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# An uncomfortable truth: What Spain's blackout really showed

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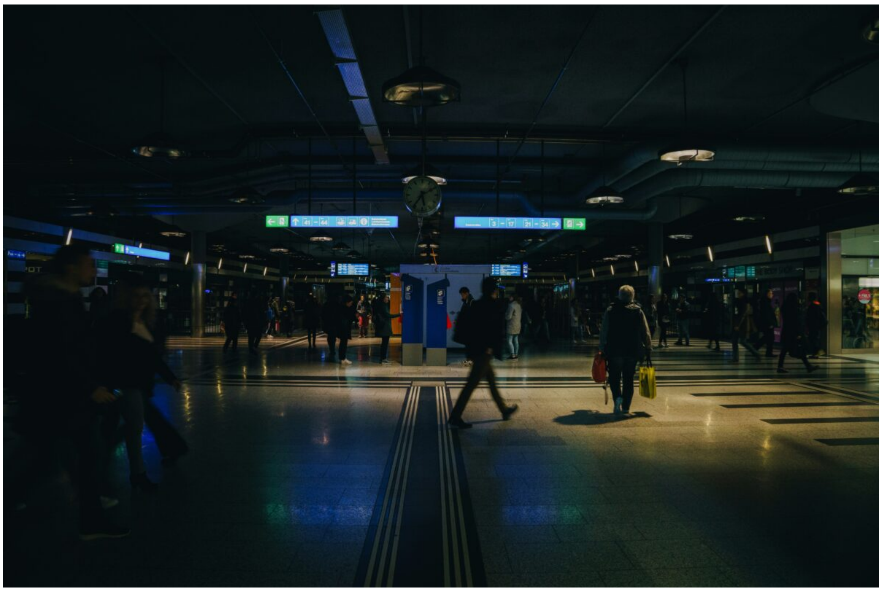

https://www.pv-magazine.com/2026/05/25/an-uncomfortable-truth-what-spains-blackout-really-showed/
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Spain and Portugal experienced a historic blackout caused not by cyberattacks or renewables alone, but by a fast-moving overvoltage event that exposed weaknesses in voltage control, grid coordination, and legacy operating practices in a renewable-heavy power system. Investigations concluded the outage was multifactorial, prompting Spain and Portugal to reform voltage-control rules, expand grid resilience measures, and accelerate deployment of batteries, grid-forming technologies, and renewable-based voltage support to stabilize future electricity networks.

At 12:33 CEST on April 28, 2025, an outage cut power across continental Spain and Portugal and briefly affected a small area of southwest France. This was the first full blackout in the history of the Spanish system and its first loss of power event in history caused by overvoltage problems.

The event was not the simple story many first reached for. It was not a cyberattack. It was not a straightforward failure of solar or wind power plants. It was not solely caused by lack of spinning generation. It was a fast-moving voltage event in a system where generation, grid operation, protection settings, regulation and visibility did not move at the same speed as the energy transition.

**Voltage control**

Before delving into the consequences of the event and what they mean for Spain and for the wider European system, let's start with the basics, what is voltage control. Everyone understands what a power shortage is, but what about reactive power? Voltage is the power grid equivalent of “pressure” in a gas-hydraulic network. A power system does not only need enough megawatts; it also needs megavars (reactive power) to stay within safe limits so equipment can operate correctly. If voltage rises or falls too far, generators, transformers and protection systems can disconnect to avoid damage, which can make a disturbance spread quickly.

For the sake of comparison, frequency is the part of power-system stability most people now associate with renewables, inertia and rotating machines. Voltage is less visible but just as decisive. It depends on reactive power, local network conditions, generator behaviour, protection settings, and the ability of grid operators to see and command assets in real time.

This is why the Spanish blackout was not simply a question of having enough power or spinning reserve available. The key issue was whether the system had enough fast, local tools to manage voltage and reactive power as conditions changed. In a solar-heavy system, that means conventional plants, renewables, batteries and grid equipment all need to be able to support voltage dynamically, not just produce electricity.

Voltage control requires of dedicated measurements and indicators to make sure that the system is working within acceptable limits, and research shows that the Spanish system was exhibiting signs of stress already days and even months prior to the blackout. An initial alarm was recorded on January 31, when abnormal voltage variations pushed a Spanish nuclear plant into its under-excitation limit; further abnormal voltage swings appeared on April 22 and 24; and, on the morning of April 28, instability was visible from around 9:00 am, growing as the day progressed. What is more important here is that voltage can remain within formal operating limits while still varying too quickly to be considered secure.

Consequently, a question arises, are modern, highly renewable penetrated power systems ready to detect these types of rapid voltage movements before they become a cascading overvoltage event? The Spanish experience shows that at least, from an operation procedure and security triggering event point of view, they are not.

Moreover, if the Spanish operator had properly identified the root causes of the event and had wished to tackle it quick enough, could the technologies dispatched at the time of the event solve the problem? It all seems that they would have failed. Why? Solar and wind can provide voltage support, but only if the rules, incentives, communications and plant settings require them to do so, which was not the case. SolarPower Europe, UNEF, APREN and other renewables associations put it bluntly after the ENTSO-E report: “It’s not about renewables, it’s about voltage control.”

### Expert reports

The previously referred to March 2026 ENTSO-E final report investigating the event concluded that the blackout resulted from multiple interacting factors: oscillations, gaps in voltage and reactive power control, different voltage regulation practices, rapid output reductions, generator disconnections in Spain, and uneven stabilisation capabilities. Those factors produced fast voltage increases and cascading generation disconnections. ENTSO-E’s language matters because it moves the debate away from a single villain and toward system design.

Spain's own government report reached a similar conclusion earlier, in June 2025. It described the blackout as a multifactorial overvoltage event. The system lacked sufficient dynamic voltage control capability; oscillations between noon and 12:30 conditioned system operation; and some generation assets disconnected in ways the government described as apparently inappropriate.

In other words, expert reports were not a verdict against renewables. It was a verdict against running a modern renewable-heavy system with legacy operating assumptions. Solar and wind can provide voltage support, but only if the rules, incentives, communications and plant settings require them to do so. SolarPower Europe, UNEF, APREN and other renewables associations put it bluntly after the ENTSO-E report: "It's not about renewables, it's about voltage control." They also noted that Spain updated Operational Procedure (P.O.) 7.4 in June 2025 to enable renewables to contribute to voltage control.

**Regulatory actions**

That regulatory change is one of the most tangible post-blackout reforms. Spanish independent competition regulator CNCM has published in Spain's official journal the resolution of June 12, 2025, modifying operating procedures for the development of a voltage-control service in the Spanish peninsular system. The revised P.O. 7.4 creates a framework for the system operator to use reactive capability from generation, demand and storage assets to keep voltage within safe limits, and introduces remuneration for the more demanding real-time setpoint-following service.

Implementation has begun. Red Eléctrica said in October 2025 that it had carried out authorisation tests for the first renewable plants able to provide dynamic voltage control under the new P.O. 7.4. By May 2026, Redeia's chair was telling shareholders that 14.5 GW already offered voltage control with setpoints, including 6 GW of renewables. That is a real change from the pre-blackout system, where the voltage toolbox was too dependent on conventional plants and manual grid devices.

But the cost of stabilization has also become visible. Red Eléctrica's "reinforced operation" regime, introduced after the blackout to strengthen voltage control, cost €711 million ($827.3 million) through April 2026, according to Redeia. The same shareholder meeting showed how politically contested the issue remains: some shareholders demanded resignations, while Redeia argued that official reports showed the incident was unprecedented, unpredictable and multifactorial.

Portugal has moved too. Its government announced a package focused on grid resilience, faster planning, renewables, critical infrastructure and international cooperation. Measures include doubling the number of black-start power stations, a €137 million investment in grid operation and control, a 750 MVA battery storage auction, and €25 million for critical infrastructure such as hospitals, water providers and utilities. Portugal also explicitly linked supply security to stronger Iberian and European interconnections.

**Conclusions**

The deeper consequence is that "flexibility" can no longer mean only storage arbitrage or demand shifting. The Iberian market is entering a phase in which solar output, negative prices, curtailment and voltage control all meet in the same hours. WSP's Electricity Market Outlook for Iberia projects

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solar-led expansion through the late 2020s, with storage scaling rapidly from 2026 onward and exceeding 30 GW by 2050. It also warns that solar faces severe capture-price erosion and that negative-price exposure can reach around 50% of solar generation in the short term. In that context, batteries, grid-forming inverters, dynamic voltage control and interconnection are not optional add-ons. They are the operating system of the near future.

The Spanish blackout serves as a warning to other European power networks and for the future of system operations. Renewable penetration can be a success story, but it comes in hand with an uncomfortable truth, too much, at the same time, using legacy rules, guidelines, communication systems and network coordination can untap problems never suffered from before.

*Author: Safa Sen, Market Engagement Lead For CWE at Ricardo, Member of WSP.*

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