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PERSPECTIVES ON EUROPEAN ENERGY RESILIENCE AND POLICY ALIGNMENT

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Table of Contents

1 Framing the EU Energy Resilience Policy Agenda

Europe's energy system is challenged in terms of resilience and security. Strains on the system that are due to climate change, energy transition, new technologies, cyber and physical attacks, and the rise of competition from notably China have been exacerbated by the geopolitical shocks of war, tariffs, and export controls on critical materials in addition to extreme weather events. The European Commission (EC) has issued a range of policies that support resilience in the energy system, including in preparedness, security and defence, digital and cyber, and competitiveness. The EC will present a review of the energy security and industrial frameworks on how to strengthen European economies' resilience and competitiveness in 2026.

Anticipating these developments and building on previous work,[1] CERRE launched in 2025 an in-depth examination of resilience in the energy sector, the Forum "*Towards an Integrated Approach to Infrastructure and Market Resilience*" (CERRE's Resilience Forum), with a particular focus on how resilience can be better integrated into existing European legal frameworks.

The purpose of CERRE's Resilience Forum, which ran from July 2025 to March 2026, has been, through a series of issue papers, to review the definition of resilience, its different components, and to analyse how it is translated into the European energy regulation, as well as to put forward recommendations for improved regulatory frameworks to foster resilience to the different shocks and threats facing Europe, specifically:

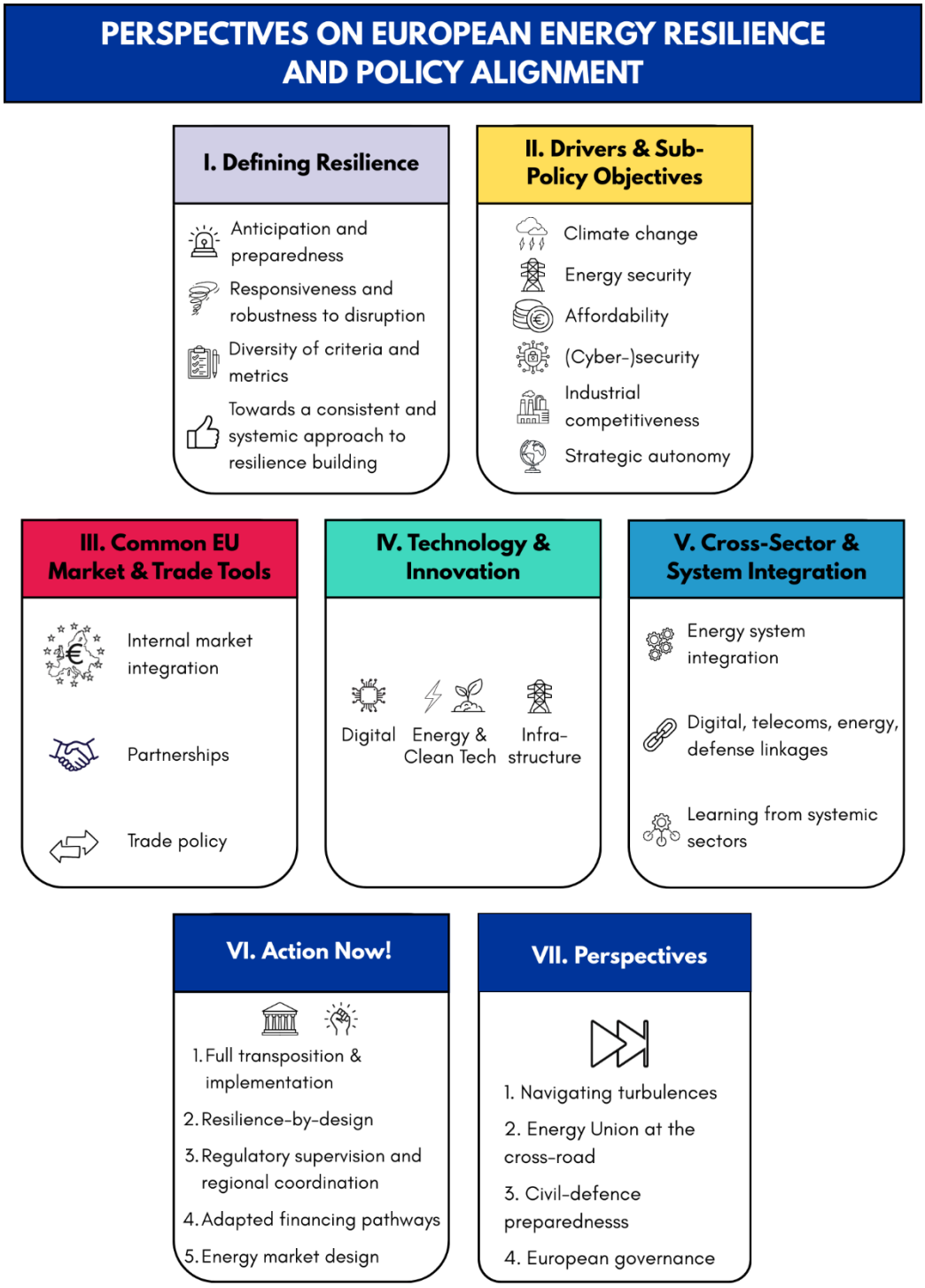
- **Climate change**: "*Embedding Climate Resilience in Regulation*", by Friðrik Már Baldursson and Nils-Henrik M. von der Fehr, 29 October 2025 (published here)
- **Security of supply**: "*Updating Security of Energy Supply Architecture and Preparedness Toolbox for an Increasingly Electrified Energy System*", by Catherine Banet and Chloé Le Coq, 4 November 2025 (published here)
- **Cyber security**: "*Cyber Resilience as a Pillar of European Energy Security*", by Alessandro Lazari, 16 December 2025 (published here)
- **Supply chains**: "*Supply Chain Resilience in the Energy Sector*", by Giancarlo Spagnolo, 17 February 2026 (published here)
- **Energy price shocks**: "*Resilience to Price Shocks in Coupled Gas-Electricity Systems*", by Kong Chyong, 4 March 2026 (published here).

The present paper, "*Perspectives on European Energy Resilience and Policy Alignment*", has two purposes: 1) present and contextualise the main findings of these issue papers; and 2) suggest policy alignment to make Europe's regulatory approach to energy resilience fit for these challenges.

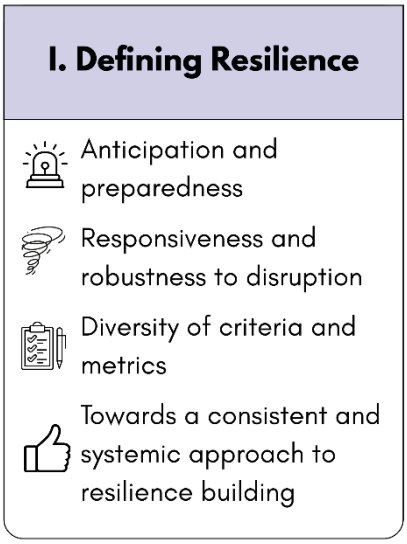
[1] Friðrik Már Baldursson, Catherine Banet, and Chi Kong Chyong. "Building Resilience in Europe's Energy System." *CERRE*, June 2023. https://cerre.eu/publications/building-resilience-in-europes-energy-system/.

A resilient European law and policy framework should generally cover two dimensions of resilience: (i) a framework that is able to address the sources of disruptions, and build resilience through a series of requirements (external dimension); (ii) a framework that is in itself resilient to changes and able to address them, as well as to adapt sufficiently to them without the need to be changed (internal dimension).

The following diagram presents an overall framing that should support energy resilience in Europe, through a series of concrete requirements and overall alignment measures. The content is further reviewed in the rest of Section 1.



1.1 Defining Resilience



The concept of 'resilience' has gained increased recognition in the European discourse over the past few years. It has appeared as a new paradigm applying across many sectors and infrastructures, including energy. Policy and regulation increasingly refer to resilience as a general objective but often fall short of defining it or having a comprehensive, systemic approach to it.

'Resilience' can be defined as the ability of a system to overcome extreme events with minimum disruptions and with a rapid restoration or adaptation phase. In the context of ecological sciences, resilience has been defined as the ability of a natural system to resist and undergo changes without losing its core structure and function.[2] As summarised by the Stockholm Resilience Centre: "*Resilience is the capacity of a system, be it an individual, a forest, a city or an economy, to deal with change and continue to develop. It is about how humans and nature can use shocks and disturbances like a financial crisis or climate change to spur renewal and innovative thinking*."[3] Resilience is therefore more than merely resistance to a shock. It shows the ability of a system to deal with change and continue to develop. The process of resilience is not linear, but more like a spiral, including a transformative phase. It can be preventive (pre-disaster), but could also follow a disaster, rebounding from it to use the window of opportunity created to introduce resilience.[4]

European legislation starts referring to resilience or the need to be more resilient. When it comes to energy, very few laws refer to 'resilience' as an objective of regulatory intervention. By contrast, policy documents contain references to the concept of resilience as a way to address a multiplicity of cumulative threats and disruptions. The EU Critical Entities Resilience Directive[5] provides a legal definition of 'resilience', meaning "*a critical entity's ability to prevent, protect against, respond to, resist, mitigate, absorb, accommodate and recover from an incident*"[6]. In addition, several energy legal acts refer to concepts like reliability, adequacy of supply, security of supply or restoration, supported by metrics criteria. These concepts and metrics all capture a side of resilience and contribute to it, but not its entirety. Similarly, cyber resilience legislation refers to availability, authenticity, integrity or confidentiality of data and services. A major challenge for fostering resilience in the European energy

[2] C.S. Holling, Resilience and stability of ecological systems, Annual Review of Ecology and Systematics (1973) 4: 1-23; C Folke, SR Carpenter, B Walker et al (2010), Resilience thinking: integrating resilience, adaptability and transformability, Ecology and Society 15(4).

[3] Stockholm Resilience Centre, What is Resilience, available at https://www.stockholmresilience.org/research/research-news/2015-02-19- what-is-resilience.html

[4] C. Banet, H. Mostert, L. Paddock, M. Montoya and I. del Guayo, Conclusion - Managing disruption and reinventing the future: resilience as requirement for legal frameworks, in C. Banet et al (eds.), Resilience in Energy, Infrastructure, and Natural Resources Law: Examining Legal Pathways for Sustainability in Times of Disruption (Oxford UP, 2022), Chapter 22.

[5] Directive (EU) 2022/2557 of the European Parliament and of the Council of 14 December 2022 on the resilience of critical entities and repealing Council Directive 2008/114/EC https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022L2557.

[6] Art. 2(2), EU Critical Entities Resilience Directive.

system is to have a consistent approach to resilience, aligning the different requirements and metrics, in such a way that they support each other's in a complete and consistent manner, in accordance with the energy system needs and the diversity of threats.

1.2 Drivers & Sub-Policy Objectives

CERRE's Resilience Forum and the issue papers have identified central drivers in building the resilience of the European energy system. Those are reflected in a series of European policy objectives which have led to legislative initiatives.

Those policy objectives include: climate change and resilience in view of extreme and frequent weather events; energy security and comprehensive security of supply (SoS); affordability concerns in periods of energy price spikes; (cyber-)security risks with the urgent need to increase resilience against hybrid and conventional attacks; competitiveness and increasing resilience in value chains supply of equipment, components and raw materials; geopolitical tensions calling for strengthening economic security and strategic autonomy.

1.3 Geopolitics & Internal Market

Geopolitical tensions impact the global and European economies deeply. They delay investment decisions, disrupt and reconfigure supply chains, increase commodity prices and energy costs, alter growth, welfare and security, and may lead to geoeconomic fragmentation. They interact with other disruption factors, increasing the extent of their impact. In 2025, the European Central Bank (ECB) elaborated an indicator for mapping country-level geopolitical risk[7] along with other similar tracking tools.[8] These indicators can inform policy makers, financial authorities and companies on how to build resilience to such shocks.

Economic and financial stability in Europe is closely linked to the performance of the internal market. Fragmentation of the internal energy market poses a particularly high risk, as it entails direct costs for governments, companies and citizens,

[7] European Central Bank, European Systemic Risk Board, Financial stability risks from geoeconomic fragmentation, January 2026. https://www.ecb.europa.eu/pub/pdf/other/ecb.report202601_financialstabilityrisks.en.pdf

[8] Caldara, D. and Iacoviello, M. (2022), "Measuring geopolitical risk", *American Economic Review*, Vol. 112, No 4, pp. 1194-1225

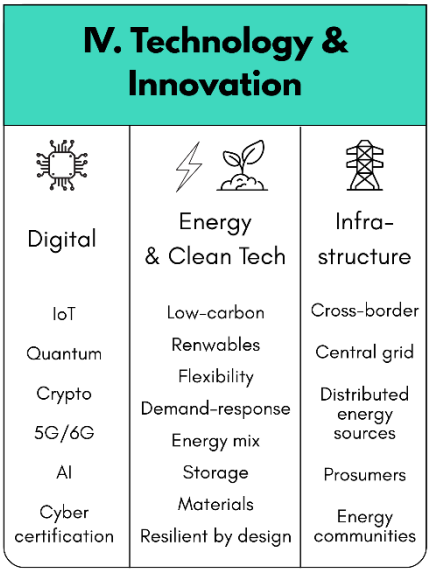
instead of maximising benefits. Realising "a true single market"[9] and deepening the internal energy market integration as well as market coupling by notably investing in cross-border infrastructure is seen as an imperative, as concluded by several of the issue papers.

At the border, strategic partnerships must be pursued and strengthened. This starts with the extension of the internal energy market, through the European Economic Area Agreement and the Energy Community Treaty.

Geo-economics is the use of economic instruments for geopolitical purposes, where recent use cases include tariffs, export controls, sanctions, and commercial restrictions due to declarations of dual use or national security. This puts international partnerships under friend- or -foe reassessment (like-mindedness and "value-based realism"). It forces the EU to quickly rethink its partnership policy with third countries, establishing new EU joint purchasing initiatives and partnerships under Team Europe and Global Gateway. The issue papers provide a deep dive into economic security from the perspective of energy supplies, equipment supply chains, and system-level resilience.

1.4 Technology & Innovation

New technologies and innovation play a major role for resilience in energy systems. They can be addressed in three pillars: digital, energy and clean technologies, and infrastructure. These are, of course, interrelated, as in the digitalisation of energy systems and the intertwining of digital (e.g., cloud, telecoms) and energy infrastructures.



Key digital technologies, with a high disruptive effect include the Internet of Things (IoT), AI, 5G/6G telecoms, emerging post-quantum encryption, and related to all of these, the certification from a (cyber-)security perspective for free circulation in the EU internal market. The issue papers address several of these technologies, the speed of their development, the challenge of keeping the speed of innovation in Europe and control through notably ownership and public procurement.

In energy and clean technologies, the issue papers stress that ambitious and coordinated action is needed to quickly implement new requirements defined in the Digital Services Act and the Net Zero Industry Act (NZIA) as a basis for further scaling up renewable, low carbon technologies enabling distributed systems, local flexibility, and battery and energy storage systems (BESS). This requires a value chain approach and recalls the criticality of supply of certain raw materials and energy efficiency requirements.

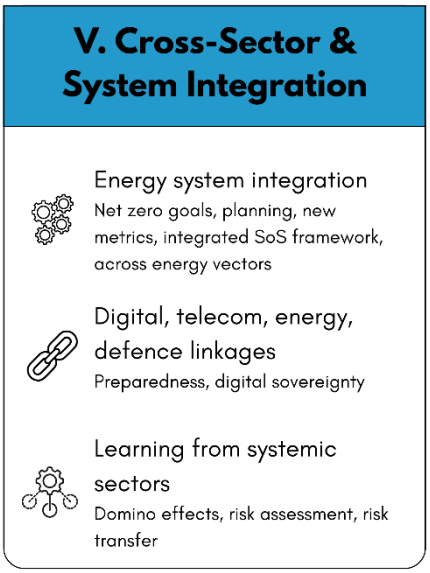
Grid technologies and secure trading operations go together, and are identified as specific areas of regulatory attention for technology and innovation, given the move towards real time trading (15

[9] International Monetary Fund, Europe's Choice: Policies for Growth and Resilience, 16 December 2024.

minute trading intervals on day-ahead wholesale markets) and more regionally coordinated grid operations (e.g. through Regional Coordination Centres, RCCs). Technological choices in one country affect other Member States, both in terms of innovation and resilience, requiring a European approach to key structural and operational requirements

This domain intersects with the earlier raised challenges of competitiveness and strategic autonomy, the willingness to invest and the availability of risk capital in Europe, ownership of companies, data sovereignty, protection of intellectual property, and the political initiatives on Europe-First with choices around “made in Europe” vs “made with Europe”.

1.5 Cross-sector & System Integration



System integration refers to the planning and operation of the energy system “as a whole”, across multiple energy carriers, infrastructures, and consumption sectors. It enables linking various energy carriers (electricity, heat, cold, gas, solid and liquid fuels) with each other and with end-use sectors such as buildings, transport or industry. The EC Strategy on energy system integration of July 2020 identified the need to provide greater flexibility to the energy system through notably system integration, but further efforts are necessary. To fully align with net zero goals, strategic planning, specific metrics and cost allocation methods are crucial tools.

Energy systems are these days extensively digitised and rely upon digital infrastructures, with digital equipment at all levels, extensive use of public and private telecom networks, cloud services, data management, and artificial intelligence (AI). Many energy systems and/or their supportive digital infrastructures also have both civil and military applications, that is, dual-use. Especially in the digital world there is a high (over 80%) dependency on foreign suppliers which creates an inroad for geopolitical pressures, which means that the EU’s digital sovereignty and thereby its energy sovereignty are at stake.

The systemic interlinkage of energy and digital systems raises concerns about spill-over, cascading or domino effects across the two domains. Indeed, we have already seen disruptive incidents due to severe weather and climate change or arson attacks or cyber-attacks where energy systems can get disrupted due to telecoms or cloud breakdowns, and, vice -versa, that telecom services can come to a halt when electricity supply gets disrupted (mobile network stations have at best for a few hours of battery backup power).

Mutatis mutandis this also holds for financial systems. Indeed, the world of energy can learn from the preparedness for systemic disruption that is relatively mature in the financial world. Preparedness includes provisions in contracting, supervision, monitoring, inspection, and exercising and is

supported by law (notably, the EU Digital Operational Resilience Act, DORA[10]) and governance such as financial authorities.

1.6 Regulatory Alignment: Action Now!

The issue papers identify actions that should be taken now to bolster resilience in energy systems. The present section highlights action-oriented findings from these papers. The broad categories to urgently address are supplier relations, where the financial sector provides concrete examples of contractual reinforcement of resilience in supplier relations (DORA Regulation); resilience against physical-cyber incidents, where experts, governments, and industry identify this as one of the top risks in the coming two years with a major impact for many years to come. Other areas for action are skills development; preparedness; energy market design; and governance.

The Issues Papers come with a series of joint recommendations to:

1. **Seek full transposition and implementation of existing frameworks before adding new layers.** The internal and external threats pose serious challenges to European policy and legislative frameworks. They add up to create a high degree of turbulence in the implementation and enforcement phases of EU legislation and doubts as to the shaping of new European regulatory initiatives. In combination, they put the robustness of the European regulatory approach to the test.

2. **Provide guidance to Member States for elaborating and aligning**: resilience-by-design criteria in regulation; indicators for investments and technological resilience; public procurement and European content requirements; cross-sector coordination in line with the twin energy & digital transition, as well as energy system integration. A cross-vector, cross-sectoral approach to gas and electricity resilience planning is necessary.

3. **Clarify objectives and competences for regulatory supervision** by national regulatory authorities (NRAs), in cooperation with European agencies (e.g. ACER) and organisations (network of TSOs). Seek for effective regional coordination using and reinforcing existing structures instead of creating new ones. Climate shocks do not respect national borders and energy shocks have collateral effects on neighbouring Member States.

4. **Adapt financing pathways at all relevant levels.** Provide clarity on what measures require supranational funding (e.g. through EU/NATO) and what can be borne by customers via network tariffs, with a recommended move from a cost-efficiency-only approach to energy regulation, whilst continuing to protect consumers. The best approach to resilience being

[10] Regulation (EU) 2022/2554 of the European Parliament and of the Council of 14 December 2022 on digital operational resilience for the financial sector.

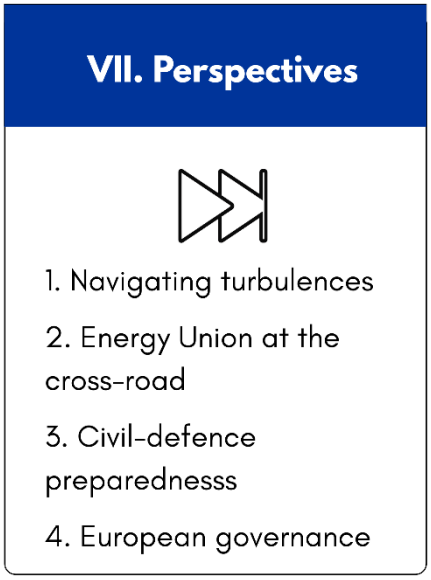
anticipatory, providing guidance as to a common approach to anticipatory investments and supporting efforts for agreeing on cost/benefits allocation between states.

5. **Energy market design legislation is the foundation of the operation of the energy system** in Europe and the basis of security of energy supply and preparedness measures. Targeted revision of energy market design legislation can address some remaining or new non-system/non-operational related risks, such as ownership risks, but should be carefully assessed

1.7 Perspectives

The Forum and the issue papers make clear that there is much work ahead to address integration, clashes, and gaps in policies and regulations.

We propose to address in these future perspectives sectoral regulation and governance, horizontal and cross-sector regulation especially to deal with cascading risks and the trend towards 'Buy European'.



1. **Navigating turbulences** requires activating both internal and external resilience. The EU legislation must be conceived and applied in a way where it can support shocks and disruption, without requiring changes or too many exemptions. Applying both a 'resilience-by-design' and 'preparedness-by-design' principle to be applied when drafting new legislation or setting up new funding instruments should be considered. It must also support resilience building across sectors, to deal with systemic effects and cyber-physical (hybrid) disruptions. In addition, European regulation reflects a series of values that should not be compromised, even when confronted with stresses and shocks, or the pressure of global competitors.

2. **Civil-Defence Cooperation and Dual Use** – The 2024 Niinistö report recommends strengthening civil-defence cooperation on preparedness and readiness.[11] First, the defence and public authorities do not have the finances and human resources to address the multiplicity of threats alone and on the entire territory. Civilians and companies therefore need to contribute, which raises questions of costs, investments, information sharing and preparedness. Second, many combined energy and digital systems are of dual-use. Strengthening resilience across the civil and military domains is a short-term priority notably in view of: wars and their spillover effects in the EU; and a long-term priority to develop technology benefiting both civil and military domains, thereby making Europe more competitive and strategically autonomous.

[11] Sauli Niinistö, Safer Together – Strengthening Europe's Civilian and Military Preparedness and Readiness, 2024.

3. **Energy Union at the cross-road** – The European Union and the Energy Union in particular (conceived in 2015), are at a conjecture moment, where they must respond to energy security and industrial competitiveness challenges at the same time as it must keep on the path towards ambitious decarbonisation goals. In doing so it faces pressure externally from geopolitical competitors and internally from some Member States. This moment in time calls for further coordination, fair allocation of costs and potentially transformative regulatory approaches, with recognition of urgency by increasing speed and flexibility.

4. **European Governance** – The Governance framework for the Energy Union supported by the 2018 Governance Regulation[12] is the only framework existing at the EU level to steer common efforts towards EU climate and energy targets compliance, consistency across targets and coordination between Member States. The Governance framework is up for review by the end of 2026.[13] The Governance Regulation defines some central planning and monitoring requirements, which should not be replaced by only investment plans. The revision should aim for a policy alignment with the resilience objectives identified in the issue papers.

[12] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action.
[13] European Commission Work Programme 2026, Europe's Independence Moment, COM(2025) 870 final, 21.10.2025. Report from the Commission on the Review of the Regulation on the Governance of the Energy Union and Climate Action, COM/2024/550 final, 11.09.2024.

2 Key Messages from Issue Papers

This Section contains the key messages from each issue paper.

2.1 Updating the Security of Energy Supply Architecture and Preparedness Toolbox for an Increasingly Electrified Energy System – Catherine Banet and Chloé Le Coq

Electrification is accelerating, and Europe's energy system is undergoing a profound transformation – becoming more decarbonised, decentralised, and digitalised. At the same time, the system faces a convergence of unprecedented risks, from cyber threats and extreme weather to geopolitical tensions. In this high-stakes environment, the EU's Security of Supply (SoS) framework faces a resilience test it cannot afford to fail.

This issue paper focuses on electricity SoS, where the primary objective is to ensure sufficient generation to meet demand at all times. The paper aims to contribute to the legislative reform on energy security currently envisaged by the European Commission.

The SoS Regulatory Pyramid

The paper reviews the structure and content of the EU's evolving SoS and preparedness frameworks. Security of supply is framed as an integrated architecture built on three distinct but interconnected layers of structural components embedded in: (1) the electricity market (only) design; (2) supplementary market mechanisms to ensure SoS; and (3) risk preparedness and emergency measures.

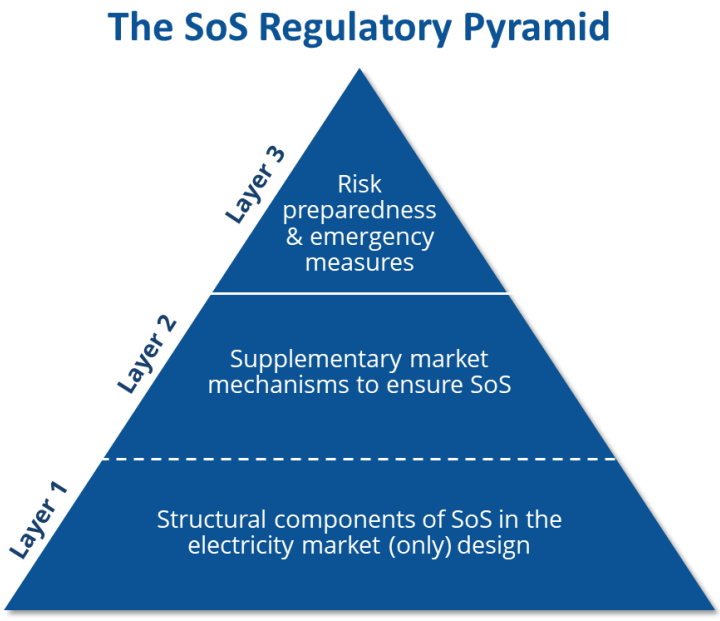


Figure 1 SoS Pyramid © Author: Catherine Banet, UiO/CERRE

Key Conclusions

The paper explores how the EU can adapt its framework to meet emerging challenges while maintaining market integration and accelerating decarbonisation – in both normal times and crisis situations. A comprehensive approach spanning all three SoS layers is deemed essential to anticipate, prepare for, and manage crises.

Recommended Key Actions

Layered but integrated SoS architecture

- Adopting targeted legislative amendments and market-based SoS tools
- Prioritising power quality and inertia, local flexibility, stronger network operation, interconnections, and "fit-for-purpose" governance
- Increasing resilience without undertaking a disruptive, full electricity market design (EMD) reform

Upgraded Adequacy Regulation with Non-Distortive Supplementary Mechanisms

- Using supplementary mechanisms only when they are non-distortive, transparent, proportionate, open to cross-border participation, technology-neutral, performance-based, and time-limited.
- Addressing scarcity beyond the energy-only market (EOM) while avoiding distortions and free riding
- Further aligning the criteria used to complete the European Resource Adequacy Assessment (ERAA) and for the EU-wide flexibility assessment platform

Consolidated, Coordinated and Efficient Preparedness Toolbox

- Adopting an EU-wide, rules-based risk-preparedness framework with harmonised assessments, regularly updated plans, streamlined crisis playbooks, and incentive-compatible solidarity conditioned on credible national preparedness to curb moral hazard

System Approach of the SoS Architecture

- Building one integrated SoS framework for electricity, gas, and low-carbon gases, with aligned rules, joint planning, and shared data, so the system is resilient, efficient, and market-consistent.

The Issue Paper was discussed at the CERRE event Virtual Roundtable on Critical Infrastructure Resilience (5 November 2026).

2.2 Embedding Climate Resilience in Regulation – Friðrik Már Baldursson and Nils-Henrik M. von der Fehr

Climate Resilience Matters

Europe's electricity and gas networks are under pressure – and climate change is turning up the heat. Extreme weather events are becoming more frequent and severe, exposing vulnerabilities in energy infrastructure and raising the spectre of cascading failures across interconnected systems. Despite mounting risks, EU and national regulatory frameworks are still struggling to capture the value of resilience investments, putting households, businesses, and critical services at risk of climate-driven disruptions.

The Regulatory Gaps

After providing an overview of the climate-related risks to energy infrastructure, this issue paper explains that resilience has not been systematically implemented in regulatory practice, either at the EU or the national level. Concentrating on transmission and distribution system operators (TSOs and DSOs), the analysis reveals that, although EU policy and regulation acknowledge resilience, **concrete regulatory tools remain underdeveloped**. Most notably, cost–benefit methodologies and performance incentives do not systematically account for climate risks, and mandatory climate risk assessments are fragmented.

Five Pathways to Embed Climate Resilience

The paper assesses and compares five policy options:

1. Increasing emphasis on climate resilience in EU-level energy legislation;
2. Strengthening EU-level project assessment through the *Ten-Year Network Development Plan* and cost–benefit analysis guidelines;
3. Incorporating resilience explicitly into national regulatory frameworks;
4. Enhancing EU-level coordination and stress testing;
5. Expanding the role of insurance and financial risk transfer.

No single measure will suffice. A combined approach is needed – one that ensures **strong EU-level consistency while allowing flexibility to adapt to regional and national contexts**. Investment in resilience can be seen as a form of insurance: costs incurred today to reduce the likelihood of greater losses tomorrow. How these costs are recognised in regulation, how responsibilities are divided between EU and national levels, and how risks are shared between operators, consumers, and insurers will determine Europe's ability to safeguard its energy systems in a changing climate.

Key Conclusions

- Climate change is making resilience an increasingly important consideration for Europe's energy networks, alongside efficiency, decarbonisation, and security of supply.
- Resilience investments may be understood as a form of insurance: costs incurred today that reduce the likelihood of greater damages in the future. Whether through reinforcement of physical assets, operational preparedness, or financial mechanisms for sharing risk, adaptation measures can reduce the chances that climate shocks escalate into systemic crises.

Recommended Key Actions:

- There are **multiple possible pathways forward**; some involve EU-level measures, others national regulatory reform, revisions to methodologies such as cost–benefit analysis, or the use of insurance and risk-sharing mechanisms
- A central challenge will be **finding the right balance** between consistency at the EU level and flexibility for national regulators to respond to diverse local risks.

The Issue Paper was discussed at the CERRE event Virtual Roundtable on Critical Infrastructure Resilience (5 November 2025).

2.3 Cyber Resilience as a Pillar of European Energy Security – Alessandro Lazari

Digitalisation, climate stress, geopolitical tensions, and increasingly complex supply chains are creating intertwined vulnerabilities across electricity, gas, oil, and hydrogen networks. Cyber threats are escalating. At the same time, volatility in electricity wholesale markets and disinformation campaigns can amplify disruptions across the entire energy ecosystem.

Overcome Siloed Approaches

Regulatory implementation remains fragmented despite the strengthening of the EU framework through NIS2, the CER Directive, the Cyber Resilience Act, Seveso III, and energy-specific Network Codes. Cyber, physical, climate, market, and hybrid risks are often addressed separately, leading to parallel risk assessments and divergent supervisory expectations. Governance fragmentation is linked to overlapping instructions for operators, separate threat models used by different authorities, and inconsistencies in supply chain oversight.

A Strategic Approach

The paper concludes that cyber resilience requires a shift from compliance-driven security to a systemic, anticipatory, and strategically integrated resilience model that empowers Europe's energy systems to deal with disruptions as much as long-term pressure.

Towards Systemic Cyber Resilience

To embed cyber resilience in energy regulation, the paper identifies a set of actions:

Recommended Key Actions:

Regulatory

- **Consolidate** implementation and enable **cyber-resilience maturity** to emerge (short-term)
- Establish a **European Programme for Critical Entities Resilience** EPCER (short-term action)
- Establish DORA-Like **Framework for lifeline critical infrastructures** (long-term)

Certification

- ENISA to develop a cybersecurity certification scheme for energy sector devices

Tactical and Harmonisation

- Produce enhanced **EU guidance** on the interaction between risks, hazards, and threats.

2.4 Supply Chain Resilience in the Electricity Sector – Giancarlo Spagnolo

Electricity Supply Chain Resilience Matters

Against the backdrop of the EU's broader effort to reduce strategic dependencies in critical industries, this paper examines how public procurement can strengthen supply chain resilience in the European electricity sector. The 2023 Critical Raw Materials Act and the Net-Zero Industry Act introduced measures to secure access to key inputs and expand European manufacturing capacity in strategic clean technologies. The Industrial Accelerator Act is expected to reinforce the role of public demand in supporting European production and reducing exposure to external shocks. Yet procurement practices remain largely price-driven and insufficiently aligned with long-term resilience objectives.

The electricity sector represents a critical test case. Grid expansion, digitalisation, renewable deployment and electrification depend on complex, globally interconnected supply chains exposed to geopolitical concentration, export controls, cyber risks and production bottlenecks. Diversification is widely recognised as one of the most effective mitigation levers but is often costly or structurally constrained to a limited number of countries or suppliers. Without coordinated intervention, contracting authorities may continue to prioritise short-term savings over long-term resilience.

Leveraging Public Procurement for Supply Chain Resilience

Public procurement constitutes a central, yet insufficiently structured, instrument for addressing these challenges at the buyer and the contractor level. In view of the upcoming revision of the EU's public procurement framework, the paper analyses how procurement rules and public demand can be redesigned to correct structural incentives and embed resilience considerations more systematically. In particular, it examines how procurement frameworks could operationalise:

- Diversification and multi-sourcing strategies, including contract division into lots, while carefully balancing competition risks and the potential for collusion;
- Targeted 'Buy European' approaches, tailored to highly concentrated strategic technologies and designed to remain compatible with international trade obligations;
- Public Procurement of Innovation (PPI) and collaborative procurement, to achieve scale, pool expertise and prevent uncoordinated purchasing from aggravating supply bottlenecks;
- National security screening mechanisms adapted to procurement, enabling the assessment of security risks without removing contracts from the scope of EU procurement law.

A Framework for Measuring and Implementing Resilience in Public Procurement

Beyond procedural design, the paper proposes a structured framework for measuring and implementing supply chain resilience within procurement procedures. It discusses resilience indicators, such as supplier diversification, geopolitical exposure, stockpiling capacity and stress-test performance, and analyses how these can be integrated into selection and award criteria. It further examines how resilience assessments could be centralised through a specialised measurement and

certification body, issuing structured resilience ratings that reduce administrative burdens while limiting duplication and free-riding. Particular emphasis is placed on stress tests as ex ante tools to simulate geopolitical or market shocks and to incentivise firms to strengthen their upstream supply chains before disruptions occur.

Recommended Key Actions:

- The regulatory toolbox is fragmented and insufficient to address key vulnerabilities. **Use public procurement** as a strategic lever to incentivise resilience.
- **Improve procurement Directives** for example, by incentivising division into lots and multi-sourcing to increase diversification and resilience.
- **Impose minimum Buy European requirements** but cautiously, targeted where the EU has high potential and current supply is highly concentrated in a single third country.
- **Step up Innovation** to reduce dependency on foreign inputs such as CRMs. Combine more centralised or collaborative procedures with PPI for scale.
- To be successful, **strengthen competences of EU public buyers personnel**, often limited to legal aspects, considerably.
- Incentivise resilience through public procurement with **resilience indicators** of suppliers – including the results of stress tests, in selection or award criteria.

2.5 Resilience to Price Shocks in Coupled Gas-Electricity Markets – Kong Chyong

This CERRE paper analyses the interlinkages between European gas and electricity markets and examines how price shocks propagate across the two systems.

The author argues that high-impact, low-probability events, including periods of LNG supply stress, can generate severe price volatility, particularly under compound gas-power conditions, and that growing global gas-market integration allows external shocks to transmit rapidly into Europe's wholesale electricity prices.

The paper suggests that many 2021–23 crisis measures functioned mainly as ex-post coping mechanisms, whereas stronger resilience depends on ex-ante measures that reduce exposure and dampen amplification, including demand-side flexibility, diversification, storage governance, and procurement and long-term contract design.

To support policy-makers in strengthening energy system resilience, the paper proposes an Energy Price Resilience (EPR) metric. Building on the existing gas n-1 security standard and electricity adequacy assessments, the EPR would better capture spillover effects between gas and electricity markets under market stress, including exposure to global LNG supply volatility.

This CERRE paper is a contribution to the renewed debate on electricity market design. It concludes that most research finds the current framework to have proven resilient during the 2021–23 energy crisis and to remain the most efficient mechanism for dispatch and investment.

Recommended Key Actions:

- Strengthening resilience requires a **balanced mix of policy measures**: reducing exposure in advance, building buffers such as storage, networks, and other flexibility options, ensuring faster recovery after shocks, and lowering long-term dependence on marginal fossil fuels.
- The proposed **Energy Price Resilience (EPR) metric** offers a practical way to measure price resilience and integrate price-risk assessment into existing EU energy security rules, helping policymakers identify and address vulnerabilities before the next crisis

About CERRE

Providing high quality studies and dissemination activities, the Centre on Regulation in Europe (CERRE) is a not-for-profit think tank. It promotes robust and consistent regulation in Europe's network, digital industry, and service sectors. CERRE's members are regulatory authorities and companies operating in these sectors, as well as universities.

CERRE's added value is based on:

- its original, multidisciplinary and cross-sector approach covering a variety of markets, e.g., energy, mobility, sustainability, tech, media, telecom, etc.;
- the widely acknowledged academic credentials and policy experience of its research team and associated staff members;
- its scientific independence and impartiality; and,
- the direct relevance and timeliness of its contributions to the policy and regulatory development process impacting network industry players and the markets for their goods and services.

CERRE's activities include contributions to the development of norms, standards, and policy recommendations related to the regulation of service providers, to the specification of market rules and to improvements in the management of infrastructure in a changing political, economic, technological, and social environment. CERRE's work also aims to clarify the respective roles of market operators, governments, and regulatory authorities, as well as contribute to the enhancement of those organisations' expertise in addressing regulatory issues of relevance to their activities.

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