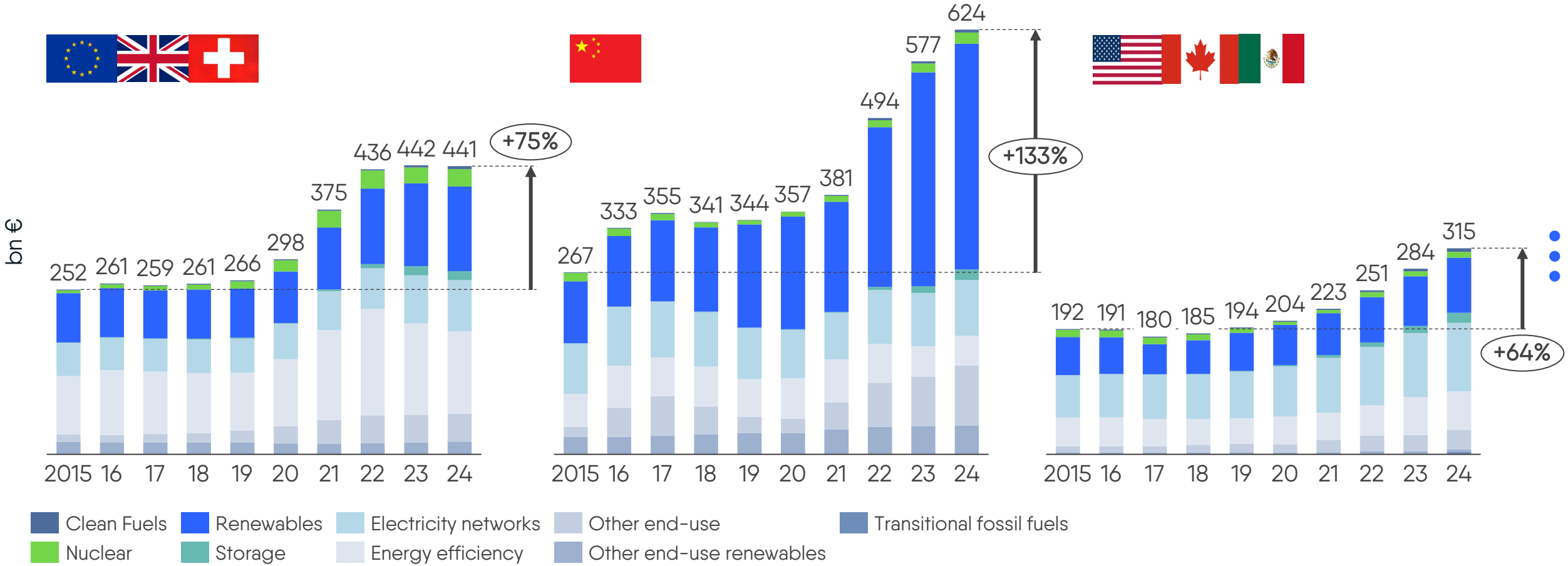
North America and Europe[1] trail behind China in clean energy investment

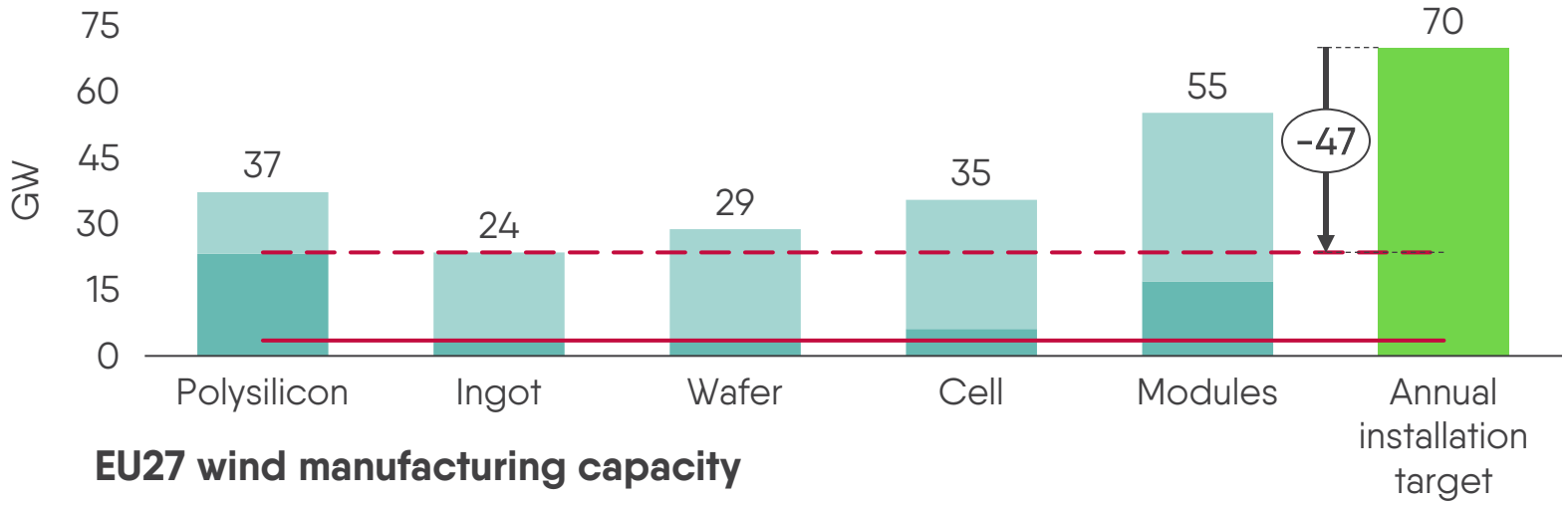
Yearly investments in clean energy technologies



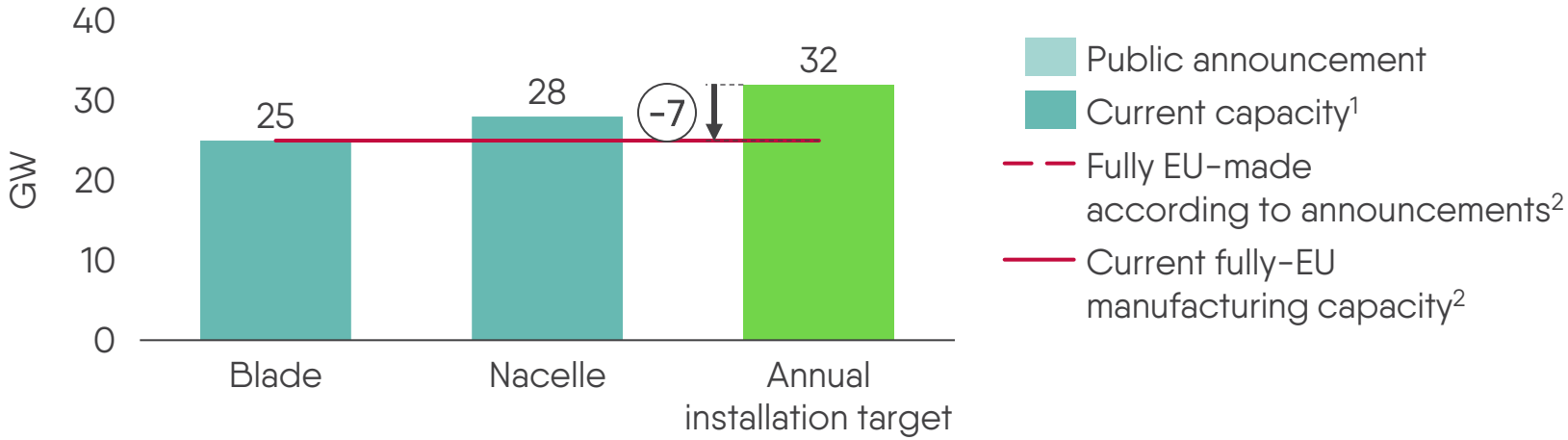
Note: 1) Europe includes European Union and Albania, Belarus, Bosnia and Herzegovina, North Macedonia, Gibraltar, Iceland, Israel, Kosovo, Montenegro, Norway, Serbia, Switzerland, Republic of Moldova, Turkey, Ukraine and United Kingdom. Source: IEA.

Europe faces rising import reliance for solar and wind components

EU27 solar manufacturing capacity



EU27 wind manufacturing capacity

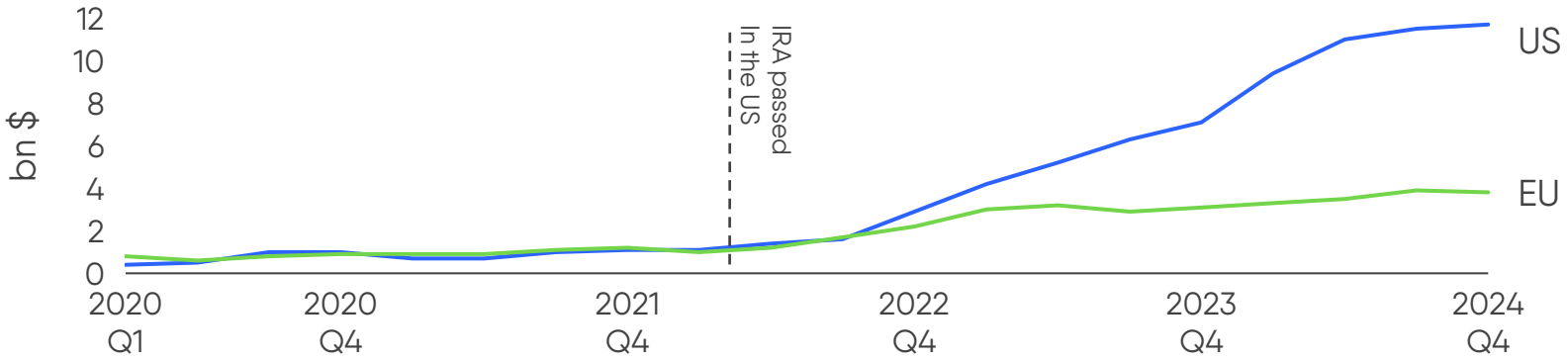


- China dominates the entire solar PV manufacturing chain, while Europe's capacity varies by component—strong in polysilicon but weak in ingot and wafer production.
- As a result, the EU27 depends heavily on imports and is expected to continue doing so, with announced manufacturing capacity falling short of the annual installation target by nearly 50 GW.
- The global wind turbine market is controlled by ten major manufacturers, five of which are EU-based. However, consolidation and growing Chinese competition have shrunk the number of players.
- To meet its 2030 decarbonisation goals, Europe would need to boost imports, as current manufacturing capacity is 7 GW short of the required annual installations.

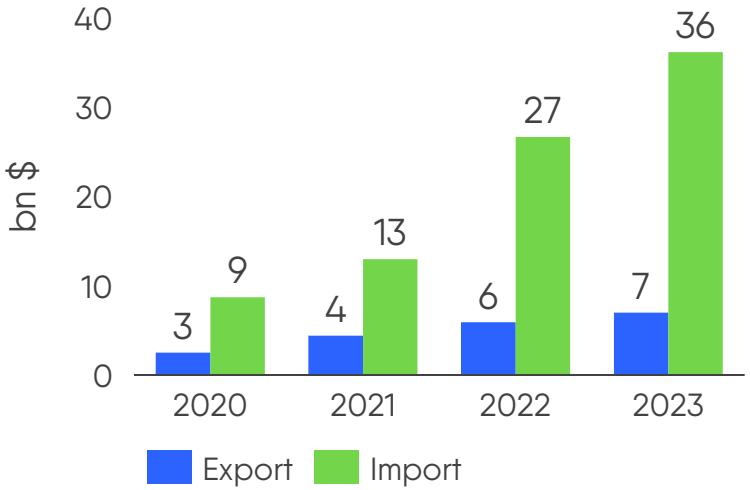
Notes: 1) It also includes actual investments. 2) Here, we assume that each components participates with the same capacity in the construction of a final product, e.g. 1 GW of blade is needed with 1 GW of nacelle to build 1 GW of wind turbines. Source: Eurelectric, Bruegel.

Lack of robust investments on batteries leads to heavy reliance on battery imports and to missed profit opportunities

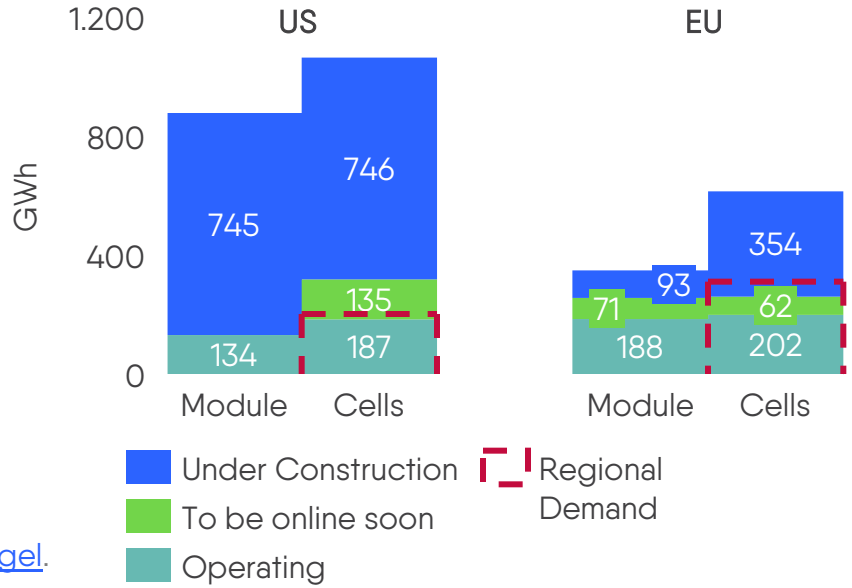
Investments in battery manufacturing[1]



Value of EU li-ion battery trade



Battery manufacturing capacities



- The IRA has significantly boosted battery production in the US, with battery making up over 70% of U.S. clean manufacturing investments across 2024.
- As a result, US cell manufacturing is projected to surpass 1,000 GWh, while the EU, with fewer projects in the pipeline, is on track to reach 600 GWh of capacity.
- By 2024, domestic battery cell production in the U.S.—and to a lesser extent, in Europe—has grown enough to meet most of the local demand.
- Despite growing cell and module manufacturing, Europe remains far from self-sufficient: it still depends on China for upstream components, imports large volumes of batteries to meet domestic demand, while at the same time exporting a significant share of its own production to North America.

Notes: 1) Data in Real 2023 USD. Sources: Bruegel.

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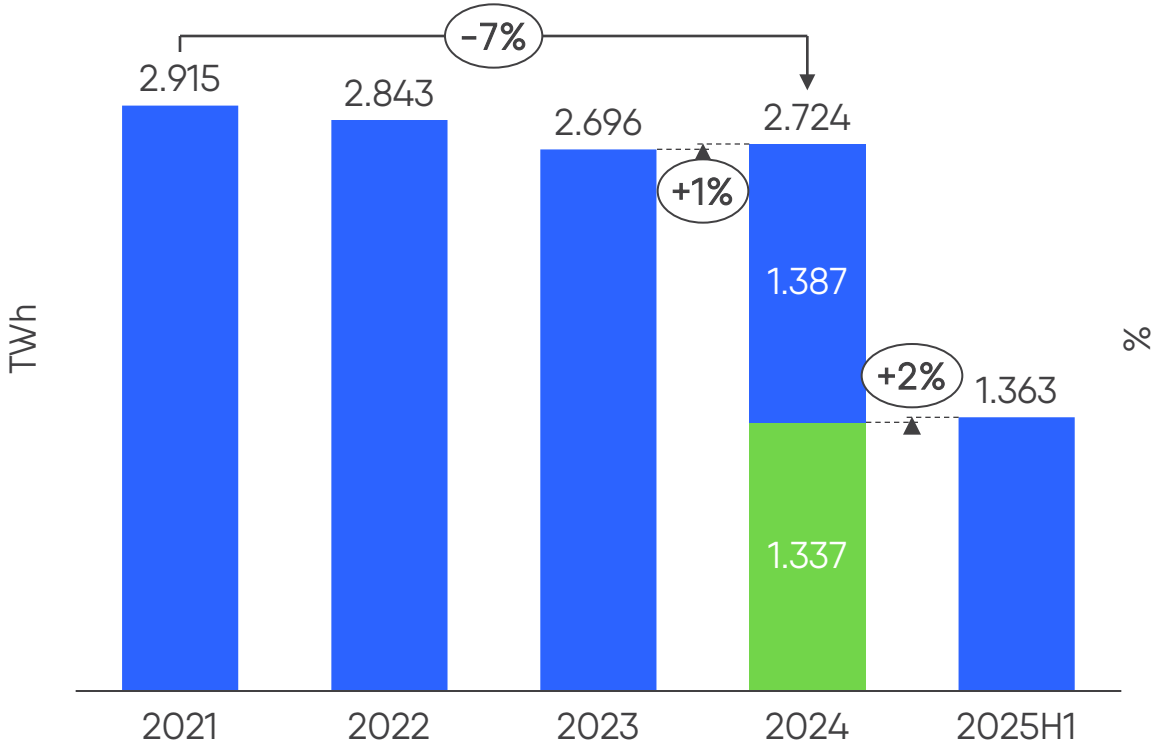
2024 saw only 1% YoY demand growth highlighting the stagnant state of electrification

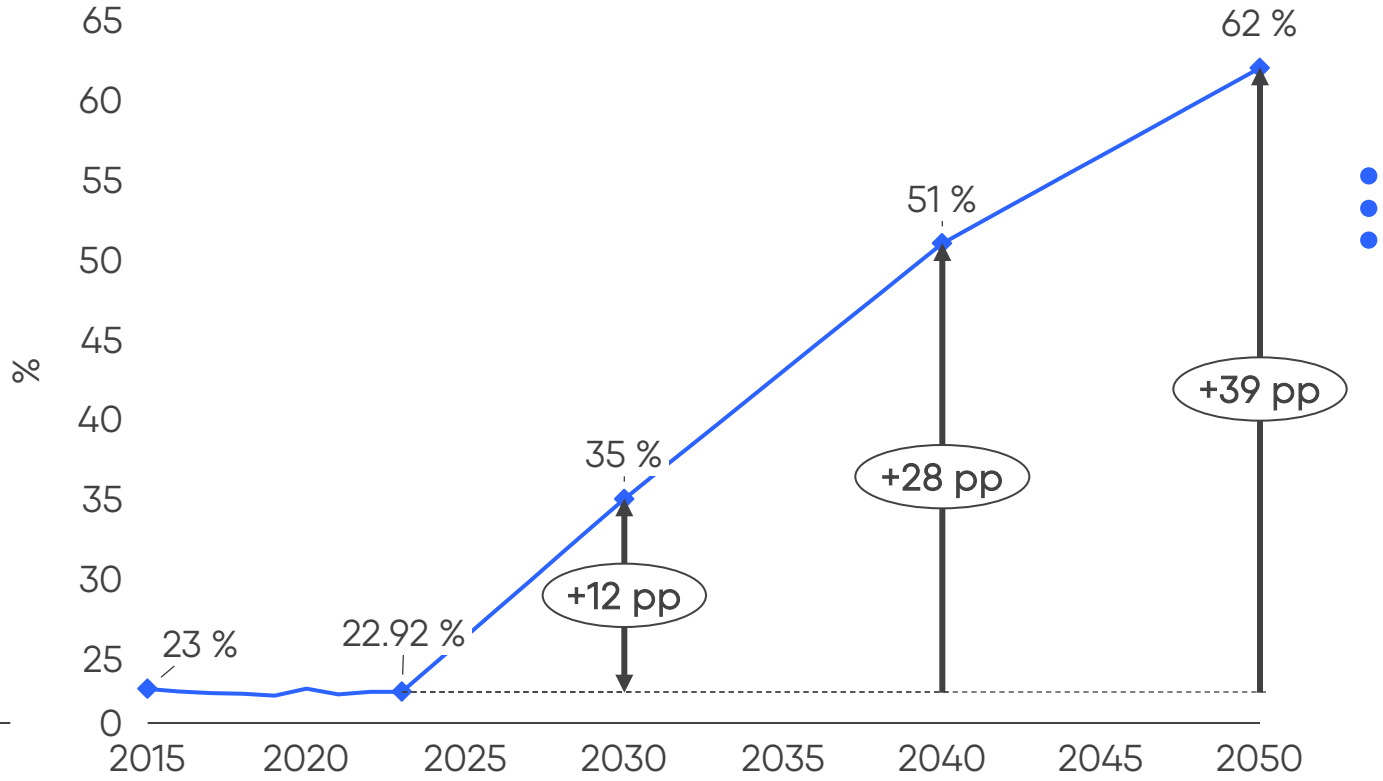
Electricity demand of the EU27

- EU27 electricity demand only grew by 1 % in 2024. The demand is still 7 % lower than the 2021 electricity demand. This shows EU is still recovering from the forced savings due to the energy price crisis. 2025 H1 demand is 2% higher than 2024H1 demand.



Electrification rate of the EU27

- EU27's electrification rate has been stagnant around 23% for the last 10 years. If the decarbonisation targets were to be achieved, electrification must reach 35% in 2030 and 62% in 2050. The Clean Industrial Deal has a KPI of 32% economy-wide electrification by 2030.

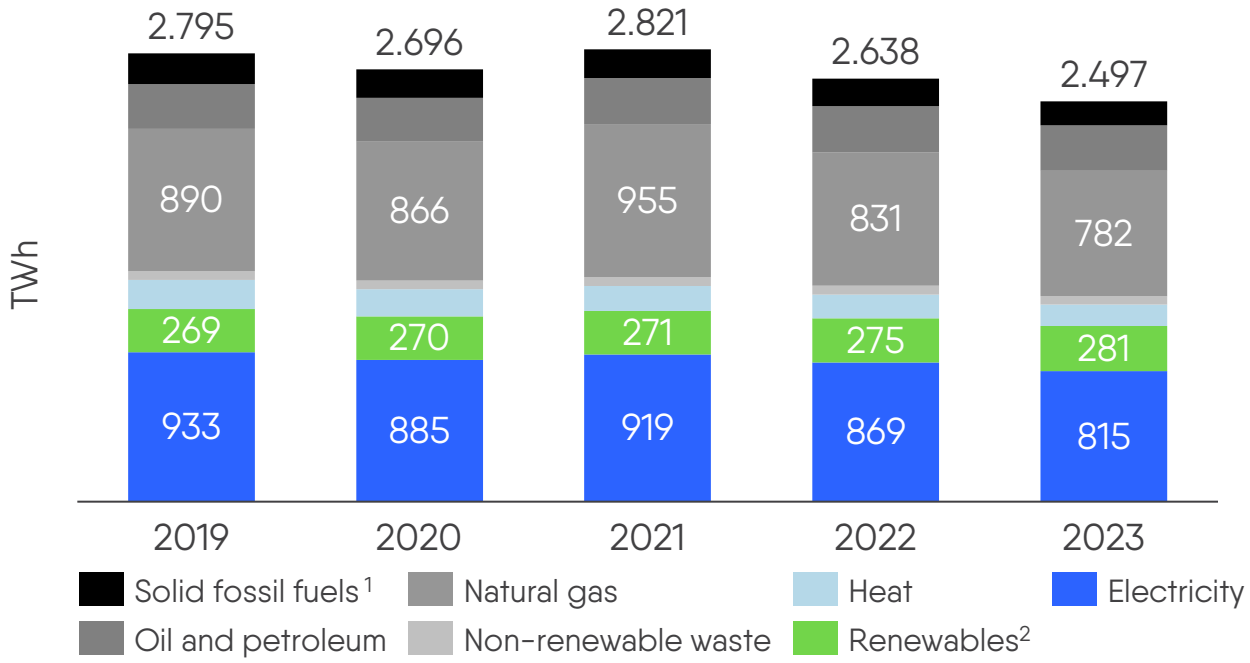


Source: Elda, Eurelectric.

Industrial demand dipped, early signs of revival ahead

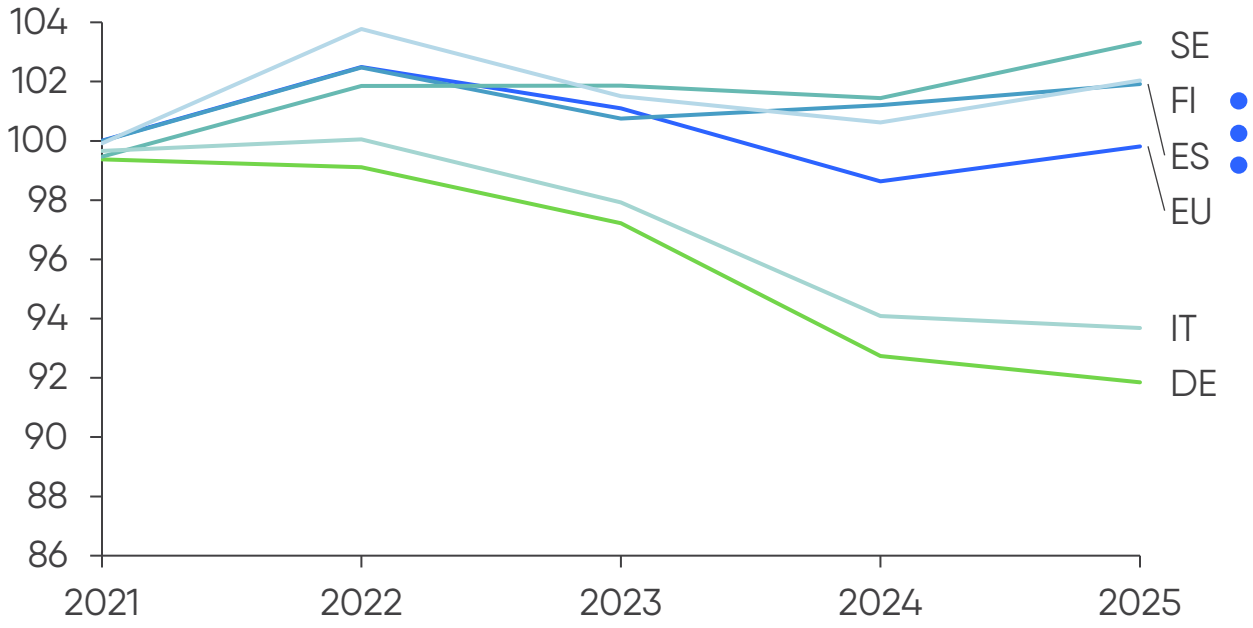
Final energy consumption of European industries

- High energy costs impacted industries' activities in Europe reducing their final energy consumption in 2023 by 5%.
- In addition to declining industrial output, improved energy efficiency and increased self-consumption – driven by greater use of renewables – further reduced industrial power demand.



Industrial production index (2021 = 100)

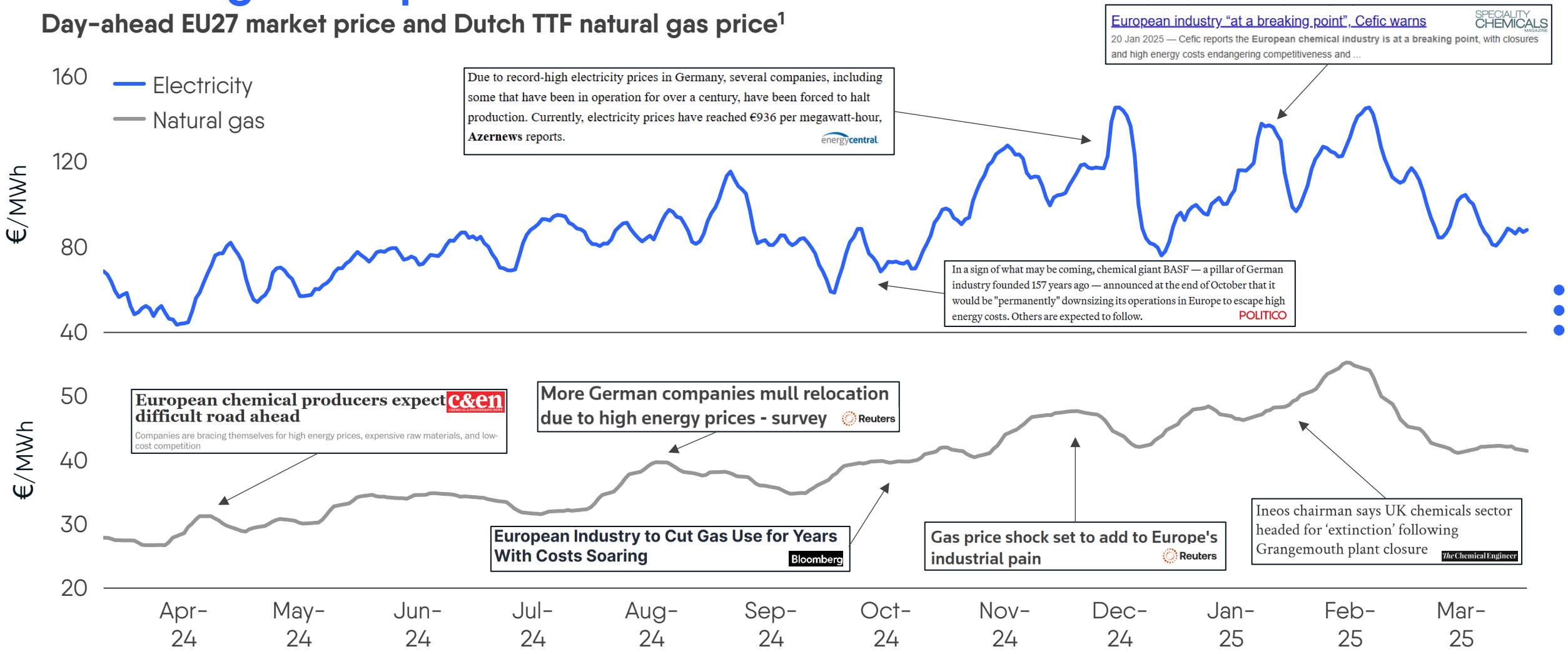
- The latest industrial output data points to a recovery in European industries, albeit with a mixed performance across countries.
- Germany and Italy still face declines, though milder, while Spain, Finland, and Sweden show recovery in 2025—potentially boosting electricity demand.



Notes: 1) Refers to primary coal products, derived coal products, manufactured gases, peat and peat products and oil shale and oil sands. 2) Include variable renewables as well as biofuels. Sources: Eurostat, European Steel Association, CSO Ireland.

Many European and especially German firms are shutting down or relocating their operations

Day-ahead EU27 market price and Dutch TTF natural gas price[1]

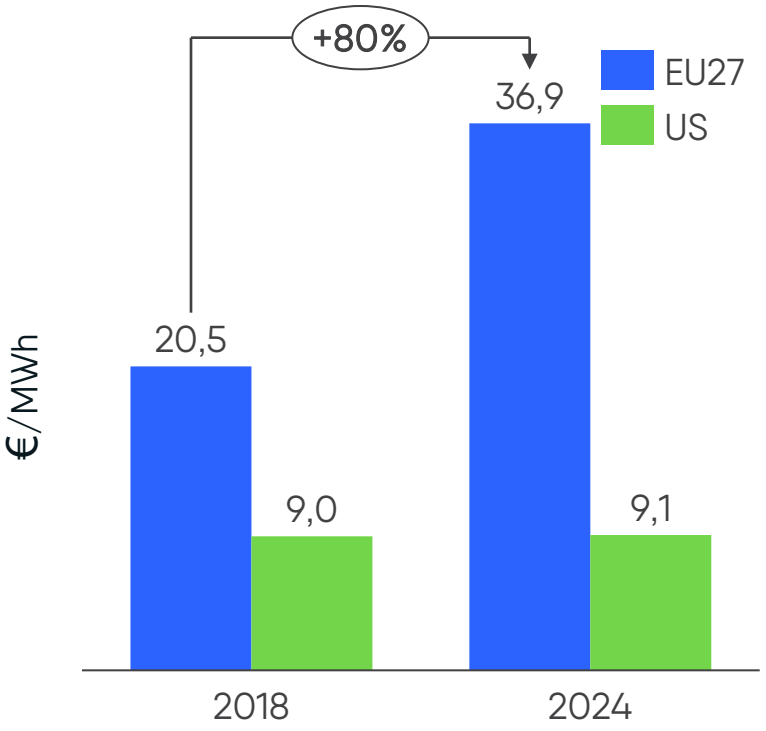


Notes: 1) Seven-days rolling average. Sources: Elda, Investing.com, Reuters, Politico, Energy Central, C&EN, Bloomberg, Speciality Chemicals, the Chemical Engineer.

Exposure to high gas prices is here to stay for energy-intensives industries

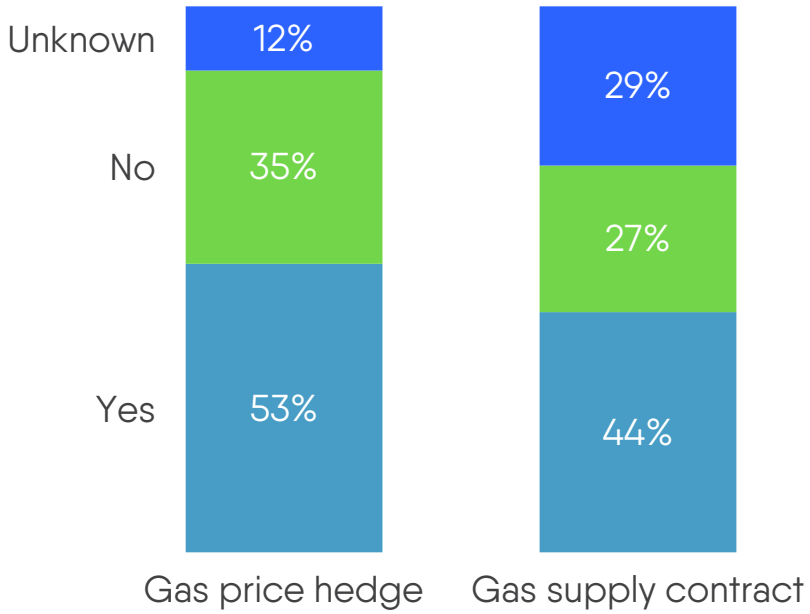
Average yearly gas price

- Gas prices in Europe rose 80% in 2024 compared to 2018, with TTF futures showing prices of 25–35 €/MWh through 2030.



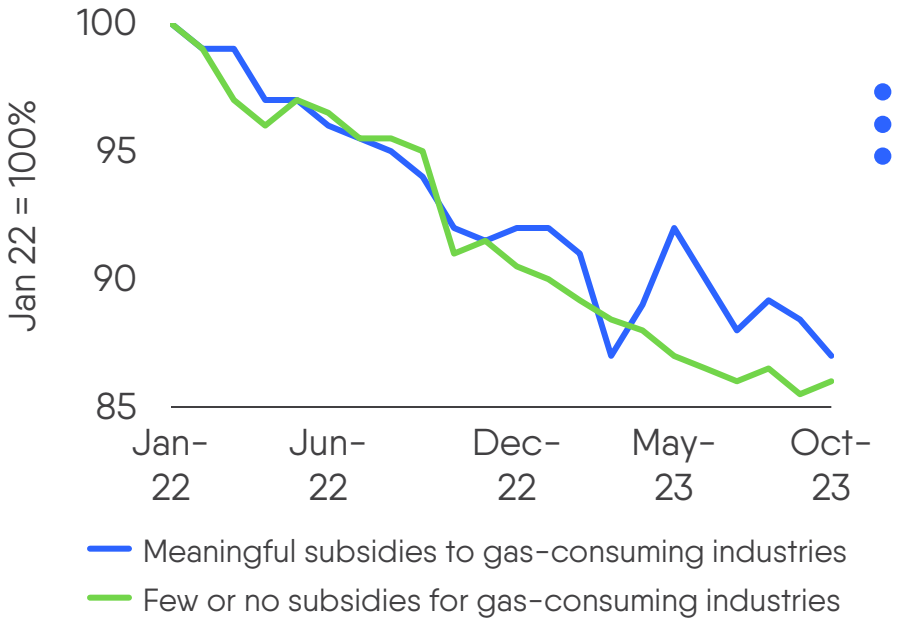
Gas price risk mitigation strategies[1]

- EU firms experienced varying levels of exposure to high energy prices.
- However, price mitigation strategies such as hedging and supply contracts are temporary, and industries no longer benefit from pre-war low prices.



Industrial output in EU countries[1]

- EU governments deployed €540 bn in energy subsidies to protect consumers during the 2022 crisis.
- They are, however, unsustainable long term - especially for energy-intensive industries not shifting to clean energy..

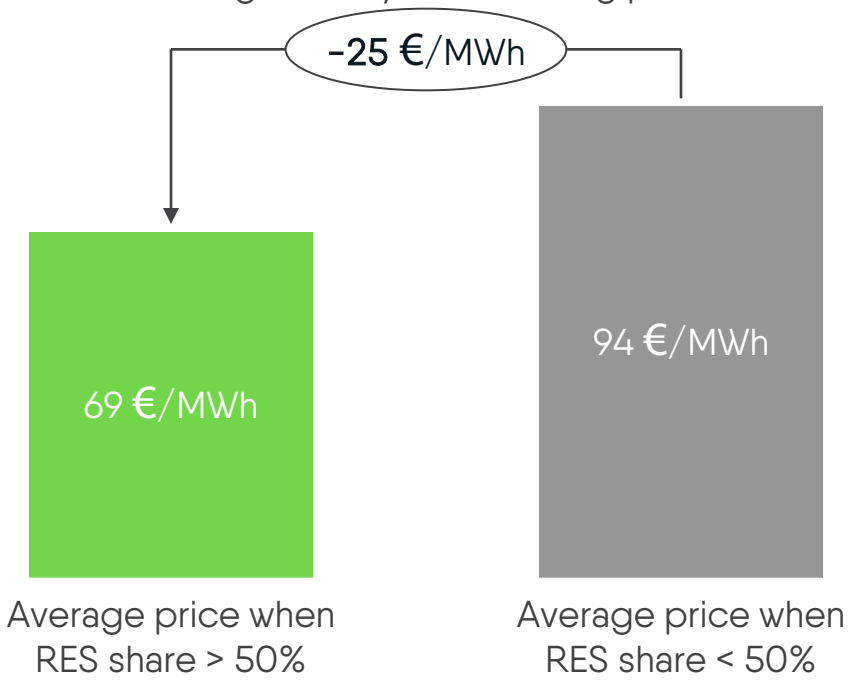


Notes: 1) Chart shows the share of companies in the sample with a gas price risk strategy: hedge and supply contract. Analysis by the Center of Global Energy Policy (CGEP) at Columbia University based on 34 listed companies affected by high energy costs with core activities in the EU. Sources: Eurelectric, CGEP, BCG, ERT.

A decarbonised and flexible grid will help industries switch to electric solutions as well as remain competitive

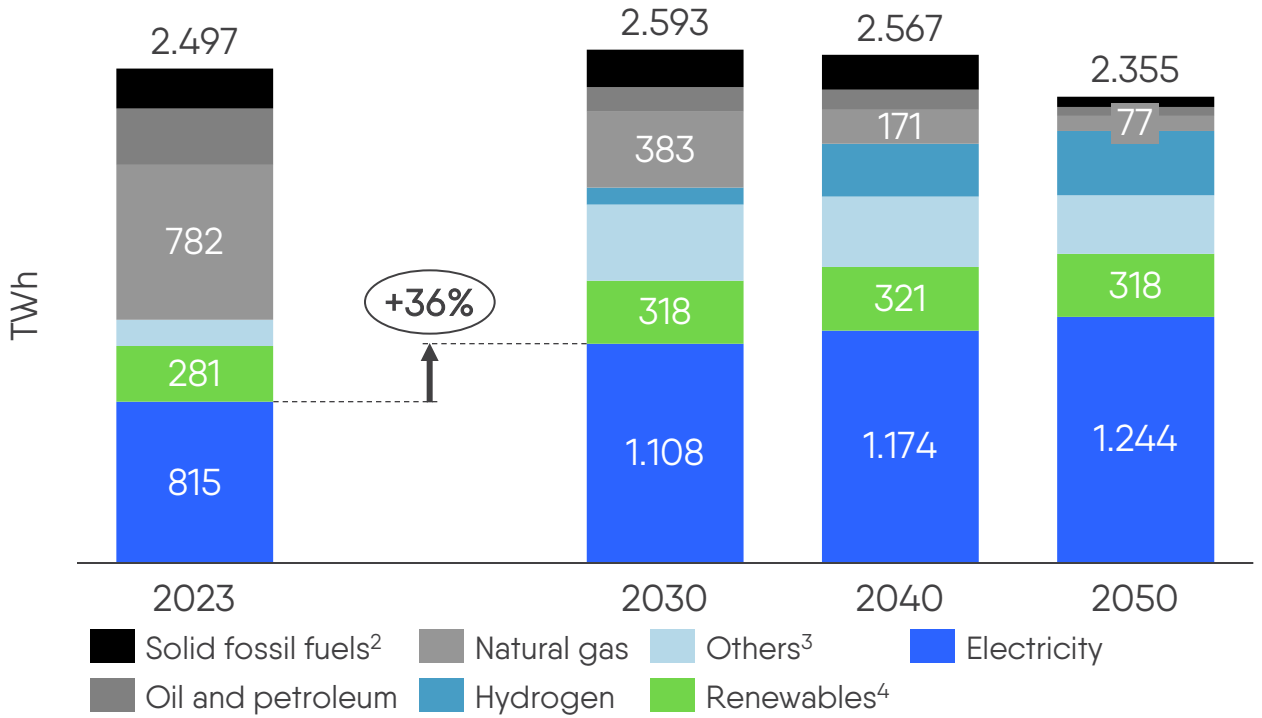
Average EU27 day-ahead prices in 2024

- When RES made up over 50% of generation, Europe's electricity prices were 27% lower than during lower-renewable periods.
- With stronger interconnections and greater flexibility, day-ahead prices are expected to stay below those of fossil-based grids while also reducing volatility and avoiding price shocks.



Industry demand forecast[1]

- A decarbonised and flexible grid supported by carbon pricing mechanisms will push power demand above 1,000 TWh by 2030.
- As efficient carriers like electricity replace fossil fuels, industrial energy demand is projected to fall to 2,355 TWh by 2050.



Notes: 1) Forecast of REPowerEU-inspired scenario from Eurelectric's Decarbonisation Speedway. 2) Include primary and derived coal and peat products, manufactured gases, and oil shale and oil sands. Here, it also includes non-renewable waste. 3) Include heat. 4) Include renewables as well as biofuels. Sources: Eurostat, Eurolectric.

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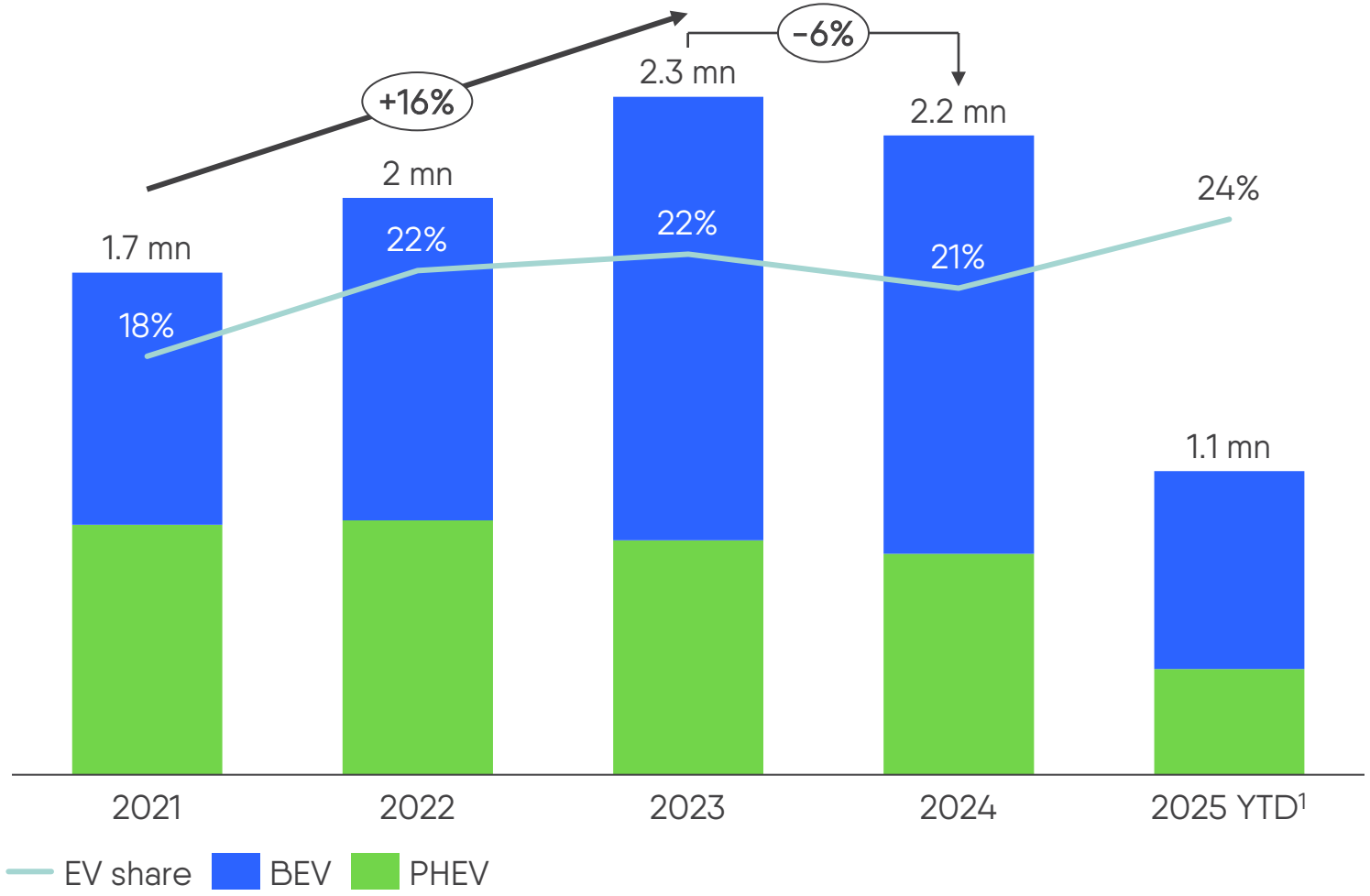
BEV sales rebound in 2025, but policy and market challenges remain

Annual sales of passenger car EVs and share in the total EU car sales



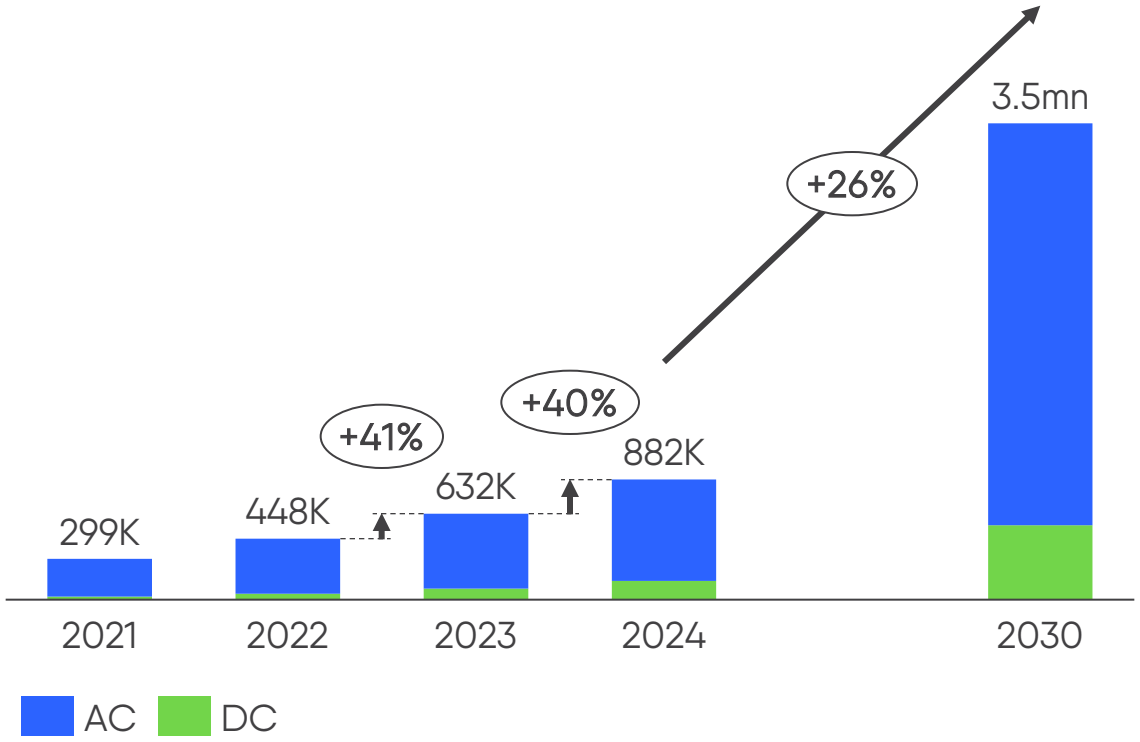
- The slowing trend appeared in 2024 seems to be changing in 2025, with early signs showing battery electric cars reached nearly a 24% market share in the EU during the first five months of 2025.
- Improvements in battery range, the expansion of charging infrastructure, and the EU's mandate to cut emissions by 15% from 2021 levels which helped boost corporate electric vehicle sales, explain the shifting trend in 2025.
- Nevertheless, BEV market share in the car sector still falls short of the EU's targets.
- High vehicle prices and the still-limited charging infrastructure remain key concerns for consumers, leading to hesitation in adopting EVs. Combined with declining incentives, these challenges are contributing to a slowdown in EV sales across the EU.

Notes: 1) For 2025 data, 12 EU countries (Belgium, Czechia, Denmark, Finland, Germany, Ireland, Italy, Luxembourg, Netherlands, Slovenia, Spain, Sweden) data are updated until May 2025, the rest until April 2025. Sources: European Alternative Fuels Observatory, ACEA.

Charging infrastructure expanded in 2024, but remains concentrated in a few member states

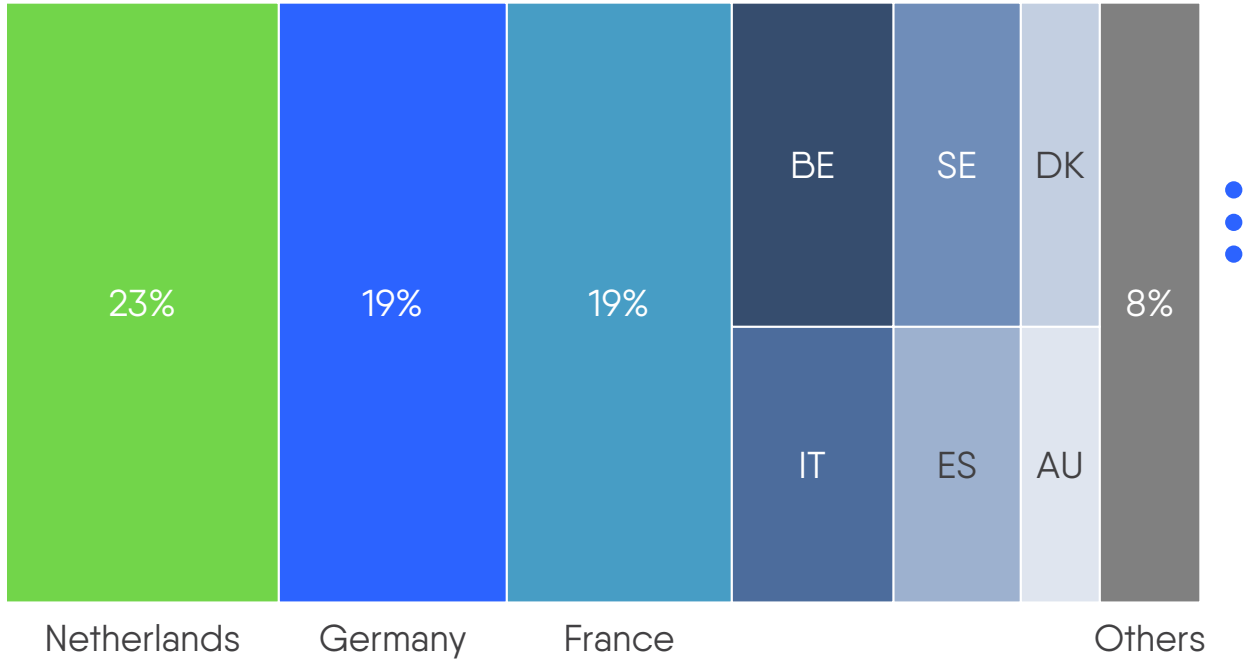
Number of public EV chargers in the EU

- Public charger installations grew by 40%, matching last year's pace. A steady 26% annual growth is needed to meet 2030 targets - but much faster rollout of DC chargers is essential.



Distribution of public EV chargers in the EU

- Netherlands, France and Germany host 61% of EU chargers yet cover only 20% of its area. Still, all member states met the 2024 AFIR target[1] - and 88% have already met the 2025 goal.



Notes: 1) AFIR requires member states to provide at least 1,3 kW charging power per BEV and 0,8 kW per PHEV registered in their fleet. Sources: EAFO, ACEA, AFIR. T&E.

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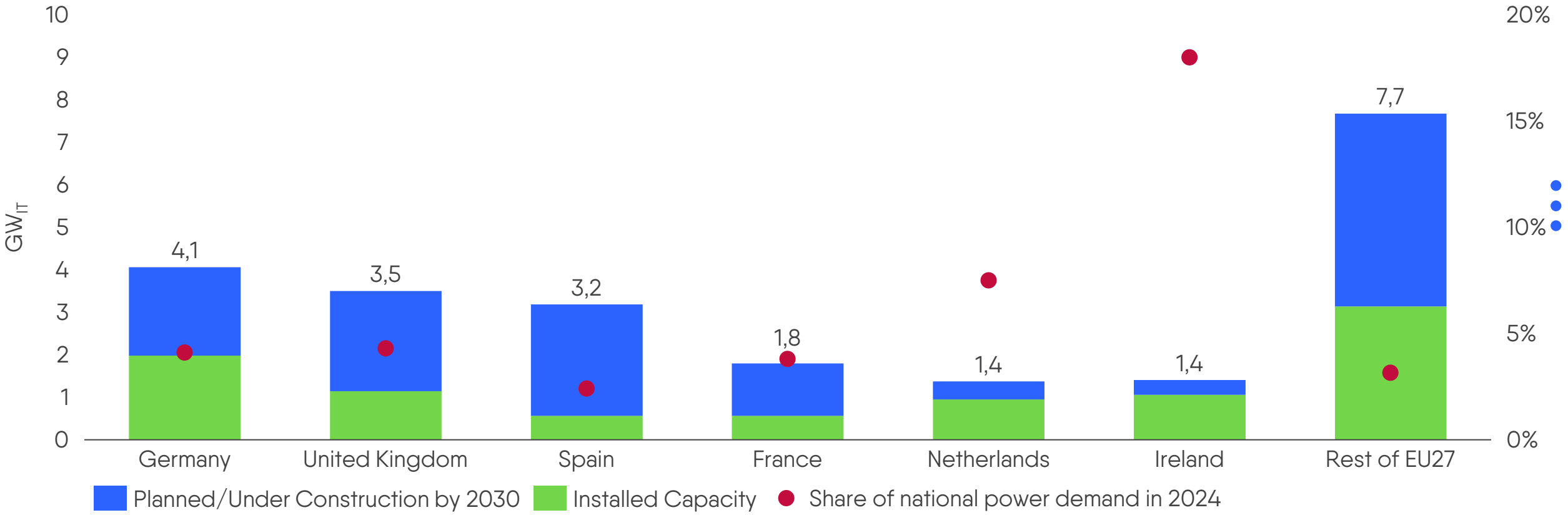
As data centres capacity expands across Europe, their electricity demand averaged over 3% of total consumption in 2024

Installed and announced data centres capacity[1]

- The number of data centres in the EU27 + UK surpassed 1,000 in 2024, with a total IT load of 9.4 GW, expected to increase 2.5 times by 2030.

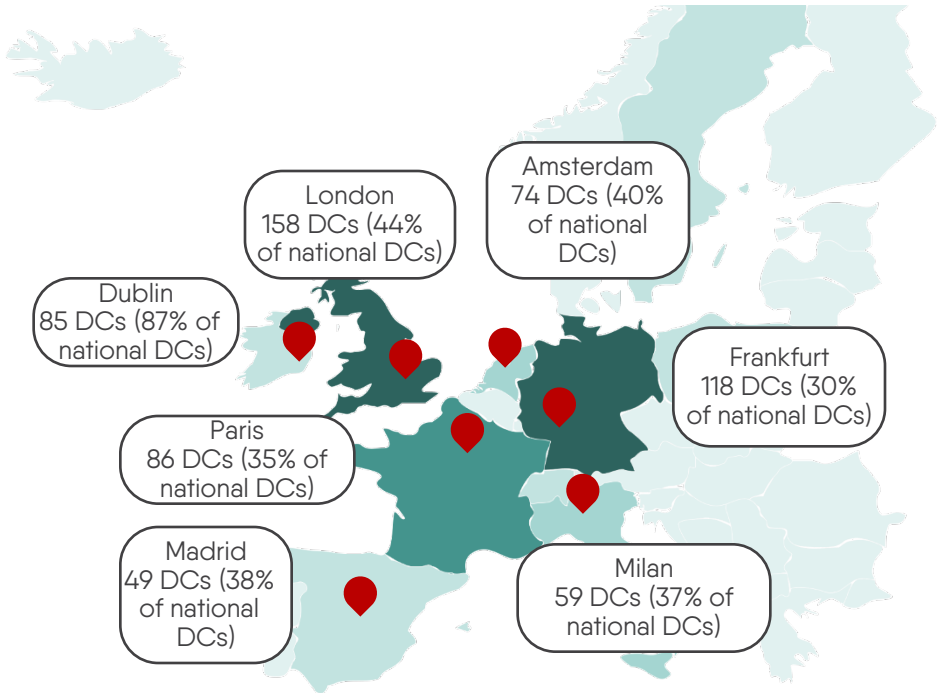


Note: 1) In the chart, we include the total IT capacity of colocation data centres combined with hyperscale centres. Sources: JRC, ICIS, McKinsey, Bitkom, EY, Cushman & Wakefield, DatacenterDynamics, DDA, Colliers, Bitpower, Pb7 Research.

Concentrated data center clusters shows the need for a robust electricity grid

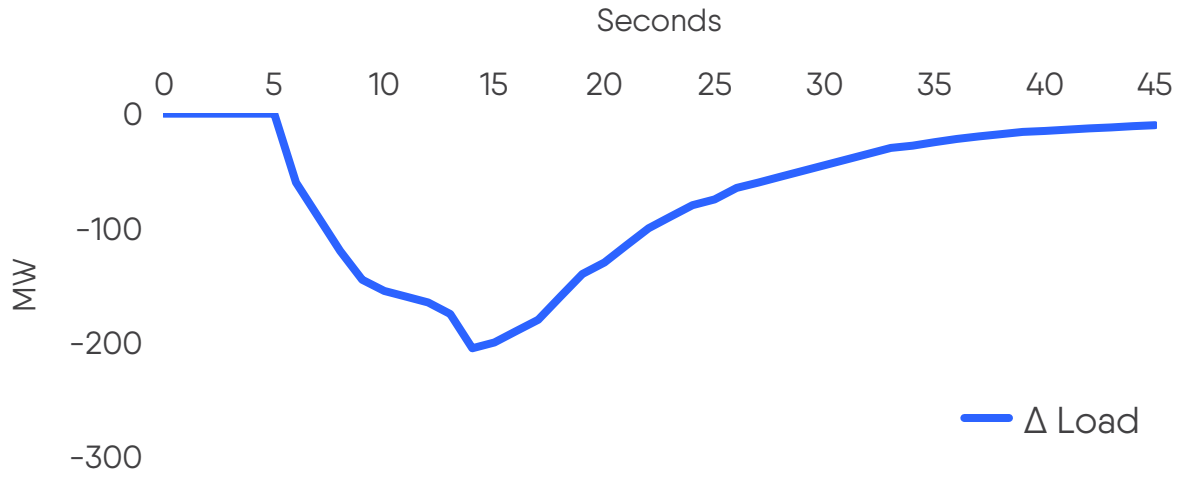
Number of DCs[1] in EU27 + UK

- Major hubs in Europe, known as FLAPD[2], account for at least one-third of the total national data centres, meaning that the demand for power is disproportionately concentrated in these key locations putting significant stress on their electricity grids and requiring strategic planning for future capacity expansion.



Example of effect of DCs instant outage[3]

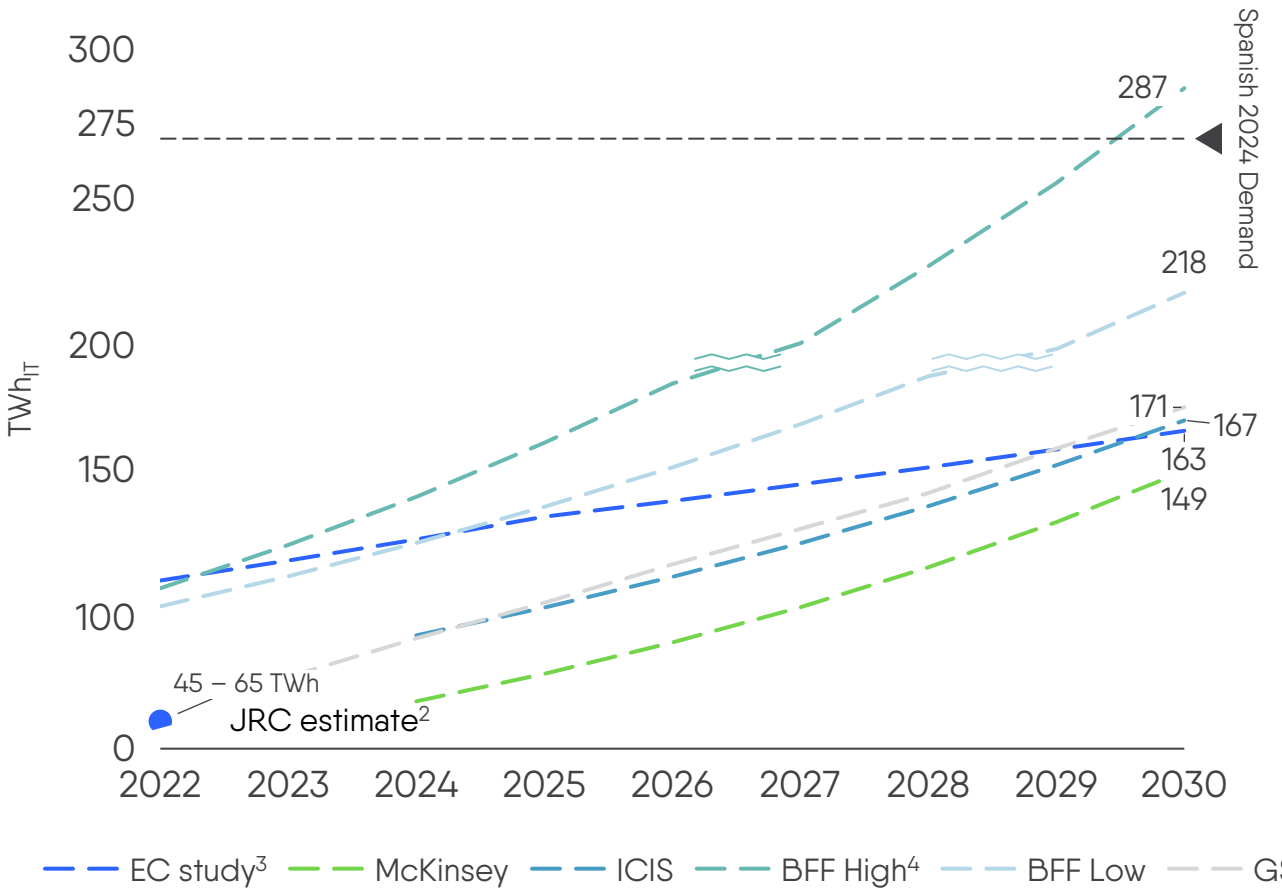
- Several cities have implemented measures such as memorandums of understanding or temporary restrictions to manage the rapid growth of data centres and mitigate their impact on local energy grids and infrastructure.
- Particularly, in Ireland, data centres exacerbate power system disturbances by disconnecting and automatically reconnecting in response to faults, causing significant frequency deviations—an issue also observed by other networks in Europe.



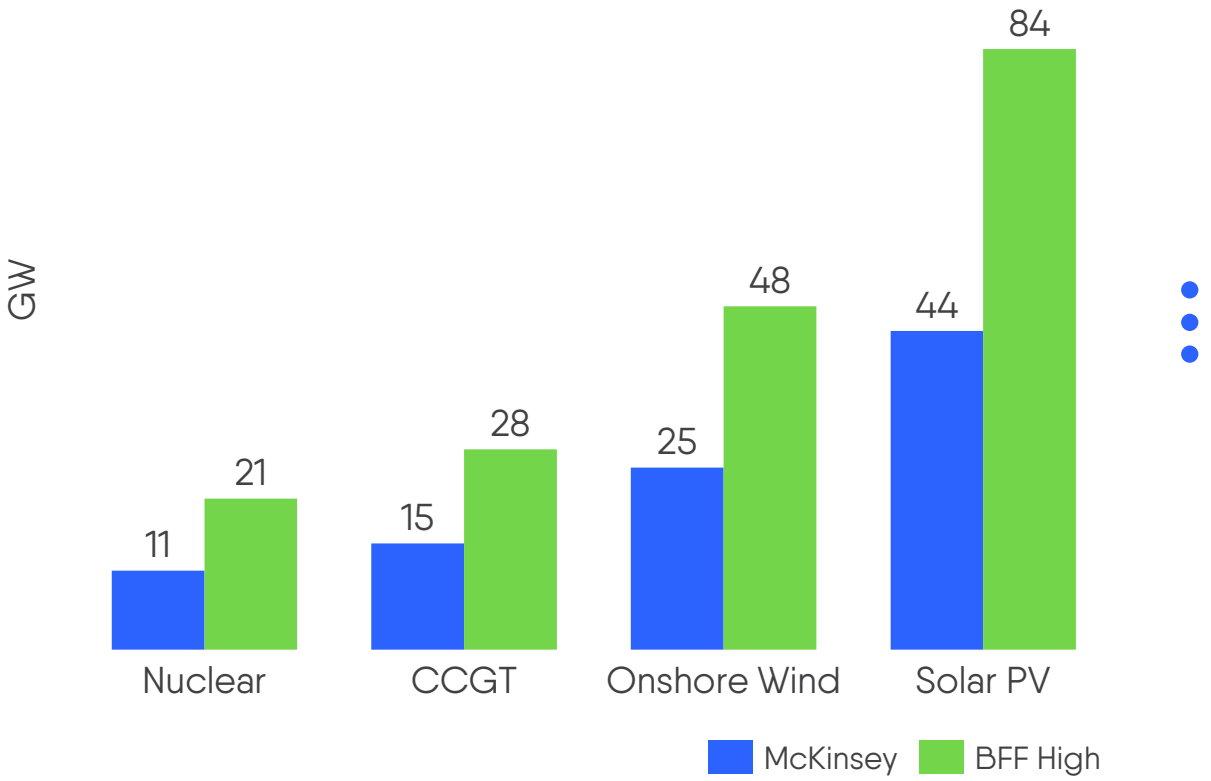
Notes: 1) Data centres. 2) Frankfurt, London, Amsterdam, Paris, Dublin. 3) This image illustrates an event that occurred on December 13, 2022 - a 220 kV fault in the Dublin area that instantly prompted multiple data centres to shut operations. Sources: DataCentresmap, Eirgrid (TSO).

Forecasts agree that data center demand will at least reach 150 TWh by 2030, more than 170% increase since 2022

EU27 + UK Data centres IT demand forecast



Capacity[5] needed to meet data centres' demand by 2030



Notes: 1) When data points for certain years are not provided, figures are interpolated. 2) The JRC estimate comes from a 2024 study and regards only EU27. 3) EC Study conducted by Dodd et al. in 2020. The remaining studies are from 2024. 4) Beyond Fossil Fuels (BFF). 5) Capacity if this additional demand was to met by a single technology. General capacity factors assumed for each technology. Sources: JRC, ICIS, EC, McKinsey, Beyond Fossil Fuels, Goldman Sachs, IRENA, Lazard.

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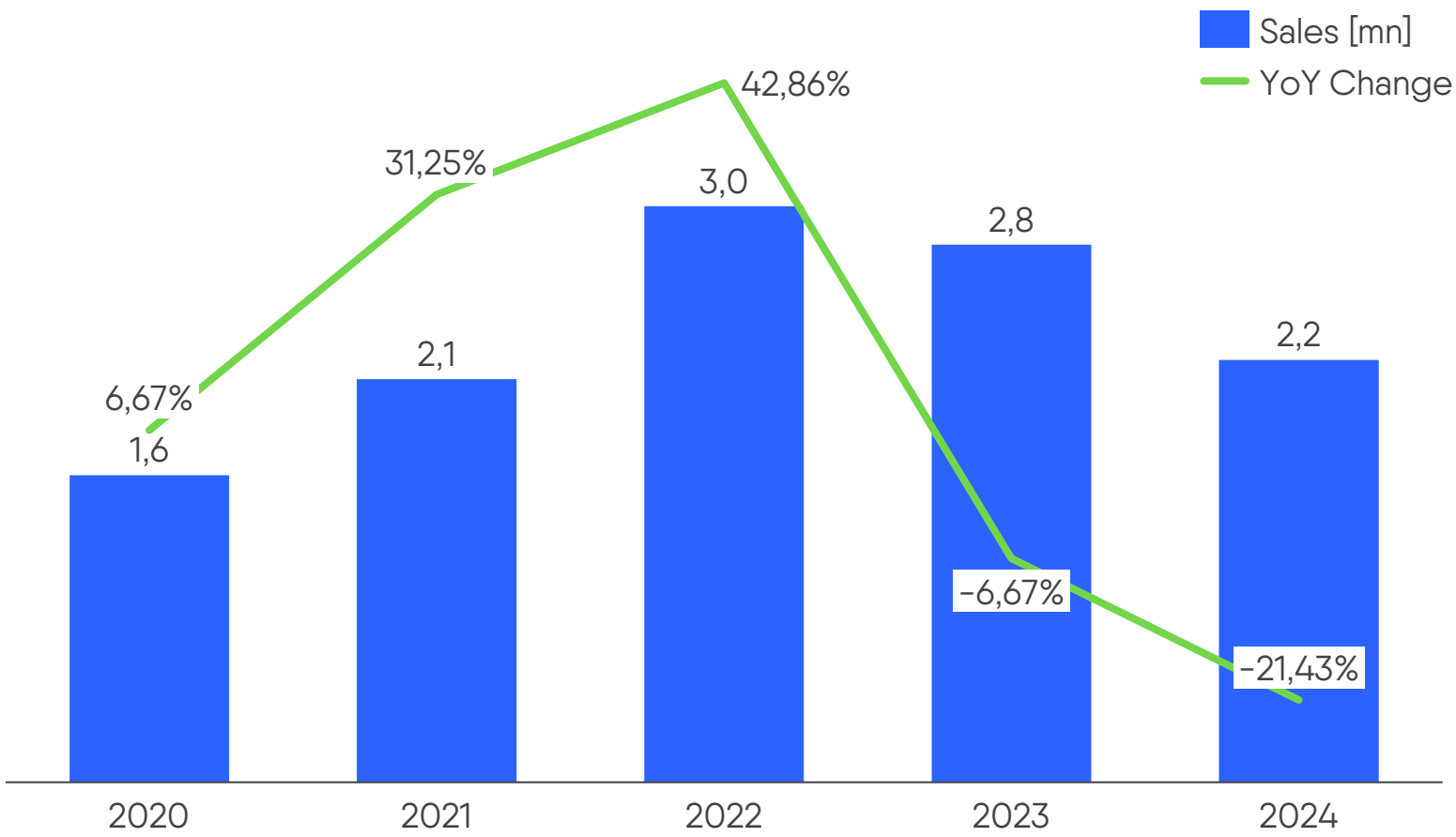
Financial barriers and complex subsidies application hinder adoption of heat pumps

Annual sales of heat pumps[1]



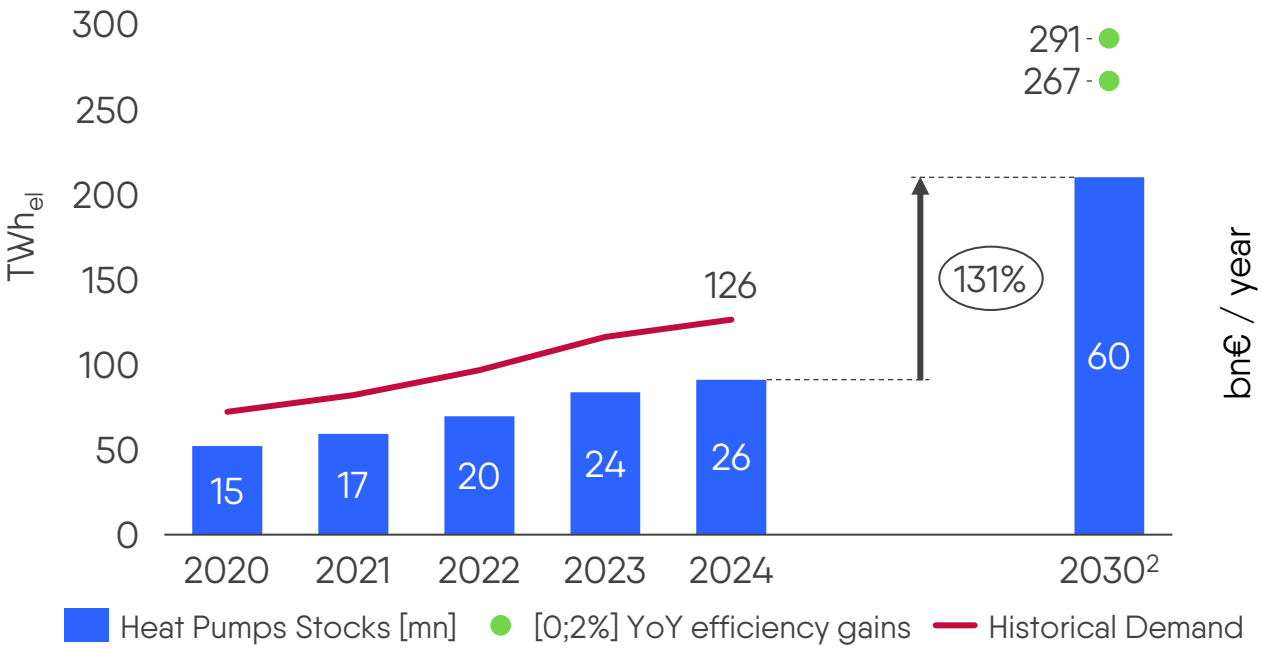
Notes: 1) The countries selected for the total values are Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, UK. 2) According to a study produced by the Reform Institute, 2024. Sources: European Heat Pump Association, Reform Institute.

- Among the reasons why heat pump adoption slowed last year, **financial barriers** is a key one[2]. Payment delays, lack of income-based support, and the absence of complementary loans made indeed it difficult for many households, especially lower-income ones, to afford heat pump installations.
- **Administrative challenges** consist of another constraint. A complex application process, excessive paperwork, and limited outreach prevented many potential beneficiaries, particularly vulnerable groups, from accessing subsidies.
- High electricity costs contributed further. **Rising electricity prices and taxes** in the second half of 2024 reduced the cost-effectiveness of heat pumps, making them a less attractive alternative to traditional heating systems.

To meet 60 million of heat pumps sales target, EU27 must boost public funding

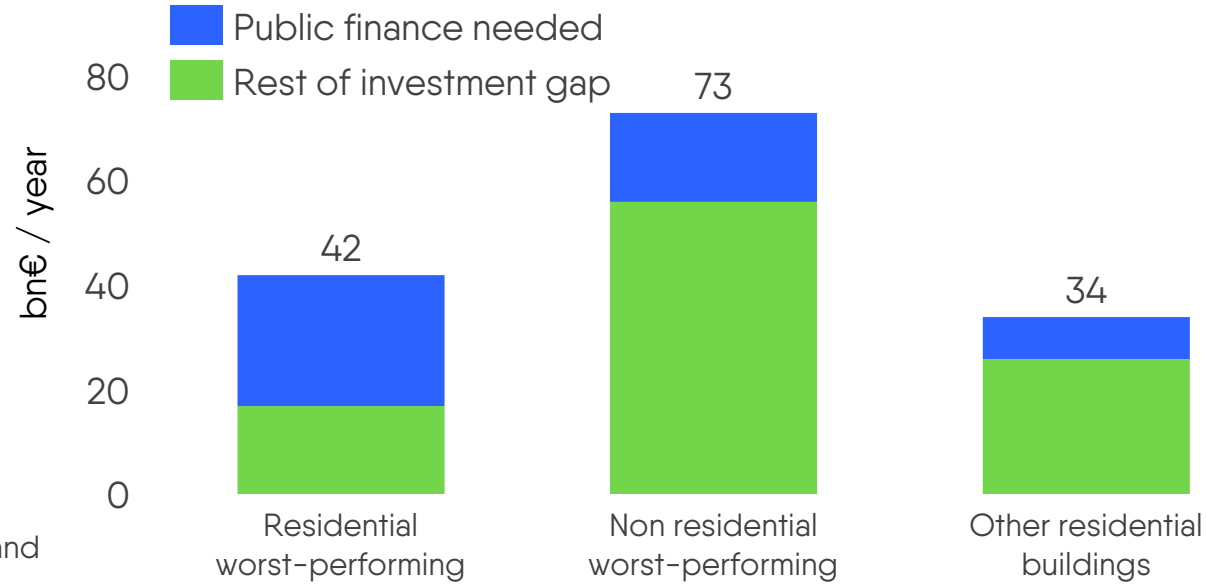
Annual total stocks of heat pumps and power demand[1]

- Heat pump adoption must increase 2.3 times to meet the EU target, necessitating higher YoY growth than in the past two years.



Annual investment gap for 2030 energy efficiency targets[3]

- Governments should deploy cost-effective policies while financing at least one third of the €150 billion needed to bridge the building renovation investment gap.
- Even with €30 billion/year from public funds and ETS2, a €20 billion annual gap remains, requiring EU fiscal flexibility.



Notes: 1) 2030 demand assumes 3,5 coefficients of performance (COP) and that the share of different heat pump types (air-to-water, air-to-air, ground-source, etc.) remains constant across the years. The efficiency gains refers to improvements of COP. Historical figures are from EHPA. 2) Figures are estimations based on REPower EU heat pump installations target. 3) Figures from Bruegel "How to finance the European Union's building decarbonisation plan" (2024). Sources: EHPA, Bruegel.

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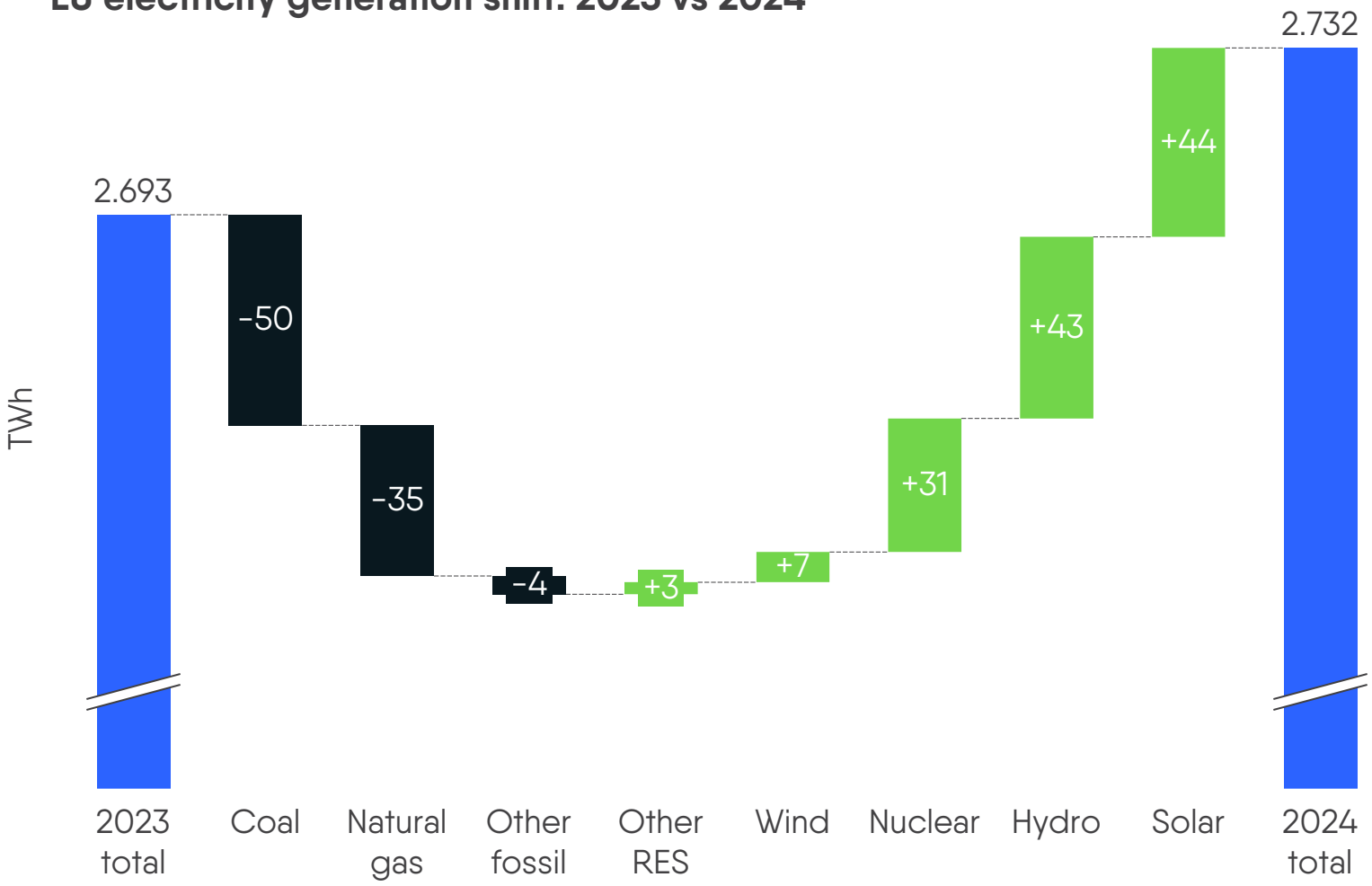
Clean power surges while fossil fuels decline to lowest share on record

EU electricity generation shift: 2023 vs 2024

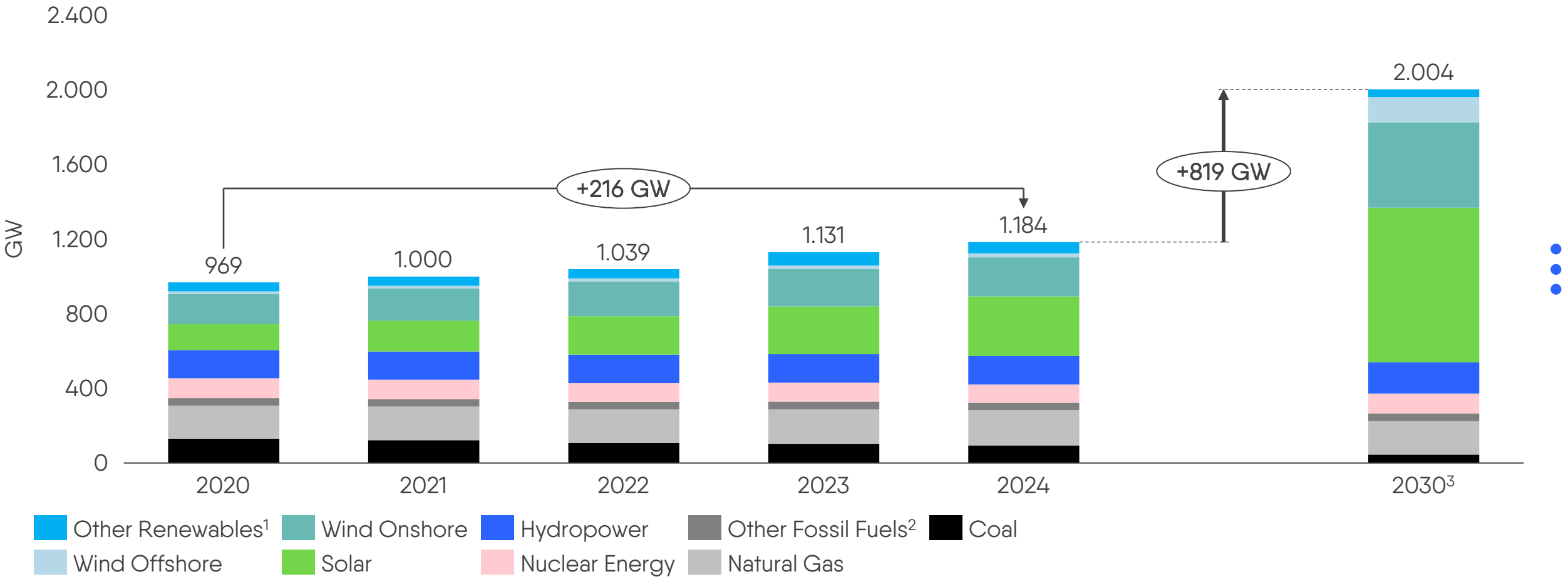


Source: Elda.

- Slight demand increase led to overall electricity generation growth with fossil fuel generation dropping significantly by 89 TWh, and resulting in a record low share of 28%.
- Low-carbon power increased by 128 TW) and created a record share of 72%, with solar surpassing coal for the first time.
- Record **solar PV installations** and improved hydro conditions added over 40 TWh of solar and hydro electricity compared to 2023 with **wind** seeing only a marginal increase of 7 TWh.
- **Nuclear** remains the leading electricity source, contributing 24% of the EU's total and adding 31 TWh more in 2024 compared to its previous year.

Capacity must double in five years to be on track for decarbonisation

Installed capacity and 2030 outlook for EU27



Notes: 1) Include bioenergy, geothermal energy, tides, wave and ocean energy. 2) Include oil, non-RES waste, manufactured gases and oil shale. 3) Eurelectric projections. Source: Elda, Eurelectric, Solar Power Europe, Wind Europe, IRENA.

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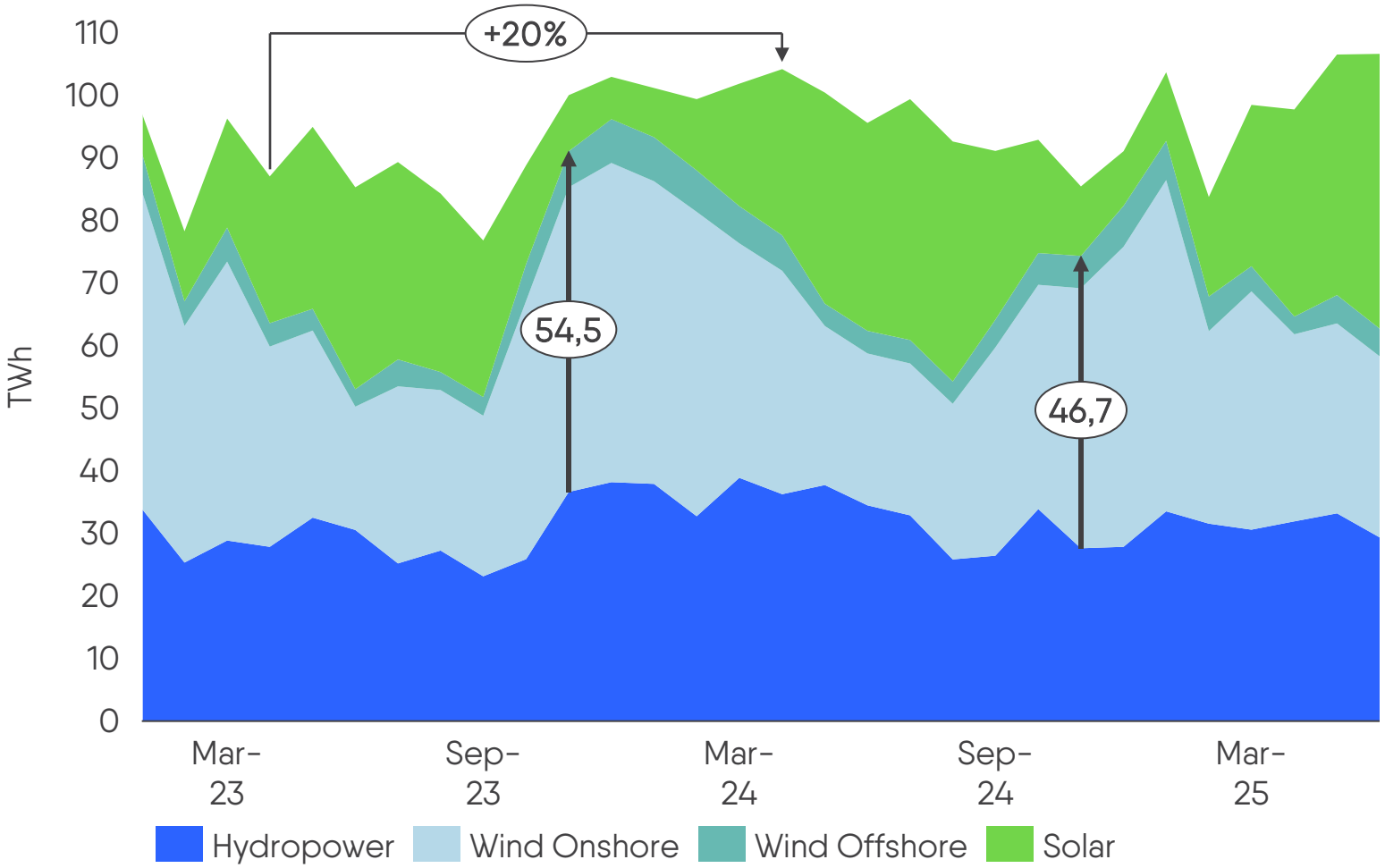
Growth in RES output in 2024 was driven by higher solar and hydroelectric generation

Electricity generation by renewables in EU27

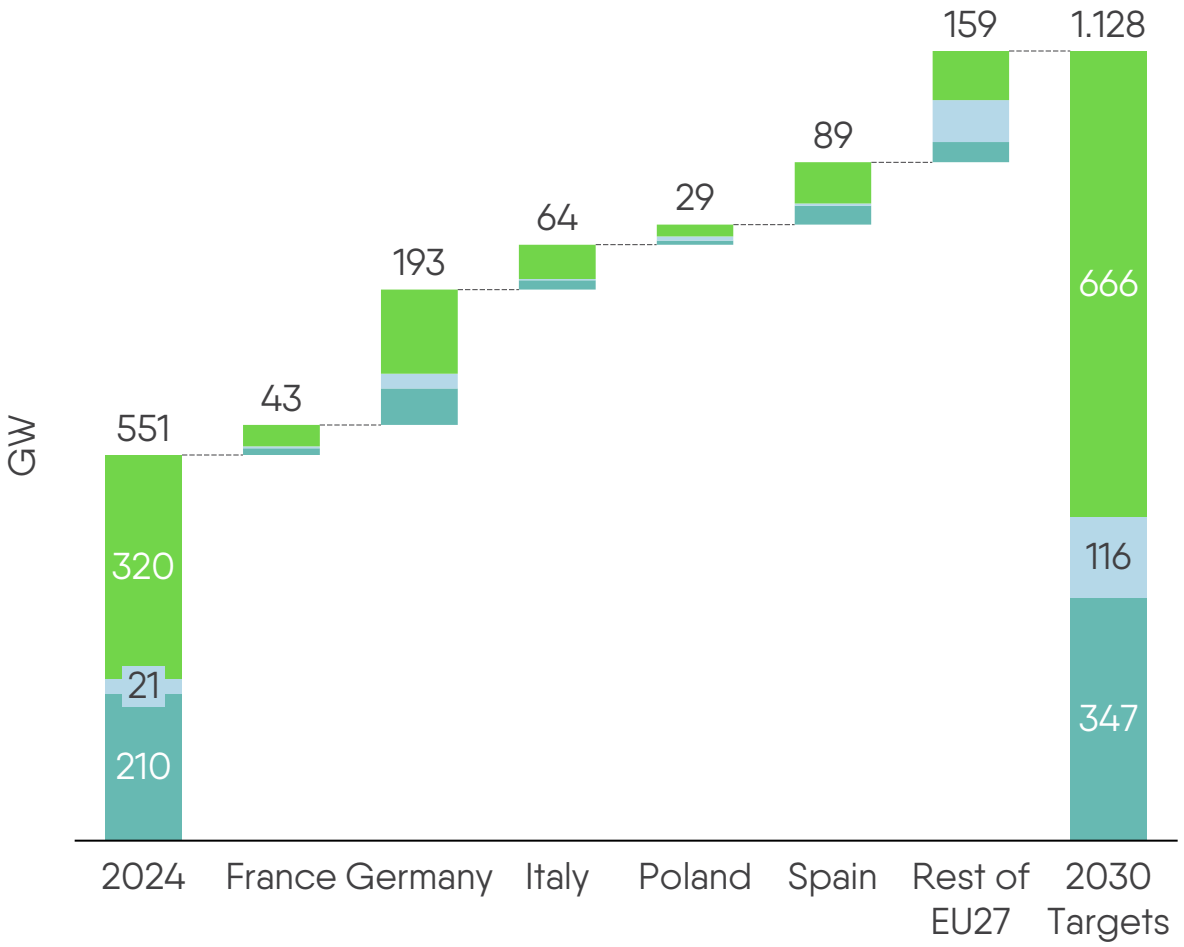


- In April 2024, while the Iberian Peninsula recorded negative electricity prices for the first time, other European markets[1] also saw notable lows, as total generation from RES and hydro increased YoY by 20%.
- In contrast, November 2024 saw *Dunkelflaute* conditions in Central Europe, leading to a YoY drop in wind generation by 14%. Wind output remained stable at 489 TWh across both 2023 and 2024.
- Hydro monthly generation averaged over 30 TWh in 2024, marking an yearly 40 TWh increase; however, in Q4 2024, it declined YoY by 12% due to a drier winter, especially in the Alps.
- In the first half of 2025, solar generation rose by one-third compared to the same period in 2024, driven by the 65.5 GW of capacity added in 2024.

Notes: 1) Such as France, the Netherlands, and the Nordic countries. Source: Elda.

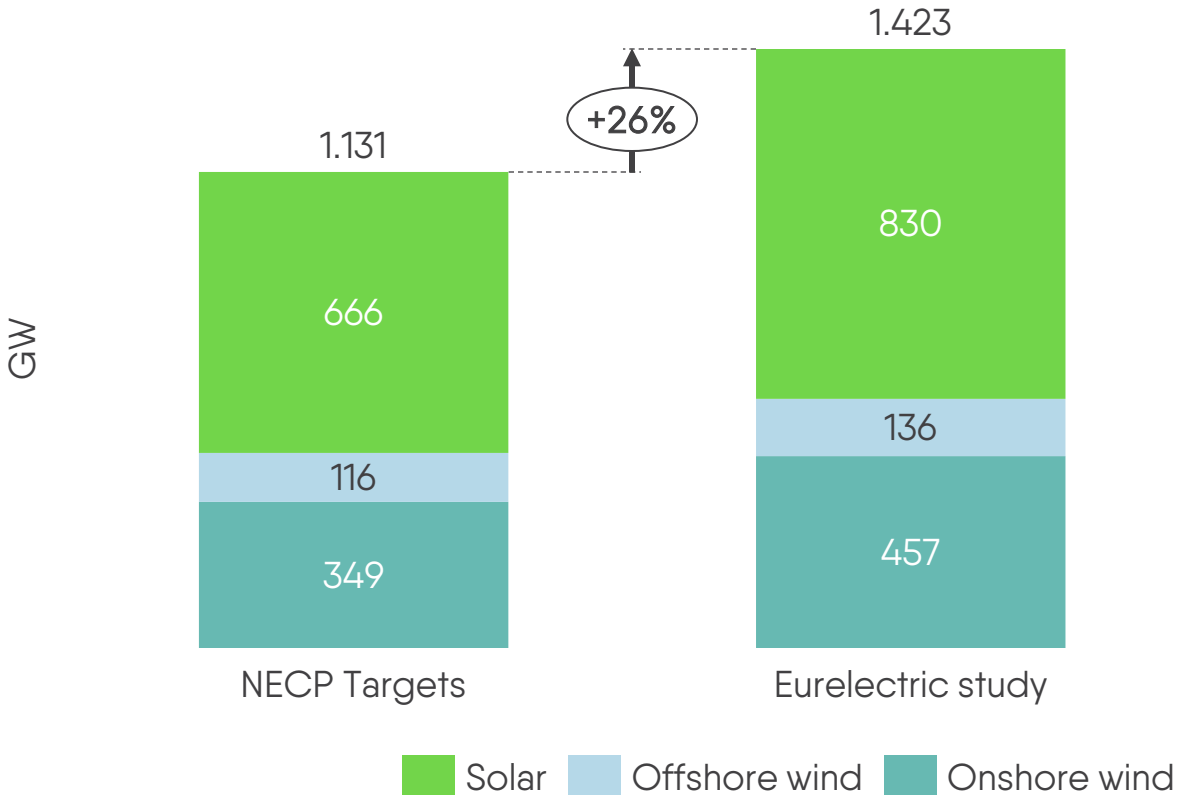
NECPs[1] target over 550 GW of variable RES but still fall short of full decarbonisation goals

Installed variable RES capacity in EU27 with NECP targets



Comparison of NECP and Eurelectric targets for 2030

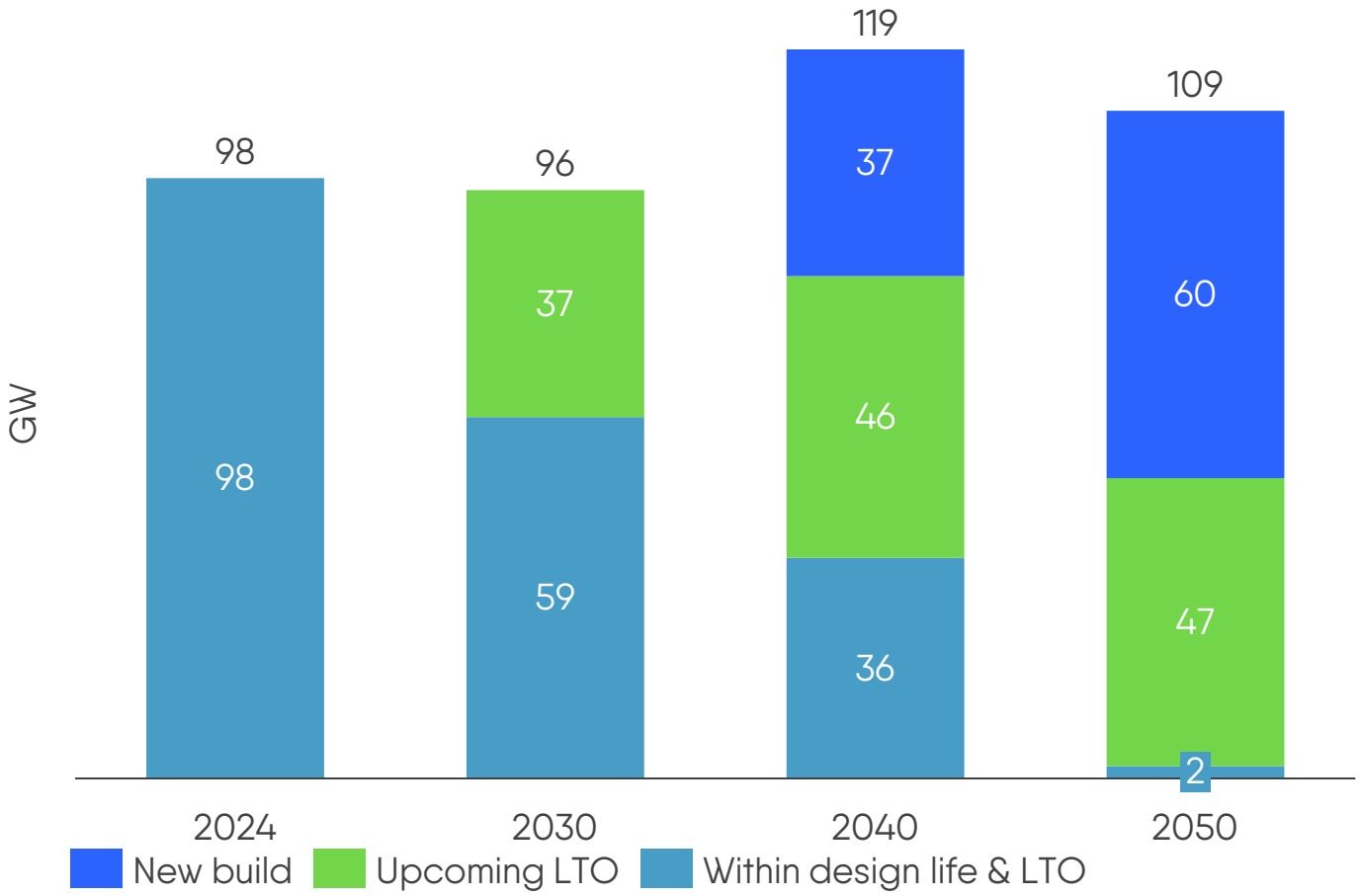
- According to Eurelectric's 2023 study[2], EU27 would need to deploy an additional 300 GW of solar and wind capacity by 2030 – on top of the 550 GW already outlined in the NECPs – to stay on track with its decarbonisation targets.



Note: 1) NECPs. 2) Eurelectric's decarbonisation speedways study. Source: Elda, European Commission, Wind Europe, Solar Power Europe.

Nuclear's evolving but enduring role in EU Electricity

Large-scale nuclear generation capacity evolution according to EC's PINC[1]

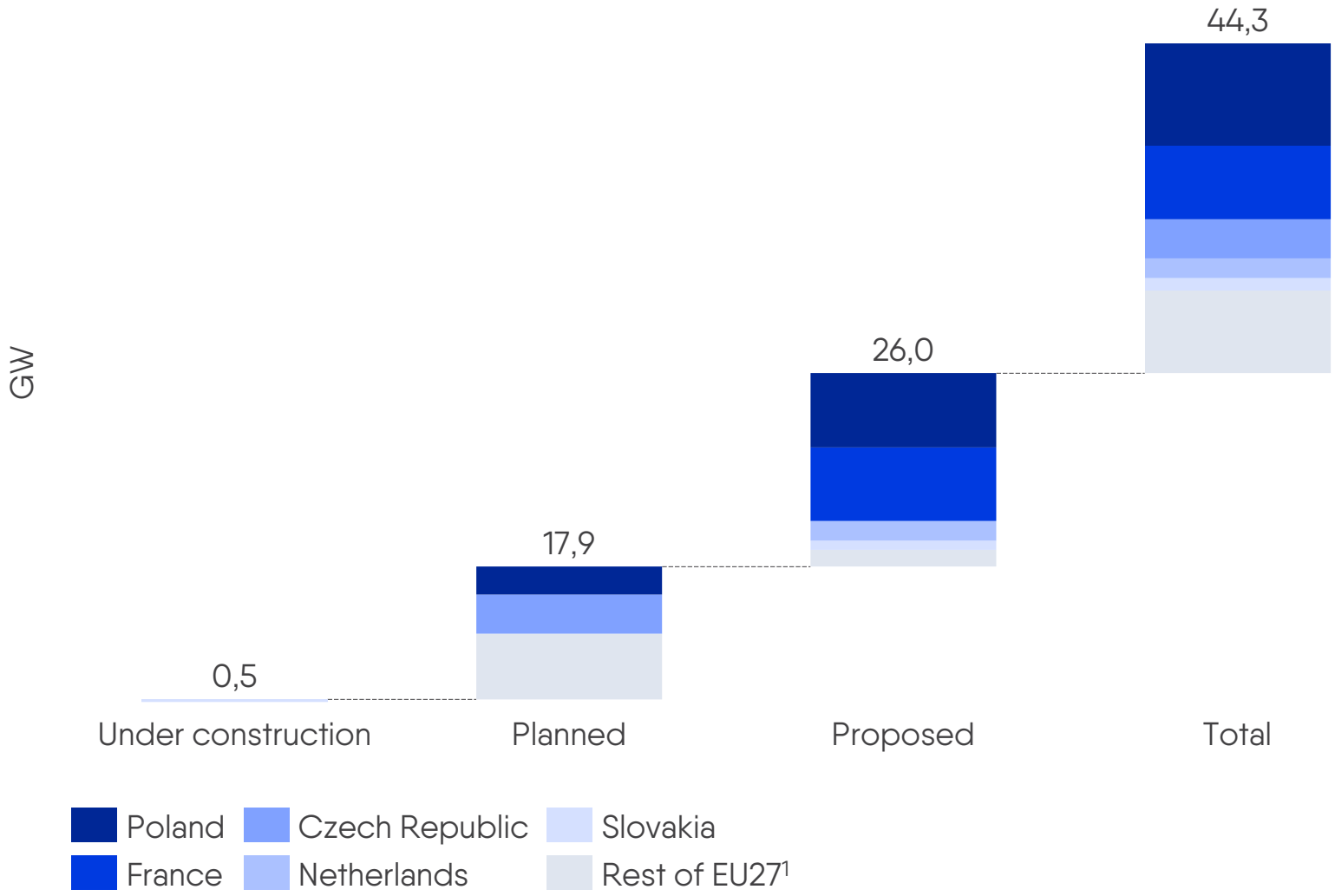


- In 2024, nuclear power– the leading source of electricity generation in the EU–had an installed capacity of 98 GW and accounted for 24% of the EU's electricity production.
- According to the PINC, Taking assumed lifetime extensions into account, the installed capacity of existing reactors is expected to decline from around 98 GWe today to about 50 GWe in 2050, while new build capacity is projected to add roughly 60 GWe–bringing total nuclear capacity to about 109 GWe in 2050.
- In 2050, nuclear power plants would produce 12 % of EU electricity.

Notes: 1) PINC is EC's nuclear illustrative programme. 2) Figures are based on the "Base Case" scenario of the PINC. Sources: European Commission's PINC.

EU27 plans 17.9 GW of new nuclear by 2040

Pipeline of nuclear reactors and SMR in EU27 by capacity



- New nuclear capacity is expected to reach a total capacity of 44.3 GW in the next years according to announcements of EU27.
- The latest Nuclear Illustrative Program report (PINC) of the European Commission highlighted the need for substantial investment in nuclear energy – €241 billion by 2050 – for extending the existing reactors and building new large-scale ones. Additional funding will also be required for SMRs, AMRs, microreactors, and fusion in the longer term.
- According to the PINC, nuclear power is essential to the European electricity system, decarbonization, energy security, and EU industrial competitiveness, while contributing to resilience and stability, limiting flexibility needs, and positively impacting system costs.

Notes: 1) Rest of EU27 includes Bulgaria, Romania, Slovenia, Sweden. 2) Planned capacity is expected online in the next 15 years. Sources: World Nuclear.

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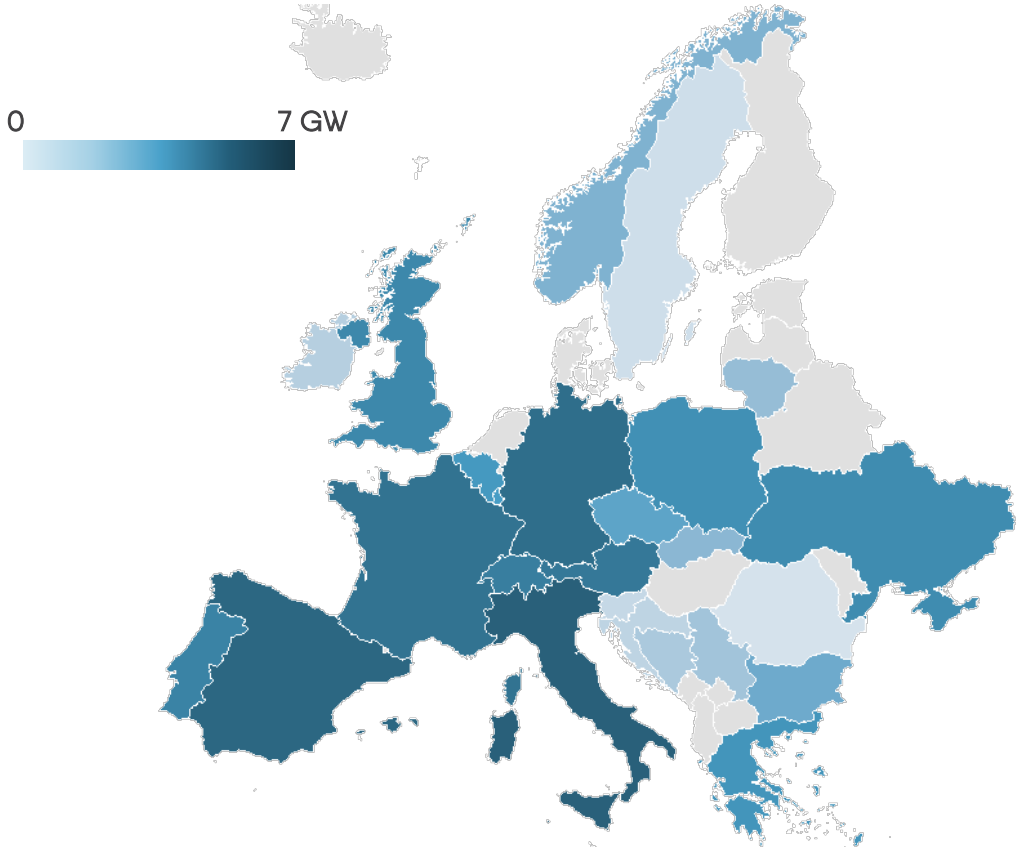
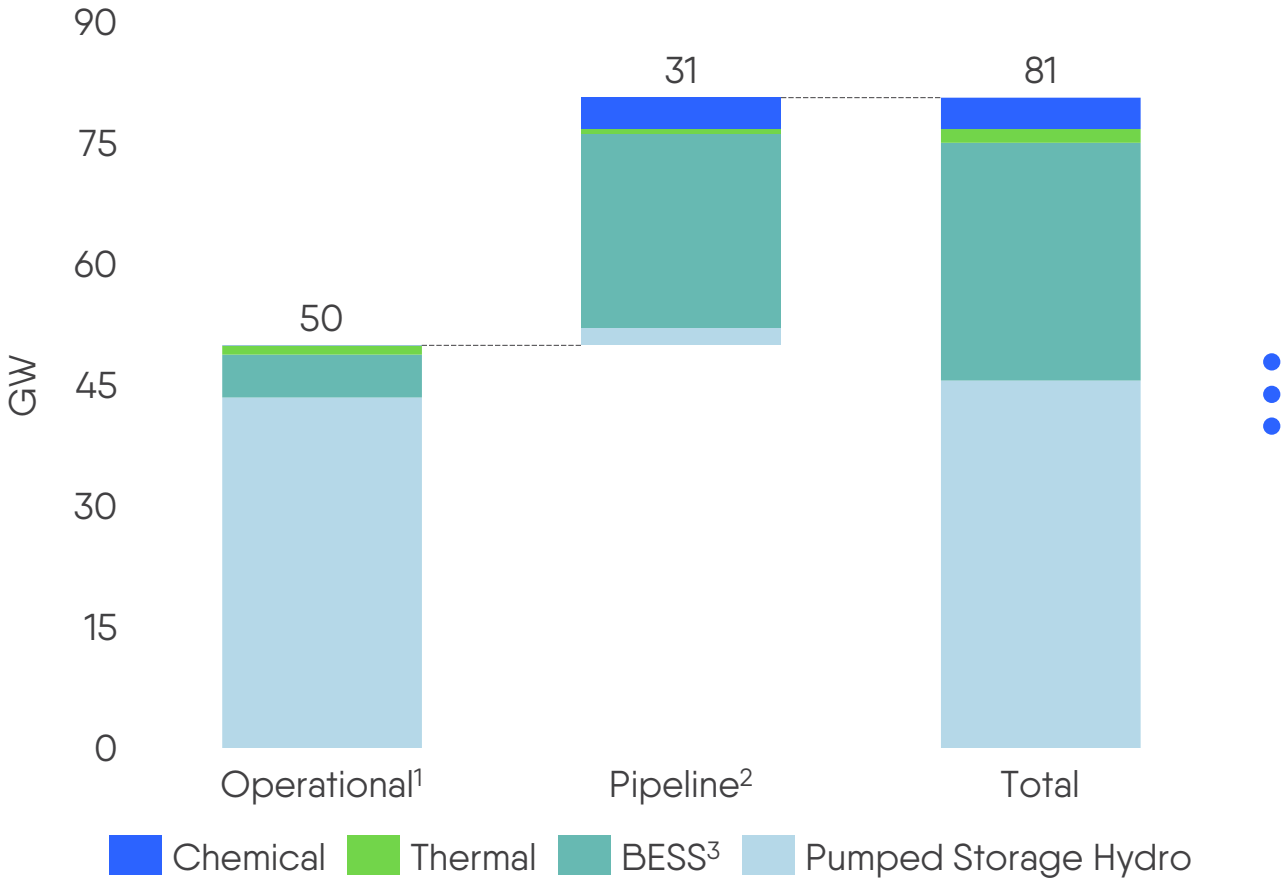
Pumped hydro continues to account for the majority of storage capacity in the EU

Operational capacity of pumped storage hydro



Storage capacity in EU27

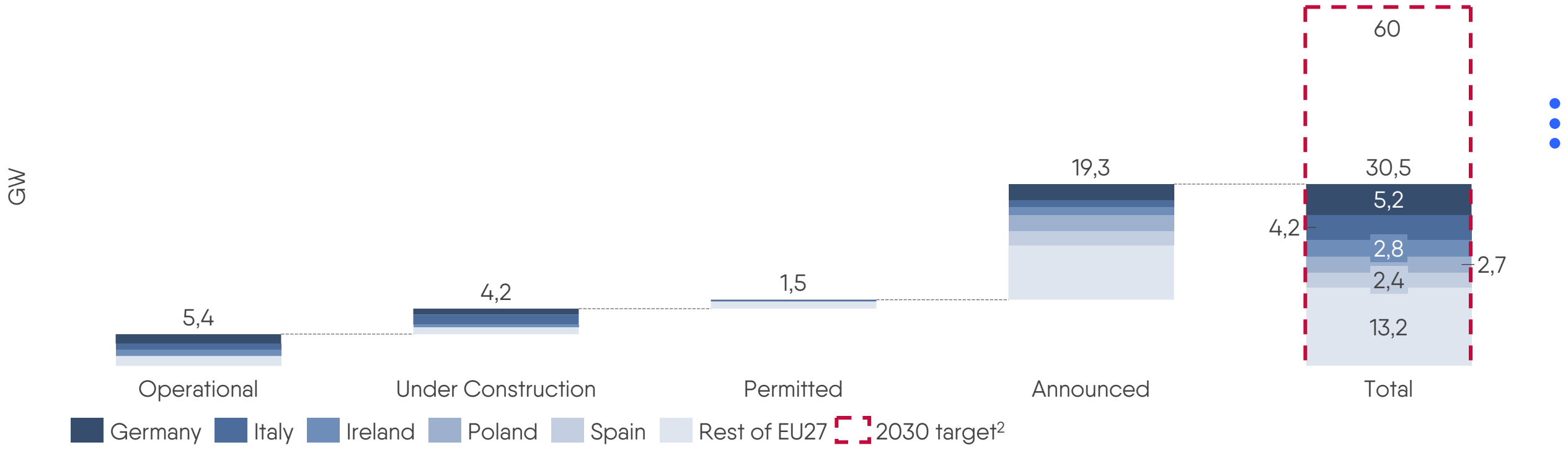


Notes: 1) As of end of 2024. 2) Pipelines includes in construction, permitted and announced projects. 3) Utility-scale. Sources: JRC, Wood Mackenzie.

EU is expected to reach 30 GW of BESS in the next few years

Pipeline of utility scale electrochemical storage grid-scale projects in EU27 by capacity[1]

- According to JRC, utility-scale batteries projects are projected to reach a total capacity of 30.5 GW in the next few years within the EU. By the end of 2024, installed BESS capacity increased by more than 50% compared to 2023, bringing the total capacity to 5.4 GW. Estimates from LCP Delta suggest that, by the end of 2025, BESS operational capacity will reach a capacity above 13 GW.
- According to a Eurelectric study[2], the EU will need to deploy at least 60 GW of BESS by 2030 to meet its flexibility targets[2].



Notes: 1) Capacity here refers to nameplate capacity, which is the maximum power output (MW) a BESS can deliver at any moment. Data provided by JRC and Wood Mackenzie. 2) Targets based on Decarbonisation Speedway study commissioned by Eurelectric, 2023. Sources: JRC, Wood Mackenzie, LCP Delta.

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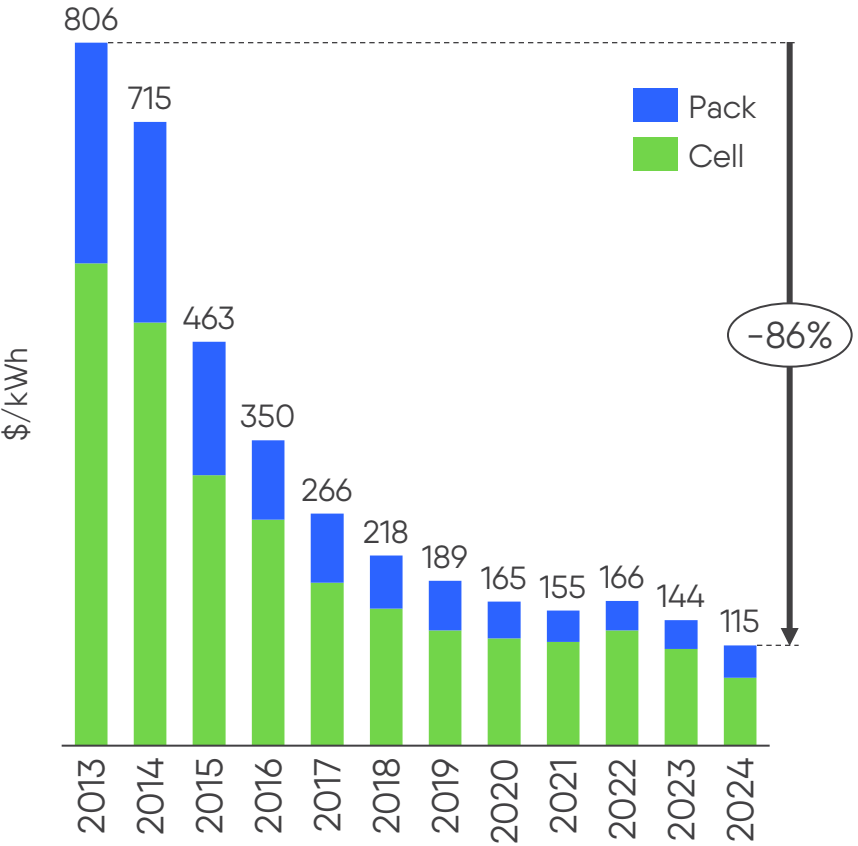
As the costs of batteries decrease, more countries adopt support schemes for utility-scale and residential storage

Average lithium-ion battery price[1]



Tax incentives and direct support schemes for residential batteries

Country	Scheme
Germany	Tax exemption, regional investment grants
Italy	Tax deduction, regional investment grants
Poland, Czech Republic, Austria, Hungary, Greece, Portugal	National investment grants
Netherlands, United Kingdom	Tax exemption
Sweden	Tax deduction
Rest of EU27	No direct support schemes

Targeted utility-scale storage auctions in selected EU countries

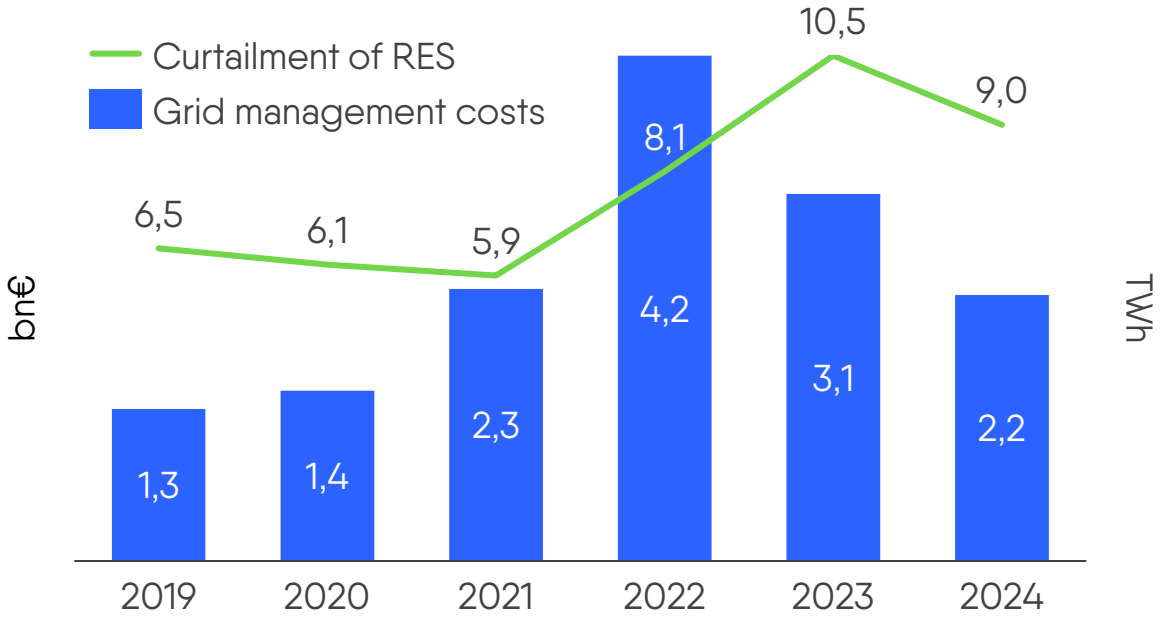
Country	Program	Subsidised up to 2024	Capacity targets
Germany	Innovation Auctions	1921 MW[2]	
Greece	National BESS auctions	711 MW	3 GW
Spain	PERTE ERHA calls	1570 MW / 4629 MWh[3]	3 GW
Italy	MACSE		10 GWh
Hungary	Storage CfD		800 MW / 1600 MWh
Bulgaria	RESTORE[4]	9713 MWh	> 3 GWh
Romania	Battery storage state aid	980 MWh	1800 MW

Notes: 1) Data in real 2024 USD. 2) This total includes the combined capacity of solar and storage. 3) 690 MW / 2820 MWh correspond to standalone BESS projects, while the remaining 880 MW / 1809 MWh are associated with projects co-located with RES. 4) The program also supports co-located storage solutions. Sources: BNEF, Solar Power Europe, Energy Storage, PV Magazine, BayWa, Renewables Now, Terna, Green Forum, European Commission.

System management costs remain at historically high levels as RES penetration increases

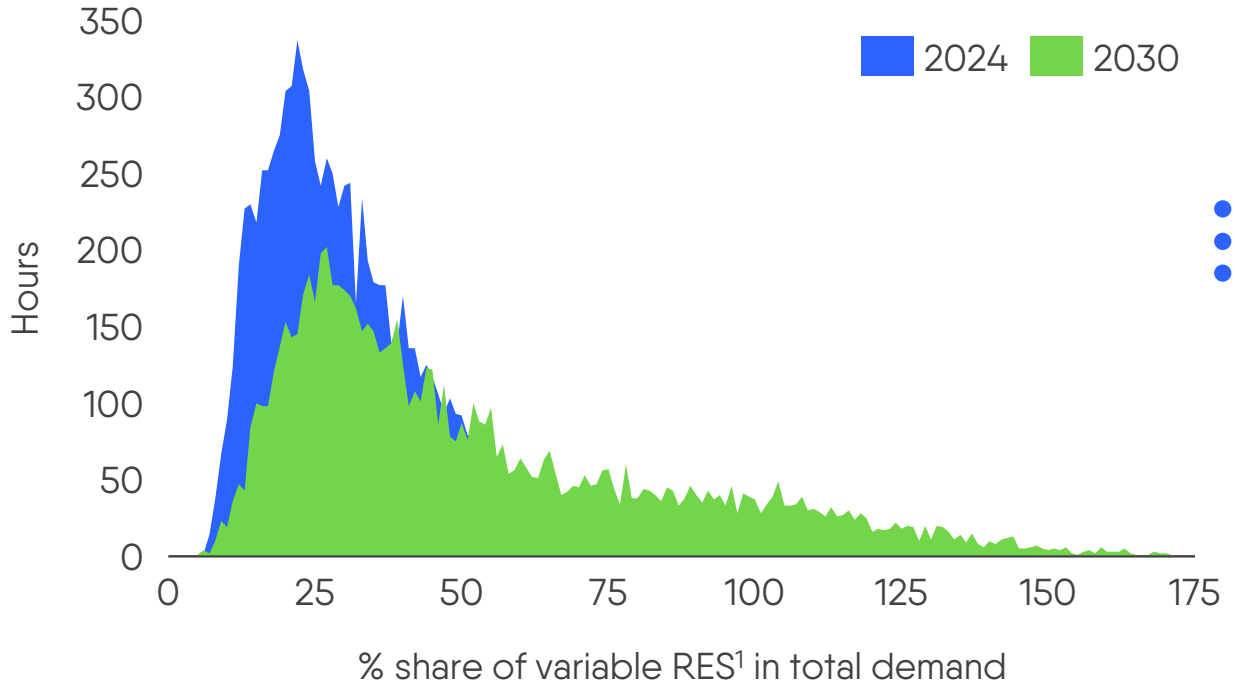
System management costs in Germany

- In 2024, grid congestions cost Germany remained above 2 bn€ with RES curtailment also decreasing to 9 TWh.
- Germany has the highest grid management costs in Europe, with over 50% of total European costs in the past four years.



Share of variable RES[1] in hourly EU27 demand[2]

- By 2030, intermittent RES are expected to supply a greater share of the EU's energy demand as more countries expand their RES contributions.



Notes: 1) By variable RES, here we mean solar PV and offshore and onshore wind. 2) Study showing total of solar, onshore and offshore wind hourly generation as a share of total EU27 hourly demand. Data of 2024 is derived from figures in Elda. RES data for 2030 is derived by multiplying the capacity factor of 2013 climate year weather data from ENTSO-E European Resource Adequacy Assessment 2024 by the pledged capacity of RES by EU27 countries. Hourly demand data for 2030 is instead taken from ENTSO-E. Sources: Elda, Eurostat, Bundesnetzagentur, SolarPowerEurope, Ember, ENTSO-E.

Storage can generate revenue through several markets

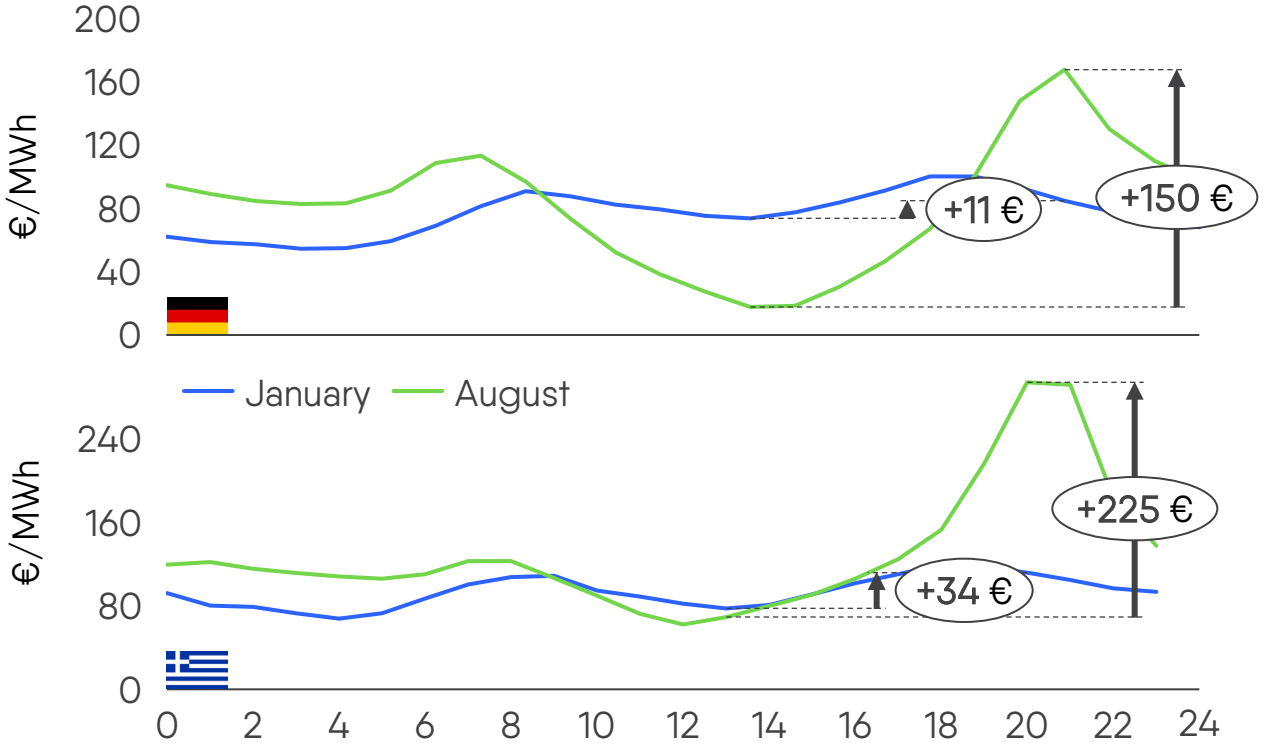
	Years	Days and hours	Minutes	Seconds
	Capacity Market	Wholesale Markets	Balancing and Restoration	Frequency Response
			Other Ancillary Services	
Type of market and service	• Ensures long-term energy security by securing firm capacity to meet peak demand. • Contracts are awarded for durations between 1 and 15 years, either annually or in four-year increments.	• The day-ahead market allows buying and selling energy to balance supply and demand on an hourly basis. • The intraday market supports real-time trading throughout the day, ranging from trades made years in advance to transactions just an hour before delivery.	• These services stabilise grid operations through balancing mechanisms and frequency control services (e.g., mFRR and Replacement Reserve). • They ensure energy system stability by managing imbalances in daily trading periods. • Non-frequency-related services, e.g. inertia support and congestion management, create further financial opportunities for many forms of storage.	• These services maintain grid stability by providing rapid-response energy injections to counteract sudden frequency changes, with reaction times ranging from sub-seconds to minutes.
How can storage generate revenues?	• Payments are made based on capacity (kW/year) and adjusted according to the security of supply contribution. • Although batteries may be derated, they can still benefit financially without significant degradation.	• Enables electricity trading in short- to medium-term markets. • Different forms of storage can take advantage of price variations, i.e. spreads, to generate revenues.	• Since they require high energy volumes and sustained delivery, storage may earn revenues by leveraging price differences in balancing markets. • They can also provide slow frequency response, earning payments for both availability and activation. • Grid charge reductions or exemptions in certain regions may offer additional economic benefits.	• These services are primarily contracted ahead of time or secured through day-ahead capacity markets (e.g., FCR). • Batteries can leverage these markets for additional revenue streams.

Source: Eurelectric.

Storage business case highly depends on intraday price spreads and on co-location with variable RES

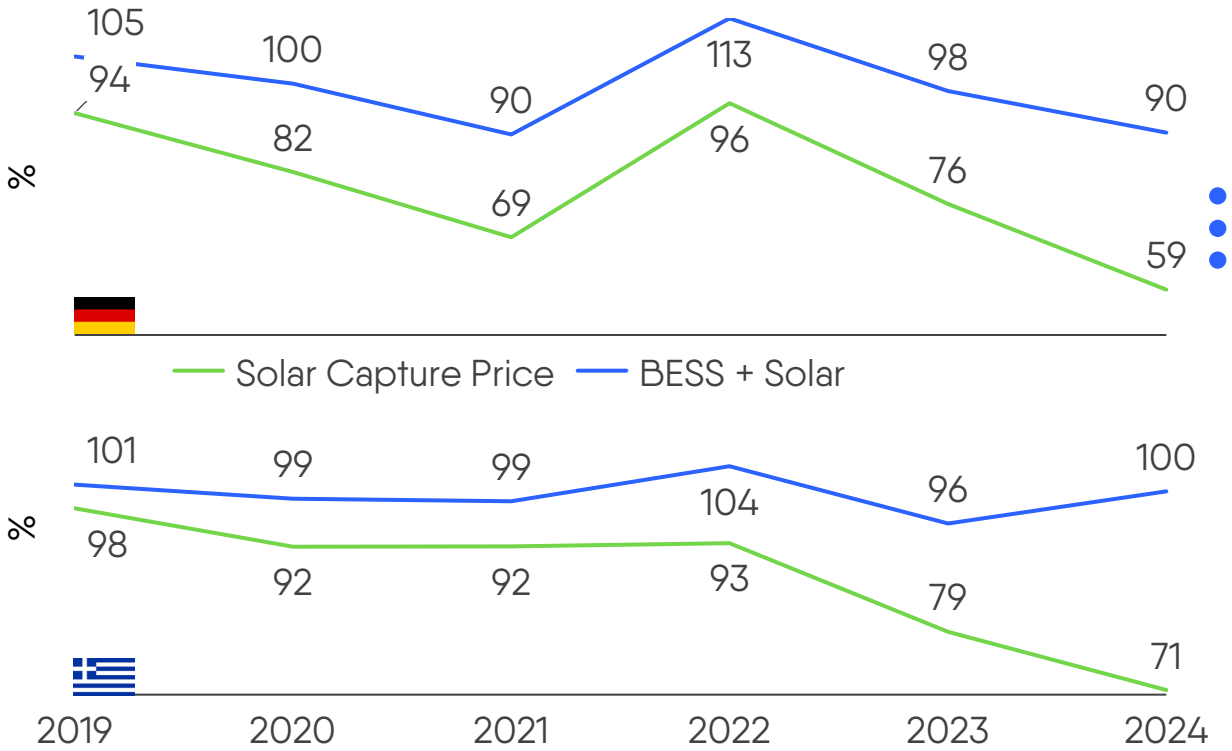
Average hourly day-ahead prices in 2024

- The spread of power prices in Europe is typically higher during the summer, allowing BESS to generate more revenues. In August 2024, Germany saw an average spread of 150 €/MWh, while Greece reached 225 €/MWh.



Solar capture rates with and without battery storage

- Solar capture prices continue decreasing across Europe due to cannibalisation. However, co-located storage would have added at least 15 p.p. to solar capture price in Central and Southern-Eastern Europe.



Notes: 1) Here, spread is intended as the difference between prices at 8pm and prices at 1pm. Sources: Elda.

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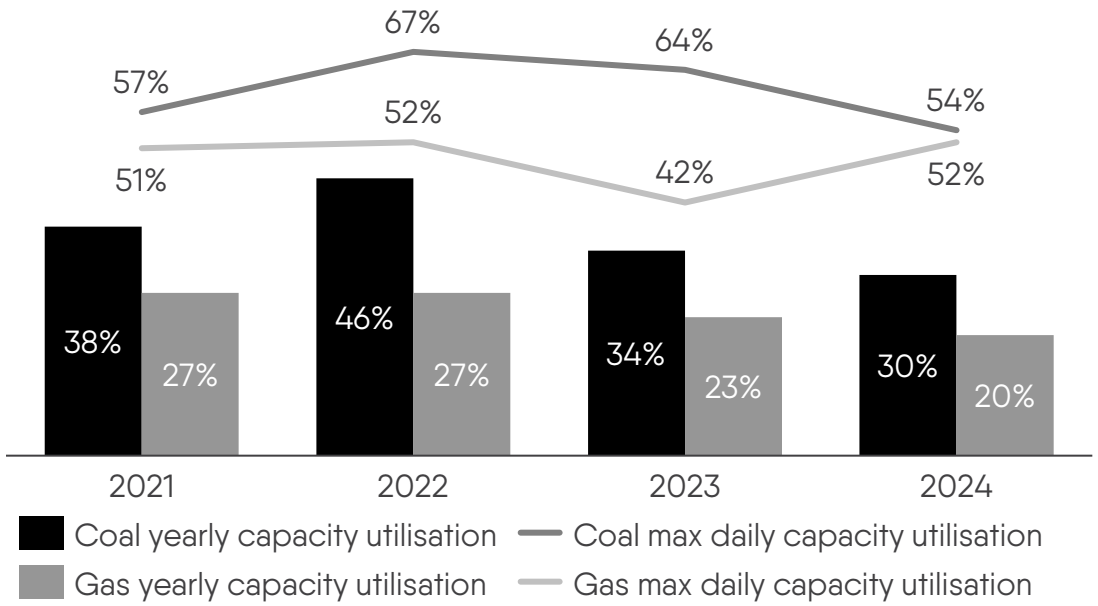
Gas continues to play a crucial role in ensuring seasonal flexibility

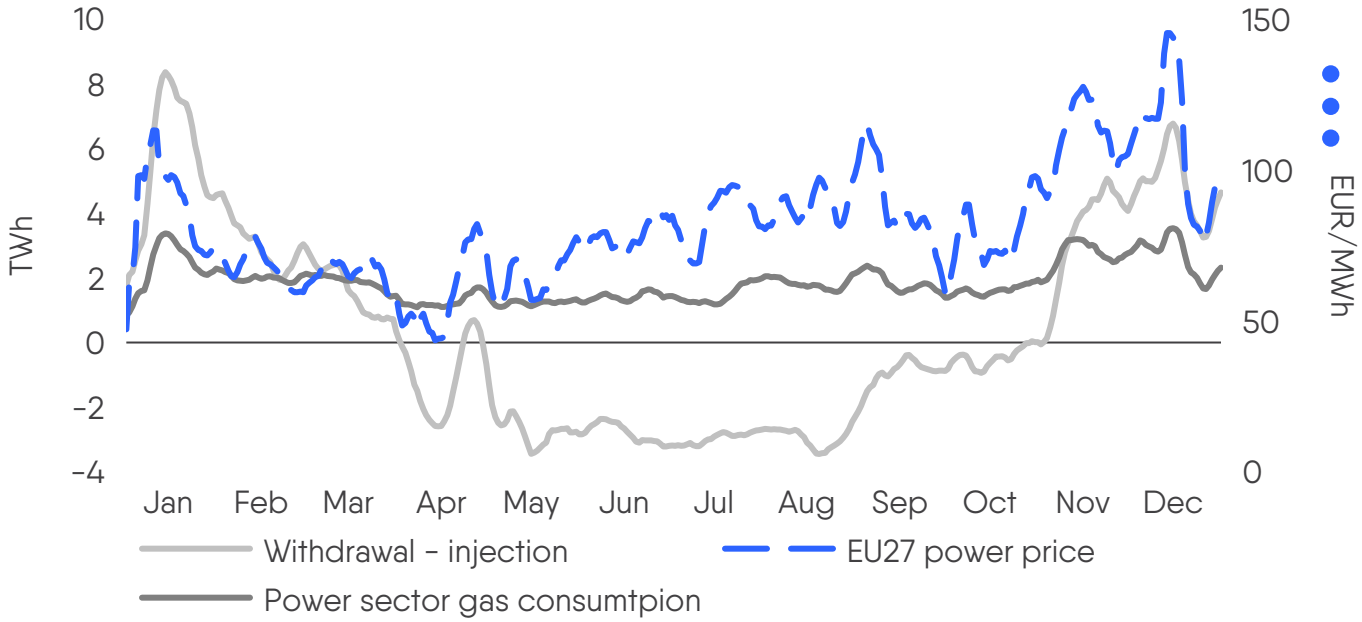
Historical utilisation of coal and gas-fired power plants in EU27+Norway[1]

- In 2024, the annual capacity utilization of dispatchable technologies such as coal and gas-fired power plants declined, due to increased RES penetration.
- However, the contribution of gas-fired power plants to electricity generation during peak hours rose by 10 p.p. compared to 2023.



Correlation of power price with gas storage levels and demand in 2024[2]

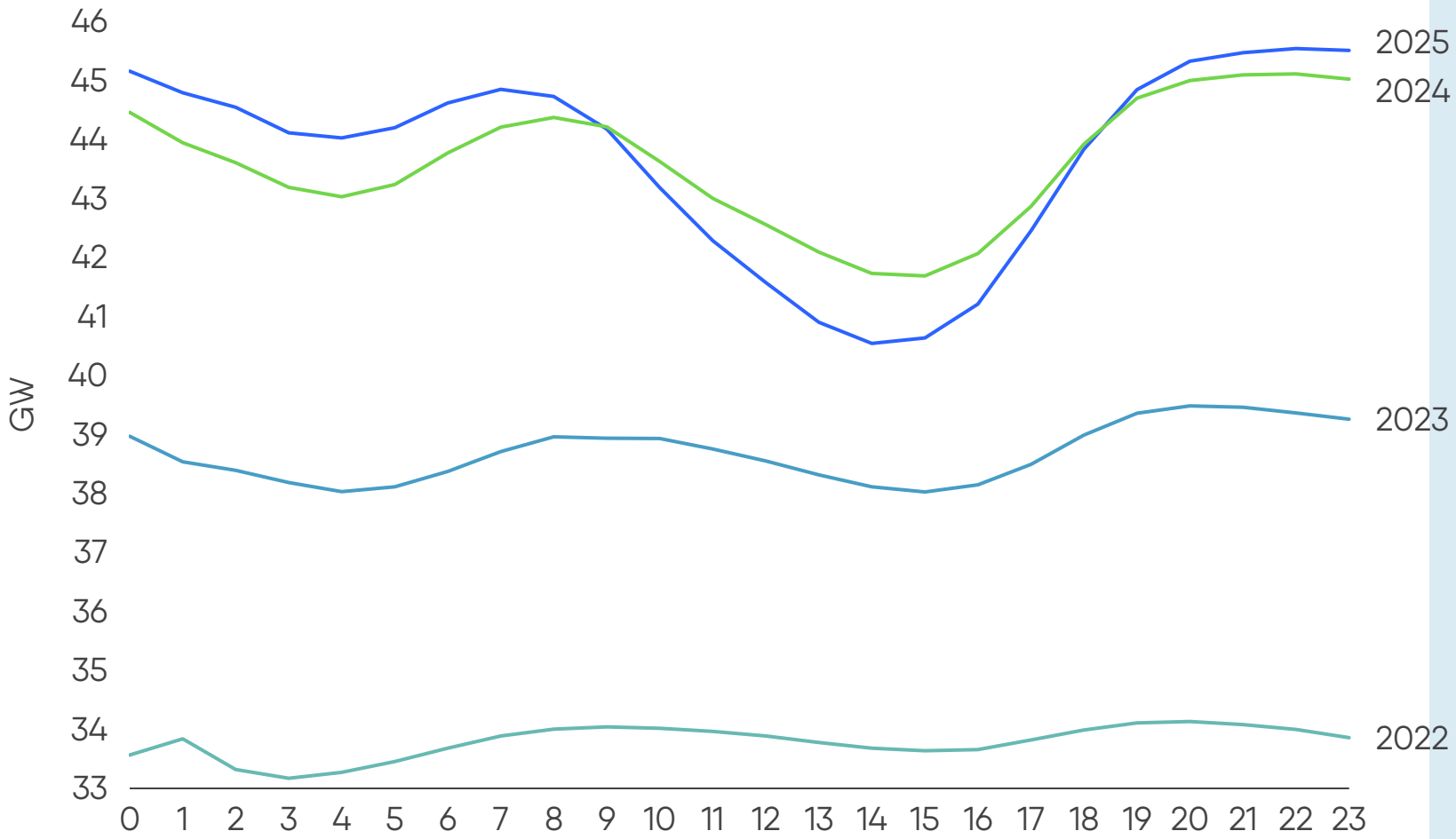
- Gas consumption in the power sector remains higher during winter, while it drops significantly in early summer due to lower electricity demand.
- As a result, power prices are more closely linked to gas consumption during peak hours and colder seasons.



Notes: 1) ACER calculations. 2) Data refers to EU27. Storage net withdrawals are taken from Gas Infrastructure Europe. Power sector gas consumption is derived from generations figures on Elda assuming an efficiency of 50% of gas power plants. All series are displayed as seven days rolling average. Sources: ACER, Elda.

French nuclear adapts with flexibility amid rising solar

Average nuclear electricity by hour of day in France (GW)

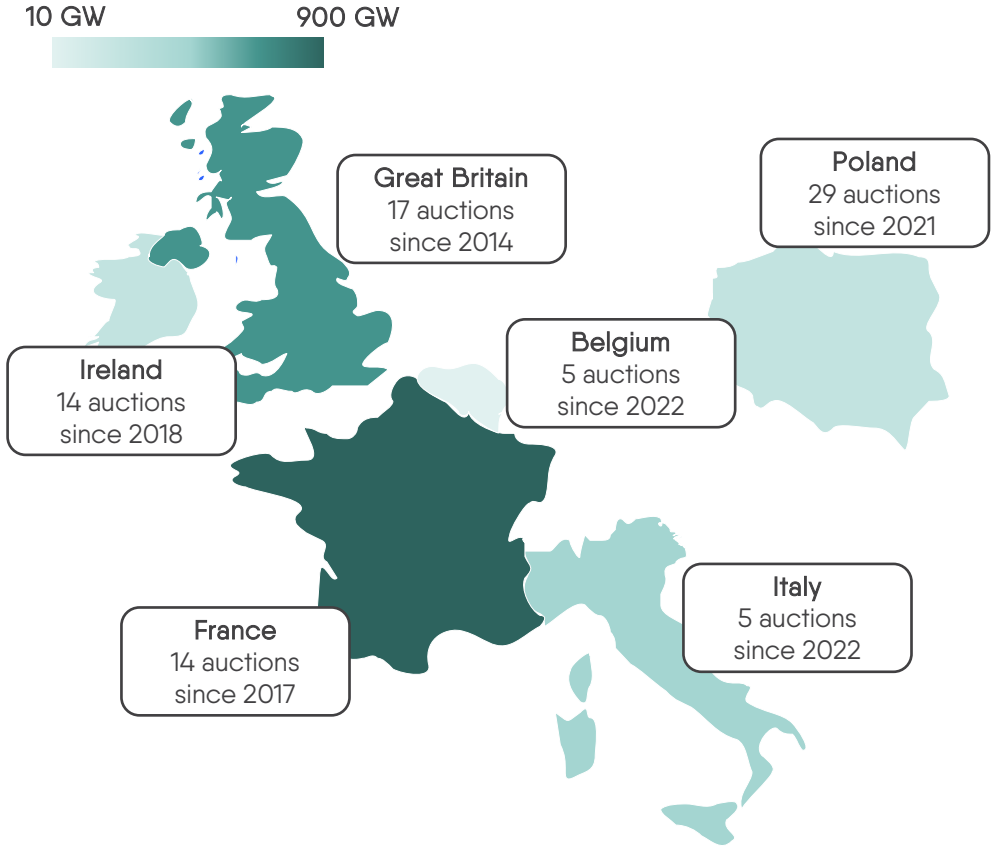


- France's nuclear fleet has significantly increased flexibility in 2024–2025 compared to 2022, with reactors flexing output at midday during solar peaks and ramping up in the evening.
- This greater modulation supports renewable integration and allows to capture more revenue by aligning output with higher evening prices.
- On August 3, output swung dramatically from 26 GW at 1pm to 45 GW at 10 pm, illustrating the scale of this new intraday modulation.
- EDF highlights that modulation is always carried out without compromising reactor safety.

Source: Calculation based on Elda.

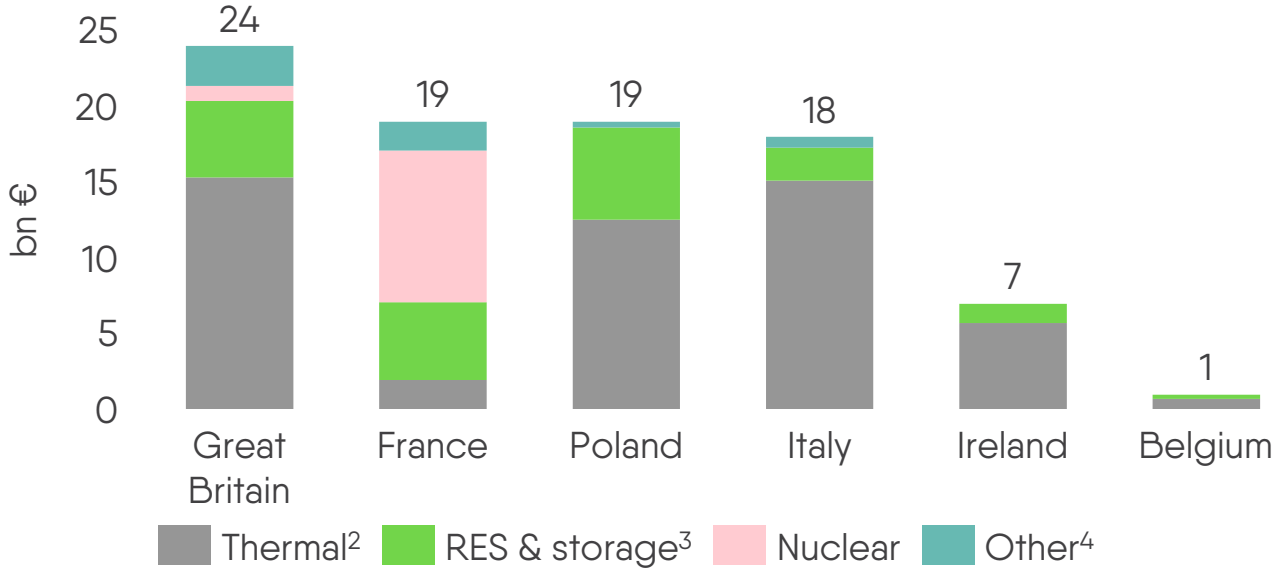
A third of capacity contracted by capacity markets is from clean and storage technologies

Capacity procured across capacity auctions 2014 - 2024



Contracted payments by region

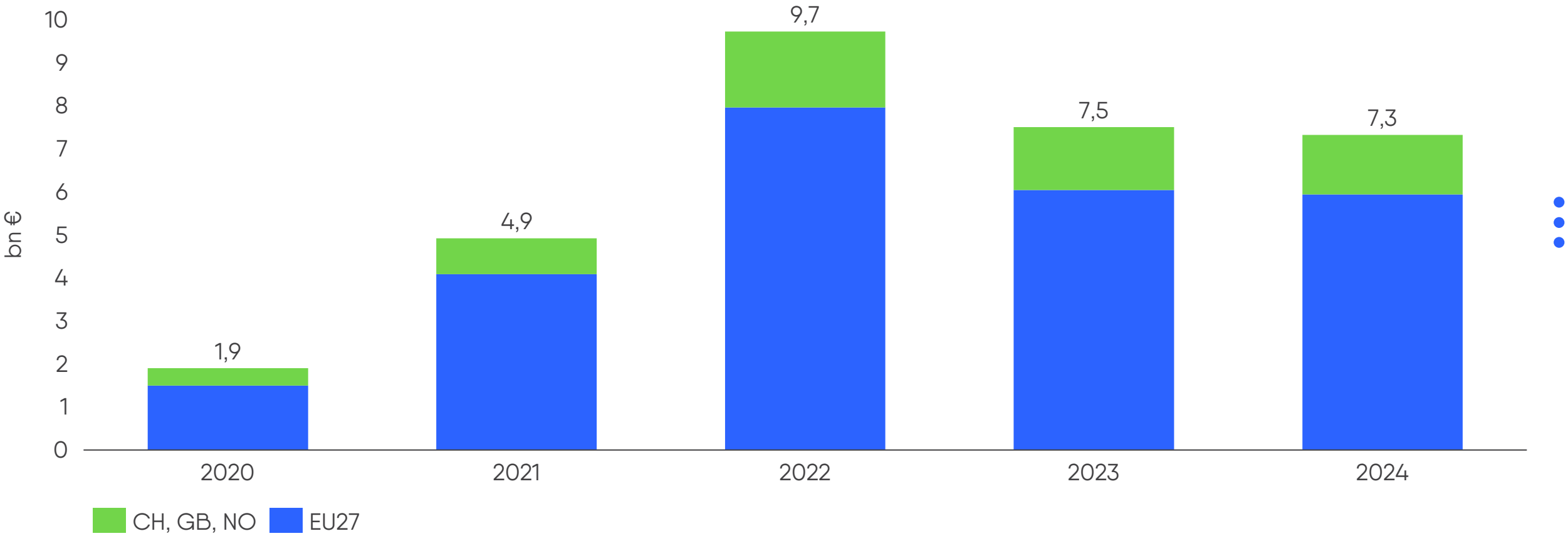
- Until 2024, European capacity markets secured contracts up until 2029[1] totalling €90 billion, with the majority in Great Britain.
- Payment rates varied significantly, starting at just over 7,000 €/MW while reaching peaks above 140,000 €/MW in Ireland.



Notes: 1) 2029 is the latest date of delivery for all CM in Europe and refers to Poland only. Other countries have final delivery dates between 2026 and 2028. 2) Includes gas and coal. 3) RES include hydropower, thermal biomass assets and biogas (together 7% of total contracted payments). Storage includes BESS and demand-side response (together 15% of total contracted payments). 4) Includes interconnectors and other undefined technologies. Sources: Aurora Energy Research, Beyond Fossil Fuel, Terna, RTE, SEM-O, NESO, PSE, Elia.

Ancillary service costs across Europe nearly quadrupled from €2 billion in 2020 to over €7 billion in 2024

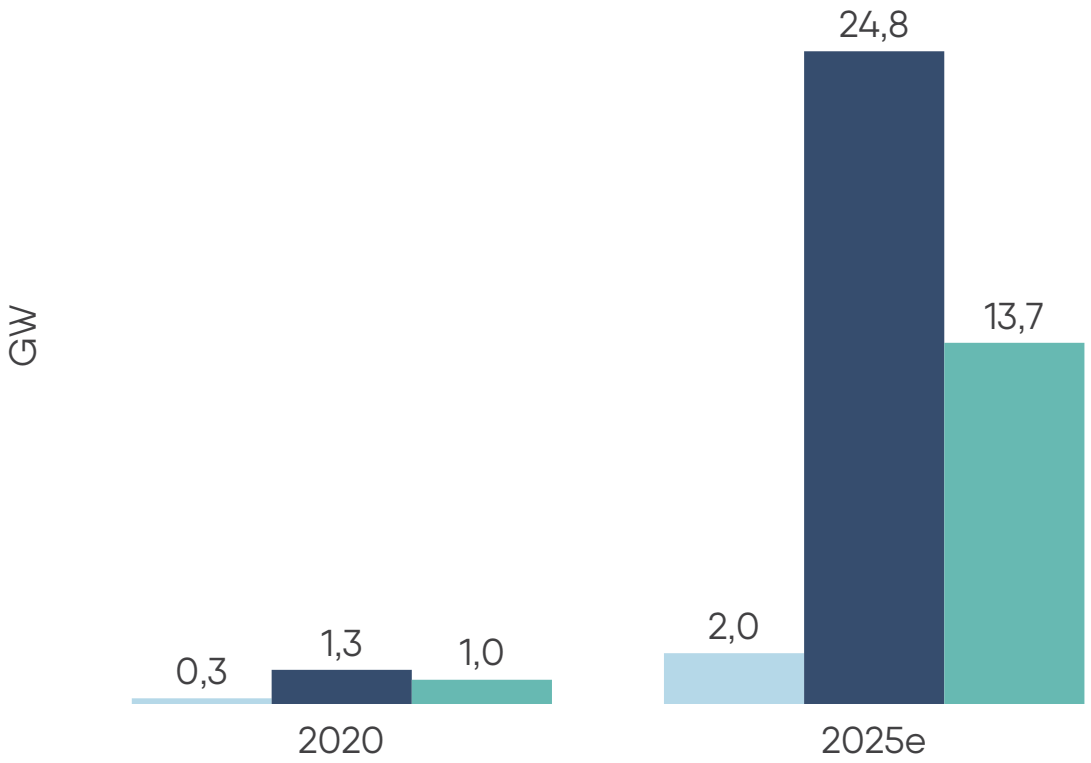
TSO spend on ancillary services (FRR, FCR, aFRR, mFRR, RR[1])



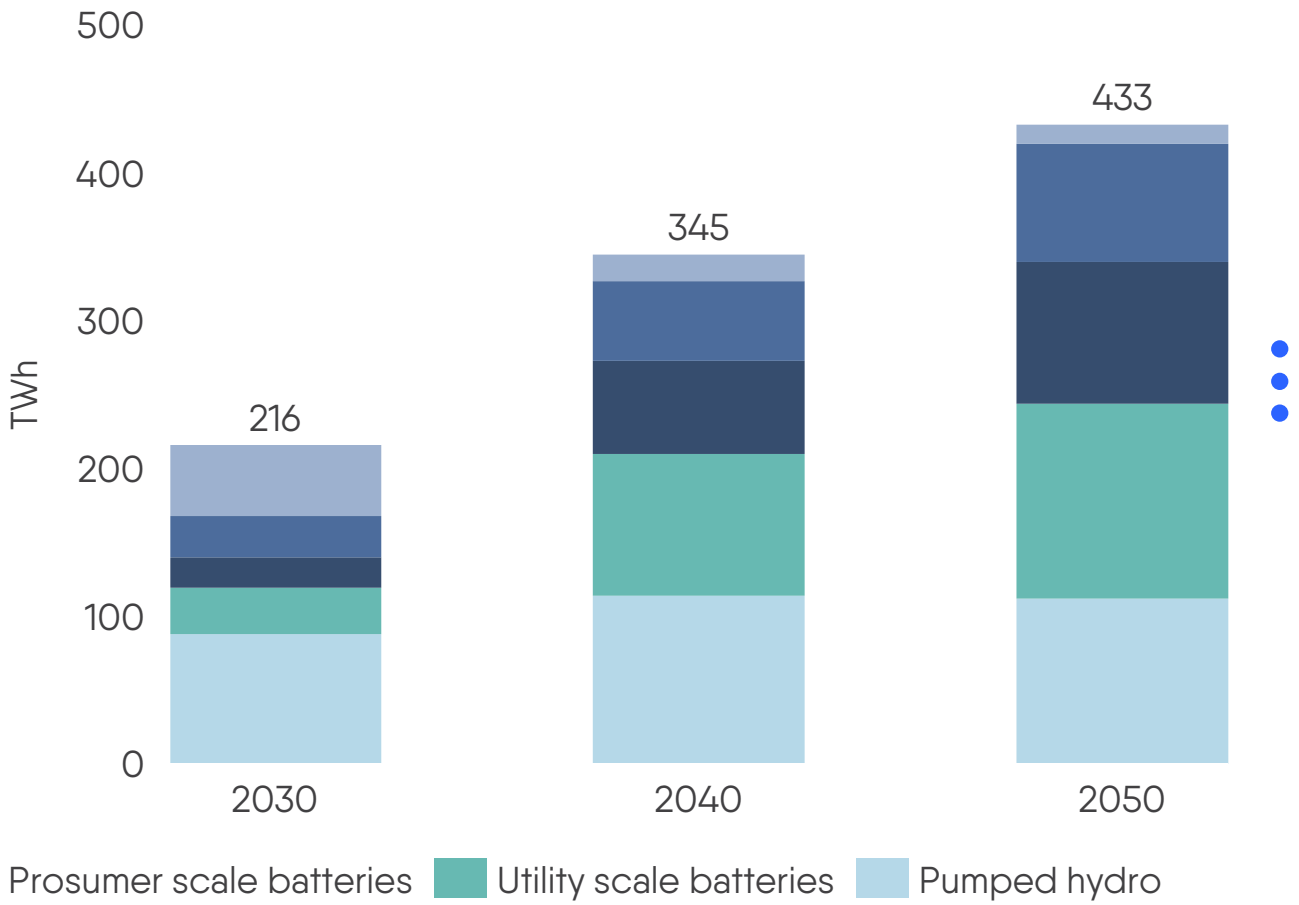
Notes: 1) FRR: Frequency Restoration Reserve; FCR: Frequency Containment Reserve, aFRR: Automatic Frequency Restoration Reserve, mFRR: Manual Frequency Restoration Reserve, RR: Replacement Reserve. Source: LCP Delta.

A greater role for flexibility by utility-scale BESS is expected, while most batteries projects are currently at prosumer scale

Cumulative capacity of batteries in EU27[1]



ENTSO-E forecast of EU generation of flexibility options[2,3]



Notes: 1) Figures from LCP Delta. 2) Excluded gas and hydro plants. 3) The forecast of ENTSO-E refers to their Distributed Energy Scenario of 2024. The numbers for 2030 refer to their scenario National Trend. Sources: LCP Delta, ENTSO-E.

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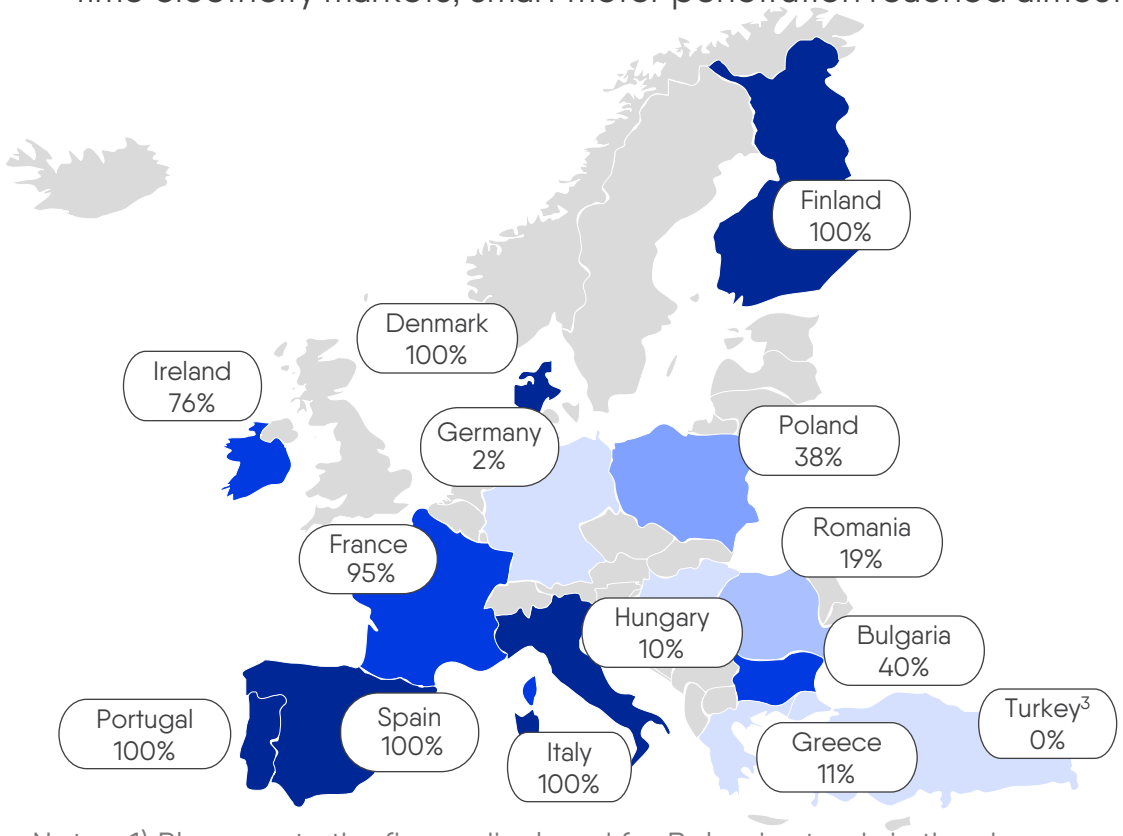
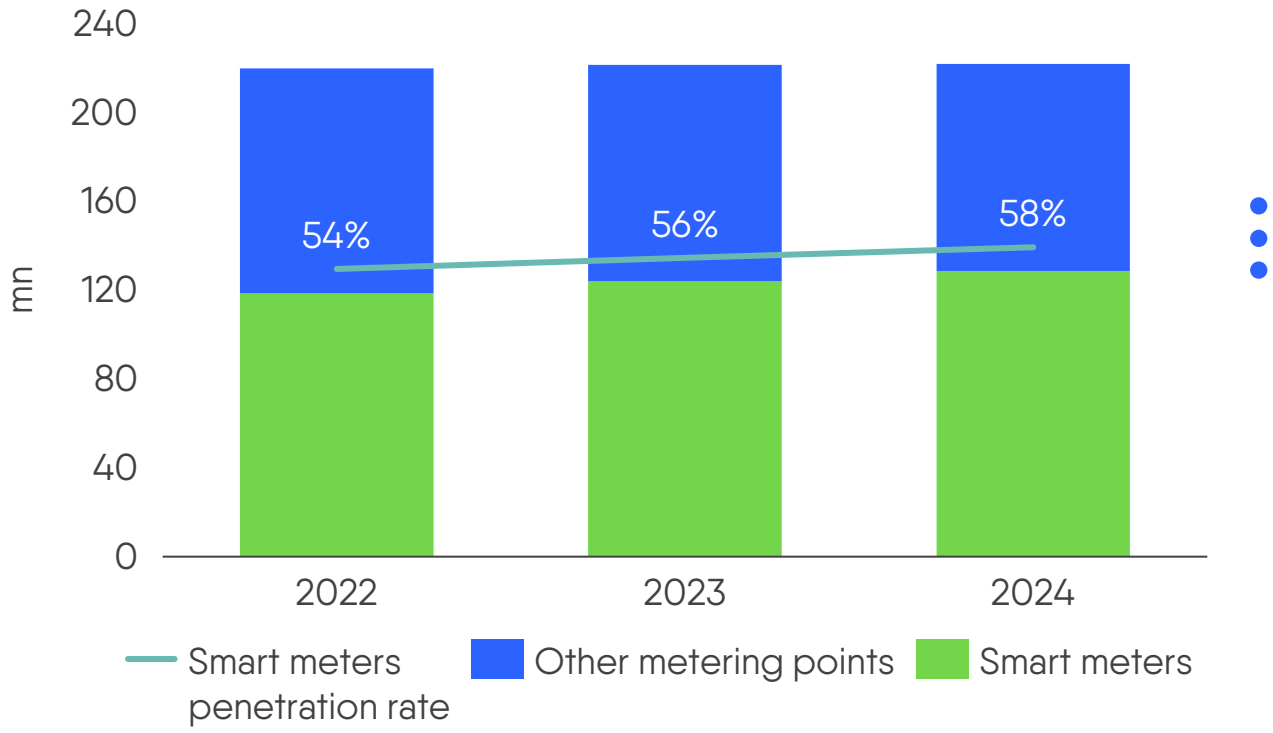
Smart metering penetration rate reached 58% in 2024, still faring behind the EU's 80% target

Smart metering penetration rate in Europe in 2024[1]

Total number of metering points in selected EU countries[2]

- While demand-side response offers significant benefits for electricity systems, consumer engagement remains critically limited.
- Smart meters emerge as a fundamental bottleneck in this challenge. Despite being essential prerequisites for consumer participation in real-time electricity markets, smart meter penetration reached almost 60% in 2024 - still falling short of the EU's 80% target.



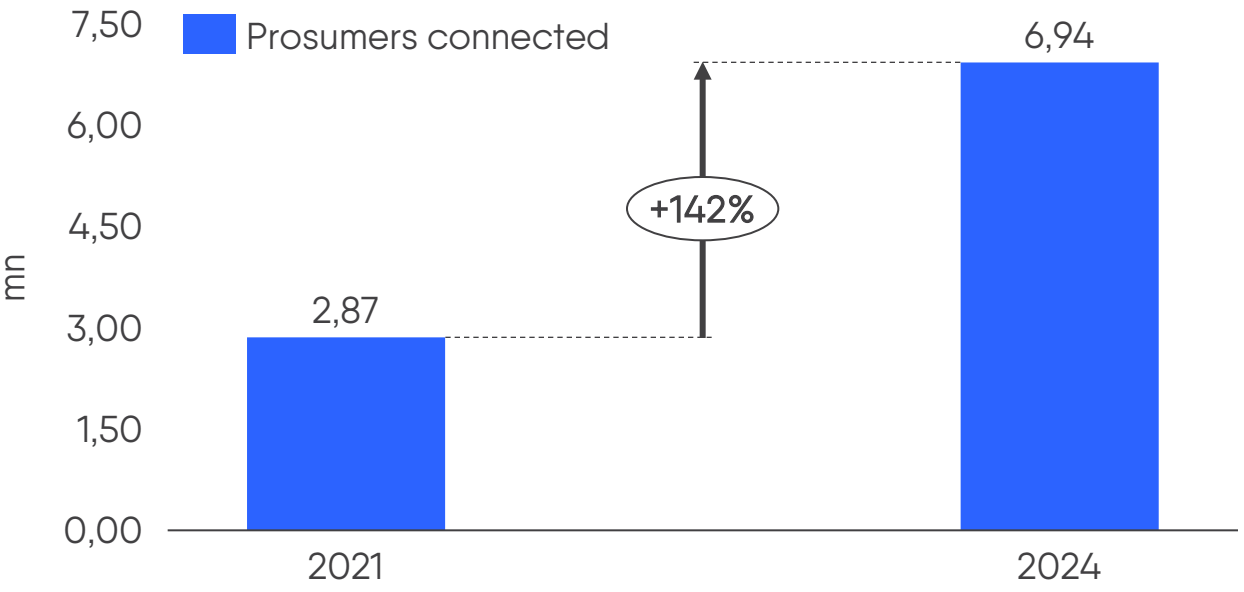


Notes: 1) Please note the figure displayed for Bulgaria stands in the absence of legal definition of smart meter functionalities to meters supporting smart metering. 2) Selected countries include Bulgaria, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Poland, Portugal, Romania, Spain. 2024 data for Finland and Romania refers to their 2023 data. 3) Smart meters will be implemented under "MASS" roll-out program in 2026. Sources: Eurelectric, National Associations, DSOs.

Prosumers and RES connections boom, highlighting grid integration challenges for distribution grids

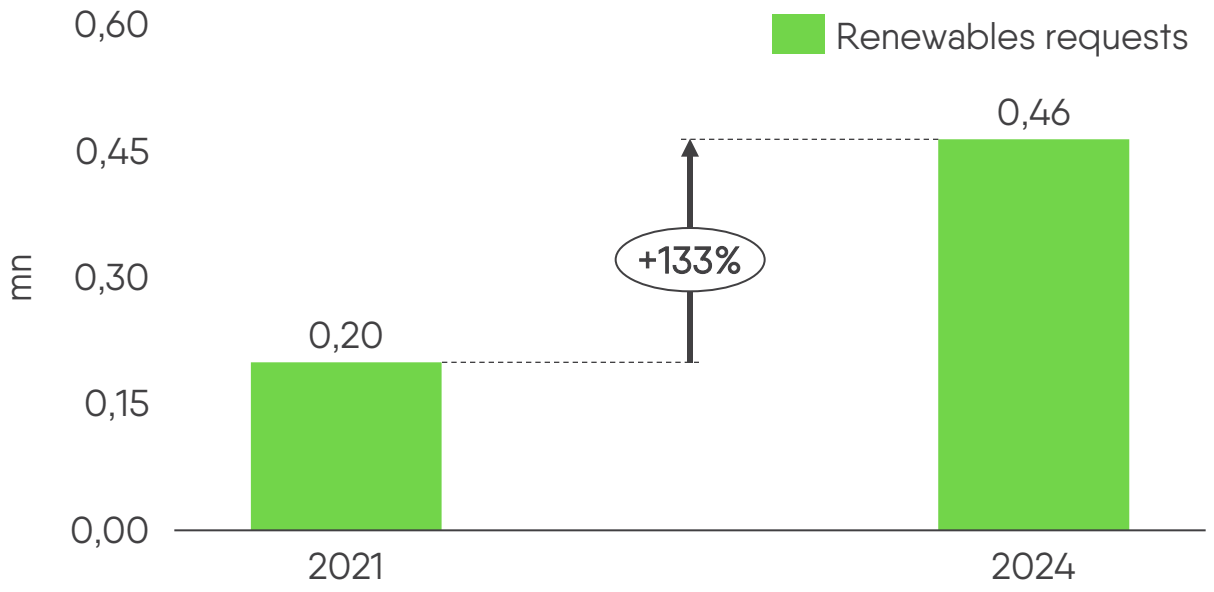
Prosumers connected to DSOs in selected EU countries[1]

- From 2021 to 2024, the number of prosumers more than doubled in the EU.
- Instead, the total number of customers connected to DSOs across low, medium and high voltage grew only marginally reaching more than 210 million of connected customers[1].



RES connection requests to DSOs in selected EU countries[1]

- In 2024, RES connection requests exceeded 450,000 annually across all the EU countries surveyed – more than double the number in 2021.
- Overall connection requests have remained relatively stable in recent years, with only a minor decline observed in 2024.

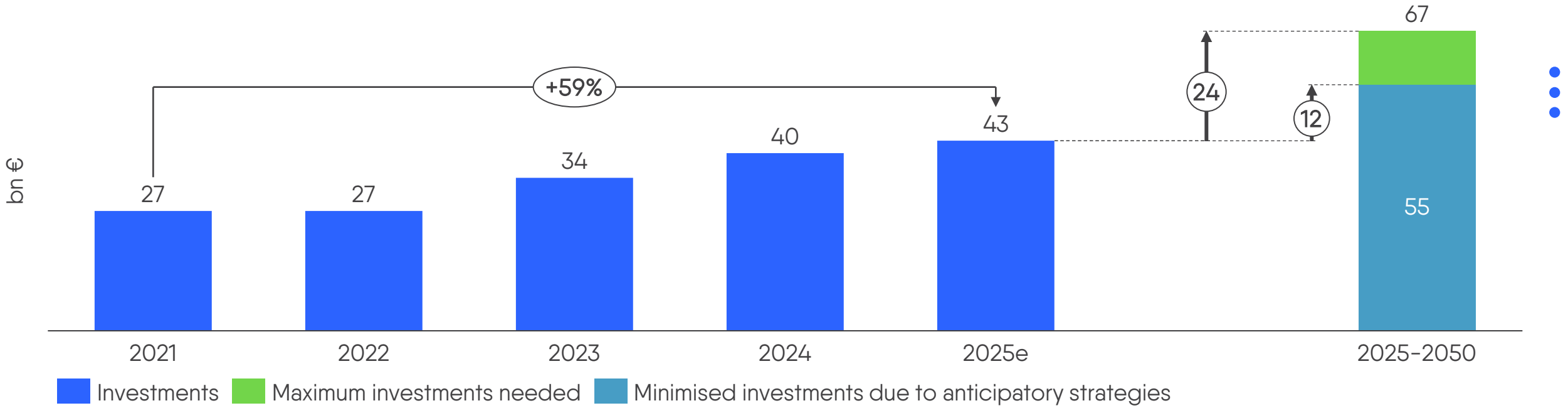


Notes: 1) Selected countries include Bulgaria, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Poland, Portugal, Romania, Spain. 2024 data for Finland and Romania refers to their 2023 data. Data for Denmark, Finland and Ireland is not available for connection requests. Data for Italy for connection requests only represent 4% of the Italian customers. Sources: Eurelectric, National Associations, DSOs.

DSOs' annual investments reached €40 billion in 2024, still far from the total resources needed

Annual investments in the distribution grids in EU27[1]

- Total investments by European DSOs in their networks have risen by 60% over the past four years. In several countries (e.g. Denmark, Germany, Italy, Poland), investment levels have nearly doubled, underscoring the growing urgency to upgrade distribution grids.
- According to IEA, the total figure of investments by DSOs in the EU reached 40bn € in 2024 and it is estimated to increase to 43bn by the end of 2025. However, according to Eurelectric's study[2], the annual amount of investments in distribution grids is still short of €24 bn, under current conditions, or €12 bn, assuming the implementation of strategies such as anticipatory investments and assets performance.



Notes: 1) Figures are from International Energy Agency (2025), World Energy Investment 2025, IEA, Paris. Figures are in real EUR 2024 converted from real USD 2024. 2) Grids 4 Speed, Eurelectric (2024). Sources: IEA, Eurelectric, National Associations, DSOs.

DSO investments are increasingly focused on grid digitalisation and enhancing grid resilience

Intensity of DSOs investments in selected EU countries[1]

- Many interventions were taken by DSOs to enhance their grids: from refurbishing aging infrastructure to extending cyber-physical security and increasing the length of underground cables, which reached, in surveyed countries, almost 4 million kilometres.

1. Network Automation & Digitalization

- Remote control equipment (circuit breakers, disconnectors)
- Automated switching devices and relay protection
- Telemechanical upgrades, online metering, remote terminal units
- Smart transformers and improved communication (fiber/satellite)

2. Infrastructure Replacement & Refurbishment

- Replacement of old cables (MV and LV), poles, transformers, and conductors
- Transition from overhead to underground cables, especially in urban/sensitive areas
- Replacement of bare conductors due to ice/snow risks

3. Security & Reliability Improvements

- Cyber-physical security improvements
- Ensuring stable supply points and voltage stabilization
- Compliance with legal security of supply requirements

4. Grid Resilience & Flexibility

- Installation of new substations, feeders, interconnection points
- Use of SVRs, OLTCs, voltage regulators, and DLR systems
- Implementation of flexibility services

Notes: 1) Selected countries include Bulgaria, Denmark, France, Finland, Germany, Greece, Hungary, Finland, Ireland, Italy, Poland, Portugal, Romania, Spain. Sources: Eurelectric, National Associations, DSOs.

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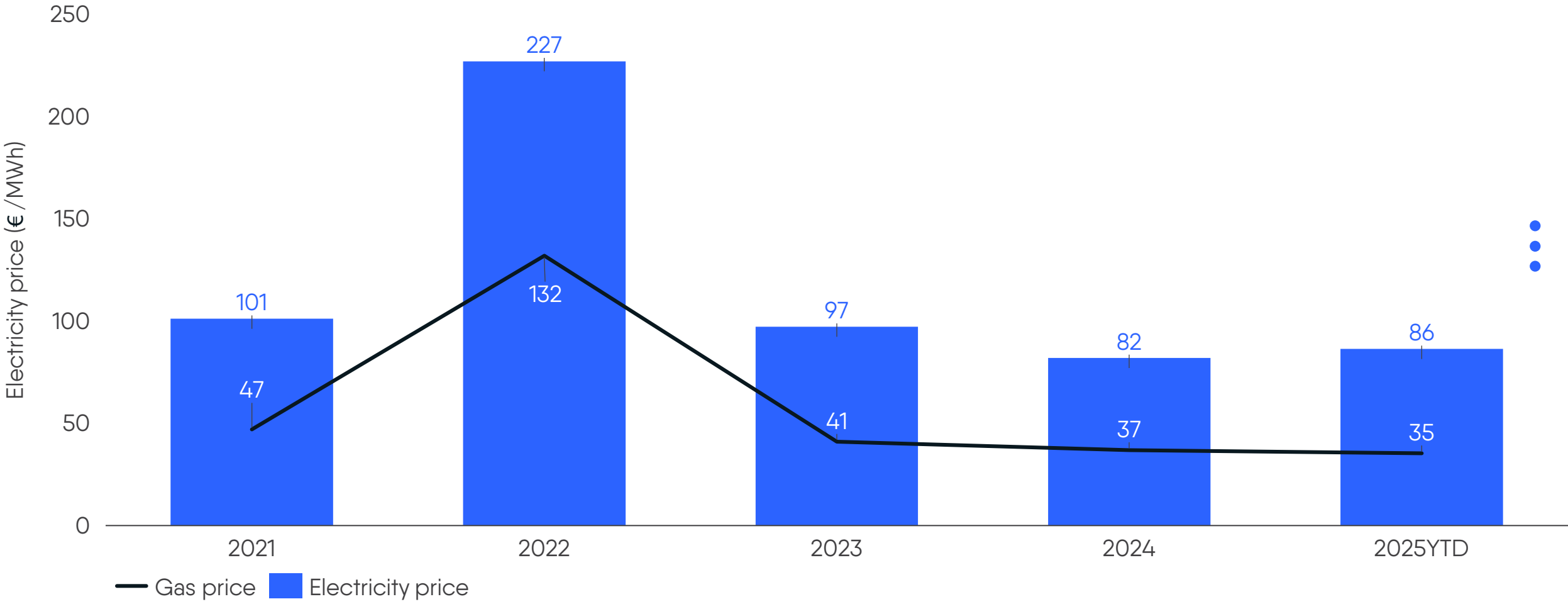
Electricity prices kept falling since 2022 reaching 82 €/MWh in 2024

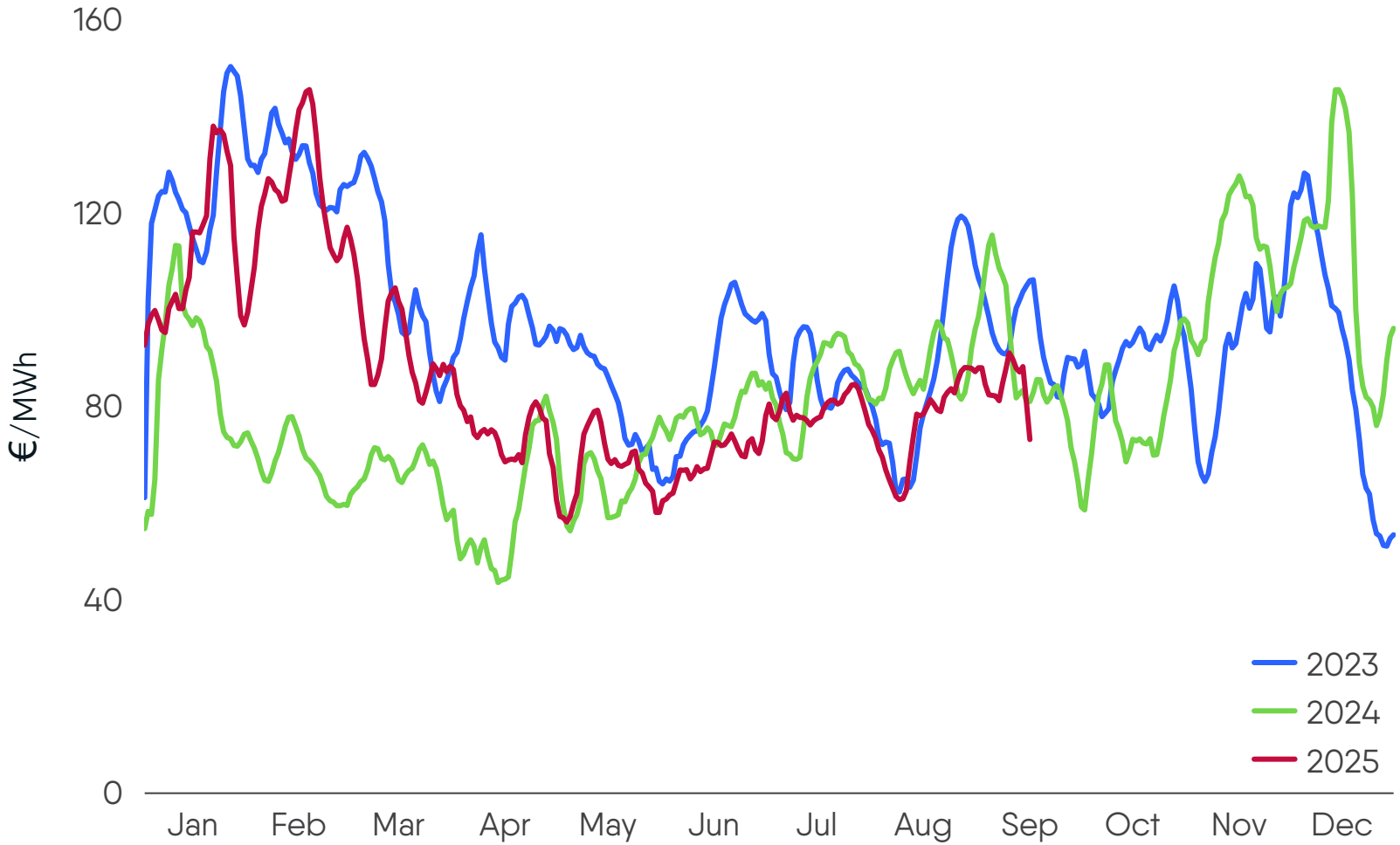
Average wholesale electricity price and gas price in the EU



Sources: Elda, investing.com.

Power prices in Q1 2025 rose to 2023 levels, before falling back to 2024 levels in Q2

Daily day-ahead electricity prices in EU27[1]



- In Q1 2025, wholesale electricity prices came close to 2023 levels, averaging just 10% lower than in Q1 2023. This trend changed in Q2 as they returned to 2024 levels signalling an expected higher volatility for 2025.
- Q4 2024 marked the return of a positive clean spark spread In Germany[2], indicating that gas-fired power generation became profitable again even after accounting for carbon costs.
- This shift was driven not only by seasonal factors but also, by weaker wind generation over the six months between 2024 and 2025, with an output 25 TWh lower than during the previous winter.
- Additionally, power demand in the EU rose by 4.7% in Q1 2025 compared to the same period in 2024 due only to colder weather, further supporting the increase in electricity prices.

Notes: 1) Seven-days rolling average. 2) Assuming 56% of short-running marginal costs for gas power plants. Sources: Elda, LSEG Data & Analytics.

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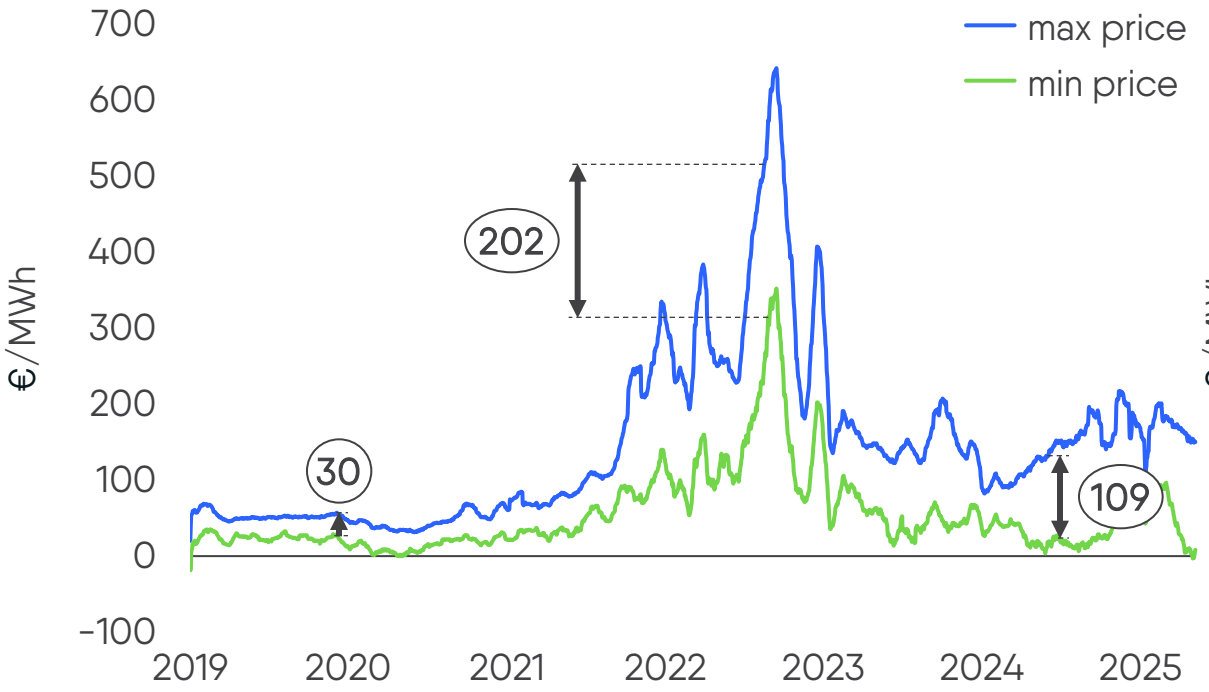
Although volatility slightly decreased in 2024, it remains quite high compared to before 2021

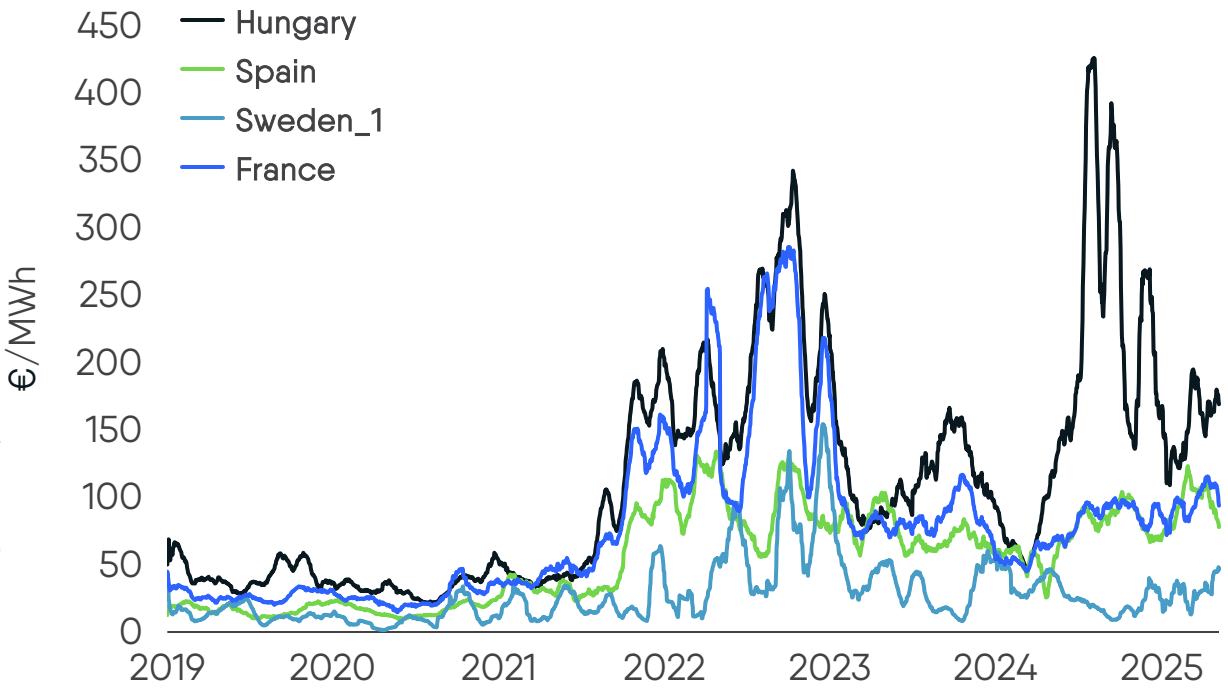
Daily price spread in German day-ahead market[1]

- The difference between the highest and lowest prices on a day has grown wider since 2021.
- While in 2019 average spread of a day was 29 €/MWh in 2024 this was 109.5 €/MWh in Germany.



Daily spread in selected bidding zones[2]

- This trend is uniform across all bidding zones although less prominent in northern most bidding zones like Sweden_1.
- Large volatility was observed in East and South East Europe with Hungary reaching spreads above 400 €/MWh.

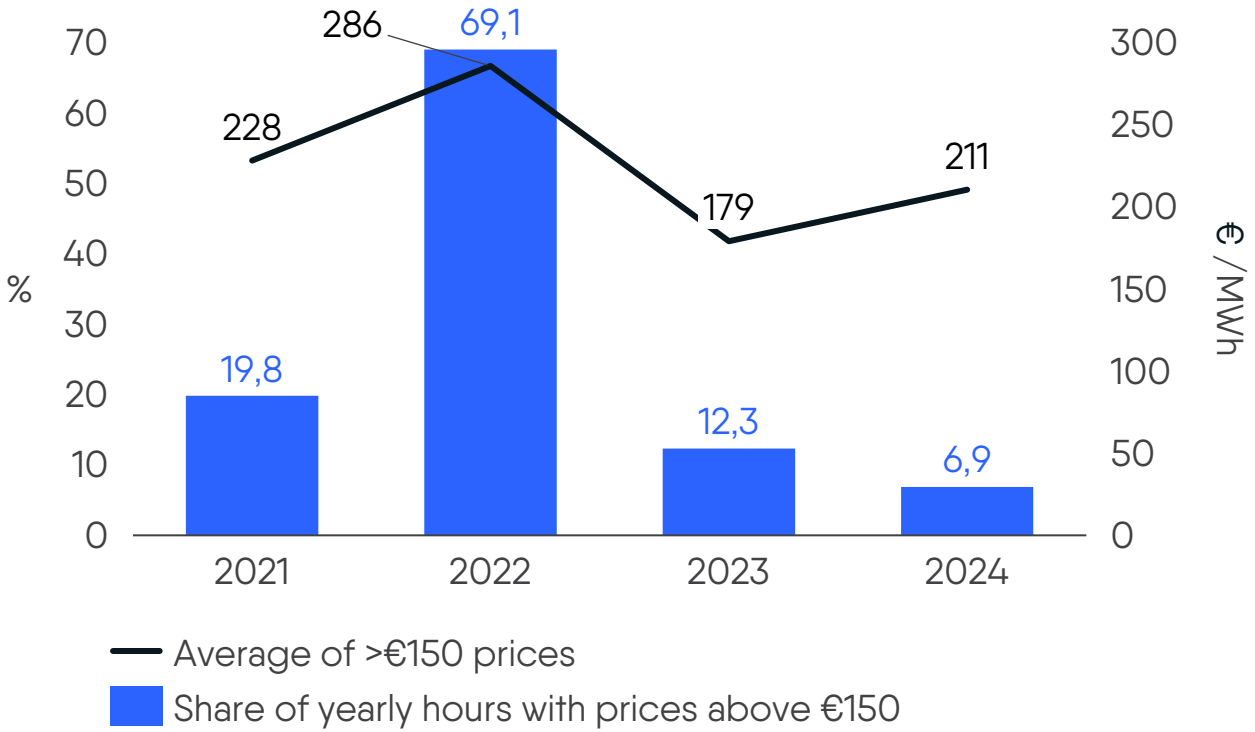


Notes: 1) Data refers to 30-days rolling average. The highest and lowest prices of each day are shown. 2) Data refers to 30-days rolling average. Spread equals the difference between the highest and the lowest price of a day. Sources: Elda.

High prices were less frequent in 2024

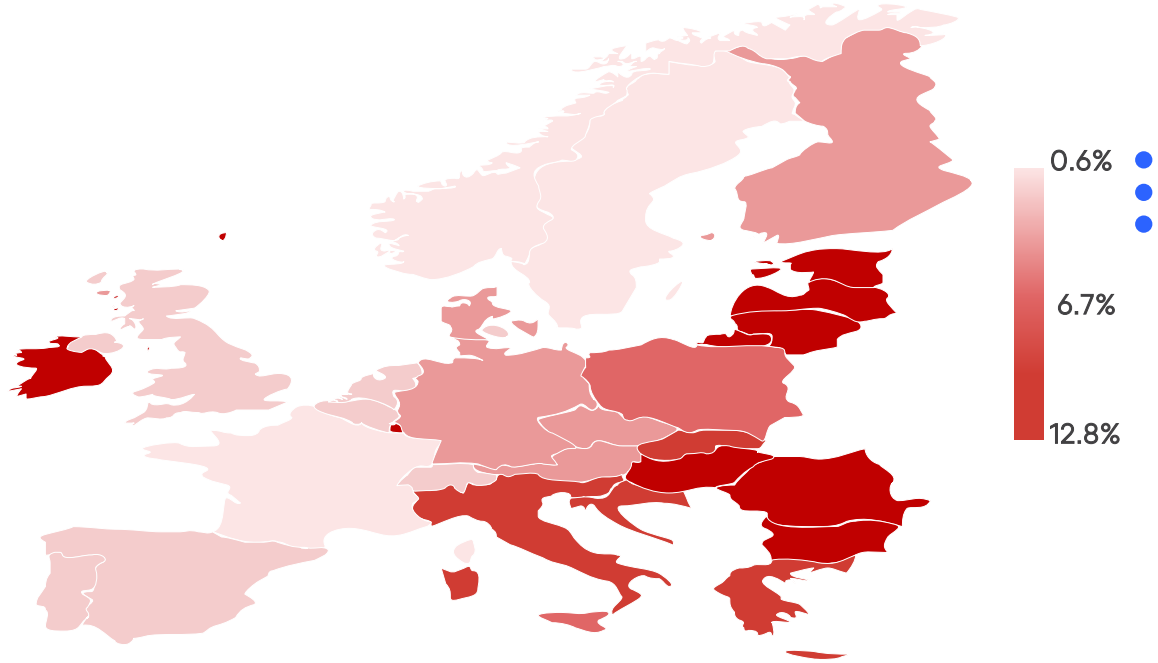
Share of hours with prices above 150 €/MWh and the average depth (average of EU member states)

- The average frequency of prices above 150 Eur/MWh was relatively lower in 2024 compared to previous 3 years.



Distribution of % of hours with prices above 150 €/MWh in 2024

- In 2024, Eastern European and Baltic countries and Ireland experienced the most number of high prices while Nordics while Nordics experienced the least.

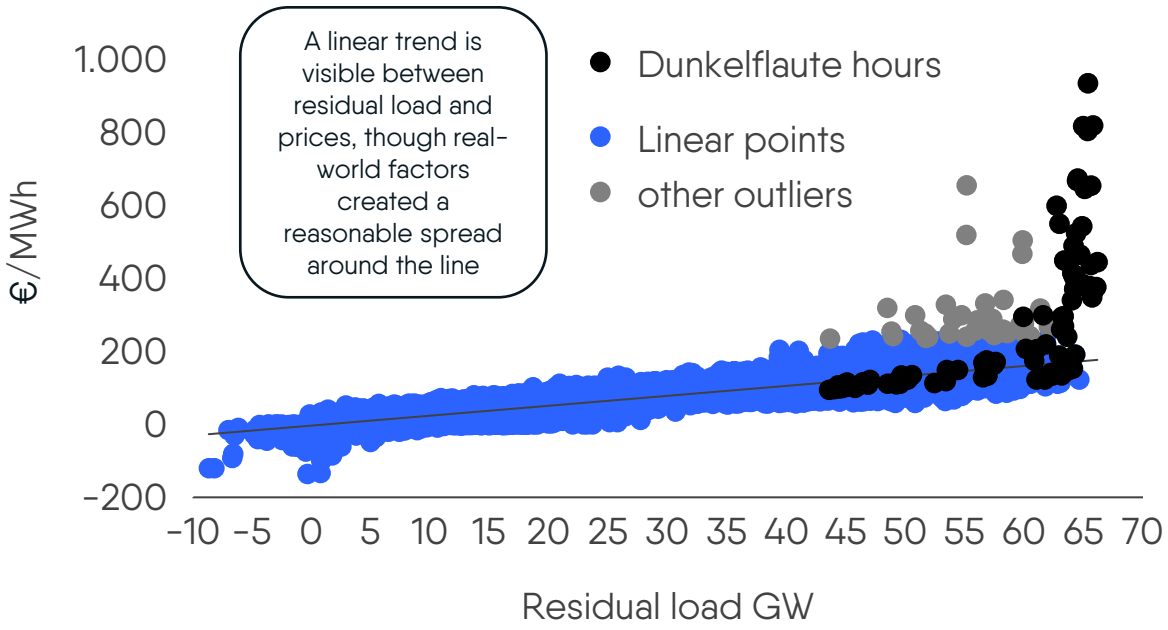


Sources: Elda.

Price spikes only during less than 1% of hours

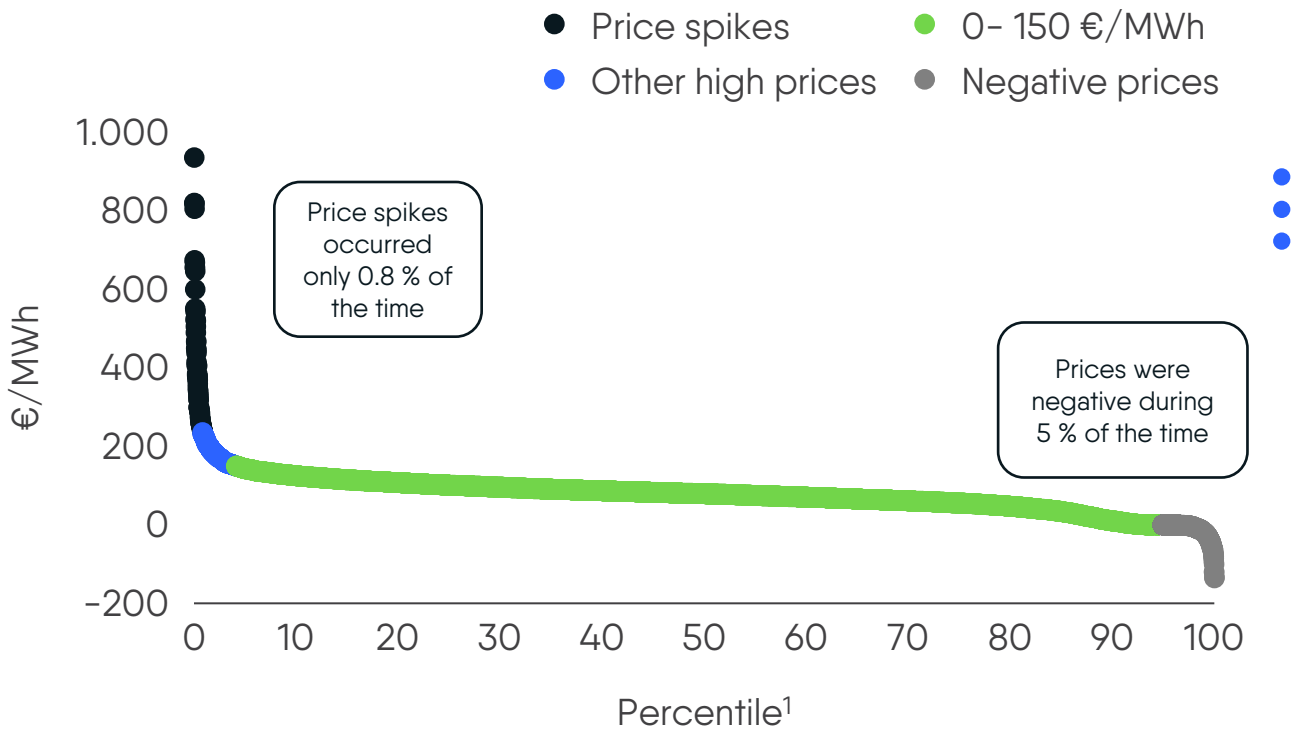
Residual load vs spot power prices in Germany in all hours of 2024[1]

- Price spikes/outliers[1] occurred only when the residual demand is close or more than 50 GW. This happens only during 0.8% (74 hours) of the total number of hours in 2024.
- Cloudy days didn't always mean price spikes, as even with low RES, 80% of those hours had prices within the normal range.



Percentile distribution of Germany's 2024 day-ahead electricity prices[2]

- 96 % of the time, prices were below €150 and 5 % of the time prices were negative. This also shows an opportunity for more storage and flexibility in the power system.



Notes: 1) Here price spikes refer to prices above €235 (+-3*Standard Deviation) are accounted as outliers. 2) The x-axis represents the percentile distribution of spot prices, with price spikesappearing at lower percentiles. Source: Elda.

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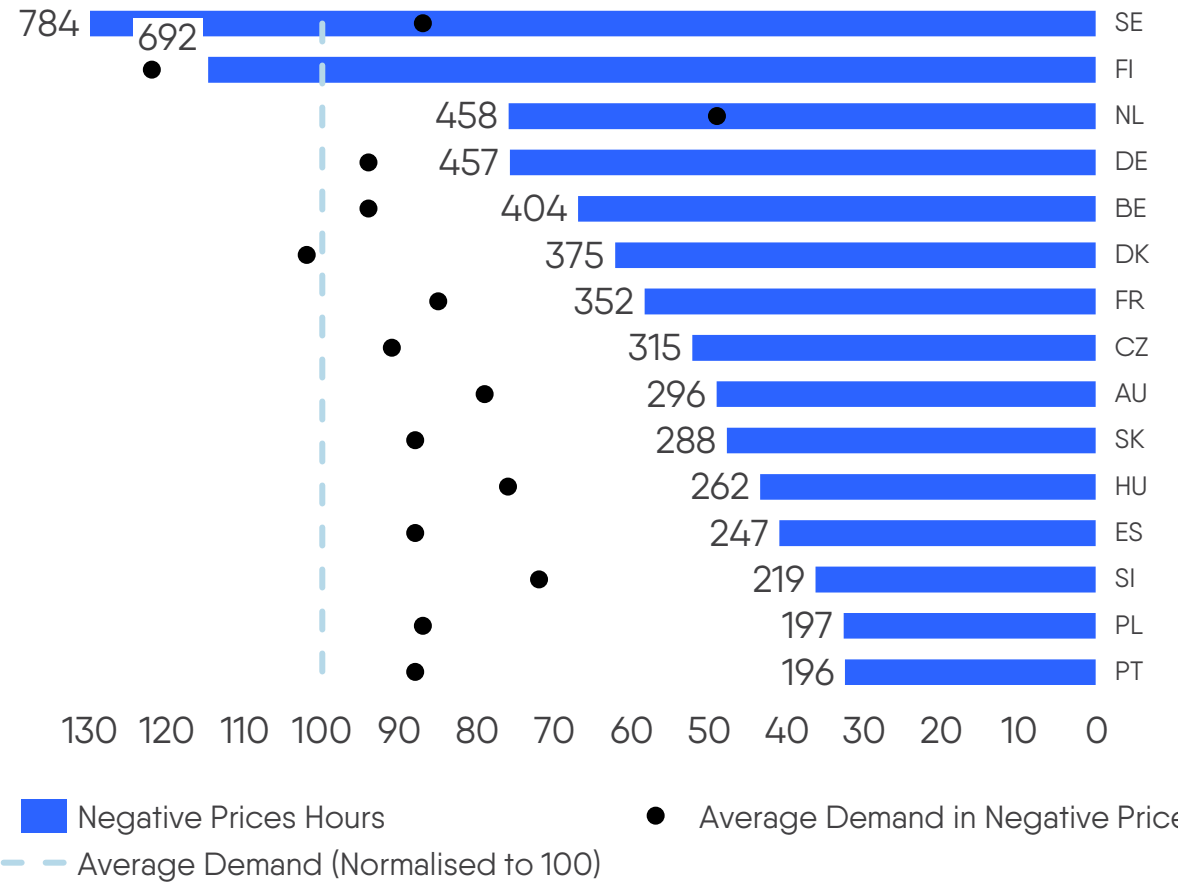
Negative prices, mainly caused by low demand and high RES output, stress the need for flexible solutions and a systemic supply–demand approach

Number of negative price instances in EU27 DA[1] markets[2]



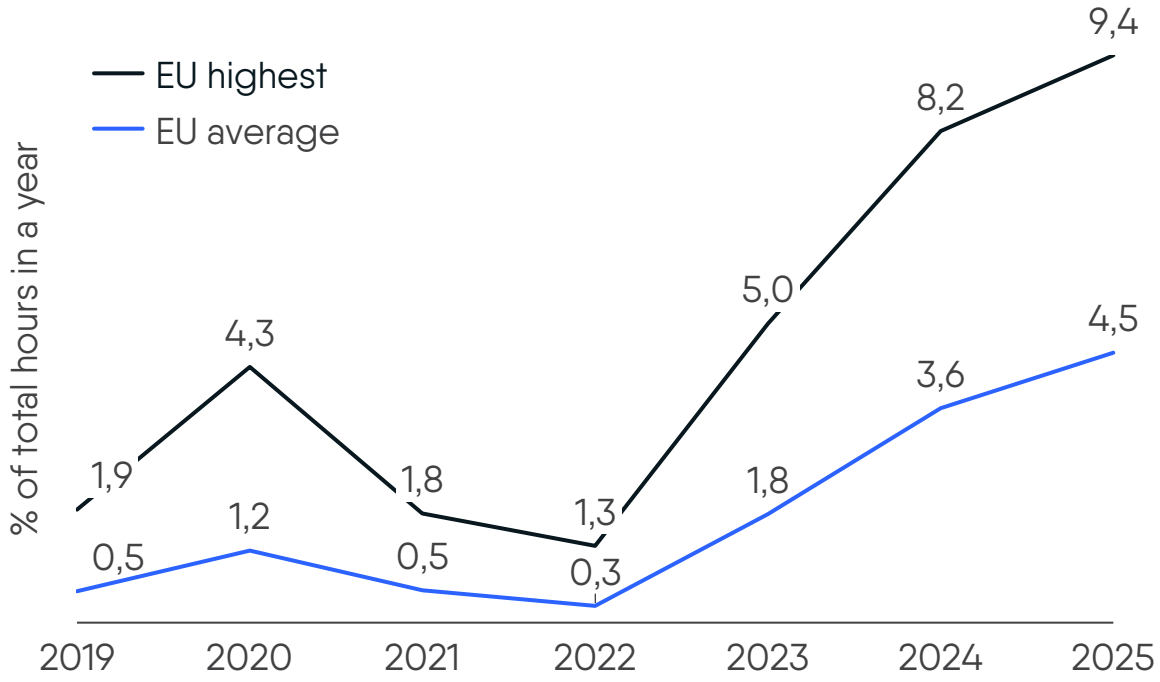
Correlation of solar and onshore wind hourly generation in German DA[1] market in 2024

Notes: 1) Day-Ahead market. 2) Countries with multiple bidding zones (e.g. Sweden) are treated as a single entity. This means that if at least one zone within the country experiences an hour with a negative price, it counts as one instance for the country. Source: Elda.

Surge in negative prices is causing steady drop in solar capture prices

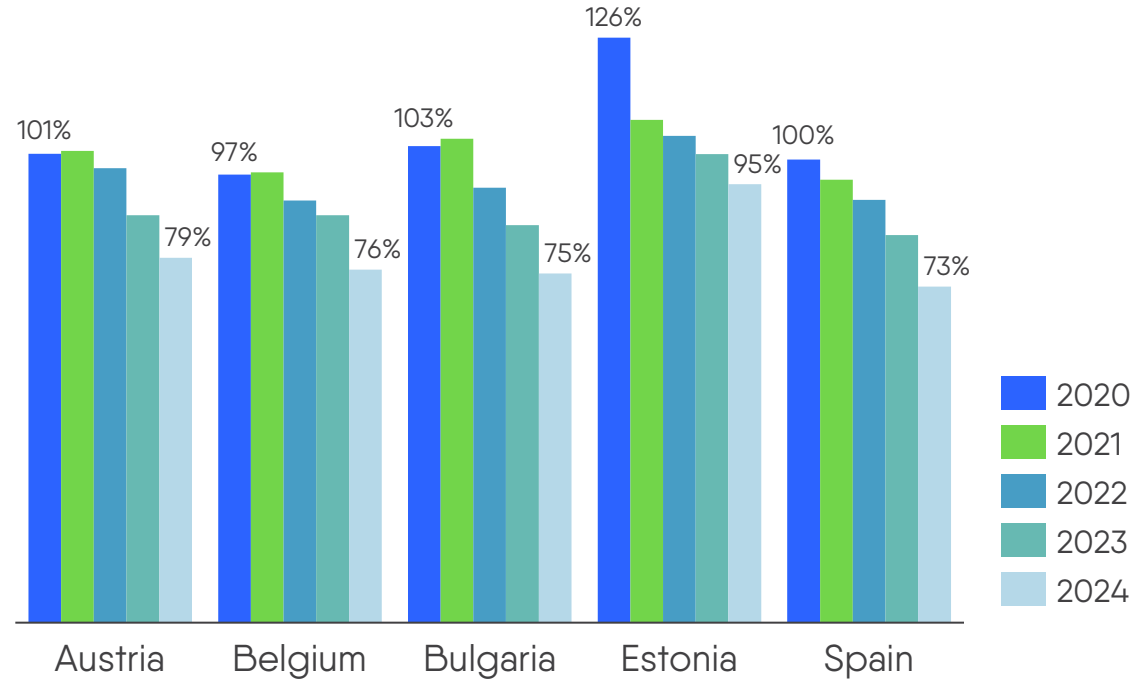
Share of negative prices in all hours in a year – EU average & EU highest[1]

- In 2025 so far, negative prices occurred in 4.5% of hours on average while this was just 0.5 % in 2019. The contrast is stark: Italy saw none, while Sweden_2 faced them 9.4% of the time.



Capture rates for solar PV assets in selected bidding zones[2]

- Surging negative prices hurt solar PV assets, as solar peaks align with price lows. The capture price, a revenue proxy, has steadily declined in recent years.

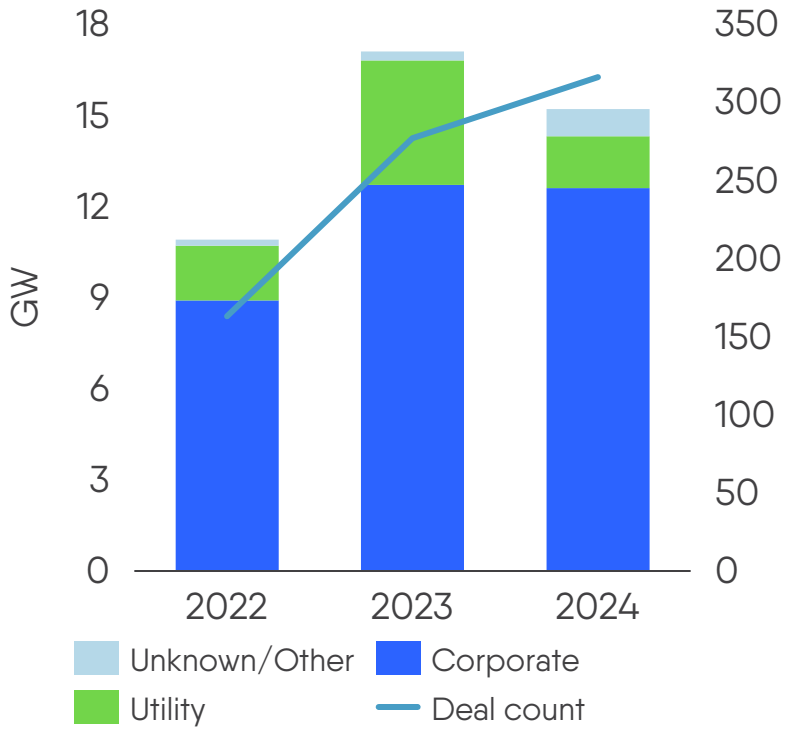


Notes: 1) The data shows what percentage of total hours in a year consisted of negative prices. 2) Capture rate shows what percentage of the average wholesale electricity is really earned by an asset. Source: Elda.

Negative prices and market risks fuelled strong PPA deal interest in 2024, but with more cautious volumes

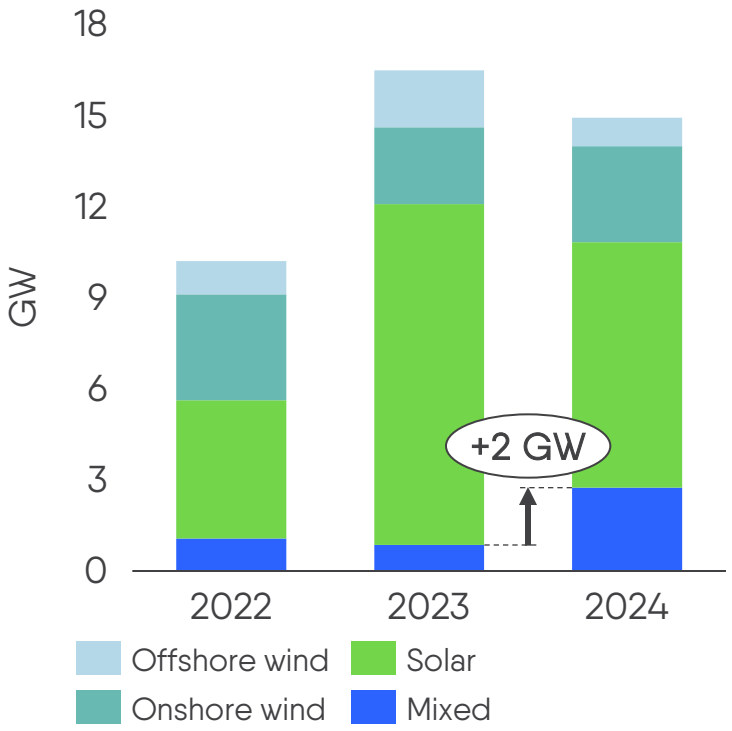
European PPAs deal flow

- In 2024, Pexapark reported 15.2 GW of PPAs[1], an 11% decline from 2023.
- Negative prices and low capture rates discouraged utilities in particular from taking on additional profile risk.



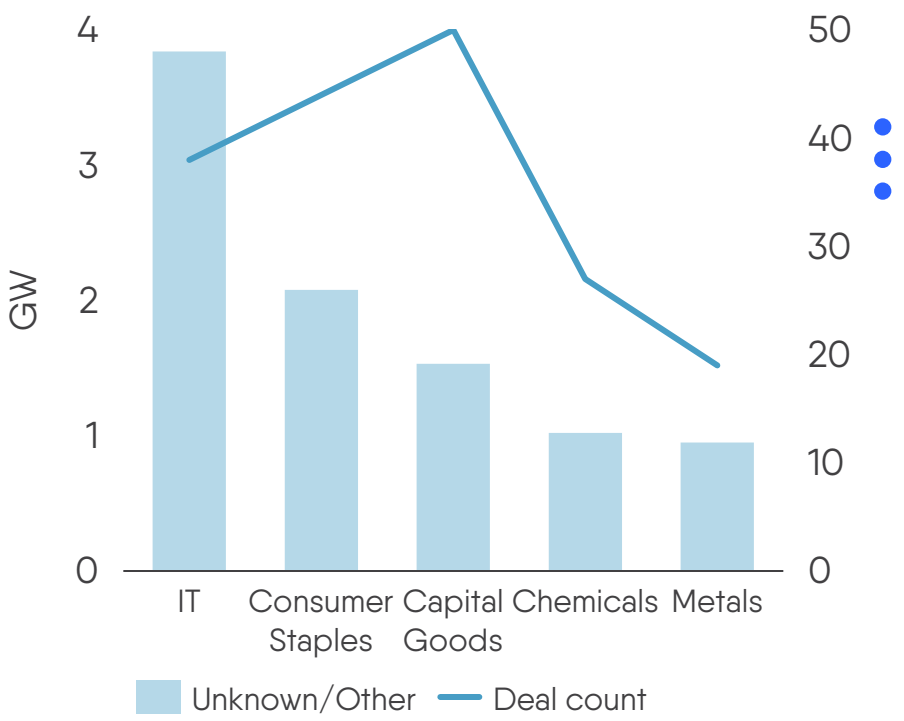
PPAs by technology

- Multi-technology PPAs gained traction with 2.7 GW recorded in 2024.
- Buyers benefit from greater certainty in improved energy profiles, while they lead to better pricing for sellers.



PPAs by corporate sector

- IT signed 38 deals totalling 3.8 GW, a 5% YoY increase in disclosed volumes.
- While sustainability goals remain key, market dynamics now play a bigger role in driving corporate PPA decisions.



Notes: 1) Publicly disclosed contracts. Sources: PPA Tracker, Pexapark.

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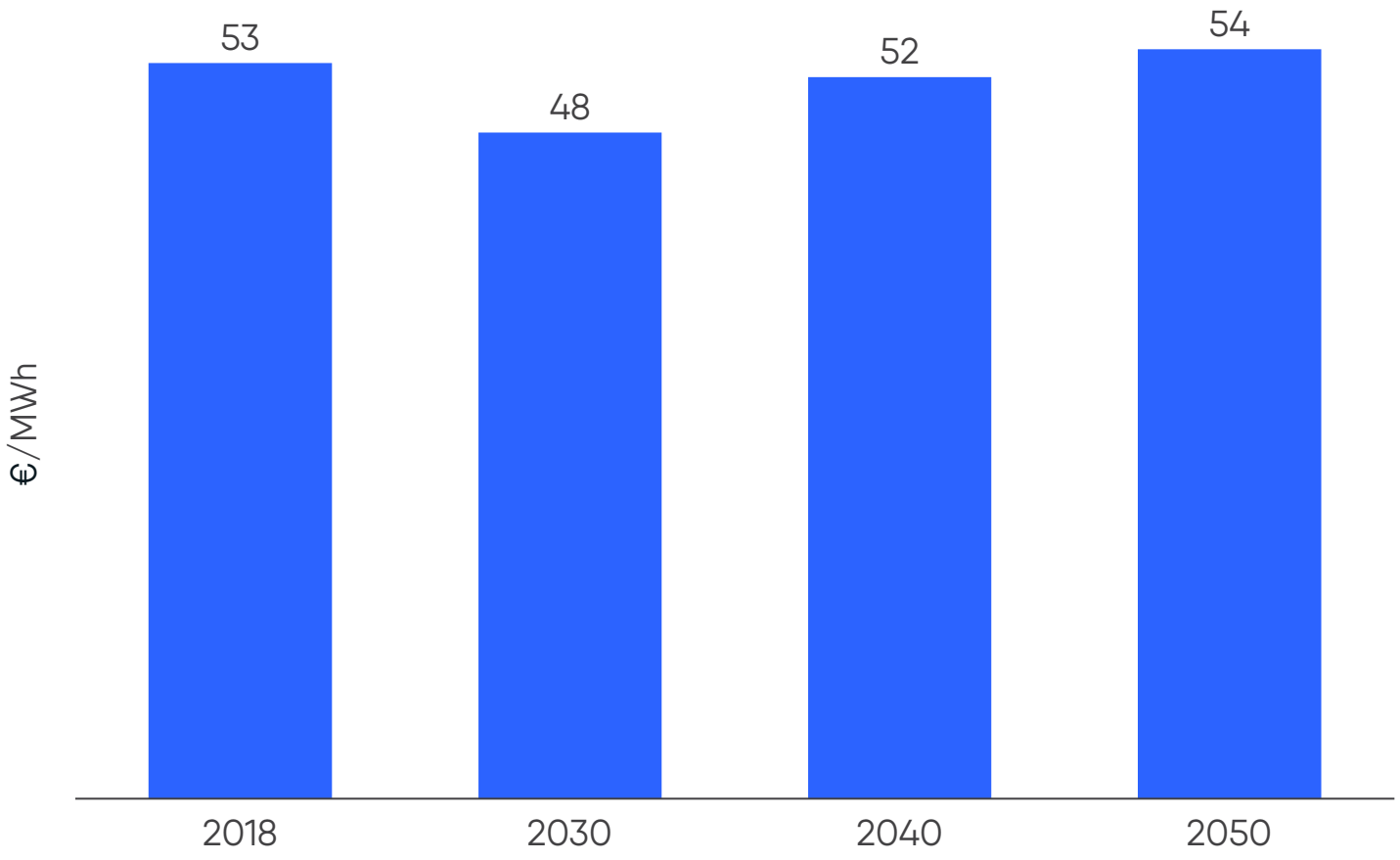
Distribution grid fees stay flat to 2050 as investment costs are offset by higher overall electricity consumption

Estimated average EU distribution tariff

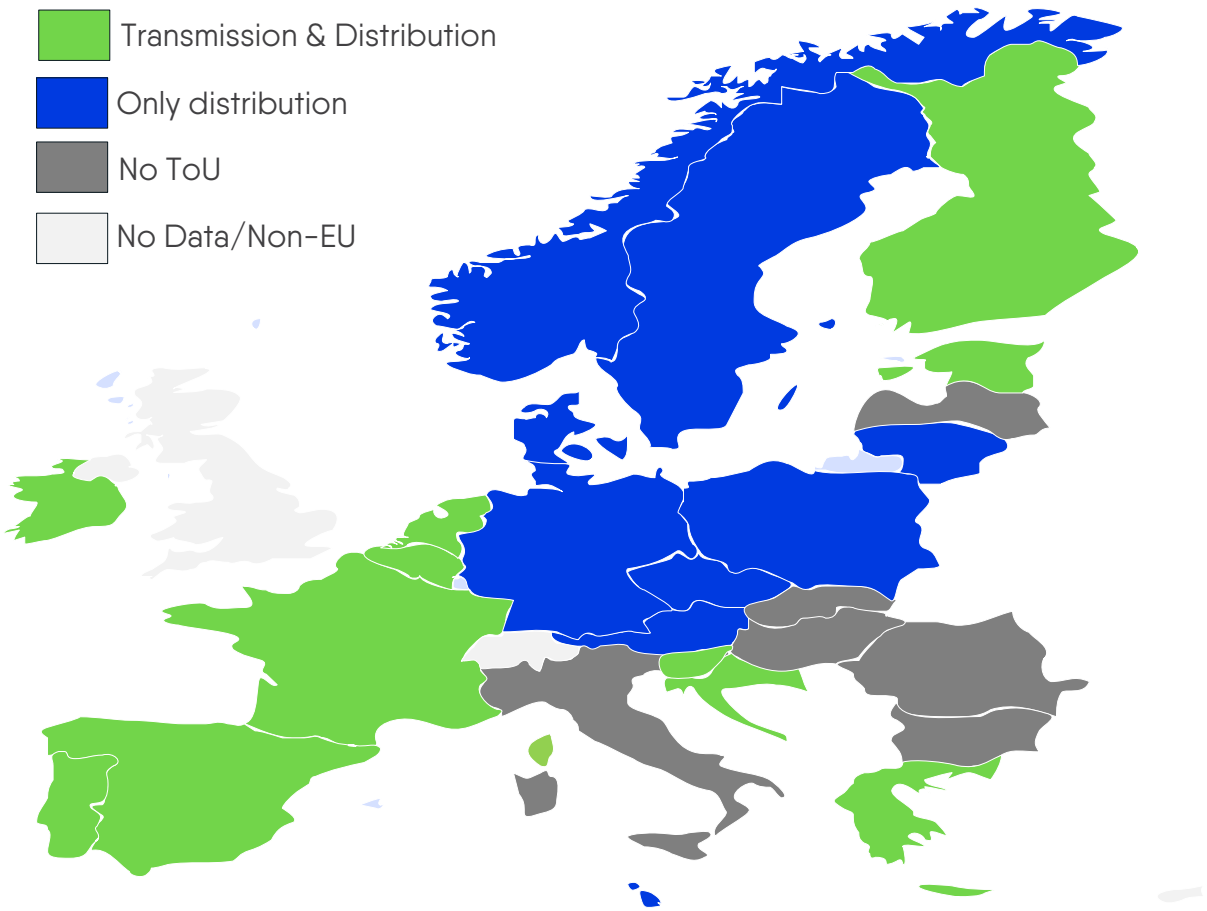


- New investments are recovered over long periods (e.g., 40+ years), so electricity distribution fees do not rise immediately with added investment.
- The amount that grid operators can recover is known as allowable revenue, calculated as: capital return + depreciation + operations and maintenance.
- Electricity distribution fees are influenced by total electricity consumption, not just investment levels.
- As electrification and demand grows, higher consumption helps spread investment costs over a larger customer base, easing the impact on individual fees.

Sources: Eurelectric's Grids4speed report.

Time-of-Use tariffs are useful to optimize the use of the grid

Static Time-of-Use Network Tariffs in Europe



- ToU network tariffs can support efficient grid use and help reduce peak-load.
- Currently, 21 out of 28 countries apply static ToU tariffs at distribution level, and 11 out of 27 at transmission level.
- In some countries, ToU tariffs are not applied due to concerns over their effectiveness, potential conflicts with market price signals, user inaction, implementation complexity, or lack of smart meters.
- Regular evaluation is needed to introduce or revise ToU signals in light of national conditions and evolving grid needs.

Sources: Eurelectric, ACER.

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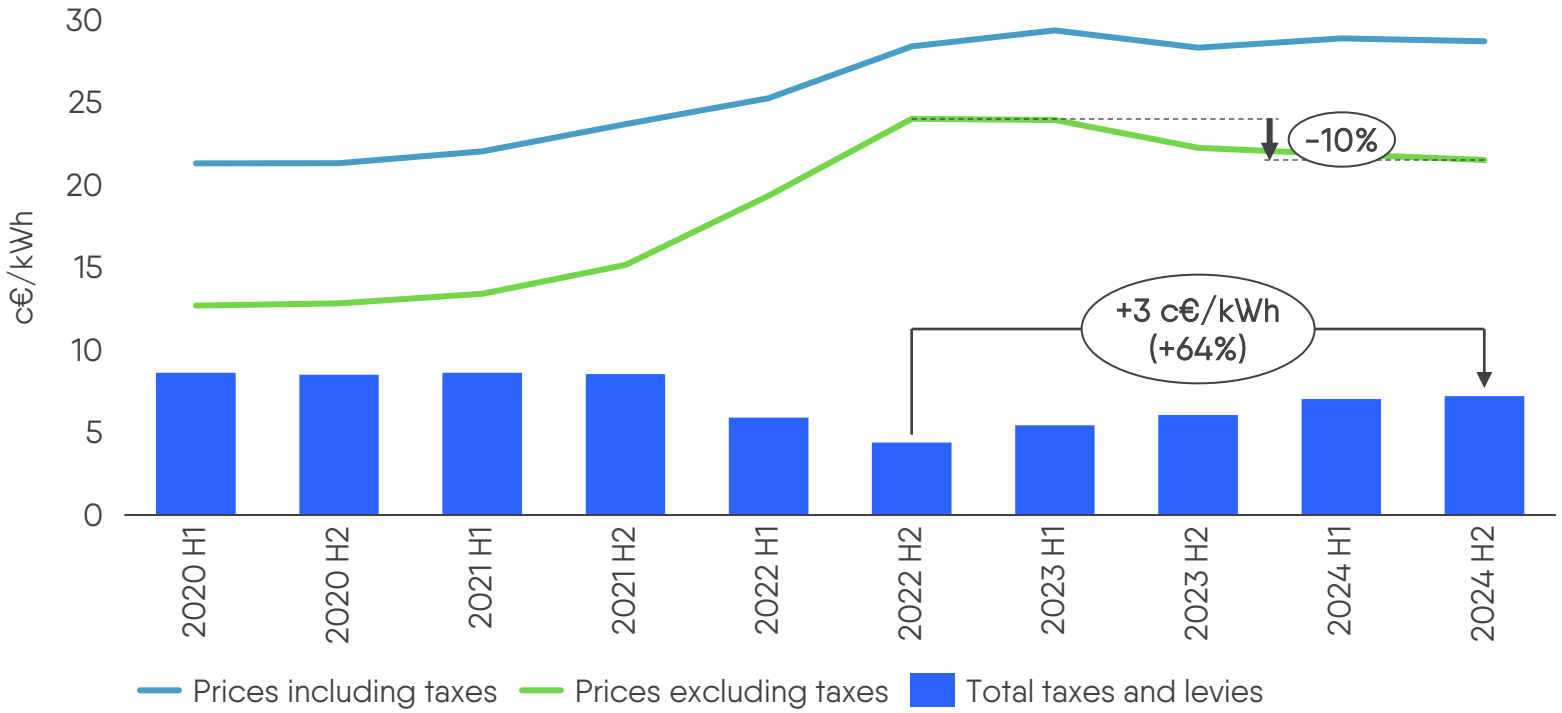
High household electricity prices persist, due to surging tax burdens

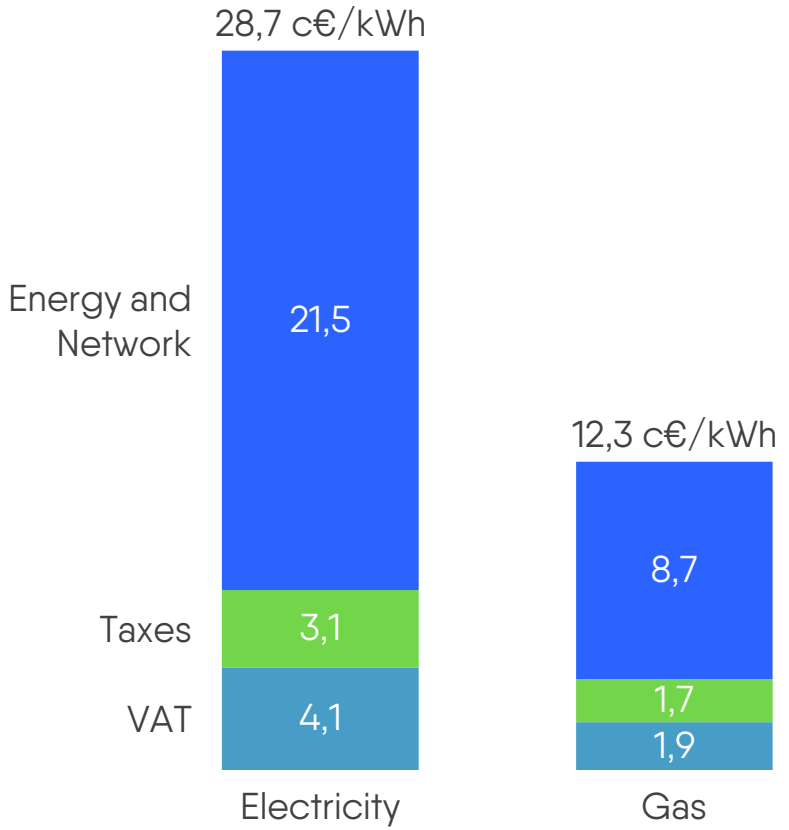
Development of electricity prices for household consumers in EU27

- Since the second half of 2022, total taxes and levies on household consumers have continued to rise year-over-year at an average rate of 28%, while retail power prices remain at historically high levels, exceeding 25 c€/kWh.



Source: Eurostat.

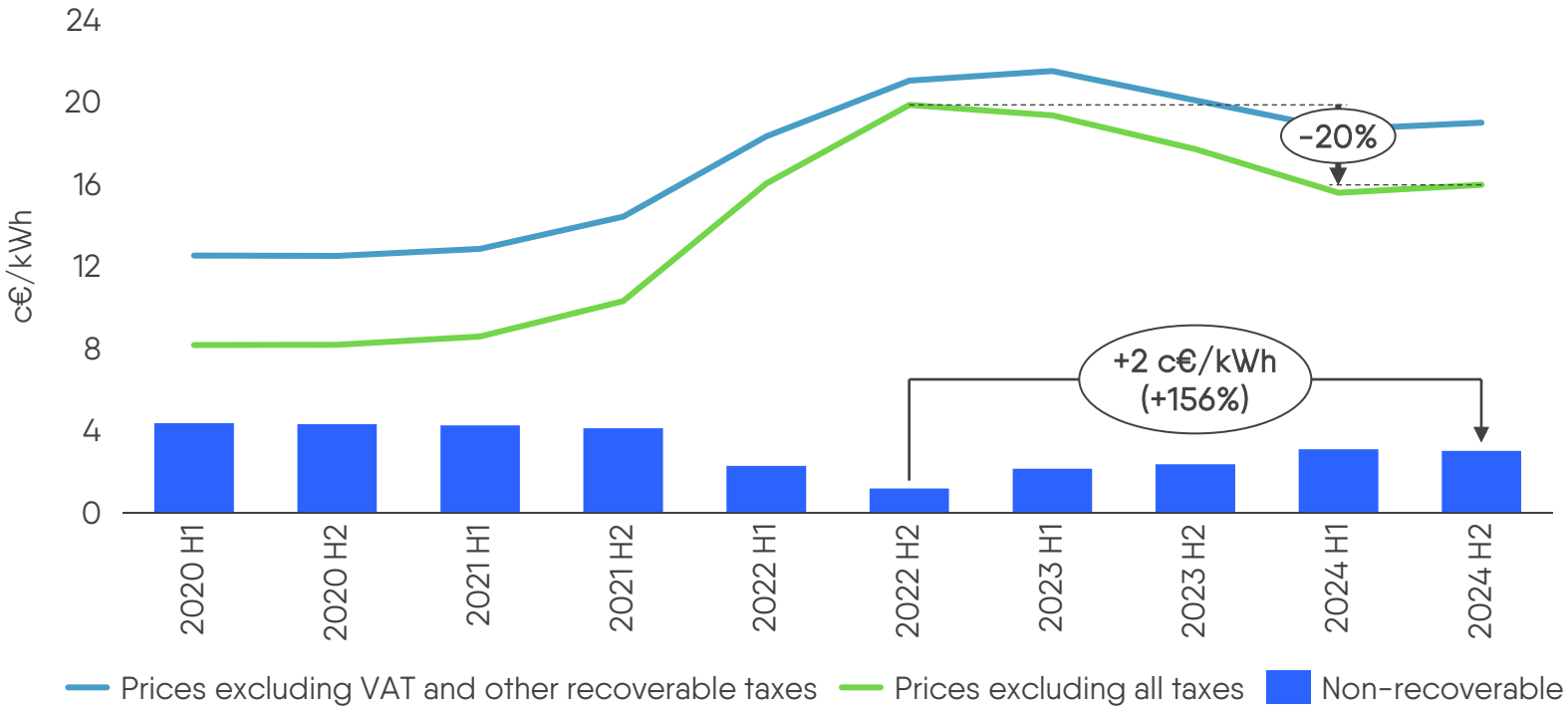
Household electricity and gas prices for in the second half of 2024



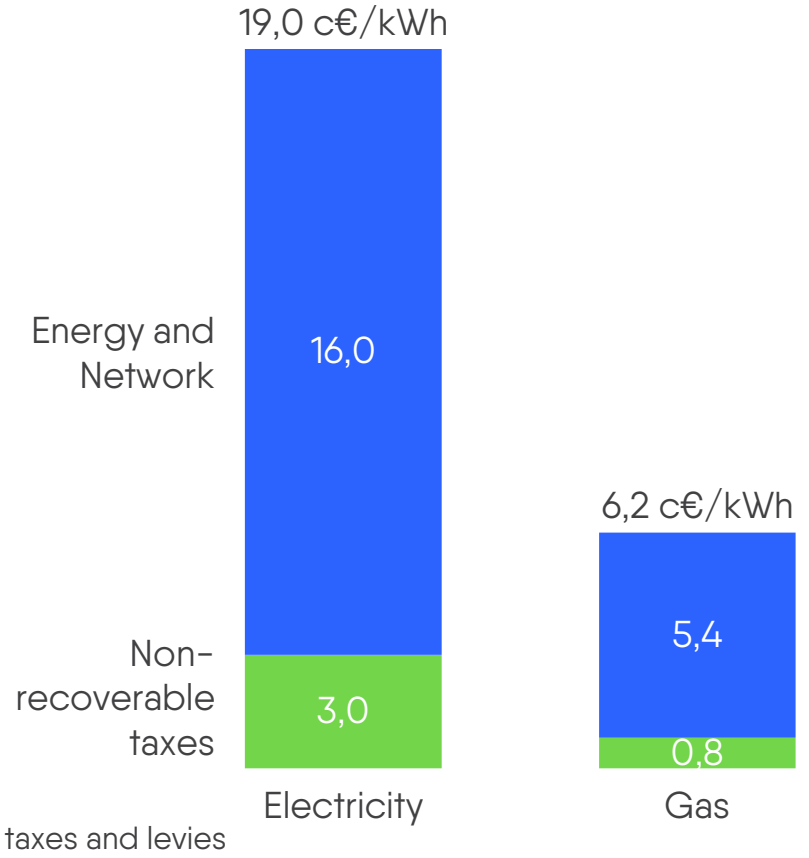
Similar to household prices, non-household electricity face increasing tax burdens while their non-recoverable prices stagnates

Development of electricity prices for non-household consumers in EU27

- Since the second half of 2022, total non-recoverable taxes and levies on non-household consumers have continued to rise year-over-year at an average rate of 60%, while retail power prices decreased to 19 c€/kWh in 2024.



Non-household electricity and gas prices for in the second half of 2024[1]



Notes: 1) VAT and other recoverable taxes excluded. Source: Eurostat.