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Author: Jordi Schröder Bosch, Researcher, Positive Money EU

How Europe's electricity markets survived the stress test of the heatwave

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In the summer of 2026, record-breaking temperatures and prolonged drought put Europe's electricity system to the test. Surging demand for cooling, nuclear plant shutdowns and reduced hydropower output from dried-up rivers have all strained the system, just as gas prices have continued to climb. The good news: solar power buffered consumers' bills and could become an even more effective shield with more batteries being deployed.

In Europe, the fastest-warming continent, we have just experienced the warmest summer on record,[1] with average temperature 2.54°C above the 1991-2020 seasonal average. This article focuses on what this means for a piece of infrastructure that underpins our daily lives: the electricity system. The recurring heatwaves and persistent drought hitting Europe this summer have strained it on multiple fronts.[2] First, electricity demand rises[3] as households increase their use of cooling to cope with higher temperatures. Second, power plants running on coal, gas or nuclear fuel that use water for cooling produce less electricity as water gets warmer and scarcer. Third, dried-up rivers limit hydropower generation. Fourth, wind generation can also decrease,[4] as wind speeds drop during heatwaves.[5] Finally, the amount of electricity that transmission cables can carry is reduced as warming increases.

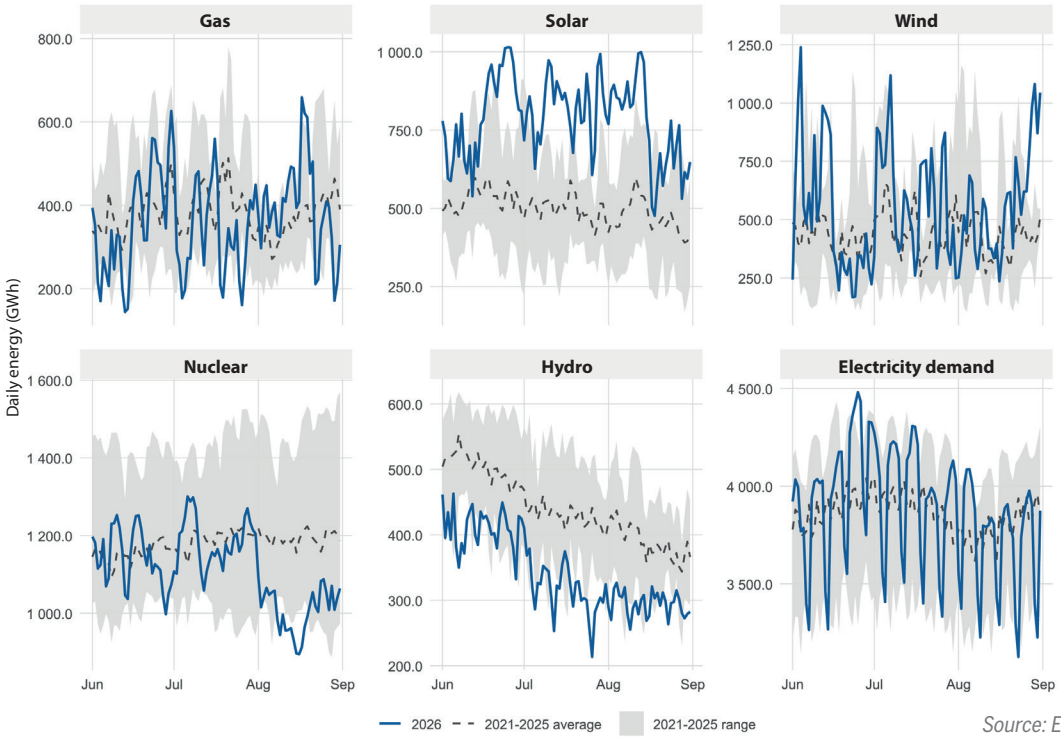
In this article, we focus on the impacts of the heat wave on the interconnected electricity markets of the Core Capacity Calculation Region (Core CCR), covering Austria, Belgium, Croatia, Czechia, France, Germany, Hungary, Luxembourg, the Netherlands, Poland, Romania, Slovakia and Slovenia. These countries calculate cross-border transmission jointly and set wholesale market prices through a common mechanism. This integration means that prices largely converge,[6] as we will see below, and that disruptions in one country affect the rest. These countries were also among the hardest hit this summer, with record temperatures and drought in two of their major rivers, the Rhine and Danube.

HOW THIS SUMMER'S HEAT AND DROUGHT DISRUPTED ELECTRICITY SUPPLY AND DEMAND

Figure 1 shows how different generation technologies performed this summer across the Core CCR, compared with 2021-2025.

Several things stand out. Electricity demand exceeded previous records on multiple occasions, particularly in late June, as a record-breaking heatwave[7] hit. At its peak, on 25 June 2026, demand ran 15.7% above the 2021-2025 average and 5.6% above the highest level recorded for that period.

Figure 1: Core CCR electricity generation and demand; summer 2026 and 2021-2025



Source: ENTSO-E. Own elaboration.

Hydropower generation underperformed all summer long. On almost 60% of days, it fell below the 2021-2025 minimum level, as rainfall from spring onwards has run well below average,[8] a shortfall that worsened during the heatwave.[9] Overall, hydropower generation was 22.9% below the 2021-2025 average.

Nuclear generation saw two marked dips. The first came in late June, just as the heatwave was increasing demand. On 28 June 2026, output was 14.5% below the seasonal average. The second longer-lasting dip came in August, when the persistent drought conditions drove the Rhine and Danube to critically low flow levels – both rivers being critical for nuclear plant cooling in several countries. On 16 August 2026, nuclear generation fell 24.7% below average, 11.2% below the previous low for that date.

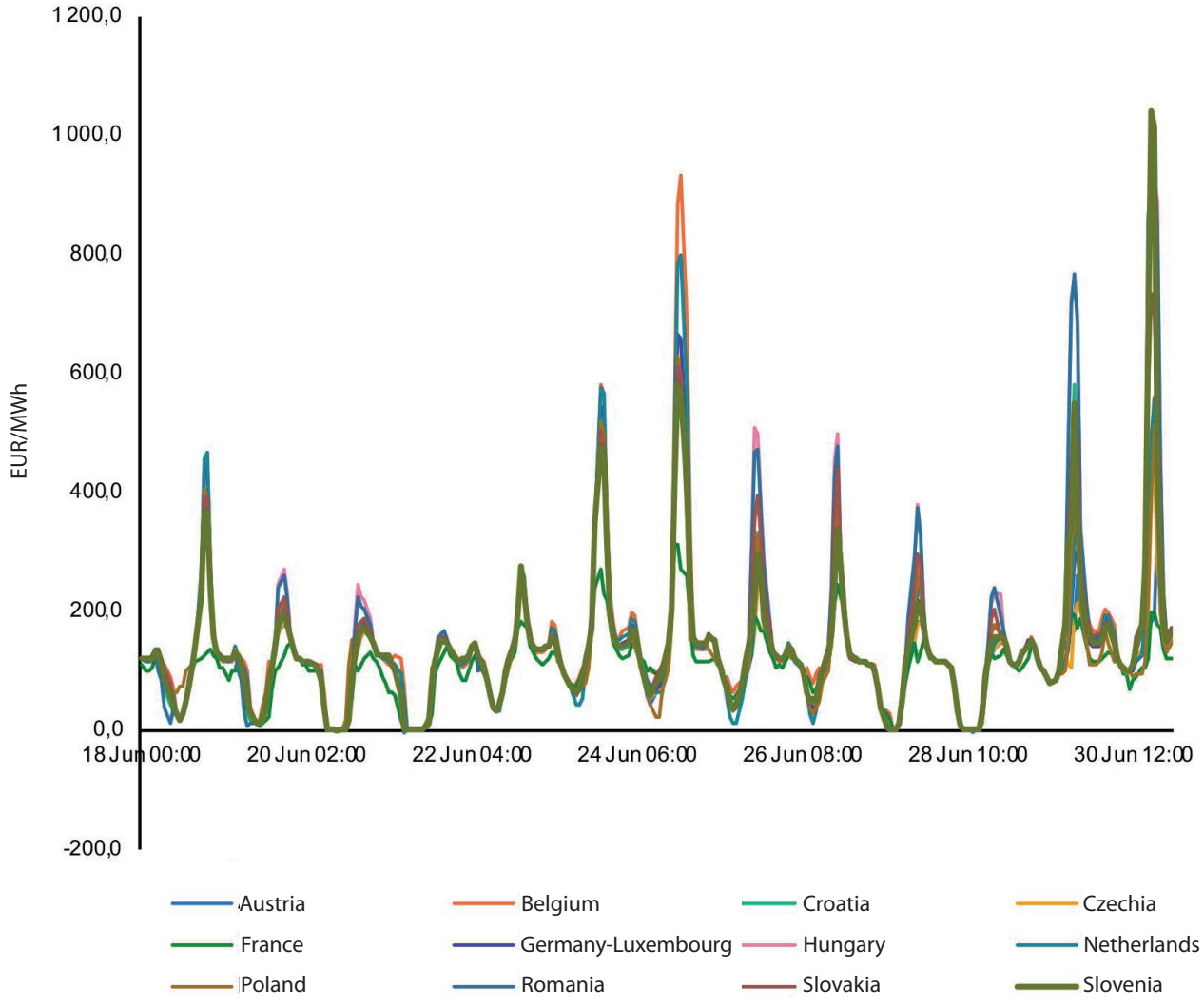
This summer's rough weather conditions therefore hit two key generation technologies, nuclear and hydropower, which provided 32.5% and 12.1% of electricity, respectively, in the Core CCR countries during 2021-2025. In parallel, the heatwave pushed demand to the upside. Next, we zoom in on two key stress events: late June and early August 2026.

RECORD HEATWAVE IN LATE JUNE 2026

This was the hottest June recorded in western Europe,[10] with most of the warming concentrated at the end of the month. As we saw above, this pushed up demand while reducing nuclear and hydro generation. This was, to a certain extent, counterbalanced by record solar generation (see Figure 1), which increased 9.7% relative to 2025. However, as can be seen in the left panel of Figure 2, prices spiked during the evening as solar generation decreased.

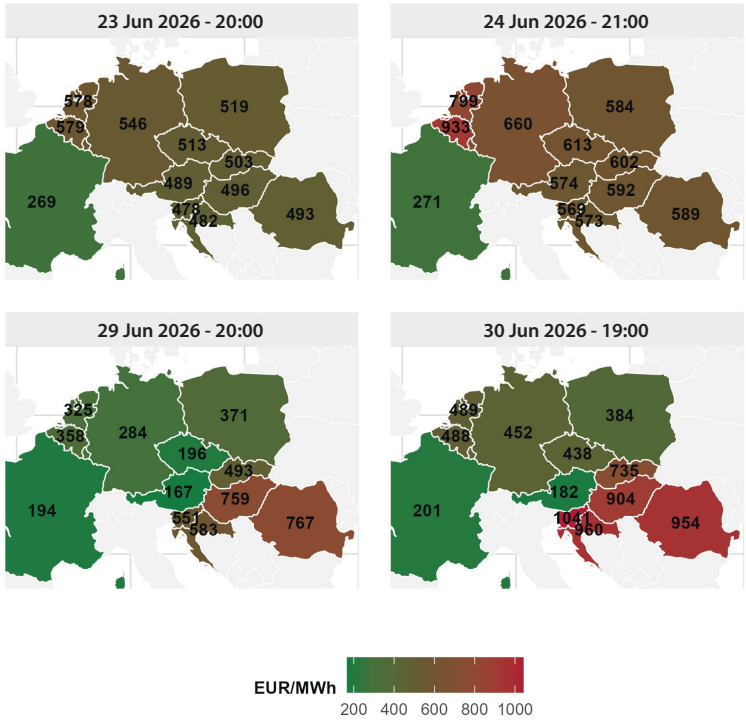
In the right panel of Figure 2, we can see how the largest price spikes moved eastward with the heatwave. On 24 June 2026, Belgium experienced an hourly peak of €933/MWh, with the Netherlands at €693/MWh and Germany at €660/MWh.[11] Wind, which performed well over the summer as a whole, also fell below average during June's heatwave (see Figure 1). Belgium was worst affected, with its nuclear capacity offline for maintenance, while French nuclear output was reduced[12] as well. On 30 June, Slovenia reached hourly peaks of €1,041/MWh, Croatia €960/MWh, Romania €954/MWh and Hungary €904/MWh. The cause was the same: high demand meeting weak nuclear and hydro output (both technologies playing a key role in the region). With every Eastern European country importing electricity at once, interconnectors hit their maximum capacity, which explains the large price gap between east and west.

Figure 2: Hourly day-ahead prices across the Core CCR (June 2026)



Source: ENTSO-E. Own elaboration. Note: Times shown are Brussels local time.

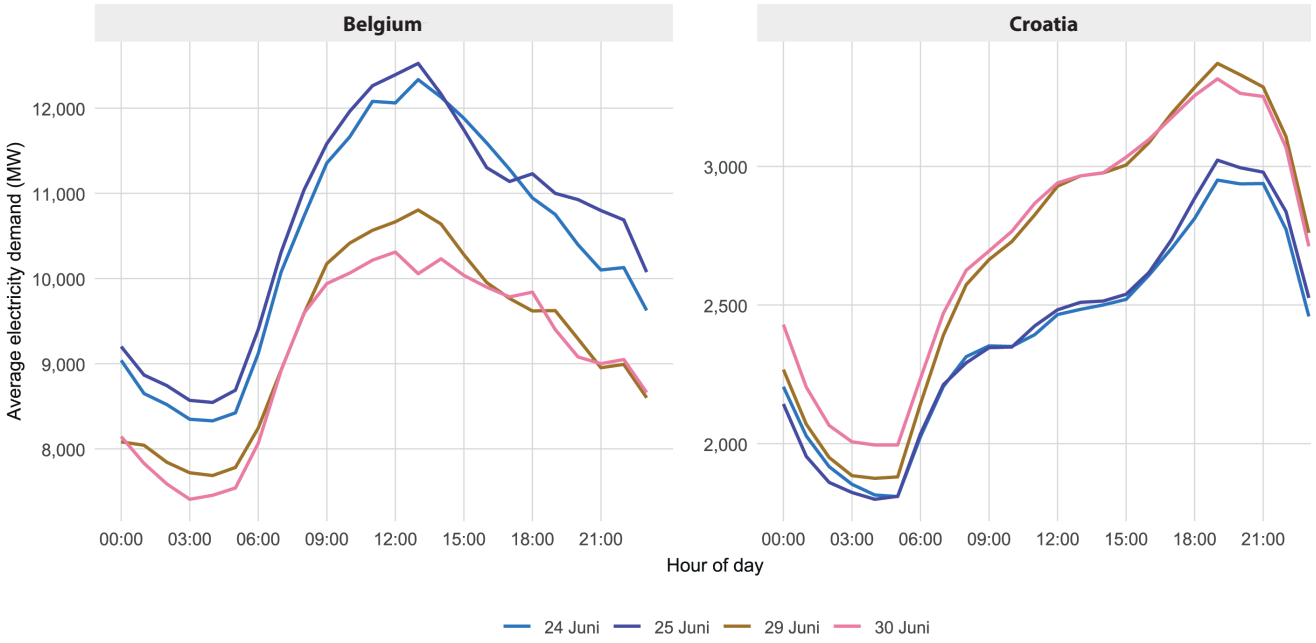
Figure 2: Hourly day-ahead prices across the Core CCR (June 2026)



Source: ENTSO-E. Own elaboration. Note: Times shown are Brussels local time.

Figure 3 shows how the eastward movement of the heatwave shaped electricity demand, which peaked in Belgium on 24-26 June and in Croatia on 29-30 June 2026.

Figure 3: Average electricity demand profile, 24-30 June 2026

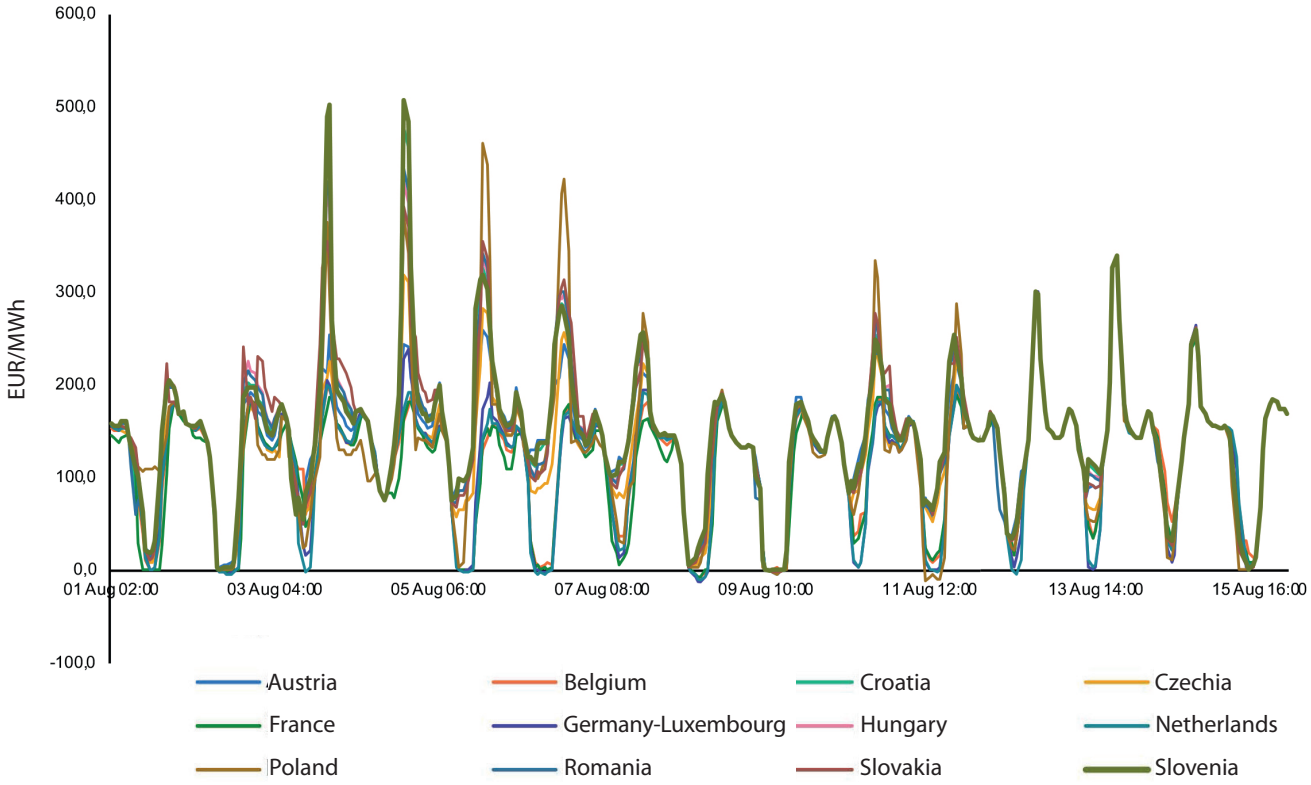


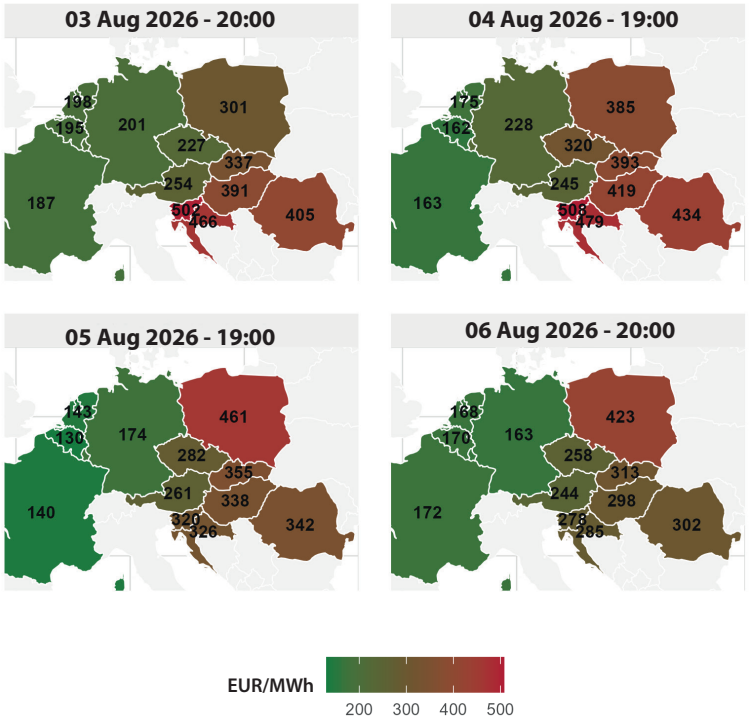
Source: ENTSO-E. Own elaboration.

A CONTINUED DROUGHT HITS NUCLEAR GENERATION IN AUGUST 2026

Continued high temperatures and the accumulation of low rainfall starting in May meant that, by August 2026, rivers that play a key role in providing cooling water for electricity generation were at critical levels. As Figure 5 shows, this hit Eastern European countries hardest, with the highest price peaks appearing there.

Figure 4: Hourly day-ahead prices across the Core CCR (August 2026)



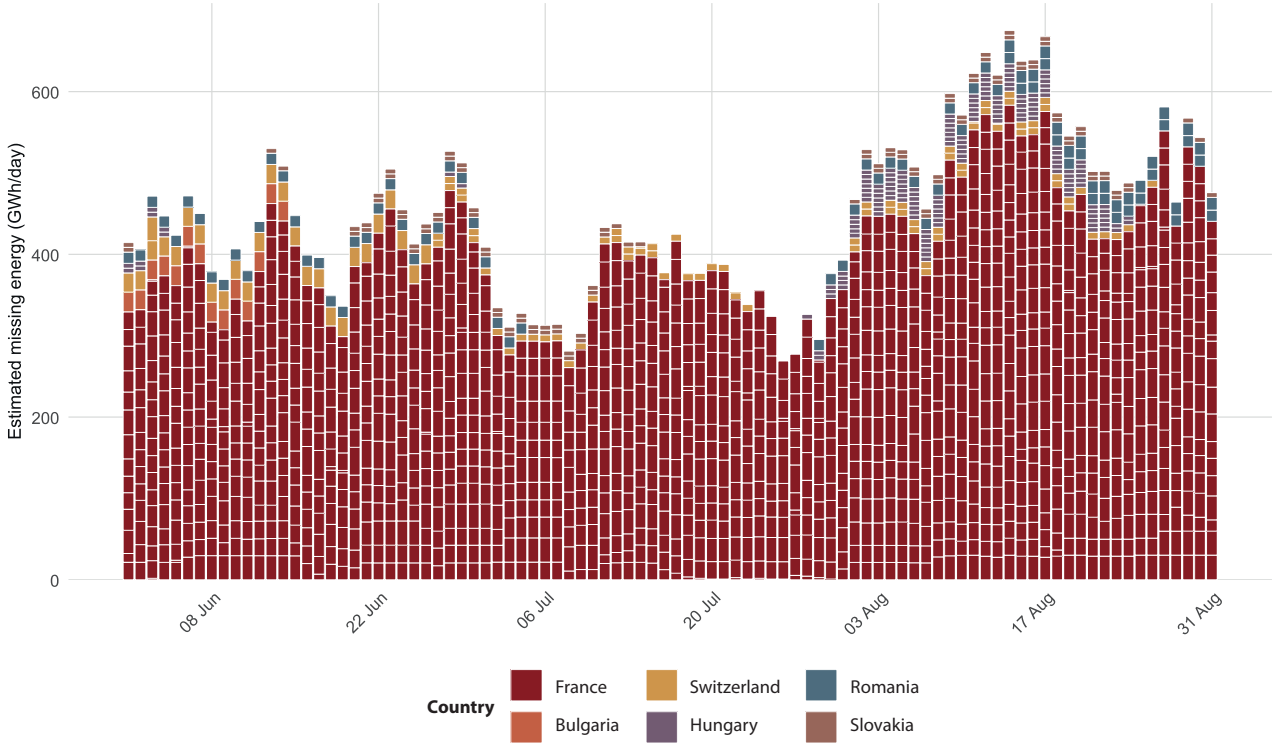


Source: ENTSO-E. Own elaboration. Note: Times shown are Brussels local time.

Output at Hungary's 2-gigawatt (GW) Paks nuclear plant, which supplies around one third of Hungary's electricity consumption, fell to very low levels.[13] In Romania, the Cernavodă plant, which supplies 20% of national generation, lost around half its output,[14] and extraordinary measures had to be taken to channel more Danube water towards the remaining reactor. In countries where nuclear carries a large share of generation, a few reactors going offline can pose big risks to the whole system.

The mechanism is twofold. Nuclear generation falls as warmer water cools less effectively, and environmental regulations limit how warm the water returned to the river can be. More importantly, drought compounds the issue, as, with less water flowing, there is less capacity to absorb the plant's heat, which makes it the hardest constraint to bypass.[15] Figure 5 shows the number of nuclear reactors in the Core CCR producing at below 10% of their normal output. The stacked bars show the estimated missing daily nuclear generation, which peaked at 675 GWh in mid-August. While a substantial share is attributable to planned maintenance, the graph shows a marked increase during early August, as heat and drought critically impacted nuclear infrastructure.

Figure 5: Estimated missing daily electricity production from nuclear reactors that operate below 10% of their normal operating level



Source: ENTSO-E. Own elaboration.
Note: A reactor is included when its mean reported output is no more than 10% of its normal operating level on that day. Normal output is defined as the median hourly output in 2026 when the unit produced at least 50% its maximum observed generation level. Each individual bar represents the reactor's missing daily generation, calculated as the difference between normal and reported generation on that day.

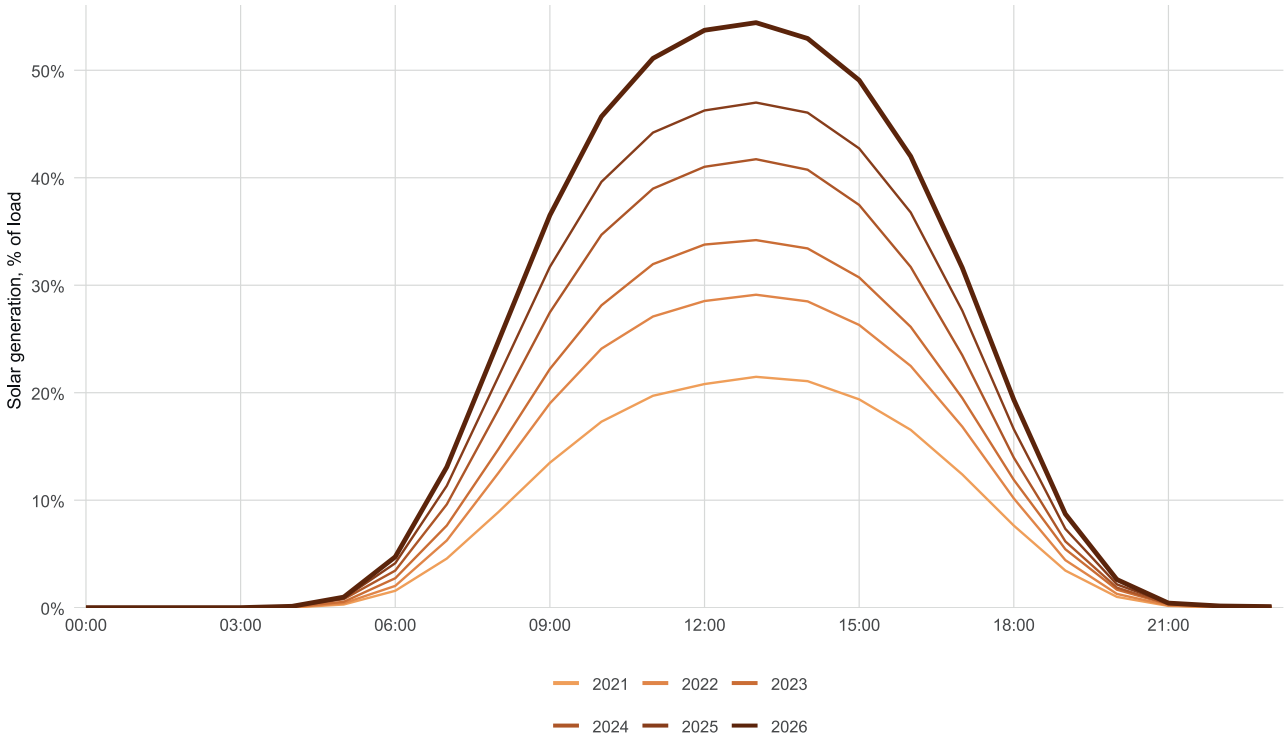
The same drought kept hydropower generation at seasonal lows. The impacts did not stop at hydro and nuclear power. In Poland, the power plant operator Enea reduced production at the large Kozienice and Połaniec coal plants[16] as exceptionally low flows on the Vistula restricted the water available for cooling. Around 1.1-1.3 GW of capacity was taken offline. Coal, nuclear and hydro are considered firm sources of power, meaning that they can generate electricity on demand, regardless of weather conditions. As this summer shows, climate change calls their 'firmness' into question.

Figure 4 also shows that August's peaks stayed well below those of late June, especially in Western Europe. The lower electricity demand due to August holidays moderated the negative impacts outlined above on the system. While prices still spiked, especially in the east, the outcome could have been far worse had these same circumstances occurred during an ordinary working week of higher electricity demand.

SOLAR COMES TO THE RESCUE, BUT STORAGE IS MISSING

As shown in Figures 2 and 4, prices decline steeply at midday, when solar generation peaks. Solar generation covered just over 20% of Core CCR demand at the midday peak in 2021. By 2026, it covered more than half (Figure 6). This increase is nothing but impressive, and a key reason for why the electricity system remained functional as other generation technologies underperformed.

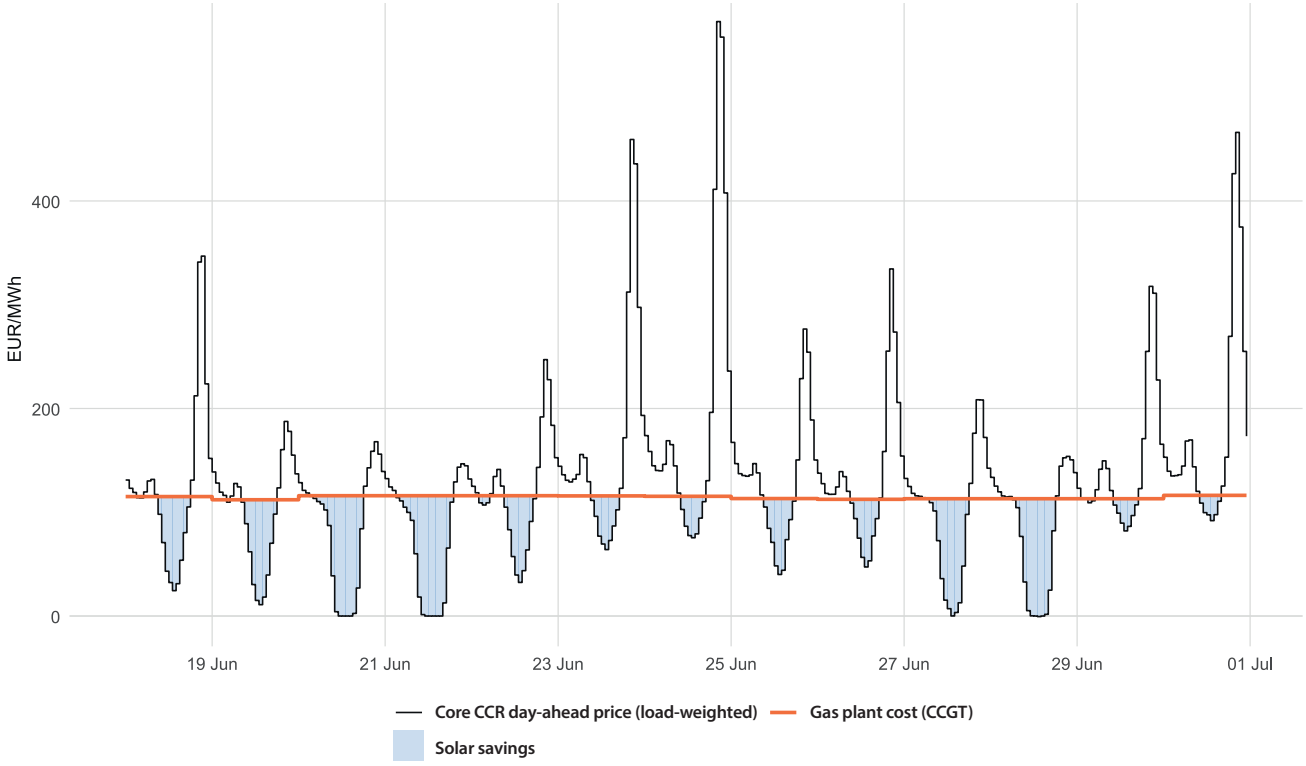
Figure 6: Solar share of Core CCR demand on an average summer day[17]



Source: ENTSO-E. Own elaboration.

Increased solar generation has delivered substantial savings for European consumers. As Figure 7 shows, in the middle of the day, Core CCR wholesale prices fall well below the cost of running a gas plant. Across 18-30 June alone, as illustrated in Figure 7, those cheap hours saved consumers around €1.13 billion, compared to a benchmark in which every hour is set by gas. Importantly, this is a conservative estimate, as it assumes the cheapest gas plants – a combined-cycle gas turbine (CCGT) unit – set the price during all hours, and hence ignores the role of gas peakers and their ramp-up costs.[18]

Figure 7: Core CCR wholesale prices vs the cost of gas-fired generation (June/July 2026)



Source: ENTSO-E. Own elaboration.
Note: Gas plant cost is the estimated short-run marginal cost of a combined-cycle gas turbine (CCGT) gas plant, including fuel, CO_2 costs and operating costs. See methodological notes at the end for more details. The Core CCR price is the load-weighted average wholesale electricity prices.

What this ultimately shows is that the solar boom needs a matching battery boom. Storage is needed to flexibly transfer solar generation into the evening, when the sun has set but demand for electricity remains. This would flatten the price spikes and increase consumers' savings.

The US State of Texas has a grid-scale battery capacity of 14 GW.[19] That is orders of magnitude higher than most Core CCR countries and sets an unexpected precedent. This summer, despite hitting record-high demand amid high temperatures, its electricity system came through unscathed, without extreme price hikes like in the Core CCR countries in Europe. This comes in sharp contrast to 2023, when battery capacity was much lower and prices were reaching the cap of US$ 5,000/MWh during the hottest days.

The climate crisis will keep testing our electricity systems, but the solutions are already in our hands. Mitigation and adaptation go hand in hand in tackling this issue. The same technologies that adapt our system to hotter temperatures can, at the same time, curb the emissions causing those hotter temperatures. This convergence of necessity and virtue is not a given, and we should strongly embrace it. The revision of the EU energy security framework offers an opportunity to place climate-related risks at the centre of the policy debate. Stress tests covering heatwaves and droughts, as well as their interaction, need to be mandatory, so as to identify the vulnerabilities they pose to the electricity system. Their findings must inform corrective measures that strengthen infrastructure resilience, adapt generation and increase flexibility. These assessments would also inform the design of capacity mechanisms being currently established in several countries. Their design should recognise the contribution that storage can play in meeting current flexibility needs, instead of doubling down on current gas vulnerabilities, as the current German capacity mechanism does.[20] Finally, the assessment should also guide cross-border investment priorities within the EU Grids Package.[21] By increasing cross-border transmission capacity, European differing weather patterns are turned into an asset, helping narrow spreads and neutralising climate-related disruptions to individual countries. At this juncture and with so much at stake, policymakers on the fastest-warming continent would be wise to press the accelerator and bring the energy transition forward, instead of holding it back.

METHODOLOGICAL NOTES

Gas plant cost (orange line in Figure 8): Short-run marginal cost of a combined-cycle gas plant, following Ember's method:[22]

$$SRMC = TTF / 0.5 + 0.37*EUA + 2€/MWh$$

TTF (Title Transfer Facility, a fossil gas trading hub) is the daily gas price (€/MWh), 0.50 the gross (HHV, higher heating value) electrical efficiency, 0.37 the emission factor in tonne of carbon dioxide (CO_2) per megawatt-hour (MWh) of electricity, EUA (EU carbon emission allowance) the carbon price (€/t) and €2/MWh variable operation and maintenance costs (O&M). The line excludes start-up, ramping and fixed costs, so it is a floor for what a gas plant needs to recover, not its full cost.

Solar savings: Each hour's Core CCR price is the load-weighted mean of the 12-bidding zone day-ahead prices, with quarter-hourly 2026 prices averaged within an hour. The difference between that price and the gas plant cost is multiplied by total Core CCR load in the same hour: hours below the cost line give savings.

1 European Commission/ECMWF: Copernicus: August was the world's joint hottest month on record, pushing global temperatures back above 1.5°C above pre-industrial levels, 10 September 2026.

2 Georg Rute: Europe's heatwave is creating quadruple whammy for the grid. Enlit, 15 July 2026.

3 EU Agency for the Coordination of Energy Regulators (ACER): Progress of EU electricity wholesale market integration. 2024 Market Monitoring Report, 14 November 2024.

4 Jiewen You, Fangxu Yin and Lu Gao: Escalating wind power shortages during heatwaves. Communications Earth and Environment 6, 245 (2025).

5 Molly Lempriere: Factcheck: How nuclear, gas, wind and solar power are affected during heatwaves. Carbon Brief, 4 August 2026.

6 ACER, 14 November 2024.

7 European Commission/ECMWF, 10 September 2026.

8 European Commission Joint Research Centre (JRC): Worsening drought and record heat grip Europe, fuelling extraordinary wildfires and extremely low river flows, 12 August 2026.

9 France, for example, had roughly a 40% summer precipitation deficit, and July rainfall was 67% below normal. Météo France: Bilan climatique de l'été 2026 (juin-juillet-août), 3 September 2026.

10 European Commission/ECMWF, 10 September 2026.

11 Computed as the average of 15-minute periods.

12 Forrest Crellin and Hugo Lhomedet: Europe's heatwave curbs French nuclear plants. Reuters, 24 June 2026.

13 Elena Giordano: Hungary faces energy crunch as drought shuts down Paks nuclear plant, PM says. Politico, 2 August 2026.

14 Gavin Blackburn: Romania shuts off second reactor at Cernavodă NPP amid low water levels on Danube. Euronews, 13 August 2026.

15 Molly Lempriere. Carbon Brief, 4 August 2026.

16 Bálint Szalai: Extreme heat and low Vistula River levels force power cuts at Polish coal plants. CEE Energy News, 6 August 2026.

17 See methodological note.

18 Neon: Preisspitzen am deutschen Strommarkt, 3 December 2025.

19 Modo Energy: ERCOT Annual Buildout Report: Battery capacity reaches 14 GW entering 2026, September 2026.

20 European Commission: Commission approves German capacity mechanism of up to €35 billion to secure electricity supply, press release, 2 September 2026.

21 European Commission: European Grids Package, September 2026.

22 Ember: European electricity prices and costs - Methodology, September 2026.

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