

EUROPE'S ENERGY SECURITY IN 2026: MORE RESILIENT, BUT SYSTEMICALLY EXPOSED

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Europe is more resilient to an external energy supply shock than it was in 2022, but it is not yet energy secure. The sharp reduction in Russian fossil fuel imports has substantially reduced the European Union (EU)'s most acute supplier dependency. Attention has consequently shifted towards a more complex risk landscape: greater reliance on globally traded liquefied natural gas (LNG) and fixed import routes, electricity networks whose expansion is lagging behind electrification, and concentrated supply chains for clean energy technologies and critical replacement equipment.

The transition to an electrified, low-carbon economy remains Europe's most credible route to reducing dependence on imported fossil fuels. Yet it also places more economic activity and essential services on the electricity system. Europe's energy security challenge therefore extends beyond securing sufficient fuel to ensuring that interconnected systems can absorb disruption, substitute for unavailable critical inputs and restore essential functions.

This brief examines this challenge across four areas: imported fuels, electricity system integration, clean technology supply chains and critical energy infrastructure. It argues that existing EU frameworks address many individual risks and provide for crisis planning and testing, but do not yet provide sufficiently consistent assurance across sectors and borders that institutions,

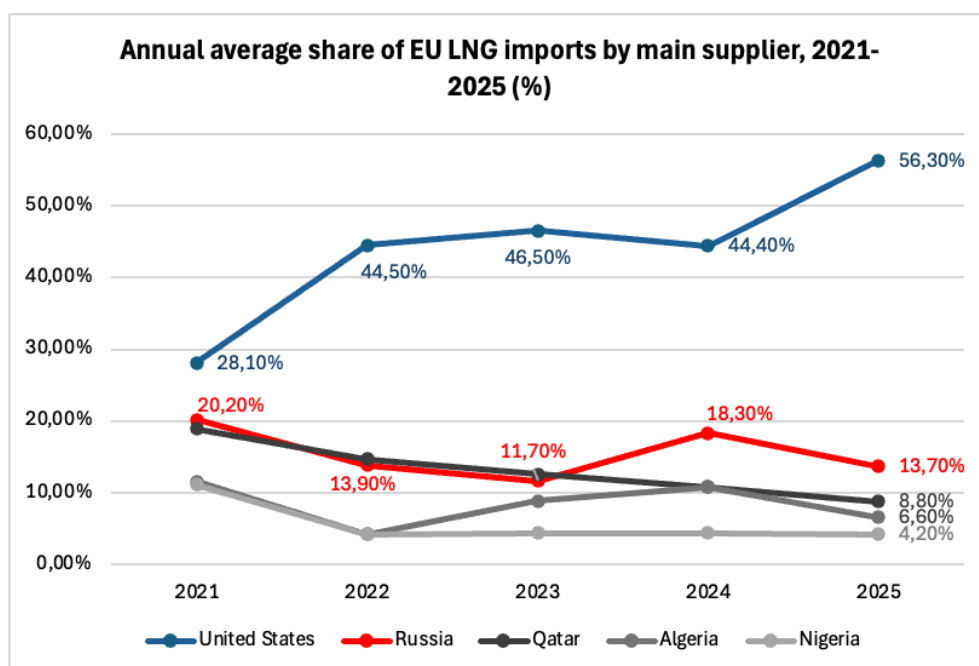
operators and essential services can function together, or that equipment, skills and alternative supplies can be mobilised during simultaneous or cascading disruptions.

Shifting energy dependencies

The sharp reduction in Russian fossil fuel imports since 2022 has substantially reduced Europe's most acute energy security vulnerability, but it has not eliminated external dependence. Exposure has instead shifted towards a different mix of suppliers, fixed transport corridors and globally traded markets. This is materially safer than heavy dependence on a hostile supplier, but still leaves the EU vulnerable to infrastructure disruption, supplier concentration and international competition for fuel.

This shift is clearest in gas. [In 2025](#), Norway supplied around 52% of the EU's imports of natural gas in gaseous form, followed by Algeria at 17.4% and Russia at 10.4%. Norway is a stable and closely aligned partner, so this concentration carries far less geopolitical risk than former dependence on Russia, but it still leaves Europe exposed to technical failure, accidental damage or deliberate disruption of the infrastructure carrying that gas.

LNG has made Europe's gas supply more flexible, but it has also increased exposure to global markets. [Its share of EU gas imports rose](#) from around 20% in 2021 to about 45% in 2025, while the United States (U.S.) supplied around 56% of EU LNG imports, compared with 28% in 2021. Russia remained the second-largest LNG supplier at approximately 14%. Therefore, U.S. LNG played a central role in replacing Russian pipeline gas, but Europe's increased reliance on one major supplier and on cargoes traded in a competitive global market creates new concentration and market risks.



Source: Authors' calculations based on [Eurostat \(2026\)](#)

This creates vulnerability not only to changes in supplier policy and trade relations, but also to disruption at liquefaction plants, shipping routes and import terminals. Disruption at major maritime chokepoints can tighten global LNG availability and raise European prices and storage-refilling costs even when Europe does not lose a direct supplier.

Diversification should therefore be understood as a reduction in supplier-specific risk, not as energy independence. In 2024, the EU still met 57% of its energy needs [through net imports](#), most of them fossil fuels. Energy security depends not only on a wider supplier base, but also on whether alternative fuels, routes and demand reductions can be mobilised quickly enough to absorb the loss of a major supplier or import facility without prolonged shortages or severe price shocks.

A cleaner electricity mix, but persistent fossil dependence

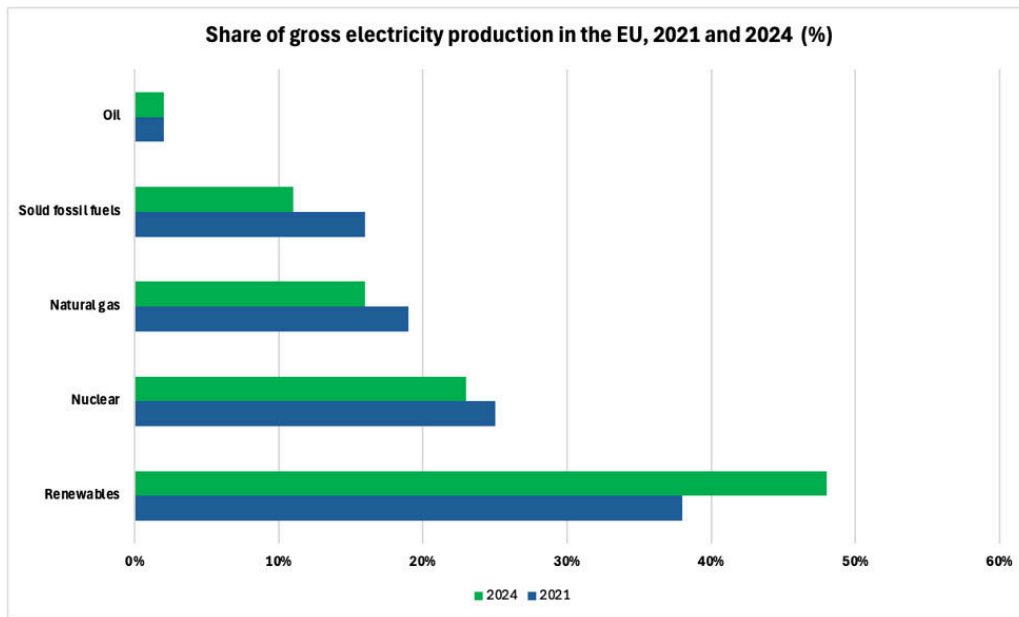
Since the 2022 energy crisis, the EU has accelerated its transition away from fossil fuels, with the clearest progress in electricity

generation. The share of renewables in the EU's gross electricity production rose from 38% in 2021 to 48% in 2024.

Progress has been slower across the wider energy system. Although renewables reached around 20% of the EU's overall energy mix by the end of 2024 (compared to 17% in 2021), oil's share increased over the same period (from 34% [in 2021](#) to 38% [in 2024](#)), while gas use declined only modestly (from 23% to 21%). Both fuels [remain central](#) to transport, heating and industry, and serve as feedstocks for sectors including chemicals, plastics and fertilisers. Europe has therefore made faster progress in electricity than in reducing fossil fuel dependence across the wider economy.

Further gains in energy security will depend on electrifying fossil-intensive sectors, expanding domestic clean energy supply and reducing demand through efficiency. EU-funded efficiency investments were already delivering [annual energy savings of 81.9 TWh](#) by the end of 2023, reducing exposure to volatile fossil-fuel markets.

Electrification will, however, place more economic activity and essential services on the power system. Its security benefits will depend



Source: Authors' visualisation based on European Commission (2026), *REPowerEU Four Years On: EU*, using [Eurostat](#) data.

on whether Europe can connect new generation, transmit power, balance variable supply and maintain reliable electricity services under stress.

System integration: The emerging resilience constraint

Europe's legacy electricity system was designed largely around centralised, predictable power plants rather than decentralised and weather-dependent wind and solar generation. Grid modernisation and expansion are now lagging behind renewable deployment and electrification of transport, heating and industry. The emerging constraint is therefore not simply how much electricity Europe can produce, but whether it can connect, move and balance power reliably - and recover quickly when infrastructure fails.

[Bottlenecks](#) affect both transmission and distribution networks. Large renewable energy projects face long waits for transmission connections, while local grids must accommodate rooftop solar, electric vehicles, heat pumps, batteries and rising demand

from data centres. [Ember estimates](#) that grid constraints place at least 120 GW, or 66%, of planned renewable energy infrastructure capacity in the countries assessed at risk of delay. Around 1.5 million prospective household solar installations could also face connection difficulties. In eight Member States, existing capacity may accommodate no more than 10% of renewable projects planned for 2030.

These constraints carry security and affordability costs. Electricity may be available but unable to reach consumers, forcing renewable curtailment and the activation of more expensive generation. Congestion-management costs [could exceed EUR 25 billion](#) by 2030.

Substantial progress has already been made. Since 2010, annual investment in European electricity grids [has increased markedly](#), while Europe has constructed [more than 16,000 km of new transmission lines](#). Yet, with renewable deployment outpacing network expansion, grid congestion, connection queues, and redispatch costs continue to increase across many Member States.

Closing the gap will require major investment. The Commission estimates that approximately EUR 584 billion [will be needed for electricity grids](#) by 2030. [By 2040](#), estimated investment needs reach around EUR 730 billion for distribution and EUR 477 billion for transmission networks. Without [commitment to predictable cost sharing](#), between the EU, individual Member States, network operators, industry and consumers, projects serving the wider European system may remain [difficult to finance](#).

[EU internal interconnection and links with neighbouring European systems](#) are important parts of the response. They enable Member States to share reserves and move electricity from areas of surplus to scarcity, reducing curtailment, smoothing geographical variations in renewable output and limiting the backup capacity each country must maintain independently. The EU has set an indicative target for interconnection capacity equivalent to at least 15% of installed generation capacity by 2030 and [seeks to accelerate planning](#), permitting and investment, including through Projects of Common Interest and Projects of Mutual Interest. Recent years have seen major advances in regional interconnection, including the commissioning of the North Sea Link between Norway and the United Kingdom in 2021, the 1.4 GW NordLink interconnector linking Germany and Norway, and the 1.4 GW Viking Link between Denmark and the United Kingdom, which became fully operational in 2024 as the world's longest subsea electricity interconnector. Additionally, the 2025 [synchronisation of the Baltic States' electricity system with the Continental European Network](#) marked a major geopolitical and infrastructural milestone by ending the region's historical dependence on the Russian-controlled BRELL power grid. However, cross-border capacity cannot compensate for inadequate national and local networks, and significant

geographical gaps remain.

Storage and demand flexibility are equally important. Storage can reduce pressure on a congested grid, absorbing excess electricity when renewable output is high, and releasing it when output falls or demand rises. The EU [currently has](#) around 55 GW of cumulative installed electricity-storage capacity, with more than 30 GW permitted or under construction. Expansion nevertheless [faces grid-connection delays, regulatory and revenue uncertainty, and dependence on concentrated battery supply chains](#). Demand response, smart charging and flexible industrial consumption can also reduce pressure during scarcity. Where their performance is verifiable, these resources should be treated as security assets, not only as instruments of market efficiency.

Grid expansion and resilience also depend on the availability of equipment and manufacturing capacity. [Rising global demand](#) for essential grid equipment such as transformers, high-voltage cables, substations, converters and power electronics has increased procurement and replacement lead times. These bottlenecks [expose the EU to external dependencies and potential geopolitical risks](#), especially when manufacturing capacity is concentrated outside Europe.

To increase resilience, grid planning must cover not only expansion, but also redundancy, the ability to contain cascading failures, such as the [2025 blackout on the Iberian Peninsula](#) and access to compatible replacement equipment after disruption. Transmission system operators already maintain technical defence and restoration plans. Regional electricity exercises and other sectoral preparedness arrangements also test elements of crisis response. A broader operational challenge, however, is ensuring that these arrangements are coordinated with

the needs of other essential systems – including water, communications, healthcare and transport – and that equipment, crews and mutual assistance can be mobilised when several operators or sectors are under pressure simultaneously.

Adequacy, flexibility and resilience are related but distinct. Adequacy concerns whether sufficient resources exist; flexibility, whether supply and demand can adjust. Resilience additionally concerns whether the system can absorb disruption, contain cascading effects, maintain priority services and restore damaged capacity.

A more renewable electricity system will therefore be secure only if grids, interconnections, flexible resources, operating procedures and repair capacity can function together under stress.

Supply chain security: Europe's critical raw materials challenge

As clean energy deployment expands, Europe's reliance on concentrated supply chains for critical materials, components and processing technologies is becoming more consequential. Unlike a fuel supply shock, which can disrupt current energy supply immediately, shortages of minerals and components are more likely to delay investment, maintenance and replacement. Their effects may be slower but can still become systemic where substitutes and alternative suppliers are limited.

The concentration is substantial. The EU meets around 98% of its rare earth magnet demand [through Chinese imports](#), while China holds an overwhelming share of most major stages of the global solar manufacturing supply chain and dominates key stages of battery processing and

component production. Since 2023, [Beijing has introduced](#) export controls on gallium, germanium and graphite, followed by restrictions on rare earth processing technologies and, in 2025, selected rare earths and magnets. These measures show how control over both critical materials and processing capacity can be used for geopolitical and industrial leverage.

The EU has sought to reduce these vulnerabilities through a growing policy framework that includes the Critical Raw Materials Act (CRMA), the Net-Zero Industry Act, RESourceEU and the EU Energy and Raw Materials Platform. The CRMA [sets 2030 benchmarks](#) for EU extraction, processing, recycling and supply diversification, while strategic project and joint purchasing mechanisms are intended to support implementation. The central challenge is to turn these instruments into commercially viable projects and diversified supply chains, particularly in the parts of the value chain where disruption would have the greatest effect on Europe's ability to deploy and replace critical energy technologies.

Building these capacities will require faster permitting and more predictable finance. European projects also compete with jurisdictions such as [Canada](#) and [Australia](#), where targeted tax credits and production incentives attract critical minerals investment. Without effective delivery mechanisms, legislative ambition may not translate into the projects and processing capacity needed to reduce concentrated dependencies.

[Europe also has assets on which to build](#), including cobalt refining in Finland, germanium and gallium capabilities in Belgium, rare-earth processing and magnet production in Estonia, and further resource potential across the Nordic region and Greenland. Emerging partnerships with Canada and the U.S. show how diversification

can extend across processing and component supply chains rather than stopping at raw material imports.

The objective is not self-sufficiency, which is unlikely across many highly concentrated value chains, but a gradual reduction in the most consequential dependencies. This will require a combination of alternative suppliers, selected European processing and recycling capacity, and durable partnerships in those parts of the value chain where disruption would have the greatest effect on clean energy deployment.

Critical energy infrastructure: Protection, continuity and repair

Access to energy and the technologies needed to produce it is only part of the security challenge. Europe must also protect – and be able to repair – the infrastructure that delivers energy to consumers.

The protection of critical energy infrastructure has moved up Europe's agenda since 2022. The EU has [adopted new rules](#) on critical entities and cybersecurity, governments discuss sabotage and hybrid threats more openly, and [operators are reviewing vulnerabilities](#). Yet translating this increased attention into tested operational resilience remains an ongoing challenge. Existing rules require risk management, continuity measures and, in the electricity sector, technical restoration planning. The practical test is whether these arrangements work together during complex disruptions involving several infrastructures, operators and jurisdictions.

Ukraine is not a direct template for EU Member States, but it provides the clearest

contemporary case of an energy system subjected to sustained, deliberate and repeated disruption. Russia's attacks have not focused on one category of asset. They have shifted between generation, transmission substations, regional distribution networks, gas infrastructure and heating systems.

The lesson for Europe is not to prepare for an identical campaign, but to examine whether its own risk assessments and operational plans adequately capture the potential for energy infrastructure failures to cascade across sectors. Electricity nodes serving water and heating systems, telecommunications, hospitals and emergency services warrant particular attention. [Protecting these interdependencies](#) requires physical and cyber safeguards, backup power and communications, and realistic plans for maintaining priority services and restoring disrupted infrastructure.

Ukraine also demonstrates that protection cannot mean prevention alone. Air defence, shelters and cyber measures reduce damage, but they do not remove the need for repair capacity. Energy resilience depends on spare transformers and control-system components, skilled crews, access to damaged sites, emergency procurement, transport arrangements and clear rules for prioritising consumers when supply is constrained. This lesson is relevant to European systems where lean staffing, limited stocks, outsourced maintenance and just-in-time procurement may reduce the margin available during simultaneous disruptions. Such models may be efficient under normal conditions but less robust when several operators require the same equipment and contractors at once.

The EU does not need to militarise its energy system. It does, however, need to move beyond separate preparedness arrangements towards more systematic testing of how critical systems interact under stress. This

means asking whether control rooms can operate with degraded communications; whether replacement equipment is available, compatible and transportable; whether repair crews and contractors can be mobilised quickly; and whether governments have determined which consumers should be prioritised during gradual restoration. Existing EU frameworks – including the Critical Entities Resilience Directive, Network and Information Systems 2 Directive, electricity risk preparedness and restoration rules, and gas security arrangements – address parts of these requirements. A useful next step would be to examine how these arrangements interact in practice, particularly where disruptions affect several sectors, operators or Member States simultaneously. Cross-sector and regional exercises should examine dependencies between essential services, the coordination of restoration priorities, access to specialised equipment, and the mobilisation of mutual assistance.

Policy recommendations

Beyond the continuing need for grid investment, electrification and supply diversification, three under-addressed priorities are to strengthen cross-sector crisis preparedness, improve practical restoration capacity and convert strategic supply-chain objectives into investable projects.

Strengthen the cross-sector dimension of electricity preparedness exercises

The Commission should work through the Electricity Coordination Group, with Member States and relevant authorities, to strengthen the cross-sector dimension of regional and national electricity preparedness exercises. Guidance and scenarios should examine

dependencies between electricity and essential services, priority-setting during constrained supply, and coordination among operators and critical sectors. Findings should inform national risk-preparedness plans while complementing, rather than duplicating, system operators' technical exercises and responsibilities.

Improve access to emergency energy equipment

The Commission and Member States should assess and regularly test whether operator, national and EU arrangements provide timely access to and deployment of emergency energy equipment, including generators and mobile substations. For specialised, often system-specific equipment such as transformers, high voltage cables and power electronics, priorities should include secure information-sharing on availability and lead times, advance compatibility and deployment planning, and pre-agreed procurement or mutual assistance arrangements where feasible. EU action should address shared gaps identified through risk assessments and exercises while building on existing national, regional and rescEU capacities.

Close the bankability gap for strategic critical-material projects

The Commission, the European Investment Bank and Member States should use instruments available under the CRMA, RESourceEU and related EU frameworks to move technically, environmentally and commercially credible strategic projects from designation to final investment decisions. Support should be coordinated at project level, combining credible long-term European offtake, advisory assistance and targeted guarantees, with temporary and capped

price-risk support only where clearly justified. Priority should go to processing, recycling and component manufacturing that address identified bottlenecks and measurably reduce concentrated dependencies affecting grids, storage and renewable energy systems.

Together, these measures would reduce Europe's exposure to external disruption, strengthen the resilience of an increasingly electrified energy system and improve its capacity to maintain essential services under stress.

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