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Crossed wires: Grid capacity could block EU energy security

Europe's energy security depends on rapidly scaling up renewables, but limited grid capacity risks leaving new projects stuck in connection queues. Immediate action can be taken to unblock this barrier.

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Lead author: Elisabeth Cremona

Summary

Europe's energy security depends on reducing imported fossil fuel reliance through electrification and rapid expansion of homegrown renewable power. Meanwhile, Europe's competitiveness relies on connecting new industrial demand. Ember's analysis of available grid capacity shows that grids are not fully prepared for the continent's ambitions.

- **At least 120 GW of planned renewable projects in Europe are at risk due to grid constraints**. Half of countries reporting grid data lack the grid capacity needed to connect new power generation. The biggest constraints are in Austria, Bulgaria, Latvia, the Netherlands, Poland, Portugal, Romania and Slovakia.
- **1.5 million households could face grid connection delays for rooftop solar**. Half of reporting countries have insufficient grid capacity to accommodate the expected growth in small-scale solar.
- **Some European grids are ready to support new household electricity demand**. At the distribution level, six out of the eight reporting countries have enough grid capacity for up to one-third of households to connect a new heat pump or electric vehicle charger. However, households in Poland and Spain would face major limitations.
- **Grid capacity for new industrial demand varies across the EU.** Available capacity is sufficient to connect large industrial sites in four out of the seven reporting countries.
- **Non-wire solutions can unlock up to 185 GW grid capacity for demand.**

Europe needs to take swift action to address grid bottlenecks. This includes reforming administrative processes and deploying non-wire solutions. Implementing such solutions will open space for both new clean power and emerging demand types such as data centres.

Grids will determine the success of Europe's mission to wean itself off imported fuels and expand its industrial base. Grid readiness is now an indicator of economic readiness, not a technical afterthought. Ambitions alone cannot move electrons.

Elisabeth Cremona
Senior Energy Analyst, Ember

Europe's ambitions depend on national networks

The ability to connect new generators and consumers to the grid has become a decisive part of Europe's strategy. Competitiveness agendas encourage new manufacturing capacity and data centres, which will increase demand. At the same time, the deployment of renewables continues to accelerate as Europe seeks to increase domestic clean power to improve energy security.

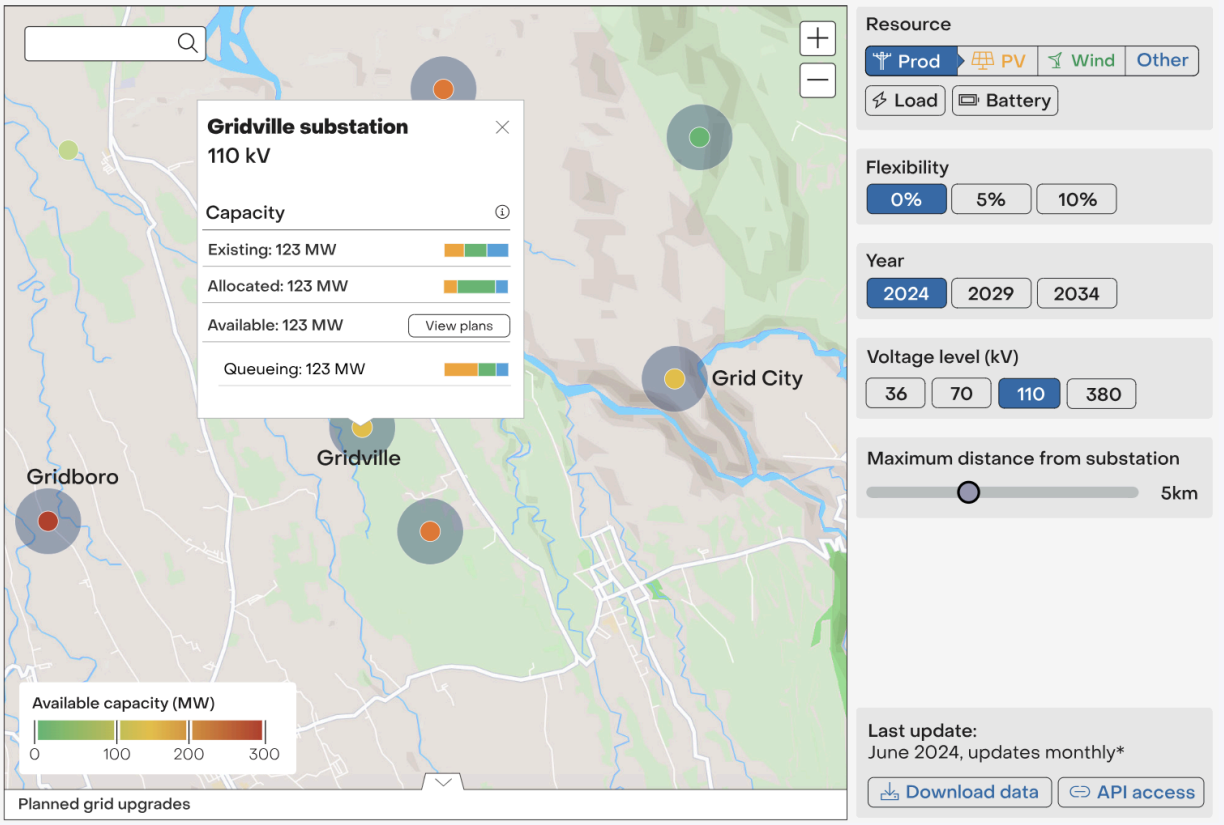
However, in many European countries, limited grid capacity is already slowing down projects. Large volumes of renewables remain stuck in connection queues, manufacturers face multi-year delays to expand production, and data centre developers relocate to regions with more secure and faster connections. Rising costs to manage grid congestion, ultimately borne by consumers, add further pressure.

The underlying issue is pace. Grid development has not kept up with the speed of the energy transition and networks are unprepared for renewed industrial investment. While capital and political will are present, infrastructure expansion has lagged behind. Without rapid and ambitious intervention on grids, Europe's security and competitiveness objectives risk being undermined.

EU-level policy has begun to address this challenge, with the 2023 Grid Action Plan, 2024 revisions to electricity market legislation and the 2025 European Grid Package. However, delivery ultimately depends on national governments, regulators and grid operators.

The state of grids and the urgency of remedial solutions is often difficult to assess, but recently published grid hosting capacity data provides important and tangible insights. Twenty EU countries report grid hosting capacity at transmission and/or distribution level. This data, often in the form of maps, indicates where and how much new generation or demand can be connected to the power grid. Comparing grid capacity to a country's near-term plans for power system expansion provides a useful indicator of grid readiness or the level of constraint.

Fictional example of a grid capacity map



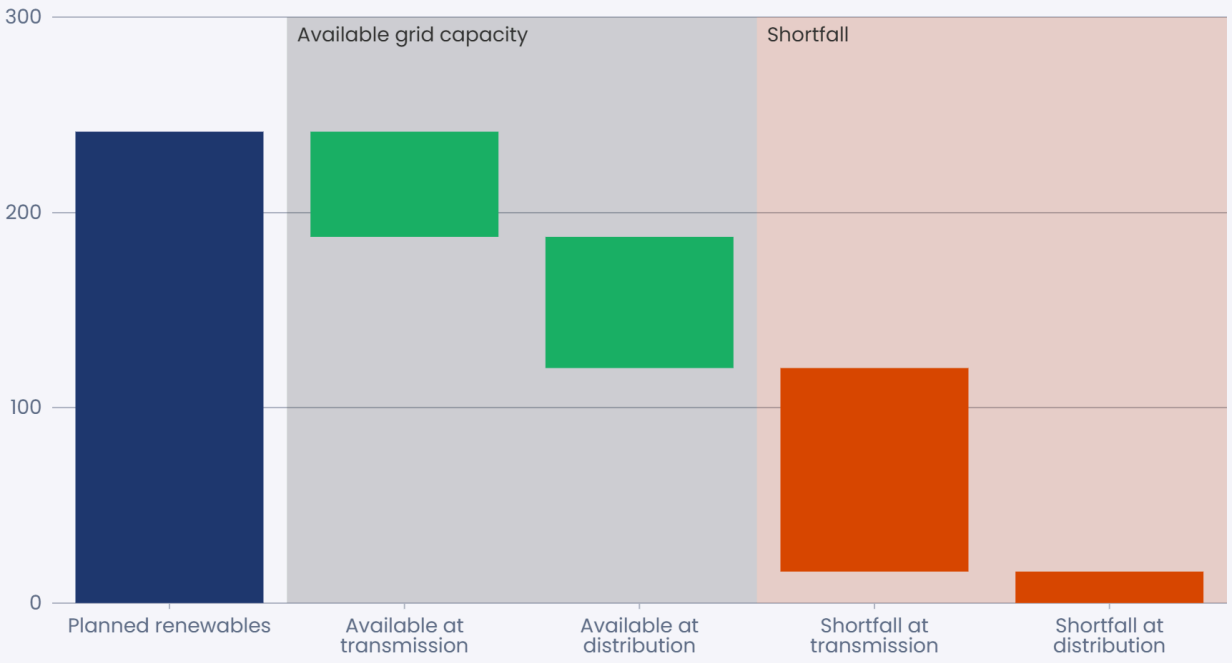
Source: Ember report: Transparent Grids for All

New renewables projects are at risk due to grid constraints

Data from reporting countries reveals a shortfall of 120 GW between planned renewable expansion by 2030 and available grid capacity across 20 reporting countries. This means a substantial share of projects could face delays unless solutions to enable connection are rapidly implemented. In reality, the challenge is likely even larger as many countries, including major power systems such as Germany and Italy, do not publish their grid capacity data.

At least 120 GW of planned renewables are at risk due to shortfall in EU grid capacity

Expected renewable additions by 2030 compared to available grid capacity in reporting countries (GW)



Source: ERAA 2025 for expected renewable additions between 2025 and 2030
See Ember methodology for overview of reporting countries and data sources relating to grid capacities.

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More than one in every two EU countries faces transmission bottlenecks

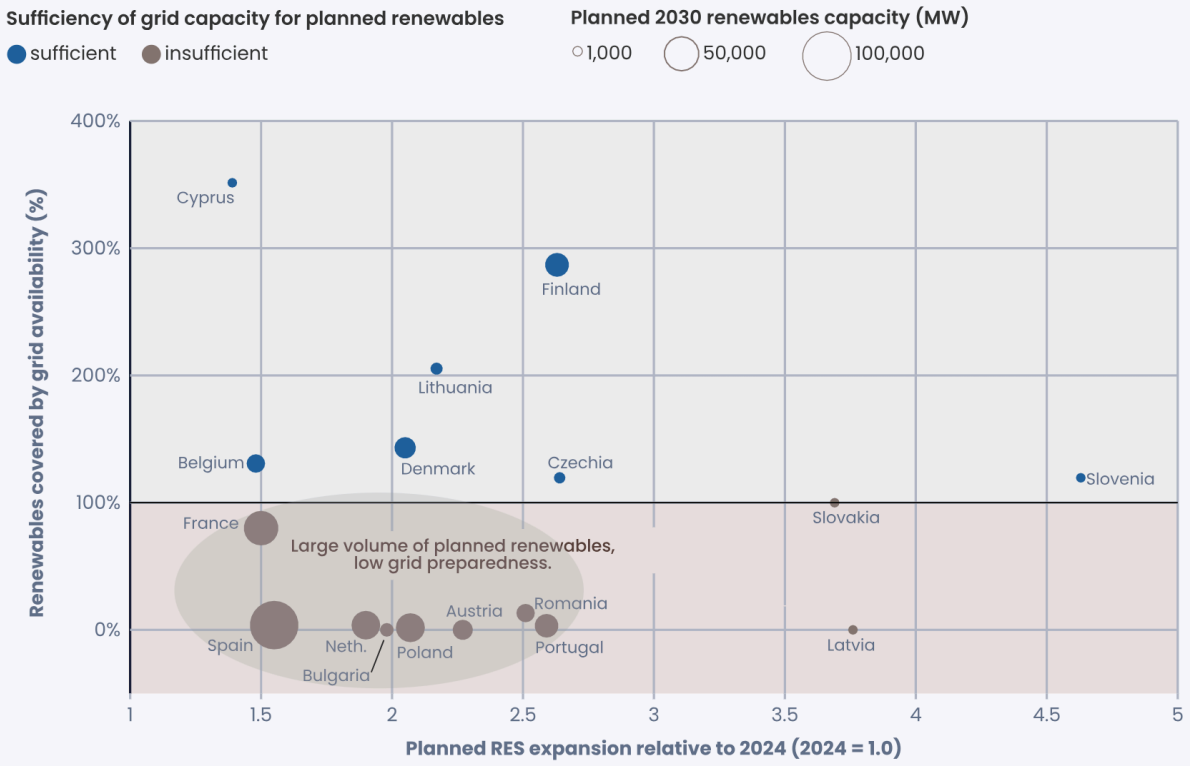
The largest gap between planned renewable deployment and available grid capacity is at transmission level, with a total shortfall of 104 GW across ten out of the 17 reporting countries. As this is where large power plants are connected, this affects wind installations and big utility solar. Two-thirds (66%) of the 158 GW renewables that the reporting countries expect to roll out by 2030 may not materialise, as projects will be unable to connect to the grid network. The biggest

constraints are found in Austria, Bulgaria, Latvia, the Netherlands, Poland, Portugal, Romania and Slovakia. In these countries, available grid capacity can accommodate less than 10% of renewables planned by 2030.

This is not a long-term risk that can afford long-term solutions. Comparing available grid capacity to even nearer-term renewable deployment expectations for 2028 shows that the grid capacity crunch is likely to become very apparent soon. This includes countries like the Netherlands, which is already experiencing impacts. Nine of 17 reporting countries are expected to face a grid capacity crunch by 2028.

EU countries anticipating the largest volumes of wind and solar have the least prepared grids

Renewables covered by available grid capacity (%) compared to planned increase in renewables (2024 = 1)



Source: ERAA 2025 for 2030 renewable capacities
Size of bubble represents volume of renewables expected to be added between 2025 and 2030 (GW).
Low grid preparedness means that there is less grid capacity than planned new renewables. Data is specific to transmission level.

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1.5 million households could face grid connection delays for rooftop solar

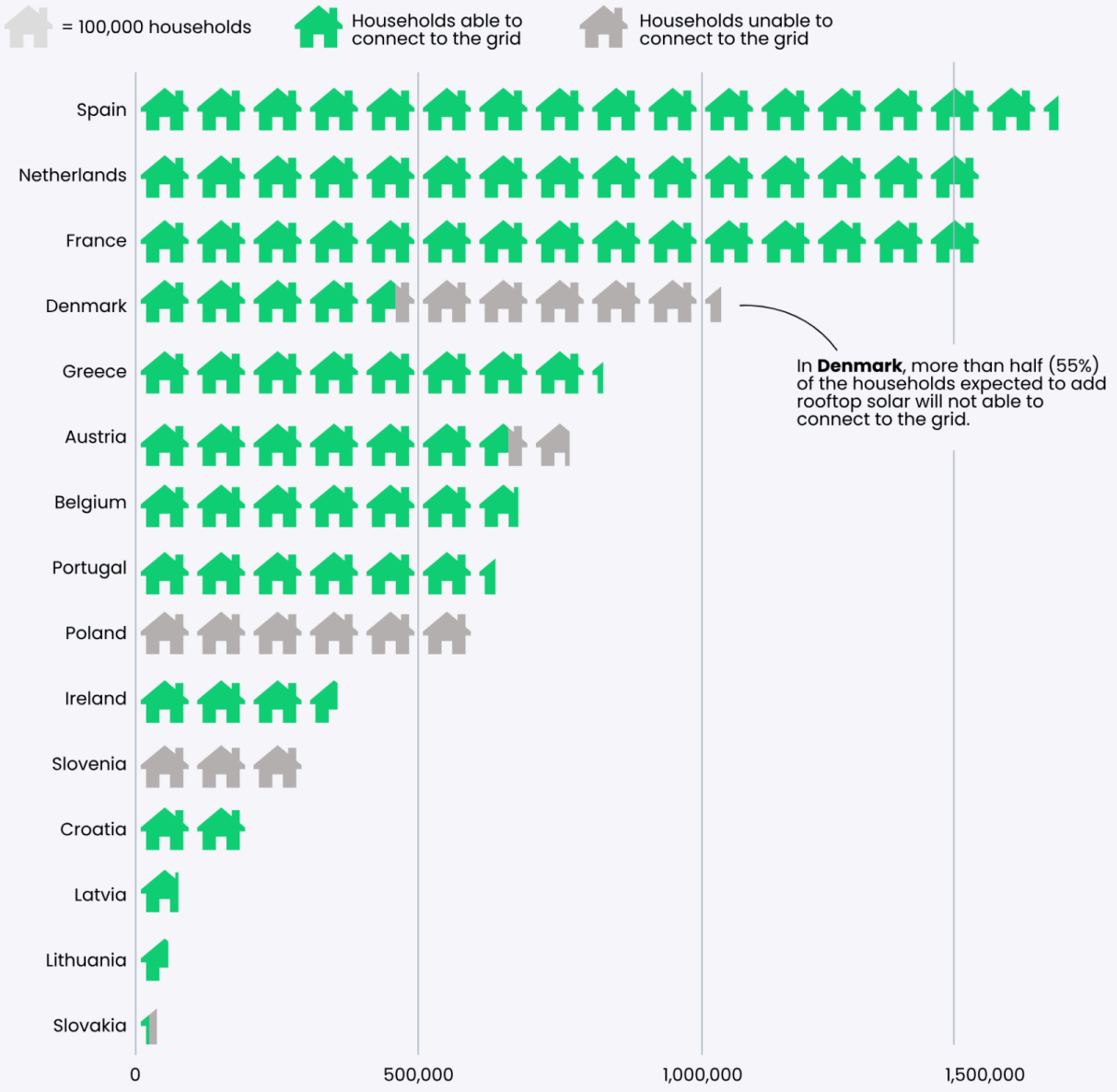
Limited capacity in Europe's distribution grids risks slowing the rollout of rooftop solar across parts of Europe. Rooftop installations account for [61% of existing solar capacity] in the EU. Ensuring sufficient capacity in distribution networks is

therefore essential for households and small businesses to benefit from cheaper solar electricity.

Of the 13 countries that publish grid capacity data for distribution networks, six show insufficient headroom to accommodate the expected growth in small-scale solar. This puts at least 16 GW of rooftop solar planned by 2030 at risk, potentially affecting up to 1.5 million households. The risk is most pronounced in Slovenia and Denmark, where insufficient grid capacity could impact 32% and 19% of all households, respectively.

Bottlenecks in the distribution grid risk more than 1.5 million EU households facing delays to connect rooftop solar

Number of households expected to add new rooftop solar between 2025 and 2030



Source: ERAA 2025 for 2030 renewable capacities, split between large and small-scale solar based on countries' existing fleet, number of households based on Eurostat data.
Only countries reporting available grid capacity at distribution level are included.

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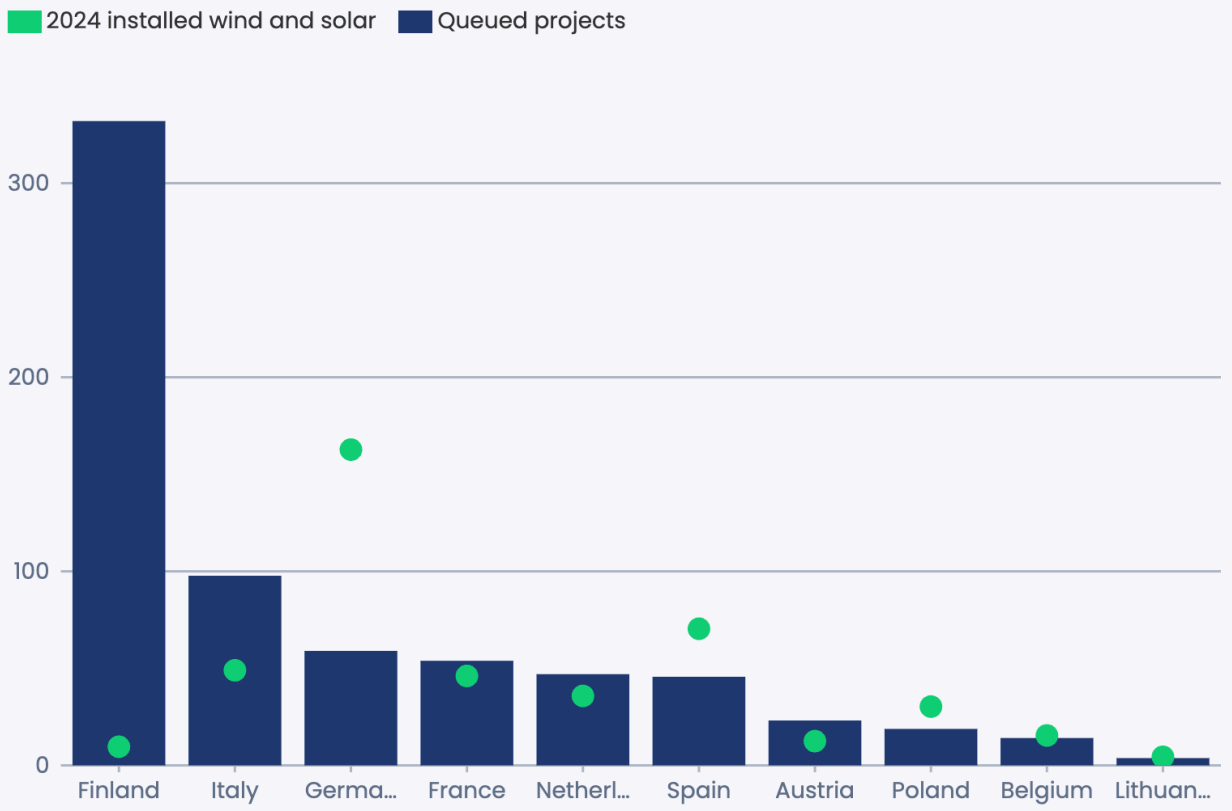
Huge connection queues compound the problem of limited grid capacity

Not only is grid capacity in certain EU countries insufficient for anticipated renewable deployment, but the large volume of projects already in the queue for a grid connection agreement means new applicants are likely to face delays. Almost 700 GW of renewables are stuck in the grid connection queue across the eight reporting countries, highlighting the continued scale of demand for grid access.

This is particularly egregious in some countries. Finnish TSO Fingrid reported that the total capacity of electricity production inquiries received exceeds 400 GW – this is more than 16 times the size of the existing system of 24.5 GW. Although this includes speculative projects that will not ultimately be built, this illustrates the risk to new proposed installations.

Almost 700 GW of renewables in 10 EU countries are in the queue for grid connection

Capacity of wind and solar projects in the connection queue (GW)



See Ember methodology for sources. Data for renewables in the queue at transmission level only, except in the case of France and the Netherlands. Queued projects refers to those which are waiting to be assessed for a grid connection agreement. Projects with an approved agreement that are not yet connected are excluded.

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Grids are ready for consumer electrification but less so for new industrial loads

While grid capacity is increasingly constraining new power generation, available hosting capacity for demand at the distribution level suggests that grids are ready to support electrification. However, constraints at the transmission level imply that new industrial loads, such as manufacturing facilities or data centres, may face barriers.

Grid capacity for new industrial demand varies across the EU

Across the seven countries that publish data on transmission grid capacity for new loads, three report zero capacity available. These are Austria, Bulgaria and Romania. Four countries retain headroom for connecting new large loads. Czechia stands out for the relatively large volume of new demand it can integrate; its available grid capacity of 6.3 GW is equivalent to 60% of its 2024 peak demand. Belgium and Latvia also boast substantial free capacity. The Netherlands offers about 1 GW of available capacity, equivalent to 5% its demand peak.

Although some countries appear better prepared, the speed and sheer volume of connection requests can still cause disruptions. For instance, Danish transmission system operator Energinet announced a temporary pause in new grid connections in March 2026 following a sudden influx of connection requests, particularly from large consumers such as data centres, batteries and power-to-X plants. More than 60 GW of new consumption is currently queued across the transmission and distribution level, an enormous volume considering Denmark's peak demand in 2024 was just 7.3 GW.

Distribution grids are ready to support electrification of households

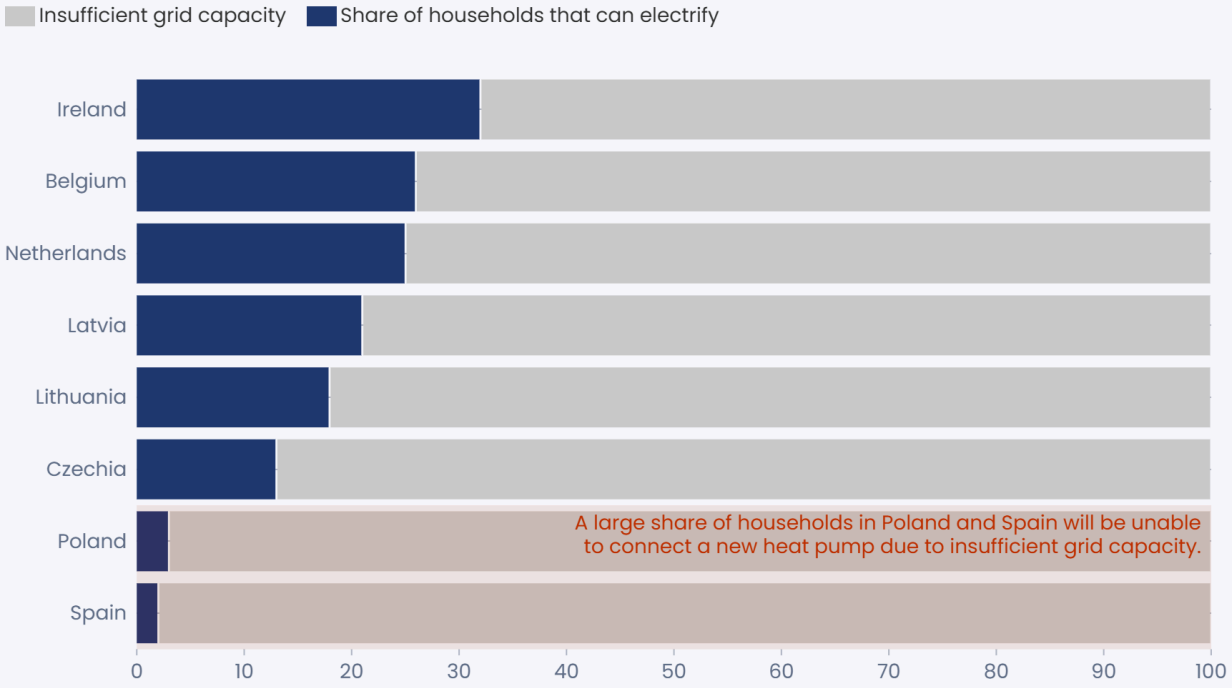
Figures for available grid capacity indicate that distribution networks are ready to accommodate new consumer loads, which are likely to primarily stem from electrification of heating and cooling.

Among the eight countries that publish the data, six can support the installation of heat pumps in 13% to 32% of all households or EV chargers in 7% to 18% of all households. These include Belgium, Czechia, Ireland, Latvia, Lithuania and the Netherlands. Ireland shows the highest potential for electrification, having the capacity to support heat pumps in 32% of households or EV chargers in 18%. Belgium and Latvia also report significant headroom, with capacity for heat pumps in 26% and 21% of households, respectively. Maintaining this headroom will require sustained grid investment as electrification accelerates.

Only two countries have a limited potential for distribution level demand increase. These are Spain, which can only accommodate electrification in 1% to 2% of households, and Poland. Only one of the five major Polish distribution system operators reports hosting capacity availability for demand, and the figures indicate that only 2% to 3% of its customers could be covered.

Distribution grids are ready for household electrification in six out of the eight EU reporting countries

Share of households that can electrify their heating (%)



Source: Number of households based on Eurostat data.
Assumes the addition of one 4 kW heat pump per household.

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Quick wins can rapidly unlock Europe's grid capacity

Europe cannot wait for new power lines. There are immediate measures that can be implemented to rapidly unlock capacity on the existing grid. This would enable Europe to reduce its reliance on imported fuels in the short term through accelerated deployment of rooftop solar, while supporting the integration of wind power over the medium term.

Non-wire solutions can unlock up to 185 GW of grid capacity for new demand

Non-wire solutions include grid-enhancing technologies (GETs) and non-firm connection agreements. These can rapidly unlock additional grid capacity without new infrastructure. GETs improve utilisation of existing networks, while non-firm connections allow more users to connect under flexible conditions. The IEA estimates these measures could unlock 140–185 GW of capacity across Europe, broadly covering the shortfall identified in reporting countries.

A number of countries are already taking steps to implement non-wire solutions in response to the grid capacity crunch. By November 2025, national regulators in 15 EU Member States had already introduced enabling frameworks for non-firm connection agreements. The Dutch TSO TenneT reported such contracts already unlocked 9.1 GW of grid capacity, equivalent to 40% of the national peak electricity demand.

Targeted allocation of grid capacity improves connection efficiency

In response to competition over scarce grid capacity, several countries introduced mechanisms that seek to actively allocate capacity to the highest-value projects with the highest probability of being completed. This makes the connection process more efficient and avoids speculative projects blocking the queue, meaning new projects would receive approval to connect to the grid much faster.

In Spain, the transmission system operator REE reports that 99% of the 200 GW of available grid capacity is blocked, with access governed through competitive tendering processes. France has taken a similar approach, reserving grid capacity specifically for renewable projects. Under its regional schemes for grid connection of renewable energies (S3REnR), around 71 GW of grid capacity is pre-allocated at different substations across the country.

Reforming national connection processes to prioritise viable projects

National reforms to grid connection processes are needed to clear backlogs, clear out speculative or duplicate projects and move viable projects to the front of the line. While this is more complex to implement than the previous two solutions, it is essential to accelerate project development and avoid years waiting in the queue.

The need for reform is underscored by the scale of projects which have already secured a grid connection agreement: more than 340 GW across the 11 reporting countries. This is in addition to the 700 GW of projects still waiting in the connection queue. In several cases, the pipeline of committed projects is larger than existing generation capacity. In Italy, 231 GW of projects are not yet online

but have secured a connection agreement. This is equivalent to 169% of the country's installed power capacity.

Policy action is beginning to follow. In response to these challenges, the UK unveiled its proposed reformed connections process and the European Commission published its guidance on efficient and timely grid connections. The onus to implement the principles contained in the guidance document now rests on national regulators.

Supporting information

Methodology

Data on available grid capacity was downloaded from published hosting capacity maps. The individual sources are listed under the Acknowledgements section. These were primarily collected from the table in DSO Entity and ENTSO-E Joint Progress Report on Capacitypedia and the European Grid Capacity Maps webpage.

Data on planned renewable deployment is based on the European Resource Adequacy Assessment (ERAA) 2025. This is considered to provide the most up-to-date and consistent source of national grid operator expectations of renewable deployment by 2030. Existing installed capacities are based on Ember's electricity data.

Grid operators typically publish data on grid availability for transmission and distribution separately, and there were few cases where data was available at both voltage levels for a single country. This means the analysis has to be performed separately for transmission and distribution level, necessitating that the wind and solar figures from ERAA were similarly split. It was assumed that 100% of wind would be connected at transmission level. The split for solar was based on the existing composition of national fleets between large and small-scale installations, published by SolarPower Europe. Where national figures were not available, the EU average was used.

Acknowledgements

See Ember webpage for list of sources.

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