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## EU energy security - evaluating the EU's security of electricity and gas supply framework

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## Glossary

| *Term or acronym* | *Meaning or definition* |
|---|---|
| ACER | Agency for the Cooperation of Energy Regulators |
| Bcm | Billion cubic meters |
| CEE | Central and Eastern Europe |
| CEER | Council of European Energy Regulators |
| CEF | Connecting Europe Facility |
| CER Directive | Critical Entities Resilience Directive |
| CRA | Common Risks Assessment |
| CRM | Critical Raw Material |
| CRMA | Critical Raw Material Act |
| DG | Directorate-General |
| DG ENER | Directorate-General for Energy |
| DSO | Distribution System Operator |
| ECG | Electricity Coordination Group |
| EnC | Energy Community |
| EENS | Expected Energy Not Served |
| ENS | Energy Not Served |
| ENTSO-E | European Network of Transmission System Operators for Electricity |
| ENTSOG | European Network of Transmission System Operators for Gas |
| EP | Emergency Plan |
| EU | European Union |
| EUCRA | European Climate Risk Assessment |
| FDI | Foreign Direct Investment |
| FSRU | Floating Storage and Regasification Unit |

| | |
|---|---|
| GCG | Gas Coordination Group |
| GFPP | Gas-Fired Power Plant |
| GWh | Gigawatt hour |
| IP | Interconnection Point |
| ISG | Interservice Steering Group |
| JRC | Commission's Joint Research Centre |
| KPI | Key Performance Indicator |
| kWh | Kilowatt hour |
| LNG | Liquefied Natural Gas |
| LOLE | Loss Of Load Expectation |
| Mcm | Million cubic meters |
| MoU | Memorandum of Understanding |
| MS | Member State |
| NATO | North Atlantic Treaty Organisation |
| NECP | National Energy and Climate Plan |
| NIS2 Directive | Network and Information Security 2 Directive |
| NRA | National Regulatory Authority |
| PACE | Integrated Resolve Parallel and Coordinated Exercises |
| PAP | Preventive Action Plan |
| PCI | Project of Common Interest |
| PMI | Projects of Mutual Interest |
| Ppm | Parts per million |
| PV | Photovoltaics |
| RCCs | Regional Coordination Centres |
| ReCo system | Regional Coordination System |
| RSB | Regulatory Scrutiny Board |

| | |
|---|---|
| RPP | Risk Preparedness Plan |
| RPR | Risk Preparedness Regulation |
| SME | Small and Medium Enterprises |
| SoS | Security of Supply |
| SSO | Storage System Operator |
| SWD | Staff Working Document |
| TEN-E | Trans-European Network for Energy |
| TSO | Transmission System Operator |
| TTX | Table-top exercise |
| TWh | Terawatt hour |
| TYNDP | Ten Year Network Development Plan |
| UGS | Underground Gas Storage |
| VIP | Virtual Interconnection Point |
| VOLL | Value of Lost Load |

# 1. INTRODUCTION

## 1.1. Purpose and scope of the fitness check

Energy security is one of three pillars of EU energy policy, alongside sustainability and affordability. It can be defined as the ability of an economy to ensure a constant match between its energy needs and its energy supply, even under challenging circumstances. This means ensuring both:

i. the long-term equilibrium between demand and supply structures (through security and diversity of supply and demand-side measures), and;
ii. the ability of the system to react to sudden shocks.

The fundamentals of energy security are primarily ensured by well-functioning and well-connected energy markets, which allow the energy to flow where it is the most needed through price signals, as well as energy efficiency and sufficiency efforts. Additionally, the EU has developed a robust energy security architecture. It was designed with the objective of limiting as much as possible the interactions with the normal functioning of the energy markets. It is supposed to work as an insurance, which kicks in mainly in situations where the markets are no longer able to deliver (e.g., when high prices do not attract additional supplies). This energy security framework relies on the following pillars: security of gas supply; electricity risk-preparedness; emergency oil stocks; the safety of offshore energy infrastructure; critical infrastructure protection (including critical entities resilience); cybersecurity; and access to critical raw materials.

In 2021-2023, the EU faced one of the worst energy crises since the oil shocks of the 1970s, in particular due to the invasion of Ukraine by Russia in February 2022 and Russian weaponisation of energy supply. This energy crisis was a stark reminder of how energy security and the clean transition towards domestically produced energy are key building blocks of a resilient, future-proof and competitive economy. At the same time, the energy transition is changing the energy system, while it brings new opportunities, it also calls for an updated energy security framework that is fit to face new challenges for the EU energy system. Thereupon, in 2024, the European Commission (hereafter: "the Commission") received calls for action from the European Council[1], the Council[2], and three former EU heads of governments[3]. More recently, the new

[1] European Council conclusions, 22 March 2024: https://www.consilium.europa.eu/media/70880/euco-conclusions-2122032024.pdf

[2] Council conclusions on "Advancing sustainable electricity grid infrastructure", 30 May 2024: https://data.consilium.europa.eu/doc/document/ST-10459-2024-INIT/en/pdf

[3] Enrico Letta, *Much more than a market*, April 2024 (https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf); Mario Draghi, *The future of European competitiveness*, September 2024 (https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en); Sauli Niinistö, *Safe Together: Strengthening Europe's Civilian and Military Preparedness and Readiness*, October 2024 (https://commission.europa.eu/document/download/5bb2881f-9e29-42f2-8b77-8739b19d047c_en?filename=2024_Niinisto-report_Book_VF.pdf).

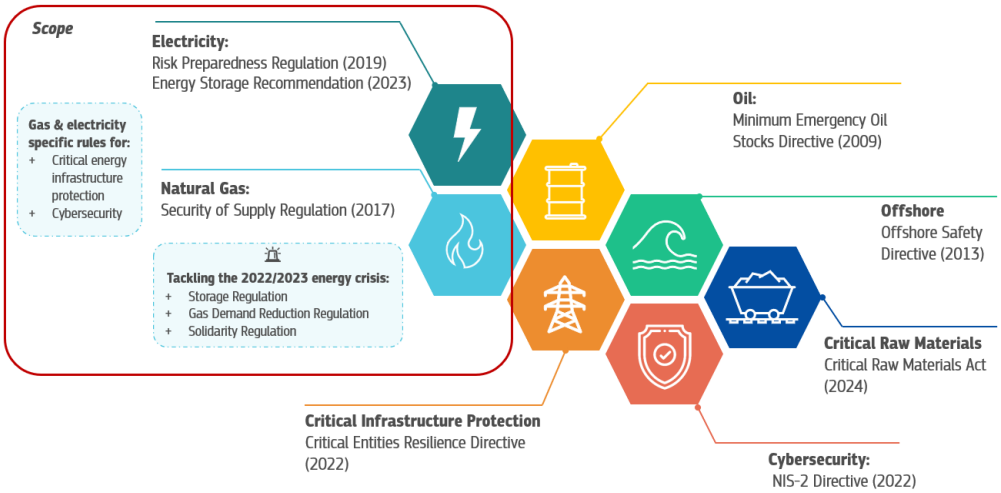
Commissioner for Energy and Housing has been tasked with conducting "a review of the security of supply framework"[4]. This fitness check report is a first step in this review.

Energy security is also closely linked to economic security and economic competitiveness with security of supply threats translating into higher and more volatile energy prices, as pointed out by the Draghi report. In addition, dependence on non-euro invoicing for energy imports exposes EU companies to foreign exchange risk and disruptions in third-country payment and settlement systems, which can amplify volatility and undermine competitiveness. This is why the Clean Industrial Deal[5] and Affordable Energy Action Plan[6] highlight that industrial competitiveness and decarbonisation strategy is also a security imperative. Similarly, the 2023 *European Economic Security Strategy* refers to energy security in the context of the assessment and the mitigation of supply chains' risks[7]. The Affordable Energy Action Plan stresses the need for a reviewed regulatory framework that increases the resilience of the EU's energy system to geopolitical tensions, cyberattacks, deliberate attacks or extreme weather events that threaten security and affordability. The most recent European Preparedness Union Strategy[8] also identified the "*resilience of vital societal functions*" as a priority area for action and highlights the review of the energy security framework as one of the main policy initiatives in this perspective for 2026 (Action 23). Moreover, the European Grid Package[9] addresses energy security by cross-border integrated planning and delivery of projects, to ensure an efficient network system that ensures that energy flows to where it is most needed.

The scope of this fitness check report is to evaluate the Gas Security of Supply Regulation[10] of 2017 and the Electricity Risk Preparedness Regulation[11] of 2019. These two Regulations are covered by this fitness check because they are the two core Regulations governing EU's energy security, while the gas and electricity markets are highly intertwined. Furthermore, both gas and electricity security of supply have been at the centre of the 2021-2023 energy crisis. Their similarly designed regulatory frameworks make a joint evaluation more meaningful. This report therefore covers the implementation period of the adoption of the first of these Regulations, i.e. from 2017 until 2024.

[4] See mission letter: 1c203799-0137-482e-bd18-4f6813535986_en
[5] COM(2025) 85 final
[6] COM(2025) 79 final
[7] JOIN(2023) 20 final
[8] JOIN(2025) 130 final.
[9] See: Commission proposes upgrade of the EU's energy infrastructure to lower bills and boost independence
[10] Regulation (EU) 2017/1938
[11] Regulation (EU) 2019/941

***Figure 1: Scope of the fitness check on security of gas and electricity supply***




*Source: European Commission*

The Oil Stocks Directive is outside the scope of this fitness check exercise, given the more limited synergies and connections with gas and electricity. At the same time, the EU gas and electricity markets are more regulated via single market regulations compared to the EU oil market. The Offshore Safety Directive, for its part, is mainly focused on the concept of *safety*, including environmental and labour safety. Whilst important, the safety requirements are distinct from the one of *security*, and this directive is therefore also outside the scope of this report. Whilst this fitness check will focus on the core elements of the EU energy security framework, oil stocks and the safety of offshore installations could be considered as part of a future wider review.

Critical infrastructure protection, cybersecurity and critical raw materials are also essential for the future energy security framework and are governed by recent horizontal legislation[12]. Although there is some margin for action in the horizontal regulations, these provisions (critical infrastructure protection, cybersecurity) are complemented by sectoral provisions included in the Risk Preparedness Regulation and the Gas Security of Supply Regulation. This fitness check primarily focusses on the provisions in the Risk Preparedness Regulation and Gas Security of Supply Regulation, their coherence with the horizontal framework, as well as their future relevance. When it comes to critical raw materials, this is a relatively recent area for EU acquis and horizontal legislation is currently being implemented, with significant milestones taking place in 2025. The Risk Preparedness Regulation and the Gas Security of Supply Regulation did not include concrete provisions in this area, but the fitness check looks at the overall relevance of critical raw materials for the future energy system. The coherence of the evaluated interventions with these horizontal provisions will also be assessed (c.f. section 4.1).

[12] Notably the Critical Entities Resilience Directive for the protection of critical energy infrastructure (2022), the NIS2 Directive for cybersecurity (2022) and the Critical Raw Materials Act (2024). The Net-Zero Industry Act (2024) addresses supply chain resilience for clean technologies.

The energy crisis, caused by hostile gas supply cuts from Russia following its full-scale invasion of Ukraine, has led to several EU-level initiatives that are part of the scope of this fitness check. These include:

i. Legislative amendments introduced by the Storage Regulation[13] and the Hydrogen and Gas Market Decarbonisation Package[14] to the Gas Security of Supply Regulation.
ii. The temporary emergency Regulations like the Gas Demand Reduction Regulation[15] and Solidarity Regulation[16].

The Regulation (EU) 2022/1854 on Emergency Intervention to mitigate the High Energy Prices is not part of the scope of this fitness check, because the objective of the Regulation was to address high electricity prices, rather than security of supply concerns.

The objective of this fitness check is to evaluate the effectiveness, efficiency, EU added value, coherence and relevance of the EU security of gas and electricity supply framework, in line with the Better Regulation guidelines[17]. This fitness check will assess:

(1) Whether the above-mentioned EU regulatory framework has been successful in meeting its objectives at the time of adoption and is fit for an evolving energy landscape.
(2) The extent to which the various pieces of legislation have worked together, to increase the EU's security of electricity and gas supply.

While primarily backward-looking in nature, this report also contains forward-looking aspects, to assess the continued relevance of the regulatory framework given the ongoing transformation of the energy sector towards decarbonisation.

### 1.2. Methodology

Most of the findings of this report are based on the activities set out below.

- The collection and assimilation of in-house expertise using (among others) experience gained from implementing the Regulations. This expertise comes from e.g.: (i) several cycles of Commission opinions on various plans[18]; and (ii) drafting two Commission reports on the implementation of the evaluated Regulations[19]. This experience also includes lessons learnt from the 2021-2023 energy crisis.
- Two table-top exercises ("dry runs") to stress-test the EU framework against crisis situations were organised in December 2022 and November 2024 by the Commission

[13] Regulation (EU) 2022/1032.
[14] Directive (EU) 2024/1788 and Regulation (EU) 2024/1789.
[15] Regulation (EU) 2022/1369.
[16] Regulation (EU) 2022/2576.
[17] SWD(2021) 305 final.
[18] One cycle for electricity, two cycles for gas.
[19] COM(2023) 572 final and COM(2025) 539 final.

to test: (i) emergency procedures and the gas system's resilience; and (ii) the interlinkages between the EU's gas system and electricity system.

- Exchanges with Member States and other key actors (EU Agency for the Cooperation of Energy Regulators (ACER), ENTSO-E, ENTSOG, Regional Coordination Centres (RCCs)) to estimate the costs linked to the Regulations.
- Extensive desk research, with support of the Commission's Joint Research Centre (JRC) and DG ENER's Chief Economist Team to provide scientific and analytical input. This was based on a set of indicators to measure the performance of the evaluated Regulations and the overall security of electricity and gas supply situation. It also incorporates findings from reports from external sources such as ACER, IEA, ENTSOG and ENTSO-E.
- A cross-DG strategic foresight exercise was organised, using the JRC's Megatrends tool[20], to collectively reflect on potential risks and opportunities for security of gas and electricity supply. More details can be found in Annex VI.
- A 12-week call for evidence and public consultation, as well as other consultation activities, were carried out to gather citizens and stakeholders' views. A synopsis report, summarising all of them, can be found in Annex V.

At the same time, this fitness check report also displays methodological shortcomings:

- Exogenous factors influence EU security of gas and electricity supplies. Energy security is a complex interplay of global dynamics, including geopolitical events, market fluctuations, and dependency on external suppliers. Quantifying the impacts on both EU security of supply and the performance of the evaluated interventions therefore proved challenging. Establishing causality between the two Regulations and the subsequent outcomes is often not possible due to the variety of factors influencing the EU's security of gas and electricity supply.
- The difficulty of quantifying benefits of security of supply. Energy security policy acts as insurance for severe but unlikely events. Several provisions in the Regulations will hopefully never have to be used, making their related benefits difficult to assess. Moreover, energy prices get influenced by factors beyond security of supply (e.g. market dynamics, tariffs and (global) competition), although having an adequate level of supply is a precondition for affordable prices.
- Data availability and key performance indicators (KPIs) on certain aspects to be assessed were not sufficiently available. The Regulations prepare for many hypothetical scenarios in order to avoid the occurrence of such scenarios. Due to this so-called 'preparedness-paradox'[21], it is not possible to determine which crises have been prevented and what their impact would have been.

[20] See: https://knowledge4policy.ec.europa.eu/foresight/tool/megatrends-hub_en

[21] The 'preparedness paradox' means that the more an entity prepares for crises, the likelier that crises get avoided which results in fewer consequences. In turn, this makes continuing investing in preparedness harder to justify because the benefits are no longer tangible.

## 2. WHAT WAS THE EXPECTED OUTCOME OF THE INTERVENTION?

### 2.1. Description of the intervention and its objectives

This section provides an overview of the rationale, provisions and expected effects of the two evaluated interventions. While it could have been an option to create one unified intervention logic for the two Regulations, this report has two separate ones, because:

(i) Even if similar in their set-up, the two Regulations were designed as two distinct policy interventions, responding to different political contexts and needs.
(ii) Gas and electricity markets, although increasingly integrated, still work differently.

Given that the Regulations reacted to different problems in different years, the intervention logics are kept separate. However, section 4 presents the evaluation findings from a cross-sectoral perspective, as much as possible. Similarly, the crisis measures were not included in this section, as they were adopted as an *add-on* in a very different context, responding therefore to different needs: they were therefore treated as *policy developments* and are extensively described in section 3.

**Box 1: Lexical clarifications about the intervention logic**

According to tool #46 of the Better Regulation toolbox, an intervention logic of an evaluation or fitness check is supposed to summarise "*how the intervention was expected to work (i.e. at the time of adoption by the Commission or later by the co-legislators, or at the time of implementation), including the underlying assumptions*".

The intervention logic should reflect the following elements:

- **The problems/needs** it responds to**:** what was the rationale behind the original intervention?
- **The objectives** (general and specific): what were the expected changes that the EU was aiming to achieve? What was the positive desired situation?
- **The inputs:** how were these changes supposed to be achieved? What kind of resources were expected to be used?
- **The activities:** which events were expected to happen? What tasks were planned in order to transform the inputs into outputs?
- **The outputs:** what were the short-term operational achievements that were expected to be delivered?
- **The results:** what were the medium-term specific achievements that were expected to be delivered?
- **The impacts:** what were the expected long-term general achievements that were expected to be delivered?
- **The external factors:** what were the factors, apart from the implementation of the interventions, that may have affected the final performance?

### *2.1.1 Intervention logic for the Gas Security of Supply Regulation*

The origin of the Gas Security of Supply Regulation can be traced back to the first EU-level gas security of supply intervention[22], adopted in 2004.

The general objective of this directive was to establish measures to safeguard an adequate security of gas supply level, contributing to the functioning of the internal gas market. This addressed the need to ensure a coherent and non-discriminatory approach among security of supply policies during the liberalisation of the energy market dominated by largely state-owned energy monopolies.

This intervention aimed to avoid socio-economic consequences of supply disruptions, by:

(1) establishing a common framework within which Member States were to define and align general, transparent and non-discriminatory security of supply policies;
(2) clarifying the roles and responsibilities of the different market players, and;
(3) implementing non-discriminatory procedures to safeguard security of gas supply, by coordinating and information exchange in the Gas Coordination Group.

In 2009, the Commission proposed a revision to address the immediate risk of disruptions resulting from the Russian-Ukrainian gas crisis of 2009[23]. This second intervention complemented the existing objectives and was meant to make the EU less vulnerable to external supply shocks and clarify roles and responsibilities.

Its specific objectives therefore were to:

(1) Achieve flexibility in the internal gas market to mitigate most supply disruptions, by creating sufficient infrastructure to deal with such disruptions.
(2) Have more effective crisis management and cooperation during emergencies, with pre-defined plans. This meant fostering solidarity among Member States, aligning national measures and ensuring they did not harm other Member States.
(3) Guarantee supplies to vulnerable customers via supply and infrastructure standards during challenging climatic episodes, constrained supply conditions, or disrupted infrastructure scenarios.

The general objective of the latest revision resulting in Regulation (EU) 2017/1938 (the Gas Security of Supply Regulation), and the focus of this fitness check, was to make the EU more resilient, with an adequate level of preparedness to supply disruptions and mitigate any effect of severe crises in a spirit of solidarity[24].

More specifically, it aimed to:

[22] Directive 2004/67/EC
[23] See impact assessment COM(2009) 363, accompanying the proposal for Regulation (EU) No 994/2010.
[24] See impact assessment SWD(2016) 25, accompanying the proposal for Regulation (EU) 2017/1938.

(1) enhance regional cooperation, as well as ensure EU-wide cooperation during crises, in a spirit of solidarity;
(2) improve transparency, by sharing information of contracts with non-EU countries;
(3) improve the infrastructure standard and reverse-flow obligations to improve the flexibility of the system;[25]

The proposed EU action primarily included the legislative input for the Gas Security of Supply Regulation, as well as financial and human resources needed to implement the Regulation, in particular for Member States. More specifically, these inputs encompassed financial and human resources needed by:

(1) Member States and the Commission to implement the objective of the Gas Security of Supply Regulation.
(2) ENTSOG to comply with regulated tasks such as the security of supply simulation.
(3) Energy undertakings to comply with obligations such as the supply standard and increased reporting requirements if a crisis level would be declared.

Several activities were planned to be conducted as part of the regulatory intervention set by the Gas Security of Supply Regulation to assess risks, establish plans, ensure adequate infrastructure, and create effective crisis management procedures, such as:

- An EU-wide security of supply simulation was performed by ENTSOG based on which national and common risk assessments by Member States were established and coordinated in the regional risk groups. The main supply disruption scenarios have been updated annually in the ENTSOG's Winter Supply Outlook since 2018.
- Preventive Action Plans (PAPs) and Emergency Plans (EPs) were required to be established by Member States by 1 March 2019, based on the risk assessments. The plans must be updated at least every four years.
- For the infrastructure standard, Member States, national regulatory authorities (NRAs), ACER, and the Commission were expected to assess and check the possible investment needs to implement the N-1[26] and bidirectionality requirements.
- Crisis management procedures were established, and crisis management was expected to be discussed regularly in the Gas Coordination Group (GCG), in addition to regular coordination and information exchange that took place in these meetings.
- Bilateral solidarity agreements were expected to be established by Member States with each other, by 1 December 2018.

[25] A fourth specific objective of the 2016 Impact Assessment accompanying the Commission proposal was enlarging the geographical scope to the Energy Community. However, in the final Regulation these obligations were replaced by Article 16, only stating areas where Member States may cooperate with the Energy Community. Given that the objective has not really been taken up in the final Regulation, it has largely been left out of this fitness check.

[26] The N – 1 formula describes the ability of the capacity of gas infrastructure to satisfy total gas demand in the calculated area in the event of disruption of the single largest gas infrastructure during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years.

- A report reviewing the Regulation was required to be published by the Commission, by 1 September 2023.

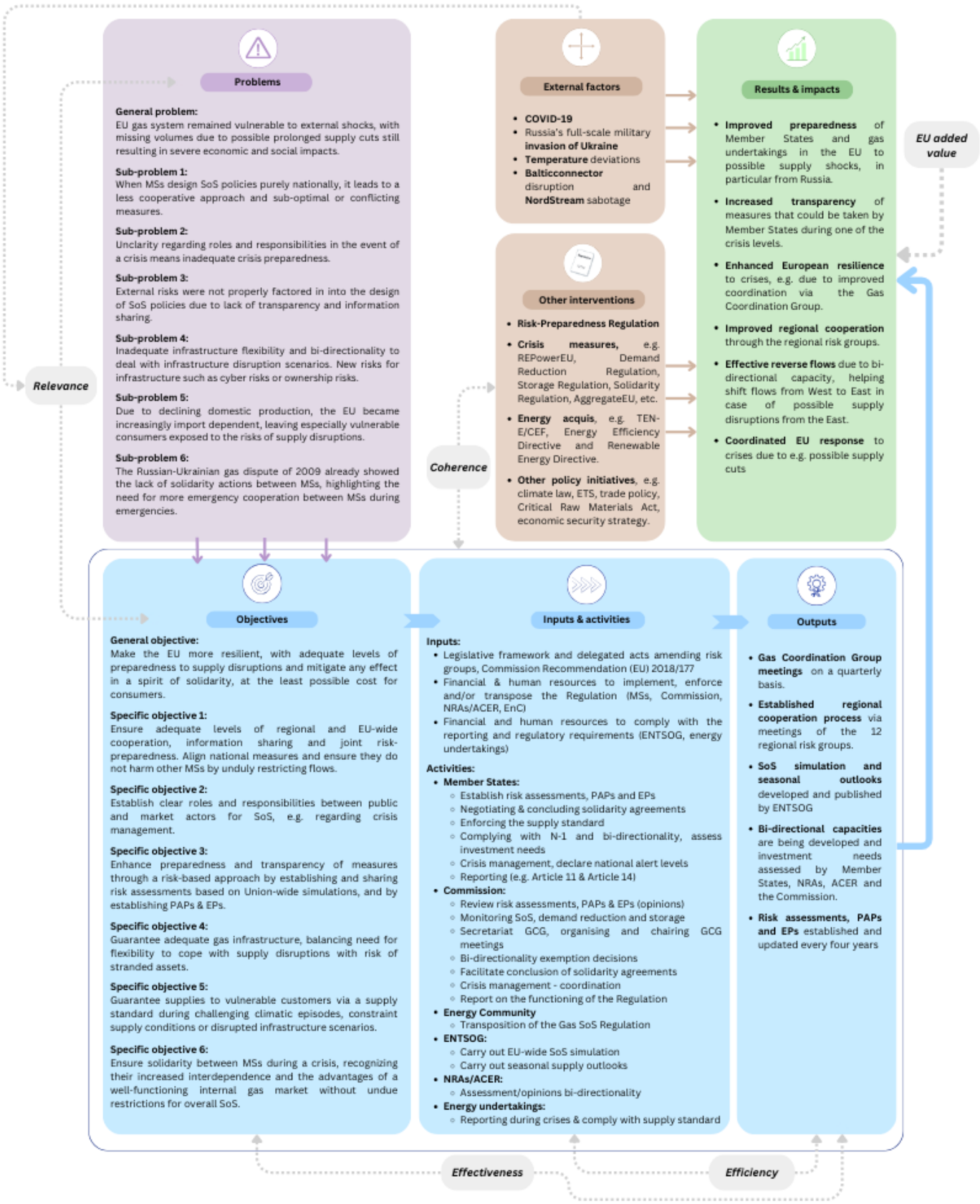
The expected outcome of the Gas Security of Supply Regulation in the short-term, medium-term and long-term were: (i) to increase the EU's preparedness for crises; (ii) improved security of supply; and (iii) enhance the resilience of the EU gas system to crisis situations. Further details on these outputs, results, and impacts are set out below.

- **Short-term outputs** included: (i) regular GCG meetings and established regional cooperation in regional risk groups; (ii) the security of supply simulation and seasonal outlooks by ENTSOG; (iii) developed bi-directional capacities; (iv) updated risk assessments and plans; (v) established bilateral solidarity agreements.
- **Medium-term results and long-term impacts** included: (i) increased regional and EU-wide cooperation; (ii) enhanced preparedness and resilience to crises through the supply standard; (iii) improved plans and crisis management procedures. Other expected results and impacts included: (i) increased transparency of measures taken by Member States; (ii) improved reverse flow capabilities; (iv) and a coordinated EU response to potential supply cuts.

There were several external factors and other policy interventions that affected the outcomes, results and impacts of the evaluated Regulations, as will be explained the section "*External factors that influenced security of electricity and gas supply beyond the Regulations"*. In addition to those, the rules governing EU gas markets, and in particular the old Gas Market Regulation and Gas Market Directive[27], as well as their revised versions following the adoption of the Hydrogen and Gas Market Decarbonisation Package in 2024, also had direct implications for the EU security of gas supply[28].

[27] Regulation (EC) 2009/715 and Directive (EC) 2009/73.
[28] Regulation (EU) 2009/1789 and Directive (EU) 2024/1788.

*Figure 2: Intervention logic: Gas SoS Regulation*



### *2.1.2. Intervention logic: Electricity Risk-Preparedness Regulation*

The EU's policy on security of electricity supply has evolved alongside the development of a more interconnected and decarbonised energy system. The urgency for greater coordination became evident after a major blackout in Italy in September 2003. In response, the Commission proposed a directive that became Directive 2005/89/EC, which required Member States to secure reliable supply, assess potential risks, and ensure adequate generation capacity and transmission infrastructure. Largely non-prescriptive and limited to general principles, the provisions of this Directive were found insufficient to cope with the growing integration of electricity markets.

Four general problems were identified in the impact assessment as part of the Clean Energy Package[29], which led to the repeal of the old Security of Electricity Supply Directive. Out of these four, only two were related to security of supply: (i) uncertainty around future investment in power generation; and (ii) the fact that Member States were not adequately considering the impact of their actions on neighbouring countries during electricity crises[30]. Two general objectives were formulated to remedy these problems (i) promoting the development of necessary resources to ensure security of supply; and (ii) enhancing cooperation and coordination among countries to better handle system stress and crises[31].

The first general problem was taken up in the Electricity Regulation and is thus beyond the scope of this fitness check (except from a consistency perspective, cf. section 4.1).

The second general problem was further broken down into three sub-problems:

(1) "*Crisis plans and actions solely national in focus*",
(2) "*Lack of information sharing and transparency*",
(3) "*No common approach to identify and assess risks*".

Consequently, 3 sub-objectives had been derived:

(1) "*Improving risk assessments and preparedness*",
(2) "*Improving transparency and information sharing*",
(3) "*Improving coordination in an emergency*".

These objectives were all taken up in the Risk Preparedness Regulation.

[29] COM(2016) 860 final

[30] The exact wording in the impact assessment was: (1) "*Uncertainty about sufficient future generation investments and uncoordinated capacity markets*", and (2) "*Member States do not take sufficient account of what happens across their borders when preparing for and managing electricity crisis situations*.

[31] The exact wording in the impact assessment was: (1) "*Facilitate investments in the right amount and type of resources to ensure security of supply, whilst limiting the distortive effects of uncoordinated capacity mechanisms*", and (2) "*Improve Member States' reliance on each other in times of system stress and reinforce their coordination and cooperation at times of crisis situations*".

The proposed EU action included the legal input of the Electricity Risk Preparedness Regulation, as well as financial and human resources to implement the Regulation. These resources encompass: (i) financial and human resources needed by Member States, the Commission and ACER to implement the legislative input of the Risk Preparedness Regulation; and (ii) financial and human resources needed by ENTSO-E and RCCs to comply with regulated tasks, such as elaborating various methodologies and performing various adequacy assessments. While the Commission and ACER were reinforced in previous years, it is still insufficient to accomplish all the tasks.

Several activities were planned to achieve the Regulation's goals:

- the designation by Member States of a competent authority;
- ENTSO-E's elaboration of methodologies for identifying regional electricity crisis scenarios and for short-term and seasonal adequacy assessments[32] ;
- the identification and update by ENTSO-E of regional electricity crisis scenarios;
- Seasonal adequacy assessments by ENTSO-E twice per year (the so-called winter and summer supply outlooks), and by RCCs of short-term adequacy assessments on a daily basis for the next seven days;
- the identification by Member States of the national electricity crisis scenarios, preceding the establishment of Risk Preparedness Plans;
- the support provided by the Commission to Member States (e.g., opinions on risk preparedness plans, Electricity Coordination Group's (ECG) secretariat, and guidance on the cooperation and assistance provisions);
- the monitoring by ACER of security of supply measures on an ongoing basis, with regular reports to the ECG;
- the effective monitoring of security of supply in the EU via the ECG;
- a Commission report reviewing the Regulation by 1 September 2025.

To mitigate the risk of external shocks and spillovers, Energy Community Contracting Parties[33] were encouraged to collaborate with EU Member States in assessing risks, developing preventive plans, and establishing emergency response plans.

There were several expected outcomes. In the short-term, the outputs included 28 Risk Preparedness Plans (with 28 Commission's opinions)[34], one methodology to identify regional electricity crisis scenarios, an assessment of regional electricity crisis scenarios, one methodology for short-term and seasonal adequacy assessments, seasonal adequacy outlooks,

[32] Article 9 of the Regulation requires "*all short-term adequacy assessments, whether carried out at national, regional or union level*", which also include the adequacy assessments performed under the System Operation Guidelines, according to which each TSO need to perform summer and winter outlooks as well as day-ahead and intraday adequacy assessments (art.105-107).

[33] Contracting parties are Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, Serbia, Moldova, Ukraine, Georgia.

[34] 27 EU Member States + Northern Ireland.

weekly and daily adequacy assessments, and regular ACER reports on security of electricity supply.

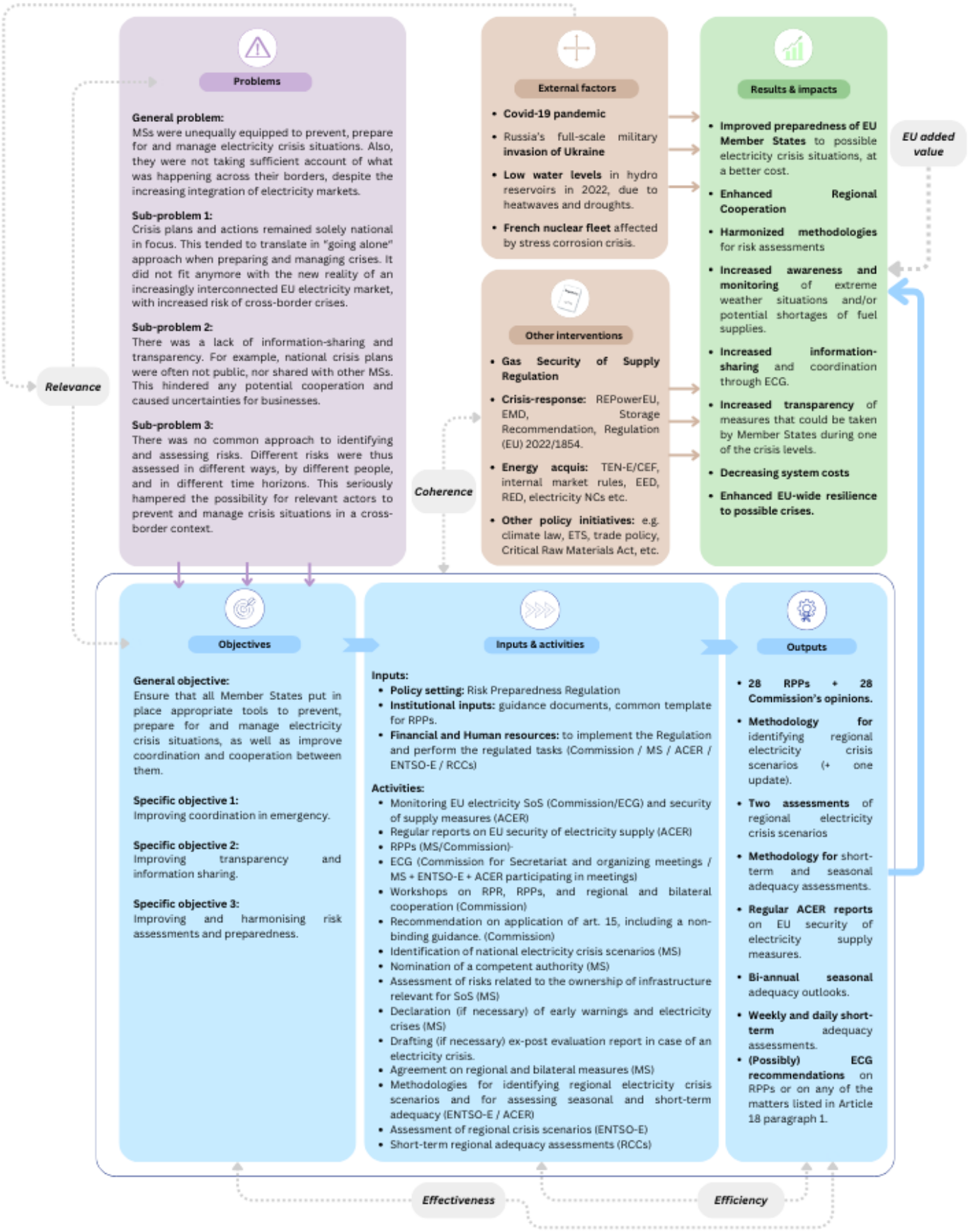
In the medium-term, the expected result was better preparedness of Member States for crises at a lower cost through enhanced regional coordination and harmonised methodologies for risk assessments. It was expected that this would translate into long-term impacts, such as more transparency and legal certainty for businesses and investors or a strengthening of the "*internal electricity market by enhancing trust and confidence across Member States and ruling out inappropriate state interventions in electricity crises*". The 2016 impact assessment also forecasted that, thanks to enhanced coordination, "*the overall cost of the system would decrease (...) and could have a positive impact on prices for consumers*". Ultimately, the main long-term impact foreseen was an enhanced EU-wide resilience to possible electricity crises.

The Clean Energy Package included other policy interventions, which were also intended to support EU security of electricity supply notably through market-based measures, such as the Electricity Directive, the Electricity Regulation and the ACER Regulation[35] that were proposed simultaneously with the Risk Preparedness Regulation. Later, some other policy interventions in response to the 2021/2023 also may have impacted the results of the Risk Preparedness Regulation, in particular: (i) the Energy Storage Recommendation; (ii) the revamped electricity market design rules; (iii) the emergency intervention to address high electricity prices. Lastly, it should be noted that some technical aspects of EU's security of electricity supply are governed by network codes[36].

[35] Respectively Directive (EU) 2019/944, Regulation (EU) 2019/943 and (Regulation (EU) 2019/942).

[36] Regulation (EU) 2017/2196 establishing a network code on emergency and restoration; and Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation.

*Figure 3: Intervention Logic: Risk Preparedness Regulation*



### *2.1.3. Other energy policies and external factors that influenced security of electricity and gas supply beyond the Regulations*

There are a number of other energy policies that influenced the security of electricity and gas supply. The most significant of these were:

- The Energy Efficiency Directive, Renewable Energy Directive, and various climate initiatives adopted in 2018, which accelerated the clean energy transition, thereby reducing the need to resort to imported fossil fuels like natural gas.
- Other important interventions are the Regulation on guidelines for trans-European energy infrastructure (TEN-E), amended in 2022, which provides the framework for identifying and developing cross-border energy infrastructure projects of common and mutual interest (PCIs and PMIs) in the EU. One of its objectives is to enhance security of supply by supporting construction of energy infrastructure and improving interconnectivity of Member States[37]. The Connecting Europe Facility (CEF) may provide financial support to such projects, helping to accelerate their implementation and bridge investment gaps.
- Moreover, the Governance Regulation[38] from 2018 endowed the Energy Union with common rules for planning, reporting and monitoring, through national energy and climate plans (NECPs) or long-term strategies. Commission guidance to Member States[39] also underlined the need for updated NECPs to reinforce preparedness and strengthen measures for collective energy security.

In addition to changes to the energy acquis, other EU interventions had an impact on EU security of gas and electricity supply:

- In the field of critical infrastructure protection for instance, the Recommendation on a Union-wide coordinated approach to strengthen the resilience of critical infrastructure (2023/C20/01) asked Member States to support operators of critical energy infrastructure in conducting stress tests, and the Directive on the Resilience of Critical Entities (EU) 2022/2557 put forward new rules to strengthen the resilience of critical entities in several sectors, including energy.
- Moreover, Directive 2022/2555 on measures for a high common level of cybersecurity across the Union (the NIS2 Directive) aims to ensure the cybersecurity resilience of entities from the energy sector. In addition, products with digital elements, including hardware and software deployed by energy operators falls under the newly adopted

[37] The TEN-E Regulation excludes natural gas projects since its revision in 2022.
[38] 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.
[39] Commission Notice on the Guidance to Member States for the update of the 2021-2030 national energy and climate plans (2022/C 495/02).

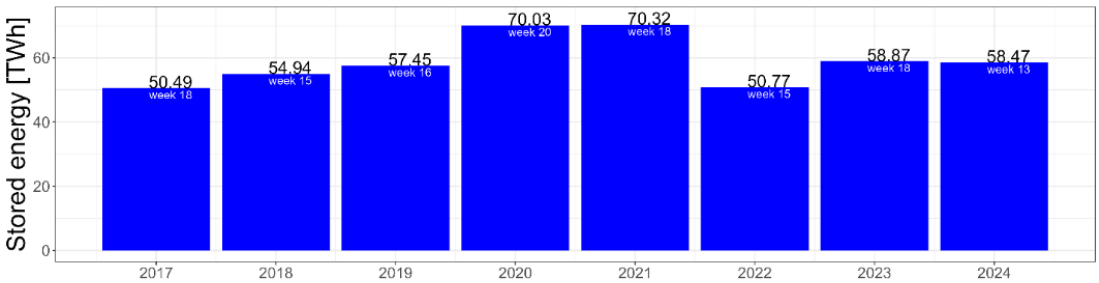
Cyber Resilience Act (Regulation (EU) 2024/2847), which entered into force on 10 December 2024.

Several external factors have also affected the actual results and impacts of both interventions since their adoption. The COVID-19 pandemic (2019-2021) exerted considerable pressure on the whole energy sector, both on the demand side (by causing a wide departure from normal consumption patterns) and on the supply side (for example, through delayed maintenance on power plants due to COVID-19 related measures). In response to these events, the Commission published a staff working document in June 2020 on good practices and lessons learnt for the energy sector[40].

The second external event was the energy crisis that started towards the end of 2021 and affected the results of the interventions by putting the EU's energy sector under historical pressure due to a combination of three unrelated events:

(1) Russia's full-scale invasion of Ukraine which resulted in considerable uncertainty over gas supply, with an indirect impact on electricity supply, due to the weaponisation of gas (the impacts on gas security of supply will be further detailed in chapter 3 "How has the situation evolved over the evaluation period?").
(2) Low hydro reservoir levels due to droughts and low precipitation levels, with the worst conditions materialising during winter 2022/2023 (cf. Figure 4).
(3) The stress corrosion crisis that affected the French nuclear fleet, which, in combination with maintenance delays due to COVID-19, resulted in a historical drop in the output from nuclear plants, from 361 TWh in 2021 to 279 TWh in 2022[41].

***Figure 4: Minimum aggregated filling rate of water reservoirs and hydro storage plants in all ENTSO-E members***




*Source: JRC, based on ENTSO-E.*

[40] SWD(2020) 104 final.
[41] See: https://www.senat.fr/rap/r23-714-1/r23-714-149.html#toc1641

The additional policy interventions and external events listed have had an important impact on the EU security of supply, and have to be taken into account when assessing the effectiveness of the Gas Security of Supply Regulation and the Electricity Risk-Preparedness Regulation.

### 2.2 Point(s) of comparison (baseline)

This fitness check evaluates the performance of the EU-level interventions against its policy objectives, in line with the Better Regulation Guidelines.[42] The policy objectives that the performance of the EU-level policy intervention will be evaluated against, have been further elaborated on in the intervention logic of section 2.1.

In addition, this fitness check uses the prior impact assessments carried out in 2016 for the evaluated Regulations to construct a qualitative point of comparison. In particular, the expected results and impacts of the policy action will be used to compare the actual results and impacts of the regulations. The points of comparisons have been adapted where the final act adopted by the co-legislators differs significantly from the impact assessments accompanying the Commission's original proposal.

The expected results and impacts of the Risk Preparedness Regulation and Gas Security of Supply Regulation have been further detailed in the respective intervention logics (c.f figure 2 and figure 3). These expected results and impacts notably include:

- Improved preparedness of EU Member States and undertakings to possible gas supply shocks or electricity crises at lower costs, especially to ensure protection of critical and vulnerable energy consumers.
- Increased transparency of measures taken by Member States during crises, in particular in case they have a cross-border dimension during crises.
- Enhanced European resilience to crises due to coordination and information sharing via e.g. the Gas and Electricity Coordination Groups.
- Improved regional cooperation through e.g. regional risk groups and developing and assessing regional crisis scenarios.
- Harmonised methodologies and risk assessments among Member States.
- Increased awareness and monitoring of extreme weather situations and potential fuel shortages for electricity.
- Flexibility in gas infrastructure and effective reverse flows due to bi-directional capacities in case of supply disruptions.
- Coordinated EU response to crises due to possible supply shocks and crises.

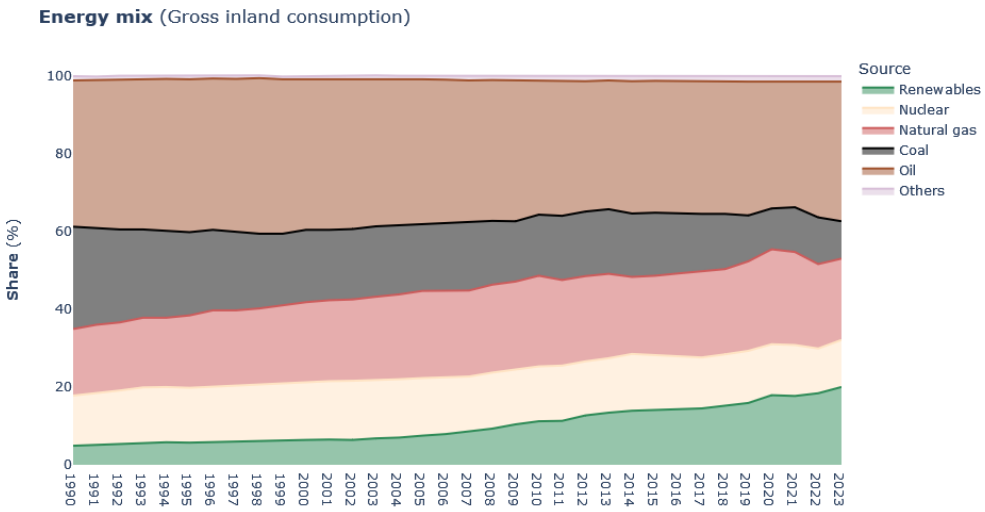
[42] Better Regulation Guidelines (SWD (2021) 305) p23 states: *"A fitness check assesses whether a set of interventions is fit for purpose by assessing its performance against its policy objectives."*

## 3. HOW HAS THE SITUATION EVOLVED OVER THE EVALUATION PERIOD?

### 3.1. Evolution of EU security of gas and electricity supply (2017-2024)

Since 2017, the EU's energy landscape has undergone significant changes, with an ongoing rise in deployment of RES. The share of renewables has risen from 18.4% in 2017 to 24.5% in 2023[43]. At the same time, the use of fossil fuels has been substantially reduced: coal for instance decreased from 18.6% in 2000, to 14.7% in 2017, declining further to 9.6% in 2023.[44] Fossil fuels remain however dominant in the EU energy mix.

***Figure 5: EU energy mix (gross inland consumption)***




*Source: ENER Chief Economist Unit based on Eurostat (nrg_bal_c)*

There is a similar trend in electricity power generation, where domestically produced renewable energy is increasingly replacing imported fossil fuels, with a significant increase in electricity generated from solar PV (from 3.6% in 2017 to 9.4% in 2024) and wind (11.2% in 2017 to 18.5% in 2024).

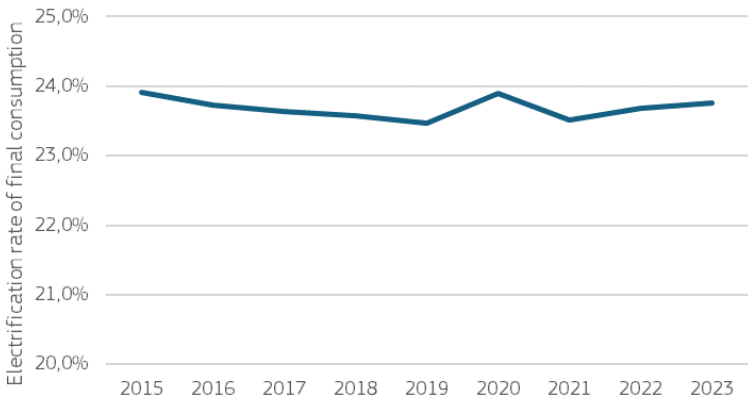
At the same time, electrification has not seen much progress. While the electrification rate of final consumption has risen by ca. five percentage points since the '90s, it has remained stable throughout the evaluation period, at slightly below 24% (Figure 6). As of 2024, electricity accounts for approximately 23% of the European Union's final energy consumption.[45] Electrification rates per sector and per country show similar patterns.

[43] Most recent annual data available at the time of writing on Eurostat is from 2023. Energy mix is measured in terms of the share in gross inland consumption (nrg_bal_c). The figures for the share of RES is in contrast taken from Eurostat's nrg_ind_ren, based on the definition of the Renewable Energy Directive.

[44] Based on Eurostat (nrg_bal_c)

[45] COM(2025) 79 final

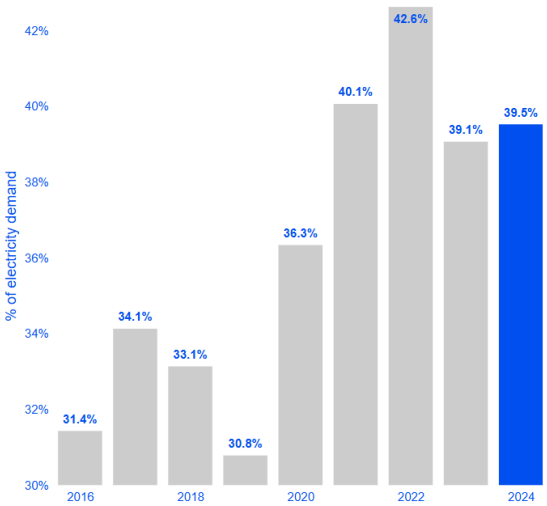
***Figure 6: Electrification rate of final consumption in the EU***




*Source: ENER Chief Economist, based on EUROSTAT data.*

In parallel, the interconnectedness of the EU electricity market continued to grow over the implementation period for most regions[46]. As shown in figure 7, for instance, the share of cross-border exchanges over EU electricity demand significantly improved on average, from 34% in 2017 and 31% in 2019 (when the Risk Preparedness Regulation came into force) until 40% in 2024 with a peak at 43% in 2022. At the same time, some bottlenecks for cross-border exchanges remain, in particular for the Iberian Peninsula as well as islands. Several Member States are still below the Governance Regulation's 15% interconnection target, while ACER finds that 32 GW of cross-border capacity needed by 2030 remain unaddressed.

***Figure 7: Evolution of the share of cross-border exchanges (net positions) over electricity demand in EU bidding zones – EU-27 average (2016-2024)***



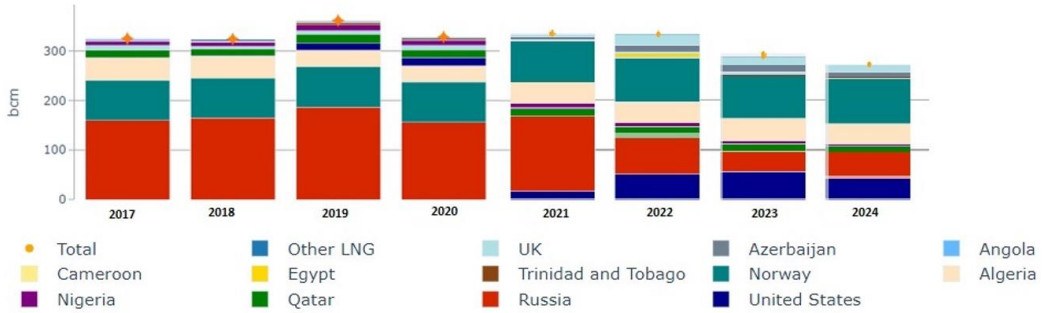

*Source: ACER*

[46] For example, work is ongoing to have more interconnections between the Iberian Peninsula with the rest of Europe. A High-Level Group on interconnections for South-West Europe exists and adopted an Action Plan for extended cooperation in the High-Level Group on Interconnections for South-West Europe to be completed by 2030.

Most of the installed electricity generation capacity remains centralised, with decentralised generation accounting for around 18% of the total installed capacity in 2024 (c.f. table 2 in Annex 2)[47]. It should be noted however that there are some uncertainties regarding the exactitude of the figures, because of high discrepancies across databases.

The EU is largely import-dependent for natural gas, which has been further exacerbated by declining domestic production[48]. Russia has historically been the dominant supplier to the EU, mainly via pipeline, representing 45% of overall EU imports (ca. 150 bcm) before its full-scale invasion of Ukraine. Norway has since then become the EU's main supplier, representing 33% of imports in 2024 (ca. 91 bcm/y), followed by Russia with 19% (ca. 52 bcm/y) and the US with 17% (ca. 45 bcm/y). Despite declining gas demand, EU import dependency of gas increased from 60% in 2017 to 79% in 2023[49], with a peak of 85% in 2022, largely due to decreasing domestic production, which decreased from 89 bcm/y in 2017 to 39 bcm/y in 2023. Currently, several Member States have successfully decreased their dependence on Russian gas imports or managed to entirely eliminate them.[50]

***Figure 8: EU natural gas imports (pipeline and LNG)***

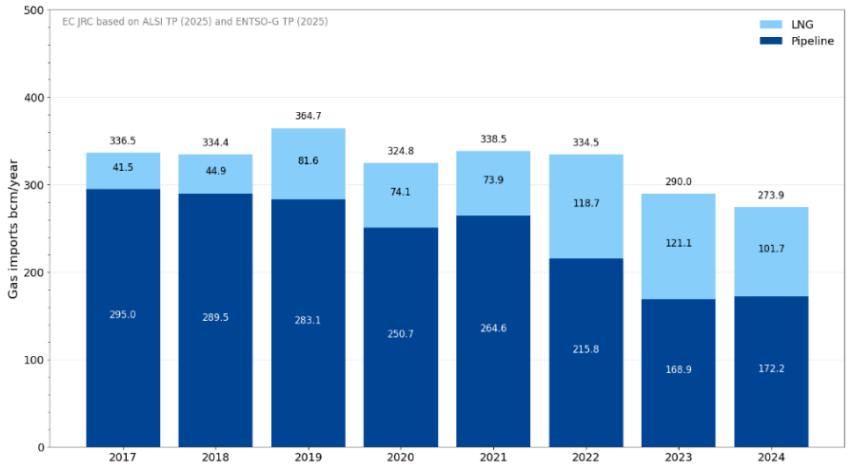



*Source: ENER Chief Economist Unit, based on ENTSOG and Refinitiv*

LNG has become increasingly important since Russia's full-scale invasion of Ukraine, with 37% of gas imports coming from LNG in 2024, compared to 10% in 2017. This has been facilitated by a significant increase in LNG import capacity, which grew significantly in recent years (e.g. by 70 bcma in 2023-2024). The EU's main LNG supplier in 2024 was the US (46% of LNG imports). Russia still covered 20% of the EU's LNG imports in 2024, followed by Qatar with 12%.[51] In this light, the Commission adopted in May 2025 the REPowerEU Roadmap[52], followed by a legislative proposal in June 2025[53], in order to end dependency on Russian gas by 2027.

[47] Decentralised capacities refers to capacities that are connected to low and medium voltage networks.
[48] Eurostat – nrg_cb_gas
[49] European Commission Joint Research Centre calculation, based on Eurostat– nrg_cb_gas
[50] For example, Estonia, Lithuania and Latvia prohibited the supply of natural gas from Russia.
[51] Increased overall LNG imports have been facilitated by additional regasification capacities through new FSRUs, as further detailed in section 3.3.
[52] COM(2025) 440 final
[53] COM(2025) 828 final

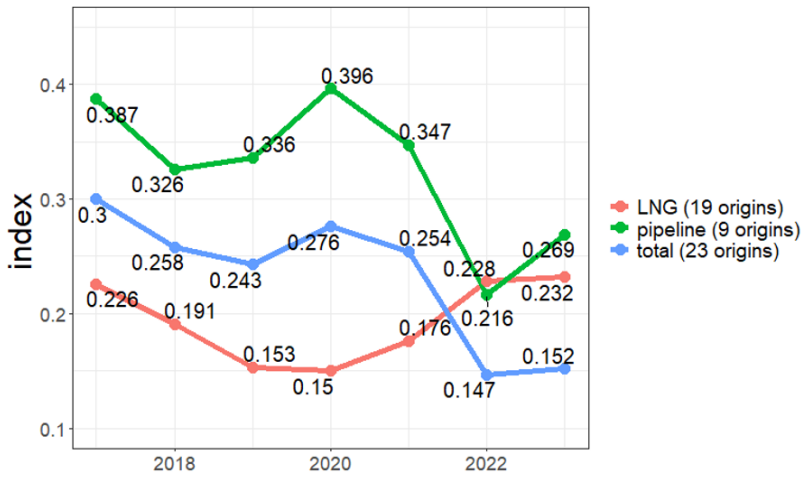
***Figure 9: Natural gas imports share LNG/pipeline***




*Source: Commission's Joint Research Centre, based on ENTSOG TP and GIE ALSI+*

The EU significantly diversified gas supplies over the evaluation period, as indicated by Figure 10[54]. This improvement is significant in pipeline supply diversification due to the phase out of the dependence on Russian gas but partly mitigated by an increase in concentration of LNG supplies. The main reason for the improved diversification is the completion of key infrastructure projects that allowed Member States to eliminate or reduce their dependence on Russian pipeline supplies which used to be the main cause of the relatively high concentration pre-crisis.

***Figure 10: HHI index for gas import origins***

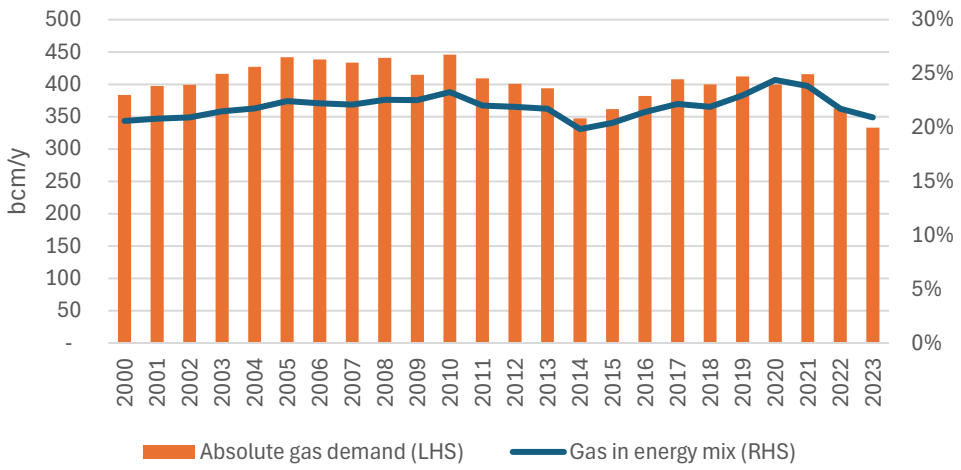



*Source: Commission Joint Research Centre, based on Eurostat nrg_ti_gas and nrg_te_gas*

[54] The gas import origin concentration index shows in one figure how varied import origins of energy sources are. It is based on the Herfindahl-Hirschman index (HHI) principle, i.e. adding the square of the shares of every origin in the total import. This indicator lies in the interval [0, 1]. Lower values of this index mean more diversified origins, higher values mean more concentrated origins. Calculations based on EUROSTAT data nrg_ti_gas and nrg_te_gas.

Since 2000, the EU's annual demand for natural gas has fluctuated between 446 bcm (2010) and ca. 330 bcm (2024).[55] Before the turbulence in energy markets in 2022, the use of natural gas was relatively stable. Overall gas consumption in the EU was 408 bcm in 2017, which varied in the following years mostly due to temperature variations during winter, before reducing drastically to 363 bcm in 2022 and further to 330 bcm in 2024. It should be noted that there are large geographical discrepancies in natural gas consumption. For example, the 5 largest gas consuming Member States (Germany, Italy, France, the Netherlands and Spain) represented more than 70% of EU gas consumption in 2022.

***Figure 11 : EU27 absolute natural gas demand (LHS) and its share in the energy mix (gross inland consumption) (RHS)***




*Source: Eurostat (nrg_cb_gas)*

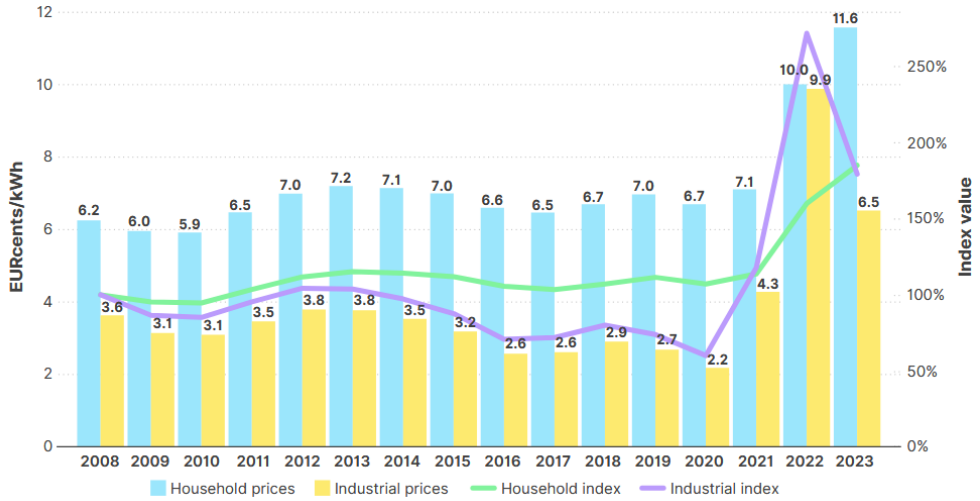
While in 2000 natural gas represented 20.6% of the EU's energy mix[56], it first rose to 22.3% in 2017, and then started to decline from 23.9% in 2021 to 20.9% in 2023[57]. As will be discussed in greater detail in chapter 4, the most significant change in gas consumption was caused by the crisis response to supply cuts from Russia, driven by efforts to reduce gas demand to counter the dwindling pipeline supplies from Russia.

[55] Annual gas consumption data from Eurostat nrg_cb_gas series for the years of 2000 to 2023. Annual statistics for 2024 where not yet available at time of writing, so were calculated by adding monthly values of the nrg_cb_gasm series, which may lead to a slight discrepancy from the 2000-2023 data.

[56] Gross inland consumption.

[57] Annual statistics for 2024 are not yet available at the time of writing on Eurostat.

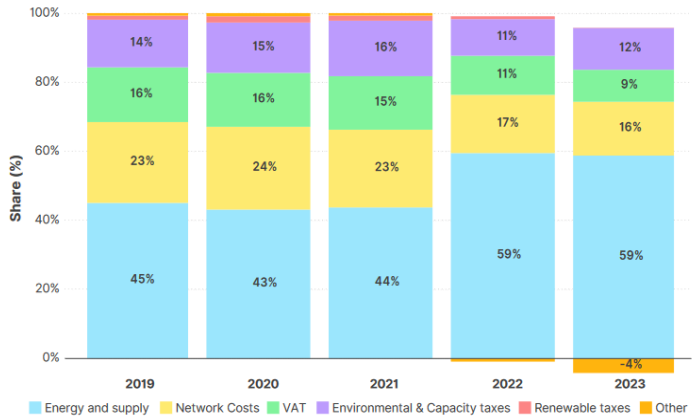
***Figure 12: Trends in final gas prices for household and industrial consumers in the EU – 2008-2023 (EUR cents/kW index change, 2008=100)***




*Source: ACER calculations based on Eurostat*[58]

High energy prices in the last four years have been an important concern for consumers, both industries and households. While prices are influenced by many factors, having an adequate level of supply is one of the preconditions for affordable energy prices. EU average retail gas prices for households increased by almost two thirds between 2021 and 2023. As shown by Figure 12, the energy component has been the main driver of the surge of gas prices for consumers: its share was 15 percentage points higher in 2022 and 2023 compared to 2021. The increase was even higher in absolute terms, as in 2023 the energy component had more than doubled compared to 2021 levels (7.2 EUR cents/kWh versus 3 EUR cents/kWh respectively).

***Figure 13: Breakdown of average gas price for households in EU-27 – 2019-2023 (%)***



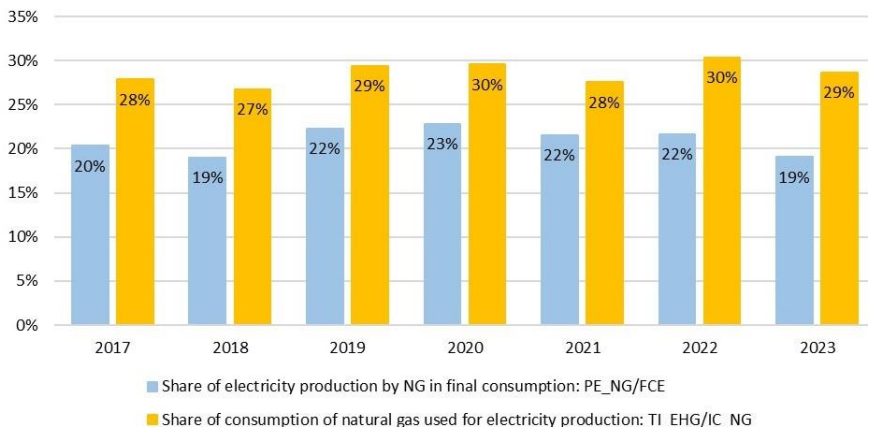

*Source: ACER calculations based on Eurostat data*[59]

[58] The index change tracks the percentage change in nominal prices since 2008, where the base year equals 100 %. Eurostat data: Band DC, 2 500–5 000 kWh (household electricity consumption, nrg_pc_204), and Band IE, 20 000–70 000 MWh (industrial electricity consumption, nrg_pc_205); updated in October 2025.

[59] Band D2, 20-200 GJ (Gas prices components for household consumers – annual data, nrg_pc_202_c)

There has been a significant but stable degree of sectoral integration between the gas and electricity systems over the evaluation period. This is notably captured when looking at the share of natural gas used to produce electricity and the share of electricity production stemming from natural gas. Both indicators have slightly increased over the evaluation period, but have remained relatively stable, as shown in Figure 14[60]. In addition, despite accounting for 14 % of the electricity mix, natural gas was the electricity price-setter in 40% of hours in the EU in 2024.[61] This shows that security of gas and electricity supply remained closely interconnected over the evaluation period.

***Figure 14: electricity produced with gas (%) & gas used for producing electricity (%)***




*Source: JRC, based on Eurostat data*[62]

Assessing the evolution of the robustness of the EU electricity system requires looking at diverse and not always comparable data, given that there has been no crisis declaration since the entry into force of the Risk Preparedness Regulation. Seasonal outlooks prepare now with a common methodology to assess potential resource adequacy risks for the upcoming season and provide a review of the situation in the previous season. However, they provide this information based on estimations of two indicators, Energy Not Served (ENS) and Loss of Load Expectation (LOLE). Regarding real situation, and covering not only short-term resource adequacy issues, the Nordic and Baltic Regions, publish a joint annual report on the disturbances observed on the electricity grids[63]. These figures, show that the power systems in these regions have evolved positively in the latest years as it is shown in Figure 15. No similar information is found for other regions to do a factual analysis on the evolution of the disturbances, the impacted assets, the reason of them and their effect on electricity users.

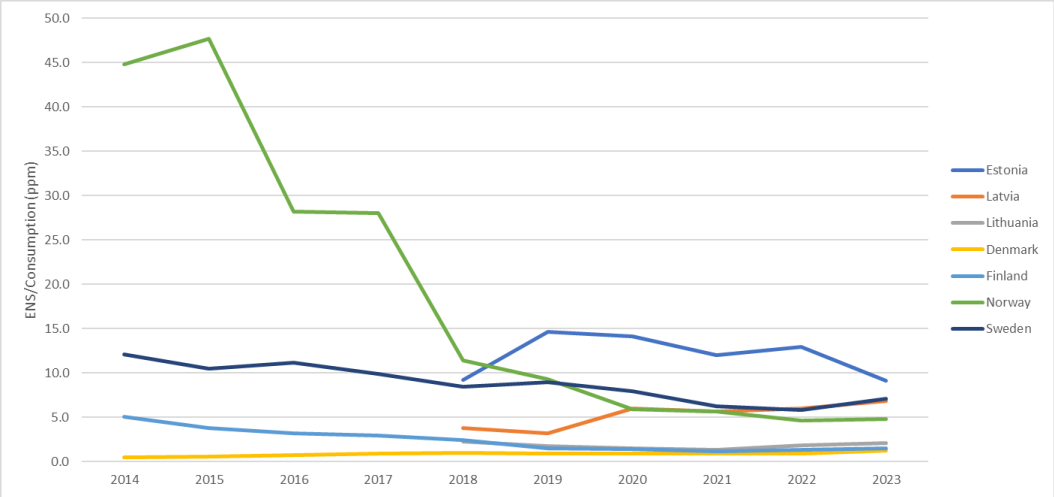
[60] The graph does not refer to absolute values. The volumes of gas used for electricity generation logically decreased (since the total gas consumption has decreased, while the share remained stable).

[61] See: Key developments in European electricity and gas markets - 2025 ACER Monitoring Report

[62] From supply, transformation and consumption of gas annual balance (nrg_cb_gas), the following categories were used to calculate the share of natural gas used to produce electricity: TI_EHG_MAPE_E, TI_EHG_MAPCHP_E, TI_EHG_APE_E, TI_EHG_APCHP_E and IC_CAL

[63]See: HVAC_NORDIC_AND_BALTIC_GRID_DISTURBANCE_STATISTICS_2023.pdf

***Figure 15: year moving average - ENS divided by consumption (ppm), 2014-2023. Parts per million (ppm) represents ENS (MWh) as proportion of consumed energy (TWh)***




*Source: Commission, based on HVAC Nordic and Baltic grid disturbance statistics 2023.*

On 28 April 2025, Spain and Portugal were affected by a major incident on their electricity systems, which resulted in one of the biggest blackouts[64] in recent EU history affecting both countries and parts of France[65]. Both Iberian countries immediately declared a crisis. Both Spain and Portugal submitted a report within 3 months assessing the causes, impacts and possible improvements, based on the Risk Preparedness Regulation. Spain and Portugal presented their findings on 30 July to the Electricity Coordination group, in line with the Risk Preparedness Regulation. Both Spain and Portugal noted that the incident had a multifactorial origin, including insufficient voltage control capability, constraints from power oscillations, and disconnections caused surge in voltage.

Additionally, an expert panel has been set up to investigate this event in accordance with EU law. It is chaired by representatives of two TSOs from non-affected countries and involves other TSOs as well as ACER and NRAs. A factual report with all the data was published on 3 October 2025[66]. A final report with conclusions and explanations of the reasons for the incident as well as recommendations will be published in the coming months.

Public information on absolute numbers of cyberattacks on the energy sector is scarce. Information on cyberattacks is usually not published openly. Most public reports in the past two years point to financially driven motivation (ransomware) without relevant impact in the reliability of energy supply. Nevertheless, the sector defines scenarios for incidents that are

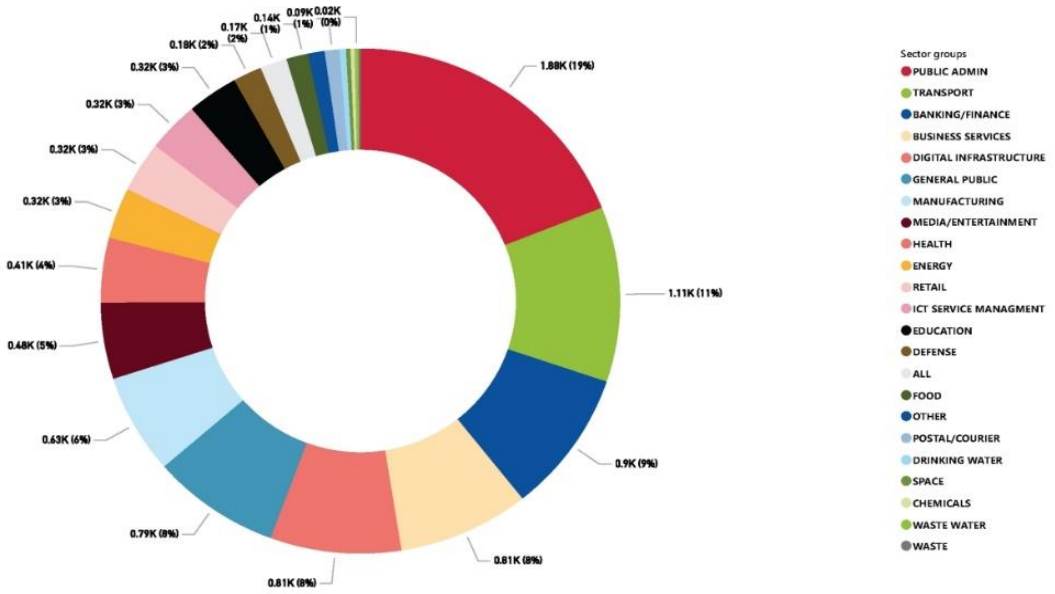
[64] This incident has been classified as Scale 3 in the Incident Classification Scale from ENTSO-E (ranging from 0 to 3).

[65] https://www.entsoe.eu/news/2025/04/28/grid-incident-in-the-power-systems-of-spain-and-portugal/

[66] https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/Publications/2025/entso-e_incident_report_ES-PT_April_2025_06.pdf

much broader than ransomware with the intention of protecting the infrastructure against, for example, interruption of supply or cyberespionage. ENISA provides trends on a quarterly or yearly basis (see Figure 16) and other authoritative sources like the Danish SektorCERT,[67] reported successful cyberattacks every year against a European energy or utility company since 2015, with at least 20 attacks in 2022.

***Figure 16: Targeted sectors per number of cybersecurity incidents (July 2023-June 2024)***




*Source: ENISA Threat Landscape 2024 report*[68]

Since 2022, the number of incidents involving sabotage or suspected sabotage have risen, in particular for critical undersea energy infrastructure, with three high profile cases (Nord Stream 1 and 2 explosions, the Balticconnector pipeline and Estlink-2 power cable disruptions caused by dragged anchors).

Additionally, the full-scale invasion of Ukraine has shown how vulnerable energy can be in conflict scenarios. Russia is conducting systematic attacks on Ukraine's energy facilities, including power plants and dams. These assaults have so far led to widespread power outages and significant challenges in maintaining energy stability.

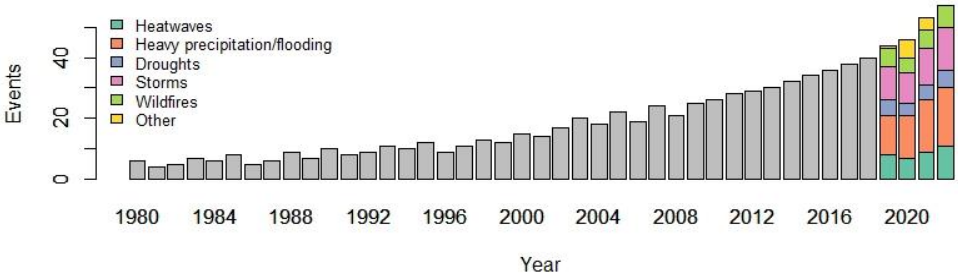
The number of extreme weather events of different sizes has increased significantly in the last years in Europe, as shown in Figure 17. Europe is warming faster than any other continent, with extreme heat becoming more frequent and contributing to wildfires. Precipitation patterns are changing, and droughts and floods are increasing in severity. Climate change will impact both energy consumption (e.g. due to peak consumption periods during heat waves), as well as

[67] Cyber-attacks against European energy & utility companies, September 2022. https://sektorcert.dk/wp-content/uploads/2022/09/Attacks-against-European-energy-and-utility-companies-2020-09-05-v3.pdf

[68] See: https://www.enisa.europa.eu/publications/enisa-threat-landscape-2024

electricity generation (e.g. reduced hydro and nuclear generation during droughts or heat waves). The European Climate Risk Assessment[69] concludes that the energy sector is projected to experience the strongest rise in infrastructure damage compared to transport, industry and the social sector.

**Figure 17: Number of extreme weather events in Europe**




*Source: European Environment Agency*[70]

## 3.2. State of play of implementation

This section provides a summary of the implementation of the two evaluated regulations by Member States, the Commission and other regulated entities. More detailed overviews can be found in the dedicated reports reviewing the respective Regulations[71].

Looking at the EU's neighbourhood, the Energy Community Secretariat releases annual reports and country-specific assessments on the implementation of the energy security acquis in the Energy Community Contracting Parties[72]. According to the 2024 report, the Contracting Parties have achieved an overall implementation score of 36% on energy security (a decrease of 5 percentage points compared to 2023). This score reflects the implementation of the Electricity Risk-Preparedness Regulation (41%), the Gas Security of Supply Regulation (37%) and the Oil Stocks Directive (23%)[73].

### *3.2.1. Gas Security of Supply Regulation*

The Gas Security of Supply Regulation included several requirements and instruments to implement the Regulation. This section provides a state of play of the implementation of:

- The preparation and submission of preventive action plans, emergency plans, national risk assessments by Member States.

[69] See: European Climate Risk Assessment | Publications | European Environment Agency (EEA)
[70] Climate Change, impacts and vulnerability in Europe 2022, European Severe Weather Database (ESWD), Copernicus Emergency Management Service (CEMS) 2022 Annual report and International Disaster Database (EM-DAT). (2022). EM-DAT Data.
[71] COM(2023) 572 final and COM(2025) 539 final.
[72] Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, Serbia, Moldova, Ukraine, Georgia.
[73] See EnC 2024 Implementation report - Implementation Report - Energy Community Homepage (energy-community.org)

- The preparation and submission of common risk assessments by Member States in regional risk groups.
- The publication of the Union-wide security of supply simulations by ENTSOG.
- Gas Coordination Group meetings.
- Implementation of the infrastructure standard and bi-directionality requirements.
- The declaration of crisis levels by Member States.
- The solidarity agreements that were signed during the evaluation period.

As one of the obligations of the Regulation Member States were required to submit their plans (gas Preventive Action and Emergency Plans) by 1 March 2019, as well as an update four years later on 1 March 2023. However, as part of the temporary Gas Demand Reduction Regulation[74], Member States had to anticipate the update of their plans by 31 December 2022, in order to reflect any demand reduction measures taken. The plans had to be developed based on the national risk assessments, as well as the common risk assessment. All plans and all Common Risk Assessments have been submitted. However, only 7 of the two plans in the two cycles were submitted on time by Member States and only 1 out of 12 Risk Groups submitted a Common Risk Assessment on time in two cycles. Member States also were required to test their Emergency Plans, but the submitted EPs contain little information on the conclusions of these tests. This has been further elaborated on in the Commission's report SWD(2023) 323.

ENTSOG published 3 Union-wide security of supply simulations, on 21 November 2017[75], on 30 November 2021 and on 22 January 2025[76]. These simulations were key inputs to the Common Risk Assessments. Moreover, ENTSOG published two seasonal supply outlooks every year, as required by the Gas Regulation (EU) 2024/1789, including an extra yearly outlook on 20 July 2022, to simulate a full Russian supply disruption.

A total of 27 GCG meetings were held in full format since the Gas Security of Supply Regulation entered into force until the end of 2024[77]. This was complemented by a series of meetings in restricted format[78]. During the energy crisis, meetings were held on a monthly or even weekly basis, mostly in restricted format.

In 2023, the Commission launched 26 EU Pilots[79] due to missing Common Risk Assessments (CRAs), Preventive Action Plans (PAPs) and Emergency Plans (EPs). In the meantime, 25 EU Pilots have been closed since the missing CRAs, PAPs and EPs have been submitted.

[74] Regulation (EU) 2022/1369
[75] Including an addendum to the Union-wide simulation published on 8 October 2020
[76] See: https://www.entsog.eu/security-of-supply-simulation
[77] See: Register of Commission expert groups and other similar entities (europa.eu)
[78] *A priori* a meeting in restricted format is limited to Member States and Commission only, with ad hoc invitations being extended to other participants when relevant.
[79] Cyprus is exempted from the obligation.

The infrastructure standard has been largely implemented by Member States, as indicated in Member States' Plans. Only three Member States did not meet the N-1 standard in 2023[80], since Luxemburg, Sweden and Slovenia have an exemption from this obligation.

The bi-directionality of EU infrastructure has significantly improved since 2017. As is further detailed in chapter 4 and in Figure 27, the average bi-directionality increased steadily since 2017, which facilitated flows that reversed eastwards since the supply cuts from Russia in 2022. The Commission keeps an updated list of ongoing exemptions to the requirement on its website: 23 IPs currently have an exemption.[81] In 2020, the Commission decided[82] that four exemptions had to be reviewed, as further outlined in Commission Report reviewing the Gas Security of Supply Regulation.[83] Out of these four, two (Mosonmagyarovar, between Austria and Hungary; and Murfeld – Ceršak, between Austria and Slovenia) were prolonged, with ACER giving positive opinions[84]. One exemption (Karksi, between Estonia and Latvia) became obsolete, as a result of a PCI project; and for the fourth one (Blaregnies – Tasnières (H), between Belgium and France), no request for prolongation was officially submitted yet by the Competent Authorities, despite the deadline set by the abovementioned decision of 31 January 2022.[85]

On 23 July 2024, Bundesnetzagentur adopted a decision regarding the expiring[86] exemption for the interconnection point "Deutschneudorf EUGAL" between Germany and the Czech Republic, arguing that there was no need to pursue the exemption, based on an alleged revised understanding of the concept permanent physical bi-directional capacity. Following an invitation to react in ACER's opinion[87], the Commission adopted[88] a decision requesting the modification of the coordinated decision and clarifying that "*in the context of Regulation (EU) 2017/1938, the concept of 'physical bi-directional capacity' means the physical capacity to transport gas in both directions in any circumstances, as it cannot be considered without the element of permanence required by the Union legislator.*".

Lastly, in December 2023, Czech and Polish authorities requested an extension of the exemption until December 2025, to provide enough time for the TSO to identify and implement the best infrastructure solutions to implement the reverse flow obligation. On 9 December 2024, ACER adopted a positive opinion[89] on the matter but recommended "*NET4GAS to follow developments regarding the understanding of the concept of permanent physical bi-directional*

[80] See Figure 41 in Annex II
[81] See https://energy.ec.europa.eu/system/files/2021-05/table_reverse_flows_-for_publication_0.pdf
[82] See Commission Decision C(2020) 6600
[83] See Staff Working Document SWD(2023) 323 accompanying Report COM(2023) 572.
[84] ACER opinions No 01/2022 and 02/2022 from February 2022.
[85] Moreover, two pairs of Member States have merged their national networks into single balancing zones: Denmark and Sweden, and Latvia and Estonia.
[86] Exemption expired February 2024
[87] Opinion No 06/2024.
[88] Commission decision requesting modifications of the coordinated decision between Germany and the Czech Republic regarding the permanent physical bi-directional capacity at the cross-border interconnection point "Deutschneudorf EUGAL Brandov", 26 February 2025, C(2025) 1337 final.
[89] Opinion No 08/2024.

*capacity*". On 10 April 2025, the Commission adopted a new decision confirming that "*merely allowing physical reverse flows at an interconnection point in the event of a gas supply crisis (…) is neither in line with the text nor with the objectives of the Regulation (EU) 2017/1938*" and requesting the competent authorities to modify the coordinated decision so as to ensure that the duration of the exemption covers the period for which the gas can only be flown in emergency situations[90].

Following these Commission's decisions, the two coordinated decisions were revised by the competent authorities accordingly.

A total of 13 'Early Warnings', 2 'Alerts' and 1 'Emergency' were declared during the evaluation period from 2017 until 2024. The majority were declared during the energy crisis, notably due to supply cuts from Russia that occurred in 2022, as outlined in Figure 18. The only emergency was declared by Italy in 2017 after the explosion at the Baumgarten compressor station in Austria, which was lifted 3 days later.

***Figure 18: crisis level declaration by Member States (2017-2025)***

*Source: European Commission, based on Member States' notifications*

A total of 9 bilateral solidarity agreements were signed between Member States, falling short of the total of 40 agreements required. Member States were required to conclude these bilateral solidarity agreements by 1 October 2018. Solidarity agreements were signed between:

- Germany and Denmark (14 December 2020);
- Germany and Austria (2 December 2021);
- Estonia and Latvia (4 January 2022);

[90] Commission decision requesting modificatins of the coordinated decision between Poland and Czech Republic regarding the permanent physical bi-directional capacity at the cross-border interconnection point "Cieszyn/Český Těšín Stork I", 10 April 2025, C(2025) 2243 final.

- Lithuania and Latvia (10 March 2022);
- Italy and Slovenia (22 April 2022);
- Finland and Estonia (25 April 2022);
- Denmark and Sweden (8 May 2023);
- Slovenia and Croatia (14 July 2023), and;
- Germany, Italy and Switzerland (19 March 2024).

The Commission launched 27 infringement procedures[91] in 2021 due to the lack of bilateral solidarity agreements. Several of them were put on hold when the obligation turned into a "best efforts" clause after the application of default solidarity provisions, since the entry into force of Regulation (EU) 2024/1789. All these cases were closed on 12 February 2025.

### *3.2.2. Electricity Risk Preparedness Regulation*

The Electricity Risk Preparedness Regulation included several requirements and instruments to implement the Regulation. This section provides a state of play of the implementation of:

- Appointment by Member States of a Competent Authority.
- Development of methodologies for short-term and seasonal adequacy assessments and regional crisis scenarios by ENTSO-E.
- Implementation of regional or bilateral arrangements for assistance during crises.
- The risk-preparedness plans of Member States.
- Declaration of crisis levels by Member States.
- Electricity Coordination Group meetings.

One of the very first steps in the implementation of the Electricity Risk Preparedness Regulation was the appointment by Member States of a Competent Authority. While the deadline was set for 5 January 2020, several Member States missed it, and in April 2021 the Commission had to launch two EU pilots. Ultimately, all Member States had designated their competent authority by August 2021. The full list is available on the Commission's website[92].

Secondly, the implementation of the new Regulation entailed the development of harmonised methodologies for short-term and seasonal adequacy assessments and crisis scenarios. Firstly, ENTSO-E had to submit a proposal to develop a methodology for short-term and seasonal adequacy assessments, which was approved by ACER in 2020[93]. This methodology is now used for all seasonal outlooks (winter and summer outlooks) and short-term adequacy assessments.

[91] This includes the UK, which as of 2020 is no longer an EU Member State but excludes CY which is exempted from the obligation.

[92] See: https://energy.ec.europa.eu/document/download/86e16360-3984-4c25-bb31-bbe5c4f20222_en?filename=competent_authorities_-_risk_prep_-_october_2021.pdf

[93] See: https://eepublicdownloads.entsoe.eu/clean-documents/sdc-documents/seasonal/Methodology%20for%20Short-term%20and%20Seasonal%20Adequacy%20Assessment%20-%20ACER%20Decision%2008-2020%20on%20the%20RPR8%20.pdf

ENTSO-E also had to submit its proposal for a methodology for identifying regional crisis scenarios, which was approved by ACER in 2020[94], allowing ENTSO-E to perform its first regional crisis scenarios assessment[95]. The ECG adopted a recommendation requesting ENTSO-E to make specific amendments to its regional crisis scenario assessment[96]. Following its legal obligation to update it where significant new information is available, and based on the lessons learnt, an updated methodology was proposed and approved in 2024[97]. Consequently, ENTSO-E presented a new assessment of the regional risk scenarios to ECG, which made new recommendations in April 2025 on topics like the *cooperation with stakeholders* or the *reassessment of certain concrete scenario*. These scenarios are being used for the development of the new RPPs due in 2026.

Following the identification of regional crisis scenarios by ENTSO-E, Member States had to identify risks related to the ownership of infrastructure relevant to security of electricity supply within four months. Most Member States met the deadline, and an ECG meeting was dedicated to the discussion of these assessments. A new assessment, based on updated regional crisis scenarios, was performed and presented during an ECG meeting.

In parallel, in June 2020, the Commission adopted a non-binding guidance to assist Member States in the implementation of the regional or bilateral arrangements for assistance[98]. It concerns the obligation to agree on technical, legal and financial issues in the regional or bilateral arrangements and describe them in their risk-preparedness plans, to operationalise the newly introduced assistance mechanism as required by the Regulation.

Competent Authorities had to submit their draft risk-preparedness plans for consultation to neighbouring Member States. According to the Regulation, the draft risk preparedness plans had to be submitted by 5 April 2021. A three-days seminar was organised in the ECG in June 2021, where Member States could present and discuss their draft plans. However, only two Member States met the deadline (Germany and Estonia). All but five of the draft plans had been submitted by the end of the second quarter of 2021. Two infringement procedures were initiated in 2022 against Member States who never submitted their draft plan: they instead submitted directly their final plan, which was then subject to ECG consultation.

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[94] See: https://www.acer.europa.eu/sites/default/files/documents/Official_documents/Acts_of_the_Agency/Annexes%2520to%2520the%2520DECISION%2520OF%2520THE%2520AGENCY%2520FOR%2520THE%2520C7/ACER%2520Decision%252007-2020%2520on%2520RPR%2520ART%25205%2520-%2520Annex%2520I.pdf

[95] This document is not for publication.

[96] This document is not publicly available.

[97] See: https://acer.europa.eu/sites/default/files/documents/Individual%20Decisions/ACER_Decision_02-2024_Regional_Electricity_Crisis_Scenarios_Methodology_Amendment.pdf

[98] Commission Recommendation (EU) 2020/775 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32020H0775

According to the Regulation, Member States were required to submit their final Risk Preparedness Plan by 5 January 2022. Only 13 met the official deadline (all the national plans were ultimately submitted by the end of 2022).

Following the Commission's opinions, Member States had to submit amended plans or notify the Commission why they object to the recommendation, within three months. Most Member States replied by sending an amended Plan or indicating that missing information would be provided in subsequent updates. As of February 2025, two Member States (Belgium and France) and Northern Ireland had not complied with the obligation.

Member States were also required to regularly test the procedures and measures developed in the RPPs. Yet, the submitted plans contained little information on these tests, as is further detailed in the Report on the implementation of the Regulation[99].

A total of 4 early warnings were declared during the implementation period (Cyprus in May 2020, Greece in August 2021, France in December 2021, Ireland in October 2022). On 28 April 2025, following the events described in section 3.1, Spain was the very first Member State to declare an electricity crisis since the adoption of the Regulation. The timeline of the different early warning declarations is further detailed in the figure below.

***Figure 19: crisis level declaration by Member States (2019-2023)***

*Source: European Commission, based on Member States' notifications*

Lastly, a total of 41 ECG meetings have been held since the Electricity Risk Preparedness Regulation entered into force (until February 2025)[100]. During the energy crisis, in particular in 2022, the group met more than once a month on average.

99 COM(2025) 539 final.

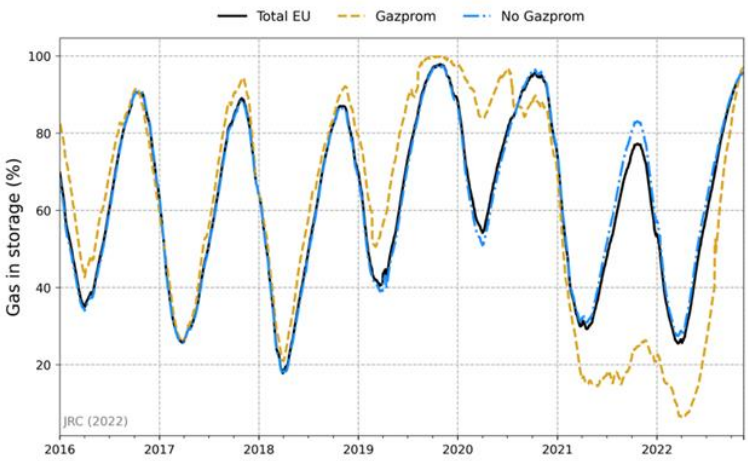
100 See: https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&do=groupDetail.groupDetail&groupID=2735

### 3.3. External factors and policy developments: energy crisis 2021-2023

The weaponisation of gas supplies from Russia radically altered the EU's security of gas supply landscape, on top of external events highlighted in section 2.1.2. The energy crisis that followed constituted the main external factor influencing the implementation of the Regulation. As will be further detailed in this section, the main difficulties experienced during the energy crisis were supply cuts from Russia, which resulted in record high prices (wholesale gas prices peaked over €300/MWh in August 2022 – see figure 21).

Yet, even before Russia's full-scale military invasion of Ukraine in 2022, Gazprom used gas supplies as political leverage by not filling storage capacities in the EU which it owned or had primary user rights to (see Figure below). This affected the EU's preparedness for the winter 2021-2022 as EU storages were filled at 72% on 1 October 2021 compared to an average of 90% in the five preceding years.

***Figure 20: Gas in storage (%) in Gazprom Storages vs non-Gazprom storages***




*Source: European Commission Joint Research Centre*[101]

Thereafter, due to unjustified demands, Gazprom:

- Unilaterally suspended gas supply to Poland and Bulgaria[102] on 27 April 2022.
- Stopped flows via Yamal pipeline for transit to and via Poland on 12 May 2022.
- Cut gas supplies to Shell Deutschland GmbH, Denmark's Ørsted and the Netherlands' GasTerra on 31 May 2022[103].
- Suspended supplies to Finland on 21 May 2022[104].
- Cut supplies to Italy's state-controlled ENI and Austrian energy company OMV[105].

[101] See: https://doi.org/10.1016/j.esr.2024.101297
[102] See: https://www.bbc.com/news/business-61237519
[103] See: https://www.reuters.com/business/energy/gazprom-cuts-gas-supply-orsted-shell-energy-2022-06-01/
[104] See: https://www.gasum.com/en/news-and-customer-stories/news-and-press-releases/2022/natural-gas-imports-from-russia-under-gasums-supply-contract-will-be-halted-on-saturday-21-may-at-07.00/
[105] See: https://www.bloomberg.com/news/articles/2022-06-15/gazprom-cuts-gas-flows-to-italy-by-about-15-eni-says

Another important external factor is the disruption of two critical gas infrastructures in the EU. In September 2022, the Nord Stream-1 (NS-1) pipeline, which used to transport gas from Russia to Germany, was sabotaged. While NS-1 was a major pipeline to import gas to Europe, flows via NS-1 were already reduced by Gazprom in July 2022 and even completely halted by the end of August 2022. After flows were stopped, Russia stressed that flows would not restart unless the "collective West" would lift its sanctions[106]. The EU's critical gas infrastructure was also disrupted in October 2023, when a ship's anchor damaged the Balticconnector connecting Estonia and Finland[107]. The disruption of the Balticconnector meant that Finland was for the duration of the repair no longer connected to neighbouring Member States, relying on the LNG terminal in Inkoo to satisfy its demand, leading the Competent Authority of Finland to declare the 'alert' crisis level.[108]

Dependencies of Member States on Russian gas, in particular in Central and Eastern Europe, had already been significantly reduced, e.g. through several EU-supported PCIs and through a well-integrated gas network. Between 2017 and 2024 key infrastructure projects, often with EU financial support under CEF or regulatory support, were commissioned, allowing Member States to respond to supply cuts from Russia. These were among others the Baltic Pipe, interconnectors between Greece and Bulgaria, Poland and Slovakia, Poland and Lithuania, the Balticconnector, enhancement of gas interconnector between Lithuania and Latvia and the FSRU terminal in Alexandroupolis.

The reduced flows of Russian gas and its replacement by gas from alternative sources led to a radical change in the flow patterns of natural gas. Even if this initially led to high levels of congestion, notably in North and Western Europe, it did not lead to curtailments. Flowing large quantities of natural gas from West to East, rather than East to West was possible because of the mature and highly integrated natural gas market reinforced by bi-directional capacities, as well as high levels of interconnectivity.

### *3.3.1. The EU's policy response to the energy crisis*

To tackle the immediate security of supply concerns due to Russia's weaponisation, the EU adopted several measures that aimed to improve the EU's security of supply, namely:

- The REPowerEU Plan in May 2022.
- The Gas Storage Regulation in June 2022.
- The Gas Demand Reduction Regulation in August 2022.
- The Solidarity Regulation in December 2022.

[106] See: Russia switches off Europe's main gas pipeline until sanctions are lifted
[107] See: https://poliisi.fi/en/-/national-bureau-of-investigation-has-clarified-technically-the-cause-of-gas-pipeline-damage
[108] See: https://gasgrid.fi/en/2023/10/27/finnish-national-emergency-supply-agency-raises-the-risk-assessment-of-gas-supply-security-finnish-gas-market-remains-stable/

Moreover, the EU adopted several measures in that had an impact on security of supply, even if their primary objective was market reform or addressing high prices:

- Regulation on an emergency intervention to address high electricity prices.
- The reform of the Electricity Market Design.
- The Hydrogen and Gas Decarbonisation Package.

The REPowerEU plan was a cornerstone of the EU's response to the crisis. REPowerEU, launched in May 2022, aimed to reduce the EU's dependence on Russian fossil fuels as soon as possible. The plan focused on three pillars: diversifying energy supplies and routes, accelerating deployment of renewable energy, and promoting energy savings. Several Member States have taken early actions to reduce or even ban Russian gas imports, including by terminating existing contracts with Russian gas suppliers.[109] In May 2025, the Commission presented the REPowerEU Roadmap[110] followed by a legislative proposal in June 2025[111], to end the EU's dependency on Russian energy by stopping the import of Russian gas and oil and phasing out Russian nuclear energy, while ensuring stable energy supplies and prices across the Union.

To implement REPowerEU and phase out dependency on Russian gas imports, it was instrumental to reduce demand and find alternative supplies from reliable partner countries. As highlighted in section 3.1, there has been a significant increase in for example LNG imports from the US (45% of all LNG imports in 2024) and sustained imports from Qatar and Algeria (12% and 8% respectively of all LNG imports in 2024), as well as pipeline gas from Norway, Algeria and Azerbaijan (50%, 18% and 7% of all pipeline imports respectively in 2024). A Memorandum of Understanding[112] was signed with Azerbaijan to establish a strategic partnership for energy. This includes e.g. doubling the capacity of the Southern Gas Corridor and cooperation to accelerate the development of renewable energy. The volumes supplied by alternative suppliers were crucial to replace missing supplies from Russia.

The realisation of the additional infrastructure identified under REPowerEU allows the EU's network to accommodate new gas flows, notably from LNG terminals, to replace Russian gas imports. Some of these projects received financial support under the Recovery and Resilience Facility given their significant regional importance.[113]

[109] Estonia, Lithuania, Latvia, Denmark, Finland, Sweden, Germany, Poland, Croatia, Malta, Ireland, Luxembourg, Austria and Czechia have prohibited or stopped gas supplies from Russia. Some Member States could, however, be indirectly supplied with gas of Russian origin through wholesale market purchases.
[110] COM(2025) 440 final
[111] COM(2025) 828 final
[112] See: STATEMENT_22_4583_EN.pdf
[113] For example, Krk LNG terminal in HR was expanded to a capacity of 6.1 bcma, together with reinforcements of the gas network to accommodate the expansion of the regasification facility, thereby facilitating access to the global LNG market. See: 604ab3a8-7919-4a6d-b05f-f52a844f0c55_en

***Figure 21: gas PCIs map***

*Source: European Commission*

Moreover, to address immediate supply concerns, the EU adopted the Gas Storage Regulation[114] in June 2022, setting a 90% storage target. The EU acted to ensure storages were sufficiently filled to prepare for supply disruptions from Russia during winter. The 90% target was exceeded each year (95% in 2022, 99% in 2023, 95% in 2024).

The most common measures taken by Member States to ensure the 90% filling include[115]:

- Minimum volume in gas storage: imposing an obligation on Storage System Operators (SSOs) on minimum filling levels;
- Reduction of storage tariffs for capacities;
- Requiring SSOs to tender capacities to market participants (via capacity auctions);
- Appointing a dedicated last resort filling entity;
- Instruments to purchase and manage strategic stocks by public or private entities;
- Ensuring that booked capacities are used by applying use-it-or-lose-it mechanisms.

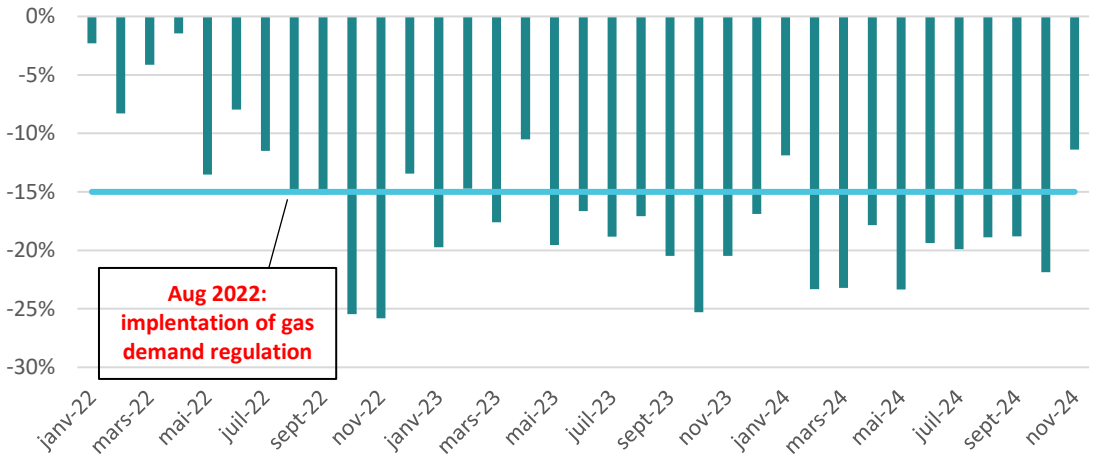
The Storage Regulation also introduced a certification mechanism for storage system operators. Certificating SSOs aimed to mitigate potential risks to security of supply from operators who might act in ways contrary to EU interests. The certification process is ongoing, but Gazprom no longer owns EU storages. At the time of writing, 40 certifications were submitted (18 pending) and 17 Commission opinions were adopted. On 5 March 2025, the Commission

[114] Regulation (EU) 2022/1032
[115] COM (2025) 98

adopted a proposal[116] to prolong the Storage Regulation by two years, accompanied by a Recommendation[117] inviting Member States to use flexibility when refilling storages, to avoid market distortions. In July 2025, the extension of the Storage Regulation by two years was adopted[118], ensuring that there are additional flexibilities for Member States to meet the targets.

In response to potential gas shortages, the Gas Demand Reduction Regulation[119] was adopted in August 2022, setting a 15% gas demand reduction target. The voluntary 15% target was introduced to reduce gas demand compared to the average consumption over the previous five years. In case of severe supply disruptions, this target could become mandatory if an "EU Alert" was declared. The Demand Reduction Regulation encouraged Member States to implement demand-side measures, such as switching to alternative fuels, improving energy efficiency, and promoting behavioural changes among households and industries. The Regulation also required Member States to update their EPs to reflect voluntary demand-reduction measures. This coordinated effort across the EU contributed to reducing gas consumption by 15% for the first time in August 2022 (see figure 22), in combination with the record high wholesale gas prices which also put pressure on gas demand. The Regulation was prolonged by 1 year by means of Regulation (EU) 2023/706 until 31 March 2024, after which Council Recommendation C/2024/2476 recommended Member States to continue reducing demand by 15% in the following year. Since August 2022, the EU reduced gas consumption by 18% until December 2024 (compared to the 5-year reference period).

***Figure 22: EU27 monthly gas demand reduction compared to 5-year reference period***[120]




*Source: Eurostat (nrg_cb_gasm)*

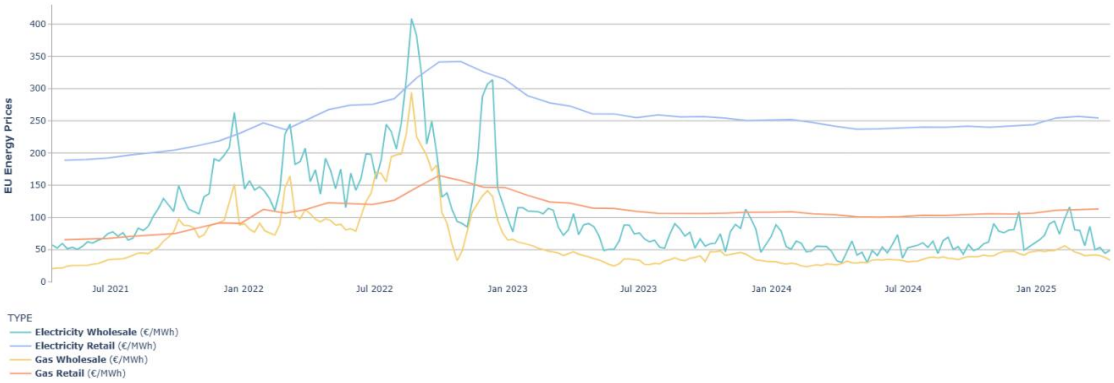
[116] COM(2025) 99 final
[117] C/2025/1481
[118] Regulation (EU) 2025/1733.
[119] Council Regulation (EU) 2022/1369.
[120] The reference period is defined as the average of the previous 5 years for the period August 2022 to May 2023 (as laid out in the demand reduction regulation). Therefore, for August-December it refers to 2017-2021, but for January-May to 2018-2022.

In December 2022 the EU adopted the Solidarity Regulation[121], to strengthen the collective ability of Member States to manage gas supply crises by ensuring that gas flows between countries are maintained even in emergencies. The Regulation also reinforced the solidarity mechanisms by setting default solidarity rules applicable in absence of bilateral agreements. It also included the EU's demand aggregation mechanism AggregateEU.

In May 2024, the EU adopted its Hydrogen and Gas Market Decarbonisation package, in which the solidarity mechanism was further operationalised[122]. This package consisted of a new Regulation (EU) 2024/1789, amending the Gas Security of Supply Regulation (EU) 2017/1938, which created a set of default rules in case Member States could not agree on bilateral solidarity arrangements.

In parallel, the EU addressed electricity market challenges exacerbated by the energy crisis, with provisions also affecting security of electricity supply. The Regulation on an emergency intervention to address high electricity prices was introduced in October 2022[123], which positively impacted security of electricity supply. Member States agreed to reduce electricity demand, through a binding demand reduction target of 5% during peak hours, and an indicative 10% monthly gross electricity consumption reduction. Aside from a cold spell in December 2022 and peaks in Southeastern Europe in 2024, average EU electricity prices started a generally downward trend afterwards and did not return to the peaks observed in summer 2022.

***Figure 23: EU energy prices €/MWh (April 2021 - April 2025)***




*Source: DG ENER Chief Economist Unit, based on Eurostat data*

Furthermore, in March 2023, the Commission adopted a reform of the EU electricity market design, which included several elements of the Recommendation on energy storage[124]. The resulting Regulation[125] facilitates the deployment of non-fossil flexibility solutions, in particular demand response and storage, and introduced provisions to streamline Commission procedures

[121] Regulation (EU) 2022/2576.
[122] The 'solidarity mechanism' is an obligation for EU Member States to offer each other assistance during an emergency by providing gas volumes to a neighbouring Member State in need.
[123] Regulation (EU) 2022/1854.
[124] Recommendation C/2023/1729.
[125] Regulation (EU) 2024/1747.

for a quicker adoption of capacity mechanisms. The impact of these provisions will be highlighted in an upcoming Commission's report[126].

The proper functioning of the electricity market during the crisis considerably minimised the impact on security of supply, thanks to cross-border flows. The electricity market allows an optimisation of the use of resources across Member States, enabling to avoid scarcity situation and soften peak prices. Where cross-border interconnectors are not used at maximum capacity or are under-developed, Member States can experience a tight supply and demand balance, leading to high prices, like the South-East region witnessed during summer 2024. Completing market integration will further strengthen security of supply, even if higher interconnectedness of energy markets also raises the risk of transnational supply crises and requires stronger and proactive coordination.

During the evaluation period, EU energy law was also marked by the "OPAL case". The General Court (case T-883/16 Poland v Commission) and then, on appeal, the Court of Justice (case C-848/19 Germany v Poland) found that the "energy solidarity" principle is not only a guiding principle for EU institutions when drafting EU energy legislation. Instead, it found that it is also directly applicable for applying EU energy law that should be "read" in relevant legal provisions (in that case, Article 36 of the Gas Directive) as an additional, "unwritten" requirement. This indirectly impacted the area of security of supply, as both the Gas Security of Supply Regulation and Risk Preparedness Regulation are largely based on the *energy solidarity* principle, and so were the emergency regulations adopted during the crisis.

[126] COM(2025) 65 final.

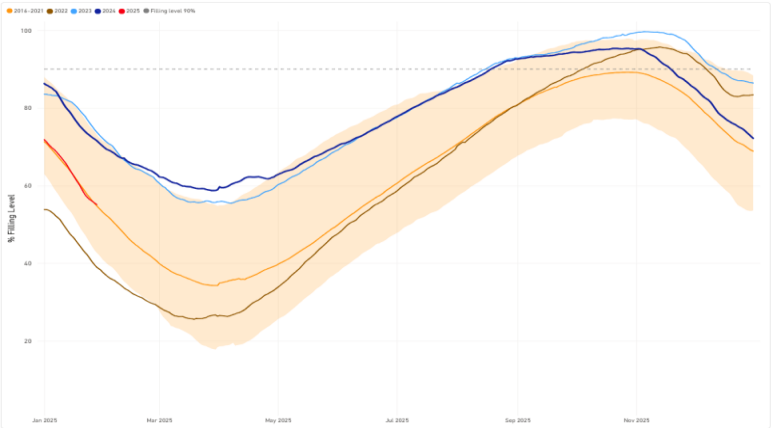
# 4. EVALUATION FINDINGS

## 4.1. To what extent was the intervention successful and why?

### *4.1.1. What is the situation of the EU's security of energy supply today?*

The EU security of gas and electricity supply situation significantly deteriorated during the energy crisis in 2021-2023 but has since then substantially improved. While unilateral supply cuts from Russia created severe challenges for security of supply in 2022, the EU now has a more diversified and secure gas supply, as was illustrated in Section 3.1. In addition, the challenging situation experienced on the electricity markets in 2022 due to droughts affecting hydro and nuclear production has improved. Average gas storage filling levels are significantly higher since the adoption of the Gas Storage Regulation, as illustrated by Figure 24.

***Figure 24: gas in storage - daily filling percentage***

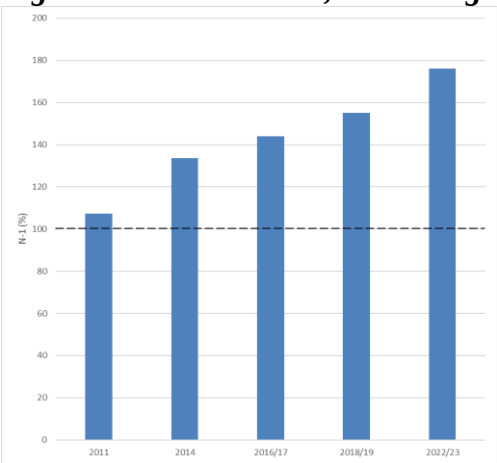



*Source: Commission's Joint Research Centre, based on GIE AGSI data*[127]

The EU's preparedness to various security of gas supply disruptions is further illustrated by ENTSOG's security of supply simulation[128], a requirement of the Gas Security of Supply Regulation. The report concludes that: *"gas infrastructure, including projects commissioned since 2022 following the invasion of Ukraine and projects to be commissioned over the next year, increases energy security in the EU and significantly improves possible cooperation among Member States during extreme climatic conditions and individual supply route disruption scenarios."* Despite that gas infrastructure allows for an efficient European gas market, a combination of extreme climatic conditions and supply disruptions may still result in security of supply concerns that may require demand response, according to the report. The improvement in the security of gas supply situation since 2022 due to e.g. the development of gas infrastructure can be further illustrated by the improvement of the EU-wide N-1 situation (see figure 25).

[127] JRC SoS Dashboard
[128] See: ENTSOG EU-wide Security of Supply Report 2024.pdf

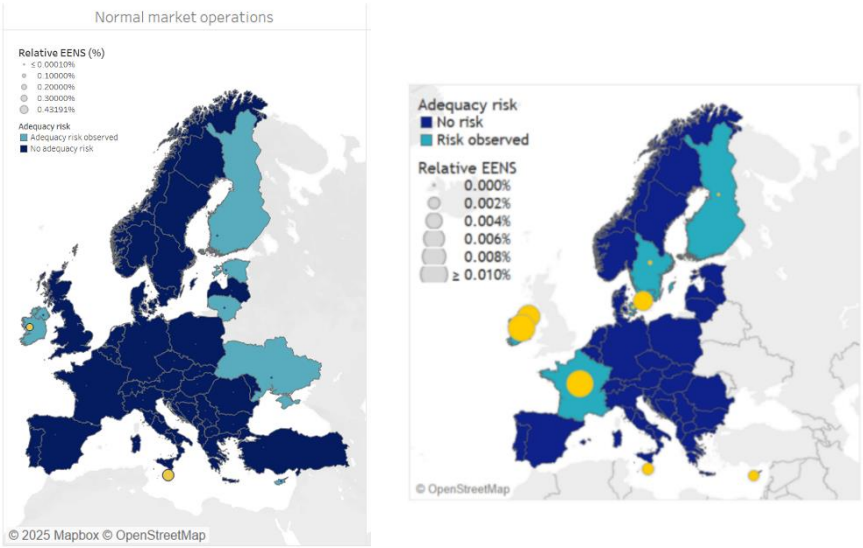
***Figure 25: N-1 situation, EU average***




*Source: Commission's Joint Research Centre, based on Member States' PAPs*

Regarding electricity, ENTSO-E's winter adequacy outlook for 2025/2026 highlighted an "overall favourable adequacy situation in Europe"[129]. Identified adequacy risks are mostly concentrated in remote areas such as Cyprus, Ireland, and Malta. In continental Europe, the only countries for which risks were found are Lithuania, Finland and Estonia, in case of exceptionally adverse operational conditions. This is a notable improvement compared to in particular winter 2022/2023, due to generation fleet expansion combined with electricity demand moderation. Even in that winter, ENTSO-E[130] recognised the value of the coordination and cooperation among European countries and acting on their national Risk Preparedness Plans as key to overcome the risks identified for the winter.

***Figure 26: results electricity 2024/2025 winter outlook (left) vs 2022/2023 winter outlook***




*Source: ENTSO-E*[131]

[129] Winter_Outlook_2025-2026_Report.pdf
[130] Winter Outlook 2022-2023_Report.pdf
[131] See: Winter Outlook 2024-2025_Report.pdf, and: Winter Outlook 2022-2023_Report.pdf

### *4.1.2. Effectiveness*

This section looks at the effectiveness of the EU's security of electricity and gas supply framework, i.e. whether it has met its original objectives: 1) to safeguard an adequate security of supply level, contributing to the functioning of the internal market, and to 2) enhancing cooperation and coordination among countries to better handle system stress and crises (see section 2.1). This section also examines if the various measures in the Regulations contributed to meeting the specific objectives. These measures are:

- Protected customers and the gas supply standard.
- The various risk assessments, simulations and plans required by the Regulations.
- The infrastructure standard and bi-directionality requirement for gas and ownership risks for infrastructure for electricity.
- The crisis management procedures and the solidarity/assistance provisions
- The crisis measures adopted during the 2021-2023 energy crisis.

The Electricity Risk-Preparedness Regulation and Gas Security of Supply Regulation were partially effective in achieving their objectives. The Regulations increased the EU's overall preparedness and made the EU more resilient to gas supply disruptions and electricity blackouts. The feedback received to the public consultation is in line with this statement, as the performance of both regulations was graded moderately positively on all their objectives. More than half of the actual respondents gave them a grade between 3 (average) and 5 (excellent) on all seven objectives that had been identified.

The categories of '*protected customers'* (gas) and '*consumers entitled to special protection against disconnection*' (electricity) were considered adequate by Member States and stakeholders to protect vulnerable or critical consumers to supply shocks. However, their effectiveness proves difficult to assess, given that fortunately neither for gas nor for electricity there was a situation that required curtailment.

- **In the gas sector**, the report reviewing the implementation of the Regulation[132] had shown that Member States did not report difficulties in implementing the provision. Some Member States had requested further harmonisation of the definition of protected customers at EU level, while others pointed towards difficulties in estimating protected customers' demand, when daily metering is not available.
- **In the electricity sector**, the feedback received through the public consultation was generally positive towards this provision. Member States took varied approaches in the definition[133] of the categories of consumers that are entitled to receive special protection against disconnection in their RPPs and the Commission had to request clarifications in eleven cases. Still, because of this provision, Member States were required to review

[132] COM(2023) 572 final.
[133] The Risk Preparedness Regulation leaves this definition to national legislation.

manual load shedding plans, which is a positive step to avoid potential propagation of an electricity crisis to essential social services.

Concerning the gas supply standard, which requires undertakings to ensure supply to protected customers under a number of pre-defined situations, no particular issues have been identified regarding the implementation[134]. Nonetheless, in the public consultation, some respondents expressed concerns regarding the perceived vagueness for the enforcement of the provision. Some respondents suggested that stronger monitoring could reduce the need for other type of measures (notably storage filling targets).

The risk assessments required by the Gas Security of Supply Regulation and Electricity Risk-Preparedness Regulation have improved the way Member States analyse risks.

- **For electricity**, a first common methodology for the identification of electricity crisis scenarios was established and two assessments at regional level were carried out, which was not the case before the Regulation entered into force. This is a considerable improvement and therefore contributed to the objective of improving and harmonising risk assessments and preparedness.
- The situation is comparable **for gas**, where two cycles of common risk assessments have been carried out. These assessed among others the risk of a full Russian supply disruption at regional level, which contributed to the policy objectives of ensuring adequate levels of regional cooperation and enhancing preparedness through a risk-based approach. This was supported by the EU-wide simulation by ENTSOG (done three times in the evaluation period), which also contributed to adapt the assessment to new risks, including the full disruption of Russian supplies.

Despite these improvements compared to the situation before the implementation of the regulations, risk assessments still feature some substantial weaknesses, such as a lack of consideration of cross-sectoral and cross-border risks. This is further developed in the sections about relevance and EU added value criteria[135].

Similarly, the plans are a useful measure that foster transparency and establish national procedures and mechanisms in case of a gas or electricity crisis. Thanks to this provision, Member States are obliged to make the necessary crisis arrangements, take into account their neighbouring Member States when designing them and ultimately also consult domestic stakeholders and neighbouring Member States on the measures they intend to take in case of a crisis.

- Regarding the gas plans, the Commission opinions recognised the overall quality and completeness of the Member States' plans, in particular as regards the description of the specificities of the national gas systems, as well as the roles and responsibilities during

[134] See SWD(2023) 323 for further details.
[135] These weaknesses however also affected the *effectiveness* of these provisions.

a crisis. All Member States now have preventive and crisis measures in place, which is a positive outcome of the Regulation.

- For the electricity plans, the quality of national measures in the plans was satisfactory (e.g., double fuel obligation for gas-fired power plants) and the link with national crisis scenarios was well-established.

However, as was indicated in the Commission opinions on the plans, there are shortcomings:

- **The gas plans** are often insufficiently linked to risks identified in the risk assessments. While it is a requirement of the Regulation, in practice this has not been sufficiently applied by Member States, making the sequence of deliverables less effective. The identification of critical gas-fired power plants, distinction between measures to be taken in different crisis levels, the identification of (solidarity) protected customers and the regional dimension are also often lacking.
- **For the electricity plans**, in 16 cases the Commission considered that the plans had to be amended to include further information on national measures, including on procedures and corresponding information flows, triggers, and conditions for their application (in particular for non-market-based measures).

Infrastructure needs have been adequately assessed based on the Gas Security of Supply Regulation and TEN-E Regulation. The evolution of the infrastructure standard of the Gas Security of Supply Regulation, in particular the N-1 requirement[136], has shown significant improvement since the Regulation entered into force (see section 3.2). Until revision of the TEN-E Regulation, each project of common interest (PCI) process had to identify gas infrastructure needs, resulting in project specific assessments in order to establish the PCI list. Five Union lists were adopted[137], always containing crucial infrastructure projects for security of supply. In the Electricity Risk Preparedness Regulation, Article 5 only requires ENTSO-E to consider "*accidental hazards going beyond the N-1 security criterion*[138] *and exceptional contingencies"* in the identification of regional crisis scenarios. While the Regulation requires Member States to include in their RPPs "*information on related and necessary plans for developing the future grid that will help to cope with the consequences of identified electricity crisis scenarios*", several Member States did not do so. As part of the first RPPs cycle, the Commission requested more information on this point in 14 cases.

[136] The N – 1 formula describes the ability of the gas infrastructure to satisfy total gas demand in a Member State in case of a disruption of the single largest gas infrastructure during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years.

[137] Since 2014, the CEF programme has awarded Union co-funding worth €6.8 billion to infrastructure projects of common interest (PCIs) in the energy sector. Out of this, €1.6 billion were for 43 gas PCIs, 19 of which have already been commissioned.

[138] The System Operation Guideline (Commission Regulation (EU) 2017/1485) sets a N-1 criterion for electricity, by which "the elements remaining in operation within a TSO's control area after occurrence of a contingency are capable of accommodating the new operational situation without violating operational security limit".

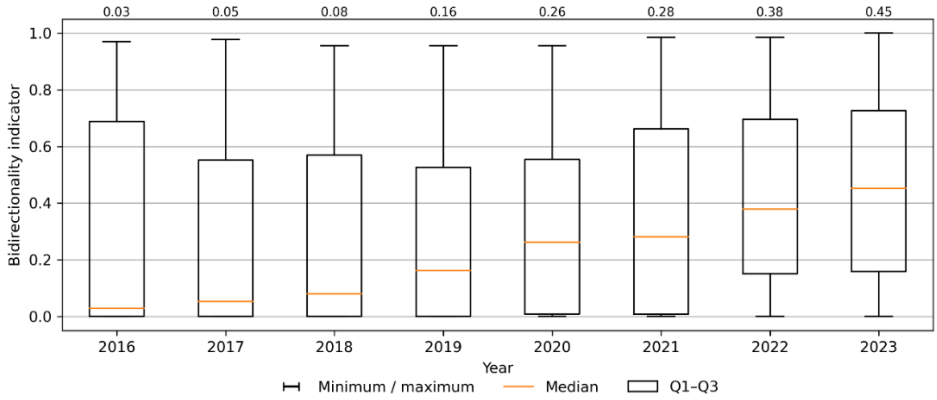
The ownership risks identified related to protection of critical energy infrastructure were inconclusive, particularly for gas.

- **For gas,** Member States were required (if relevant) to consider risks for the control of infrastructure in the updated national risk assessment (e.g. due to third country ownership). In only 5 out of 25 national risk assessments, the risk related to control of critical infrastructure was assessed, with no significant impacts identified. Assessing ownership risks has become increasingly important during the evaluation period since Gazprom's manipulation of EU gas storages (cf. chapter 3). Consequently, the EU introduced an obligation for Member States to certify their gas SSOs under the Gas Storage Regulation. There is currently no longer a direct risk stemming from ownership of storage facilities that could put the security of gas supply of the EU at immediate risk.[139] There are no such certification provisions for LNG terminal operators.
- **For electricity,** Member States assessed risks related to the ownership relevant to electricity security of supply and notified the Commission in January 2021. While no major risks were identified, the assessments did not sufficiently cover the generation sector as well as risks related to the ownership of relevant infrastructure in the gas sector, despite their importance for security of electricity supply.

The bi-directionality requirement was an instrumental measure of the Gas Security of Supply Regulation for preparedness. As Figure 27 shows, the median IP bi-directionality has increased steadily from 0.05 in 2017 to 0.45 in 2023. This has helped facilitating reverse flows during the energy crisis. When Russia cut gas supplies to the EU, flows had to be redirected for example from West to East, instead of the traditional East to West direction. This was precisely the objective of the bi-directionality requirement, adding necessary infrastructure flexibility in times of crisis. However, a legal uncertainty arose during the implementation period regarding the concept "permanent physical bi-directional capacity" concerning virtual interconnection points, following the decision from German authorities regarding Deutschneudorf EUGAL IP (cf. section "current state of implementation"). Conceptual clarification may be required in the future.

[139] This is confirmed by Commission reports reviewing the Storage Regulation COM(2023) 182, COM(2024) 89.

***Figure 27: Boxplot of bi-directionality of all borders inside the EU from 2016 to 2023***[140]




*Source: Commission's Joint Research Centre, based on ENTSOG capacity data*

While the EU would have arguably been worse-off without them, in retrospect the two Regulations displayed clear weaknesses regarding upfront preparedness for the 2021-2023 energy crisis.

- **In the gas sector**, despite the risk of Russian supply disruptions being recognised in most national risk assessments, the Regulation was not designed to mitigate prolonged supply disruptions from the EU's main supplier. Therefore, the regulatory framework had to be complemented with emergency measures to refill storages, reduce demand and improve the solidarity mechanism. The Regulation did not have the appropriate tools to prevent manipulation from Russian operators on the storage market, resulting in security of supply concerns and high prices due to historically low storage levels in Autumn 2021.
- **In the electricity sector,** the RPPs' scenarios proved to be too shallow, in particular regarding gas crisis spillover risk, with some Member States having to elaborate *ad hoc* scenarios or perform stress tests in the midst of the crisis.

To mitigate the impacts of the crisis, the EU complemented its security of gas supply framework, notably through the REPowerEU Plan of May 2022[141]. Building on the REPowerEU plan, the EU adopted the Gas Demand Reduction Regulation,[142] to reduce gas demand by 15%. Reducing gas demand was essential to preserve the delicate gas supply-demand balance amid the crisis. It is estimated that surpassing the objectives of the Gas Demand Reduction Regulation (18% demand reduction) allowed to replace 65 bcm of Russian gas in 2023 (cf.

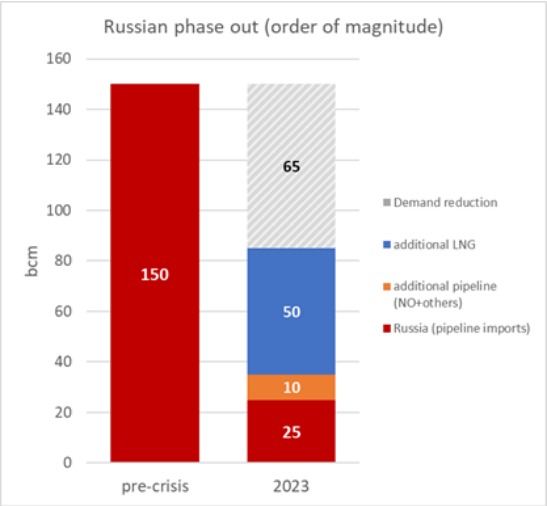
[140] The boxplot shows the degree of EU gas interconnections between MSs have capacities in both directions. If the indicator is 1, all interconnections would have the same capacity in both directions. If the indicator is 0, all interconnections could only flow one direction. The orange line is the median.

[141] COM(2022)230

[142] Regulation (EU) 2022/1369, prolonged for a year in March 2023 by Regulation (EU) 2023/706. In March 2024, the Regulation was replaced by Council Recommendation C/2024/2476.

figure below), thereby being the biggest contributor to phasing out Russian gas in 2023.[143] As further detailed in the reports[144] reviewing the Demand Reduction Regulation, the objectives of the Regulation were surpassed by a combination of policy driven, weather driven and price driven factors. As a result of this Regulation, Member States took measures to pro-actively reduce demand through communication campaigns to raise awareness of saving energy, introduce heating and cooling limitations in public buildings, facilitate fuel switching and electrification, prolonging lifespans of power plants to substitute gas for power consumption or subsidise energy efficiency.

***Figure 28: Russian pipeline gas phase-out progress 2023 vs. pre-crisis[145]***




*Source: European Commission, based on ENTSOG data*

After the adoption of the Storage Regulation, gas storage filling levels exceeded the 90% target. While storages were only filled until 77% by 1 November 2021 due to Gazprom not filling its EU storage facilities (see section 3.3), storage levels after adoption of the Storage Regulation reached record heights of 95% in 2022, 99% in 2023 and 95% in 2024. The measures taken by Member States highlighted in section 3.2, significantly contributed to storage filling, as were favourable market conditions in those years. This was instrumental to prepare the EU to face the winter season, when supplies from Russia were dwindling. In addition to the immediate security of supply benefits this had, full storages also helped to reassure the market and contributed to driving prices down.[146]

However, the fact that additional measures were needed to combat the energy crisis reflects the insufficiency of the Gas Security of Supply Regulation in tackling a protracted crisis of such a

[143] Further information on the functioning and effectiveness of the Demand Reduction Regulation can be found in the reports reviewing the Regulation COM(2024) 88, COM(2023) 173 and SWD(2023) 63.
[144] COM(2023) 173, SWD(2023) 63 and COM(2024) 88
[145] COM(2024) 88 final.
[146] See Commission Report COM(2024) 89, or ACER report which concluded that: "*Storage filling levels are significantly above last years' average and have contributed to driving prices down.*" https://www.acer.europa.eu/sites/default/files/documents/Publications/ACER_MMR_Key_Developments_Gas_2023.pdf

magnitude. The Gas Security of Supply Regulation was designed to tackle time-limited supply crises and was therefore not sufficiently effective in tackling prolonged disruptions of the EU's single largest supplier. However, combined with the effective implementation of the crisis measures through filling storages to over 90% and reducing demand by more than 15%, the supply disruptions from Russia did not lead to curtailments, meaning that with the framework in its entirety shortages were avoided.

**In the electricity sector**, the response was more focused on limiting price increases as the risks for supply were more limited than in gas. Council Regulation (EU) 2022/1854 on emergency interventions to address high energy prices also introduced measures to cut electricity demand however, through a binding demand reduction target of 5% during peak hours as well as an indicative one 10% monthly gross electricity consumption reduction, which had a positive effect on security of supply. While reporting Member States overall reached the former target, they faced more difficulties with the latter[147].

The EU's crisis management procedures are designed to mitigate high-impact low-probability emergencies. Due to the low likelihood, most crisis management procedures have never been applied in practice. However, several crisis levels have been declared throughout the implementation period[148], the majority of which during the energy crisis in 2022. While the activation of national crisis levels was generally well-coordinated via the GCG and ECG, several Member States considered the criteria for lowering crisis levels post-crisis unclear in the gas sector. For both gas and electricity there is an EU definition for crisis levels, but these definitions leave significant margin of discretion to Member States as they rely on when Member States introduce non-market-based measures (gas) or when an electricity shortage is considered significant (electricity)[149]. Until the Iberian incident of April 2025, no electricity crisis had been declared under the Risk Preparedness Regulation. During this incident, the Commission was notified of the crisis declaration in the afternoon, contacts at expert level started in the early moments of the incident, and the neighbouring Member States were informed.

The EU's crisis management procedures proved effective when tested in table-top exercises ('dry runs') for gas organised by the Commission in December 2022 and November 2024. However, the EU emergency level for gas security of supply was considered unclear during the 2022 exercise, in contrast to e.g. the EU alert that was established as part of the Demand Reduction Regulation, where the role of the Commission was more clearly defined. The identification of critical gas-fired power plants and the estimation of critical gas volumes for electricity differs per Member State, so the importance of aligning emergency response systems between gas and electricity was a key learning (e.g. ENTSOG's ReCo and the Regional

[147] COM(2023) 302 final.

[148] Gas: 13 Early Warnings, 2 Alerts and 1 emergency declared since 2017. Electricity: 4 Early warnings declared since 2019, no electricity crisis declared.

[149] As part of the RPPs exercise, the Commission requested additional information on definitions in 16 cases. See notably the report on the implementation of the Risk Preparedness Regulation for further details (COM(2025) 539 final).

Coordination Centre for electricity). It also showed the need to further clarify coordination procedures between critical infrastructure protection and energy security competent authorities and highlighted the importance of gas demand reduction measures to overcome a supply crisis.

The two dry runs organised in December 2022 and November 2024 tested the solidarity mechanism, which showed it is an adequate framework to activate a crisis response[150]. It also identified areas for that require further consideration:

(1) The 2022 exercise showed the complexity of establishing fair compensation for solidarity. This has been partially addressed through amendments introduced in 2024 by Article 84 of the Hydrogen and Gas Market Decarbonisation Package.
(2) There is a potential usefulness to incorporate LNG solidarity, as LNG can play a key role during a solidarity request through outreach to relevant LNG suppliers. However, legal tools to enforce redirecting LNG cargoes remains a challenge and it ultimately depends on contractual arrangements between concerned parties.
(3) The extension of solidarity to indirectly connected Member States on market-basis introduced in 2024[151] allows access to a larger and likely cheaper pool of solidarity. The effectiveness would benefit from a clearer identification of procedures and of actors responsible for collecting and transferring gas and clearer guidelines on monitoring actions taken before requesting solidarity.

By contrast, no such pan-European exercise has been organised for the electricity sector. However, the Risk Preparedness Regulation requires Member States to carry out biennial regional crisis exercises. Some regions have been active, performing exercises even before the Regulation came into force or performing the exercises on annual basis. Member States will have to describe the tests carried out and how their results have been included in updated risk preparedness plans (to be submitted in 2026), with Pentex 2023 as a recent example. The overall evaluation of the exercise was positive, and it was widely agreed among participants that the regular Penta exercises are beneficial for the preparation for regional crises. Electricity supply disruptions due to critical energy infrastructure damage related to physical and cyber-attacks was also considered in horizontal EU crisis management exercises such as EU Integrated Resolve Parallel and Coordinated Exercises (PACE). The latest example, PACE 2024, which is done in cooperation with NATO, considered simultaneous hybrid threats crises affecting critical energy infrastructure from several Member States. Other table-top exercises with NATO also address critical energy infrastructure resilience, including maritime infrastructure damage (gas pipelines, power cables and offshore wind farms). The Coherent Resilience 2023 – Baltic (CORE 23- B) that focused on the Baltics energy system is an illustrative case. Some Member States suggested that the Commission should organise EU-wide or regional electricity crisis exercises, mirroring the gas dry runs.

[150] Commission's press release: https://energy.ec.europa.eu/news/eus-energy-security-framework-successfully-tested-ensure-winter-preparedness-2024-11-08_en
[151] Introduced through the amendments of Article 84 of the Decarbonised Hydrogen and Gas Package.

This fitness check used a public consultation to corroborate the findings on effectiveness. The Gas Security of Supply Regulation received the following average grades in terms of meeting its objectives[152]:

a) 3.47/5 for the objective "*Secure an adequate level of preparedness in Europe for gas supply disruptions, e.g. through assessing risks and sufficient infrastructure*";
b) 3.18/5 for the objective "*Ensure that all necessary measures are taken to safeguard an uninterrupted supply of gas, in particular to protected customers*";
c) 3.43/5 for the objective "*Enhance regional and EU-wide cooperation, including in times of supply emergencies*".

The Electricity Risk Preparedness Regulation received the following average grades:
a) 3.19/5 for the objective "*Improving prevention and preparedness*";
b) 3.48/5 for the objective "*Improving transparency and information sharing*";
c) 3.27/5 for the objective "*Improving coordination in electricity crisis*";
d) 2.76/5 for the objective "*Reducing the risk of negative spillover effects that purely national measures could have in neighbouring Member States*".

These grades, although not representative of the EU population, show an overall satisfaction from responding citizens and stakeholders with the functioning of both Regulations. Yet, they also suggest that improvement is possible, in particular regarding objective b) of the Gas Security of Supply Regulation, and objective d) of the Electricity Risk-Preparedness Regulation. Overall, the level of satisfaction seems to be slightly lower for the latter.

#### *4.1.3. Efficiency*

This section assesses the efficiency of the EU's security of supply framework. It considers the costs needed to drive the benefits generated by the Regulations. It specifically looks at:

- The costs to develop infrastructure that are a direct result of the two Regulations.
- The administrative burden of the various reporting requirements, risk assessments and plans.
- The administrative burden and costs of the crisis management provisions, solidarity/assistance mechanism and the crisis measures.

This section also illustrates the benefits of a functional security of supply framework. The costs of past or potential future crises are used as a proxy for the benefits of avoiding such crises from happening.

An assessment of the efficiency of both Regulations reveals a mixed picture. While the direct financial costs associated with compliance for energy undertakings have been relatively contained, the administrative burden imposed on Competent Authorities by reporting

[152] The maximum grade possible was 5 (Excellent).

requirements and lengthy procedures has been significant, especially for national administrations. This is a finding shared both by stakeholders and Member States, as expressed through responses to the public consultation or bilateral exchanges, and by the Commission based on its experience with the implementation of the regulation. A mapping of the costs induced by the implementation of these Regulations is provided in Annex IV of this document. The main costs are linked to the development of infrastructure and to the various administrative costs (e.g., reporting requirements, enforcement costs, obligations to negotiate bilateral agreements, etc.). In the public consultation, some measures were praised for their low implementation costs combined with a large effectiveness, such as the two coordination groups.

As regards infrastructure, the main costs were borne to meet the Gas Security of Supply Regulation infrastructure requirements (N-1 and reverse flows). These costs were borne mainly by TSOs, often with the financial and regulatory support from the EU and public authorities (and thus indirectly by both consumers, network users and citizens), alleviating the exponential growth of transmission and storage tariffs. Assessing the exact costs linked to the fulfilment of these obligations is not possible because it would require isolating all infrastructure projects that were completed for security of supply purposes only, that are directly attributable to the Regulation (a share of them were undertaken also partly for market integration purposes). It is however possible to take projects as case studies (cf. Box 1), which gives an order of magnitude of the costs that may have been caused by these provisions. In the public consultation, when asked about the costs of the infrastructure obligations, the majority of respondents gave a grade of 1 (negligible) or 2 (low).

**BOX 1: TWO CASE STUDIES OF THE COSTS INDUCED BY THE GAS SOS REGULATION INFRASTRUCTURE REQUIREMENTS**

A CEF Action with significant externalities for security of supply was the Bilciurești underground gas storage (largest storage in Romania). It was confirmed during the CEF evaluation that the CEF Action would increase daily withdrawal capacity of the facility by over 40% and improve its overall capacity, mitigating risks of gas disruptions during peak consumption periods. The assessment confirmed security of supply benefits for Romania, Bulgaria, Hungary and Moldova. The project would improve the N-1 indicator from 106.3% to 114.6%. The project received CEF funding of 38 mln EUR, directly contributing to the implementation of the Gas Security of Supply Regulation.

Another example is the PCI project Estonia-Latvia gas interconnection enhancement. The Karksi project was supported with a CEF grant of 18.7 mln EUR (covering half of the total cost) to construct a gas metering station; a border valve and a bidirectional compressor station. The CEF grant provided to this PCI project allowed for bidirectional flows between Estonia and Latvia, as well as solidarity since the project's impact was identified for Estonia, Latvia, Finland and Lithuania. The implementation of the Karksi project was closely linked with the gas interconnector between Finland and Estonia ('Balticconnector') which ended Finland's gas isolation. The implementation of the project is directly attributable to the Gas

Security of Supply Regulation, as it followed Commission's Decision C(2020) 6600 requiring to review the exemption for this IP.

The benefits of having reverse flow capability have surpassed the costs of developing bi-directional capacities that are directly attributable to the Gas Security of Supply Regulation. First, the project cost of establishing reverse flow on existing pipelines is relatively low (EUR 5-15 mln) compared to the cost of pipeline or interconnection projects (hundreds of millions). Second, most reverse flow projects were built during the years following the 2008/09 crisis where significant EU funds were dedicated to it. Third, since the obligation is in place, any new pipeline or interconnection project needs to be able to allow flows in both directions by design, therefore the cost of reverse flow is included in the overall cost of those projects. The marginal cost of that ability is relatively limited.

A total of 23 reverse flow projects were identified in the ENTSOG Ten-Year Network Development Plans (TYNDP) that were carried since 2017, of which ten have been commissioned during the evaluation period. Other projects were cancelled, temporarily halted, or an exemption was granted. One project will be commissioned in 2028. Of the ten commissioned projects, six projects included a capital expenditure figure (CAPEX) in the TYNDP, which totals 286 mln EUR[153]. Other projects' CAPEX were either confidential, or not reported. Two of these reverse flow projects received CEF funding, namely the Karksi project described in Box 1 and the TENP reverse flow project, which received 8.7 mln EUR in support for procurement and execution of the works[154] and 0.4 mln EUR for studies[155]. It should be noted, however, that the costs of these projects cannot be solely attributed to the Gas Security of Supply Regulation, as some of the projects may also have been carried out for other reasons, such as market integration. Compared to the benefits of a flexible system in case of a supply disruption, these costs are reasonable. This is illustrated by the need to reverse the gas flows from West to East during the energy crisis of 2022, when supplies from Russia largely stopped.

However, the process to request an exemption from the obligation of enabling bi-directional flows[156] is cumbersome and imposes unnecessary administrative burden on energy utilities, national administrations, and EU institutions and agencies. This process requires TSOs to submit exemption requests to competent authorities, followed by consultations with national regulatory authorities, potentially affected Member States, ACER, and the Commission. Upon receiving the proposal or request, competent authorities must consult various stakeholders and allow them to issue opinions, which can prolong decision-making. The process could be simplified keeping in mind the objective of not compromising the integrity of the regulatory oversight, by deleting for instance the possibility for both ACER and the Commission to adopt

[153] Figure based on CAPEX figures reported for reverse flow or bidirectional capacity purposes in ENTSOG TYNDPs Annex A in 2018, 2020, 2022 and 2024, that were commissioned in between 2017 and 2024. See: https://www.entsog.eu/tyndp

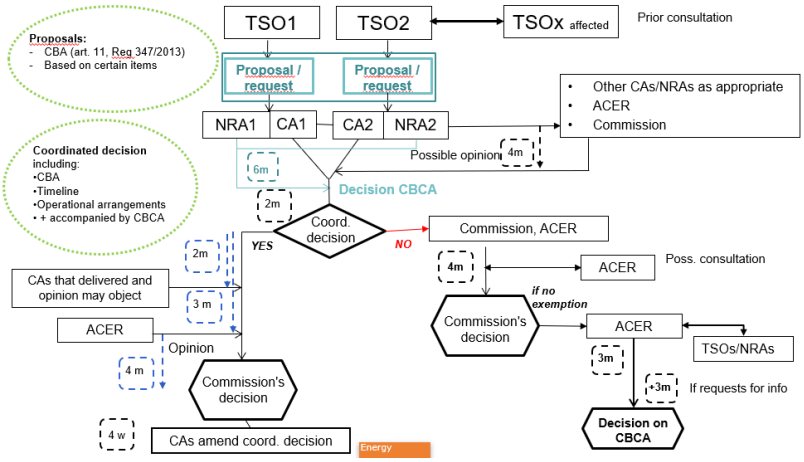
[154] See https://ec.europa.eu/energy/infrastructure/transparency_platform/map-viewer/main.html

[155] See: https://ec.europa.eu/assets/cinea/project_fiches/cef/cef_energy/5.10-0010-DE-S-M-15.pdf

[156] As outlined in Annex III of the Gas Security of Supply Regulation

a first opinion before the coordinated decision (paragraph 3 of Annex III of the Regulation), which was never used during the evaluation period.

***Figure 29: process to request exemption from the bi-directional capacity obligation***



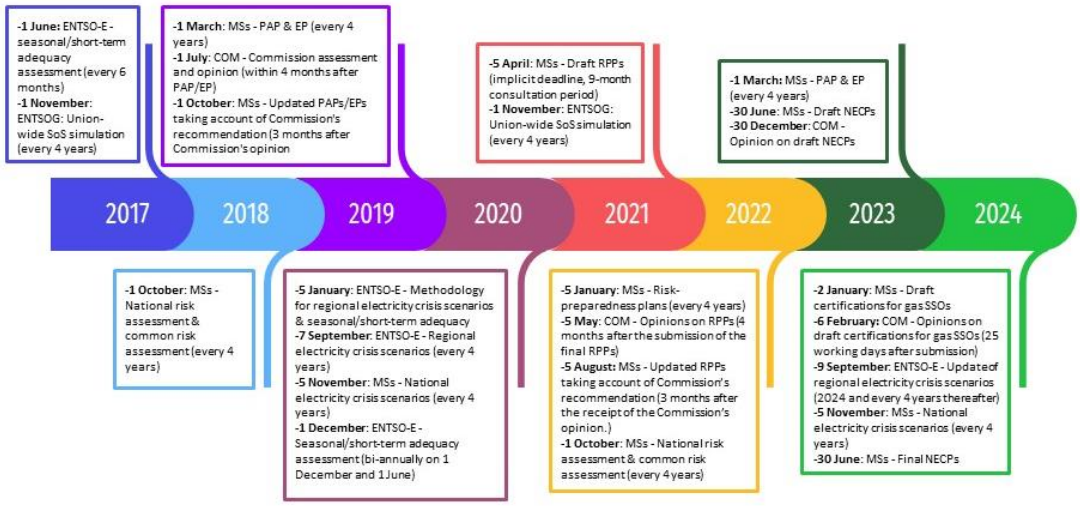

*Source: European Commission*

In fact, most of the provisions in both Regulations relate to planning and reporting, resulting in administrative costs. They are borne mostly by national administrations, as well as by the Commission, and more marginally by ACER, TSOs and ENTSOs. A mapping of these costs, with tentative estimations of the amounts based on data provided by Member States, ACER, ENTSOG and ENTSO-E, is provided in Annex IV.

The deadlines stemming from the Gas Security of Supply Regulation and Electricity Risk Preparedness Regulation lead to a logical sequence in deliverables. The sequence is based on first conducting simulations, followed by risk assessments, based on which plans are developed. The deadlines largely do not overlap, unless this is necessary to ensure consistency between deliverables (e.g. national and common risk assessments being delivered at the same time). However, deadlines proved difficult to comply with. In gas only one Common Risk Assessment (out 24) and 10 plans (out of 104) were delivered on time and in electricity two draft and 13 final RPPs (out of 28) were delivered on time. This is mainly due to reporting fatigue as well as to burdensome and inoperative procedures. Besides, the updates of the PAPs and EPs come shortly before the draft NECPs have to be issued, while the latter also include a mandatory section about energy security[157]. Overlaps are limited between the Plans and the NECPs, as they arguably cover different timeframes. In this regard, several Member States have adequate cross-references to their security of supply plans in their NECPs.

[157] In particular, according to the Governance regulation, Member States have to set national objectives with regard to: *"increasing the diversification of energy sources and supply from third countries (...); increasing the flexibility of the national energy system; and addressing constrained or interrupted supply of an energy source*".

*Figure 30: Timeline of reporting deadlines*




*Source: European Commission*

While the deadlines should not create unnecessary administrative burden, the number of deliverables leads to high administrative burden for national authorities. Member States may have to submit two versions of their electricity RPPs (original and updated) in addition to the exchange of drafts for consultation. For gas there are two risk assessments in addition to 2 sets of two plans and the drafts for consultation. Some of the information requirements in the various deliverables for gas also show duplication, for example regarding the N-1 calculation or the description of the regional gas system which are required in both the risk assessments and the PAPs. At the same time, the common risk assessments had to be developed for 12 regional risk groups, which has led to heavy duplication. The risk assessment of the Belarus risk group was merged with the North-Eastern risk group, while also the Norway and UK risk groups were merged to alleviate administrative burden. Given the high degree of interconnectedness of the EU's energy system, fewer regional risk groups would be justifiable to lower administrative burden on Member States. All electricity RPPs[158], as well as the gas PAPs and EPs[159], along with the corresponding Commission's opinions have been made publicly available in different languages.

These late submissions and a lack of administrative capacity were considered hurdles for assessing risks effectively, especially for the update of the gas risk assessments and plans due during the energy crisis. For this reason, to complete the risk assessments, the Commission's JRC had to carry out the modelling efforts for the majority of risk groups, which ordinarily should be done by Member States.

Regarding the solidarity/assistance provisions, the results achieved are not seen as commensurate with the efforts by some respondents to the public consultation. While time has

[158] See: Risk preparedness plans in the electricity sector by national competent authorities and Commission's opinions

[159] See: Commission's opinions on the preventive action plans and emergency plans

been invested by public authorities in the negotiations, only 9 gas solidarity agreements were reached (out of 40), and the results in electricity are also far from being satisfactory (cf. section about effectiveness). This issue was also highlighted by some respondents, while others also raised concerns regarding the clarity of defaults solidarity provisions, which may hinder their operationalisation. However, data sent by Member States regarding the costs of implementing various provisions of the Regulations did not point to a high additional workload due to negotiating solidarity agreements (see Annex IV). The difference between perception and time spent may indicate an inaccuracy in the data, or that there are '*hassle costs*', caused by frustration of spending time on a file that sees only marginal progress. It should be noted that the default solidarity rules adopted as part of the measures to combat the energy crisis via Regulation (EU) 2022/2576 and later via Regulation (EU) 2024/1789, lifted the obligation to conclude bilateral solidarity agreements, alleviating these costs.

Some of the measures adopted during the energy crisis are at times seen as expensive. This is notably the case of gas storage filling requirements. In the public consultation, the storage targets were the only measure where most respondents gave a grade of 4 (high) or 5 (very high) to the question about whether the provision had created disproportionate burden (e.g., administrative, financial or other). Market participants usually see this measure as particularly costly, and some highlight that forcing operators to fill storages regardless of market conditions, increases costs. This view is supported by an ACER study, which assessed that certain national measures in three Member States to establish strategic reserves cost €19 billion, with total cost of the 2022 injection season exceeding that by some margin[160]. The unprecedentedly high costs of this injection season were also partly offset by the volumes sold during withdrawal season, due to falling prices after summer 2022. However, these costs are also due to the exceptional circumstances of 2022/2023, with record high prices on the gas market, largely due to external circumstances. Drawing lessons from the implementation of the gas storage regulation, and taking into account evolving market conditions, the Commission published a recommendation[161] inviting Member States to consider current market conditions and introduce flexibility when storage facilities are being refilled in summer 2025, to optimise purchasing conditions. The extension of the Storage Regulation by two years came into force in September 2025[162], ensuring that there are additional flexibilities for Member States to meet the targets to alleviate any potentially high costs associated with storage filling.

In terms of overall distribution of costs of the Regulations, most of the burden lies on public administrations and TSOs. This was also recognized in the responses to the public consultation. One other marginal issue that was identified, specific to the electricity sector, is the lack of "*fairness*" requirements for the design of manual load-shedding plans. This may raise questions in terms of the social acceptability of those plans.

[160] See https://acer.europa.eu/sites/default/files/documents/Publications/VIS-Study_Gas_Storage_Report.pdf
[161] C/2025/1481
[162] Regulation (EU) 2025/1733

On the other hand, the benefits tied with the implementation of these Regulations are difficult to quantify. Security of supply functions as an insurance. This implies that there are always costs while the benefits are often never fully quantifiable, unless an actual supply disruption occurs. Therefore, making a rough assessment of the benefits requires to use proxies, such as past crises. Even if they use quantitative figures, such assessments need to be used with caution, and only in a qualitative manner, since each crisis is *sui generis*. It is generally recognised that the benefits linked to these Regulations outweigh the costs, because of the significant societal benefits (e.g., minimising forced energy supply cuts to citizens and industries).

In the past decades, several examples of energy crises have occurred. In the gas sector, the 2009 crisis following the Ukraine-Russia gas dispute gave a tangible flavour of potential consequences of a gas supply crisis in Europe. A 14-days complete cut of Russian gas along the Ukrainian corridor resulted in deep economic hardships in several European countries, with a collapse in industrial output and severe stress on power systems. For Bulgaria, which was among the most affected countries, a 30% shortage of gas supply for a month has been estimated to have led to a "*total GDP shortfall due to the cut was 0.35% of 2009 GDP, equivalent to a 9.1% GDP shortfall for the 14-day period of the disruption*"[163]. Similarly, preventing damage to critical energy infrastructure is a potential benefit of the EU's security of supply framework, as these incidents can create significant costs, as further detailed in Box 2.

**BOX 2: CASE STUDY – COST OF A PHYSICAL ATTACK ON ENERGY INFRASTRUCTURE**

The EstLink2 interconnector is a critical undersea cable linking Finland and Estonia with a capacity of 650 MW. It was disconnected from the grid on 26 January and on 25 December 2024, due to damage within the Finnish economic zone. The second disruption is considered part of a series of frequent incidents, possibly systematic attacks against critical infrastructure in the Baltic Sea.[164] The suspected vessel is sanctioned due to it being part of the Russian shadow fleet[165].

The Estonian authorities informed the Commission that the first damage of EstLink2 led to repairs for a 9 month-period, costing EUR 30 million. According to Estonian authorities, at the time the disruption had significantly impacted Estonian consumers due to higher prices, resulting in an additional cost of EUR 94 million. The second outage resulted in total repair costs of ca. EUR 50-60 million.

[163] See: https://www.fiw.ac.at/wp-content/uploads/2023/02/03.ResearchReport.Christie_etal.Vulnerability_and_Bargaining_Power_in_EU_Russia_Gas_Relations-1.pdf

[164] See: Joint Statement by the European Commission and the High Representative on the Investigation into Damaged Electricity and Data Cables in the Baltic Sea | EEAS

[165] The vessel Eagle S is sanctioned through Council Decision (CFSP) 2025/931 of 20 May 2025: Decision - CFSP - 2025/931 - EN - EUR-Lex

There have been several instances of crises with severe economic impacts on society in electricity as well. The 2016 Impact Assessment referred to cases summarised in Table 7, which illustrate the severity of such incidents within the EU. Evidence from outside the EU also illustrates the huge costs associated with severe energy supply disruptions. For example, a severe winter storm in Texas caused numerous electricity outages and over 200 deaths, partly because of outages of gas-fired power plants.[166] The cost was estimated to be $80 billion–$130 billion in direct and indirect economic loss, with estimates of more easy to quantify insured losses ranging between $10 billion to $20 billion.[167] It should be noted that this crisis occurred in a different socio-economic context, with different market rules and preventive measures in place, making a direct comparison with the EU challenging. Nevertheless, both EU examples that occurred pre-2016 and extra-EU examples provide case studies to illustrate the impact that supply disruptions can have, including in terms of major economic costs.

***Table 1: Overview of significant historical blackouts in Europe[168]***

| Country & Year | Number of end-consumers interrupted | Duration energy not served | Estimated costs to whole society |
|---|---|---|---|
| Sweden/Denmark, 2003 | 0.86 million (Sweden), 2.4 million (Denmark) | 2.1 hours, 18 GWh | EUR 145-180 million |
| France, 1999 | 1.4-3.5 million | 2 days – 2 weeks, 400 GWh | EUR 11.5 billion |
| Italy/Switzerland, 2003 | 55 million | 18 hours | |
| Sweden, 2005 | 0.7 million | 1 day – 5 weeks, 11 GWh | EUR 400 million |
| Central Europe, 2006 | 45 million | Less than 2 hours | |

*Source: SESAME*

More recently, on 28 April 2025, the EU was affected by a very severe blackout in the Iberian Peninsula. The blackout lasted 15 hours 25 minutes in Portugal and 18 hours 27 minutes in Spain. A total of 6.4 million and 44.6 million people were respectively affected.

There are tools to assess the costs of electricity crises too, as further illustrated in Box 3. The 'blackout' simulator, a software tool co-funded by the Commission, can estimate the economic loss associated with electricity blackouts. See Box 3 for further details.

**BOX 3: CASE STUDY - COST OF AN ELECTRICITY CRISIS**

The authors of blackout simulator, an online tool co-funded by the Commission[169], show a case study of the outage of 28 September 2003, in Italy[170]. The incident impacted all of Italy except for Sardinia. The duration of the blackout was 3, 9, 12 and 16 hours in the north of Italy, the centre of the country, the South, and Sicily respectively. The total economic losses were EUR 1.2 billion, equivalent to 0.08% of annual GDP.

[166] See Final Report on February 2021 Freeze Underscores Winterization Recommendations | Federal Energy Regulatory Commission
[167] See https://www.dallasfed.org/research/economics/2021/0415
[168] See 2016 Impact Assessment SWD(2016) 410 final.
[169] More information is provided in Annex II on methodology.
[170] See http://blackout-simulator.com/methodology.

For this report, the socio-economic impacts of a second historical black-out were simulated, namely a blackout that occurred in the Balearic Islands on 13 November 2008. The blackout was triggered by a lightning strike that hit the 260 MW power plant in Alcudia, resulting in a power outage that affected ca. 500,000 inhabitants for seven hours[171]. According to the simulator, the black-out would have resulted in 5.29 GWh of Energy Not Served (ENS), and in damage costs of EUR 38.48 million[172], which represents ca. 0.14% of annual GDP of the Balearic Islands in 2008[173]. These results indicate that, despite the relatively limited duration and small geographical area affected, the economic impacts of the blackout were substantial.

The importance of preventing gas supply crises is also illustrated by the price impacts of such energy crises. As highlighted in Figure 31, the supply cuts from Russia disturbed the supply-demand equilibrium significantly in 2022. While the market equilibrium was comparatively stable in 2022 with pre-crisis price levels at ca. 25 EUR/MWh in 2021[174], prices rose significantly directly after a series of Russian supply cuts, peaking in August 2022 at over 300 EUR/MWh. These record high wholesale gas prices in turn created price spikes in both the retail gas markets (negatively affecting e.g. households), as well as the wholesale electricity prices given that gas was the primary price setter for electricity, as shown in Figure 23. The effect of supply shocks on gas and electricity prices highlights the socio-economic consequences of such crises, which the security of supply framework aims to avoid. In contrast, the high prices resulting from Russia's weaponisation of gas supplies also highlights that the security of supply framework was not sufficient to shield EU citizens and industries from gas supply shocks.

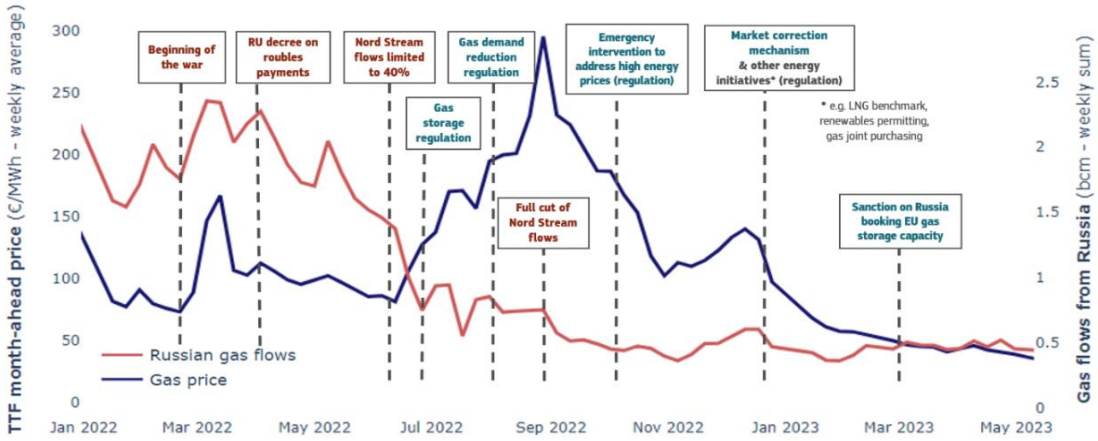
[171] https://www.elmundo.es/elmundo/2008/11/19/baleares/1227133309.html & https://www.elconfidencial.com/mundo/2008-11-13/el-apagon-ha-afectado-a-574-000-clientes-de-mallorca-y-menorca_933339/

[172] The results are roughly adjusted for inflation, by using an average annual rate of 2%.

[173] See Annex II for more information on the methodology

[174] TTF Day Ahead in January 2021 – June 2021. This period is chosen because from July 2021 onwards prices started to rise due to low gas storage levels because of a lack of storage filling by Gazprom.

***Figure 31: price impacts of Russian gas supply disruptions in 2022***




*Source: Commission, based on S&P Global Platts and ENTSOG Transparency Platform*

The prevention of such energy crises would be a benefit of the EU's security of supply framework but it is difficult to establish causality between the Regulations and the prevention of such crises. This is exacerbated by the 'preparedness-paradox', meaning that it is impossible to know which crises have been prevented by the Regulations, since they have not occurred in practice. Overall, however, it can be argued that the potential benefits of these Regulations and preventing potentially devastating crises substantially outweigh the costs, and that the interventions improve social welfare. However, there is scope to decrease administrative burden (e.g., simplifying administrative procedures and reporting obligations, reducing the regional risk groups) and thus to improve the cost-benefit balance.

### *4.1.4. Coherence*

In line with the Better Regulation toolbox, the coherence criterion assesses the consistency within and across the different provisions in the Gas Security of Supply Regulation and the Electricity Risk-Preparedness Regulation. To this end, this section analyses:

- Internal coherence, i.e. the coherence between different measures (a) within a single Regulation, and (b) within the security of supply framework as a whole
- External coherence, i.e. the coherence between the evaluated Regulation and other Regulations, both from (a) the EU energy acquis and (b) beyond.

*Internal coherence (within the regulations per se)*

No significant internal incoherence was detected in the Electricity Risk-Preparedness Regulation, nor in the Gas Security of Supply Regulation. The various measures within the two Regulations work well together and follow a logical sequence, as was further elaborated in section 4.1.3.

The only incoherence detected for gas, is that the Crisis Management Group and the Gas Coordination Group may overlap. While the Crisis Management Group should consist of the crisis managers assigned in Member States' Emergency Plans and should only be active during an emergency, in practice they will mostly consist of similar representatives as the GCG which operates in pre-emergency. The GCG was instrumental in addressing the energy crisis and has been a widely appreciated forum, as supported by several responses to the public consultation. Therefore, there is room either for simplification or clarification as regards the role of the Crisis Management Group.

*Internal coherence (within the security of supply framework)*

The Regulations were largely coherent with one another and were mostly aligned with the EU's wider policy objective. The Electricity Risk-Preparedness Regulation and Gas Security of Supply Regulation were designed in a similar way; they both follow a risk-based approach using risk assessment and plans, transparency and cooperation is fostered through coordination groups, while they both have crisis management provisions containing crisis levels and emergency cooperation procedures.

Furthermore, the Gas Security of Supply Regulation is also largely coherent with the crisis measures adopted in 2022. The crisis measures aimed to tackle the Russian gas supply cuts in 2022 and were specifically designed to complement shortcomings of the Regulation. While the Gas Security of Supply Regulation was well equipped to deal with short-term and smaller scale supply cuts, it was not designed to tackle prolonged and full supply cuts from the EU's biggest gas supplier. As two Commission reports show[175], the 90% storage target could only be met through continued subdued gas demand due to reduced Russian supplies. The necessity of reducing demand by 15% to reach the storage target and avoid demand curtailment in case of a Russian supply disruption was also stressed by ENTSOG, for example in ENTSOG's Winter Supply Outlook 2024[176]. While the storage and demand reduction targets aimed to address immediate security of supply concerns, the default solidarity provisions introduced by Regulation (EU) 2022/2576 ensured that if these targets were not sufficient, the crisis management mechanisms would be operational to address a severe emergency.

However, this fitness checks identifies a number of areas where coherence can be improved, most notably:

1. The definitions of 'protected customers';
2. The frameworks for gas storage and electricity storage;

[175] COM(2023) 173 and COM(2024) 88.

[176] *"In case of full disruption of Russian pipeline supplies during winter, additional measures might be needed to save significant volumes of the gas for the end of the season, and to avoid risk of demand curtailment in case of cold winter and peak demand situations. Simulation results showed that the introduction of possible measures, such as enhanced capacities, additional supplies, and a 15% decrease in gas demand, would avoid demand curtailment risks and allow for reaching an adequate storage level."* See: https://www.entsog.eu/sites/default/files/2023-10/SO0052-23_Winter%20Supply%20Outlook%202023-24%20with%20Summer%202024%20Overview.pdf

3. The coherence between gas supply standards and gas storage targets.

The coherence between the two legislations can be further improved by aligning the concepts of "protected customers" and "special protection against disconnection". Protected customers are defined in the Gas Security of Supply Regulation at EU level and include households, and under certain conditions district heating, essential social services and SMEs[177]. The objective is to protect a critical energy need (heating), as well as protect consumers who do not have the possibility to negotiate their security of supply conditions (e.g. households). In the Electricity Risk-Preparedness Regulation, 'users entitled to special protection against disconnection' are defined nationally to protect public safety and personal security, which usually include consumers in e.g. the transport, health, and public security sectors, in line with Commission Recommendation (EU) 2020/775. While there are reasons for this difference stemming from the differences in the management of gas and electricity grids, there is a risk that both concepts could become un-operational in case of a cross-sectoral or cascading crisis. For example, gas boilers in households need electricity to function, meaning that misalignment may result in lower overall protection of households. The fact that households do not necessarily qualify as 'protected customers' in electricity, while they do in gas, could arguably constitute a hurdle to electrification in the longer term. Customers may feel less protected and could be more reluctant to change. Similarly, it should be noted that there is no mandatory supply standard in electricity legislation.

The coherence between the frameworks on gas storage and electricity storage could be improved. While the former is an already existing security of supply tool of EU energy policy, the latter is less regulated at EU-level. However, the solutions to store electricity (e.g., batteries, thermal storage, hydrogen) are developing fast and will be essential for the reliability and stability of the future energy system. Electricity storage is crucial to manage peak loads and integrate variable renewables e.g. during 'dunkelflaute' events such as the ones in November and December 2024[178]. The Commission estimated in 2023 that "*the need for flexibility in the electricity system will increase significantly in all Member States, reaching 24 % (288 TWh) of total electricity EU demand in 2030 and 30 % (2 189 TWh) by 2050 across all timescales*"[179]. The new Electricity Market Design introduced an obligation for Member States to perform a national assessment of flexibility needs, based on an EU methodology, and to set an indicative national objective for non-fossil flexibility (including energy storage). In the public

[177] Essential social services, district heating and SMEs can be included, provided that they do not jointly represent more than 20 % of annual gas consumption in a Member State. SMEs are excluded from the category of 'solidarity protected customers', which are the consumers that are eligible to receive solidarity volumes during an emergency.

[178] IEA report of 2025 included a case study on dunkelflaute events, temporary periods with reduced wind and solar PV generation, stressing the importance of having sufficient flexibility measures, such as dispatchable capacity, (long-term) storage, as well as demand-side flexibility and interconnections: https://iea.blob.core.windows.net/assets/0f028d5f-26b1-47ca-ad2a-5ca3103d070a/Electricity2025.pdf

[179] SWD(2023) 57 final.

consultation, some participants called for a more unified energy storage policy, defining storage needs for security of supply adapted to end user consumption, irrespective of the energy carrier.

There is also a certain overlap between the supply standard and the 90% gas storage target adopted in 2022[180]. The supply standard and storage target lead to similar outcomes, namely that sufficient gas volumes are available to ensure security of supply during challenging times. Storage booking is one of the main options available to energy undertakings to comply with the supply standard. The layer of storage filling obligations had to be added because of the severity of the crisis in 2022. While they are not inconsistent with one another, there may be scope for alignment and simplification.

The views of the participants to the public consultation were varied when asked about whether inconsistencies had arisen in the recent years between the two Regulations. Around 30% of the respondents answered "yes", 20% answered "no", while around half of the respondents did not express any opinion. Participants notably stressed that interdependence between the gas and electricity sectors was insufficiently addressed in the existing Regulations, and that an increased focus on cross-sectoral integration would create a more cohesive and efficient energy system. Integrated risk assessments, harmonised crisis declaration procedures, and cross-sectoral exercises were notably mentioned as possible areas for improvement. Participants also stressed that the analysis of critical gas volumes within electricity adequacy outlooks was an improvement to build cross-sectoral scenarios. The Commission has also raised the insufficient coordination between gas and electricity measures in several opinions on national gas and electricity plans (e.g. insufficient assessment of spillover effects of a gas crisis in the electricity sector or the justification of why that assessment would not be relevant).

When asked about potential policy areas where synergies between the electricity and gas security of supply frameworks can be sought, respondents predominantly answered "yes" to all proposed options (cf. Figure 32). This tends to show that there is a perception among respondents to the public consultation that the complementarities between the two frameworks could be improved. The policy areas that received most support in this regard were the plans and the risk assessments/scenarios.

[180] In June 2025, a political agreement was reached to extend the Gas Storage Regulation until 2027.

***Figure 32: Public consultation: answers to question on the potential areas where synergies between gas and electricity framework could be improved***

*Source: DG ENER, based on public consultation responses*[181]

<u>*External coherence (other energy legislation)*</u>

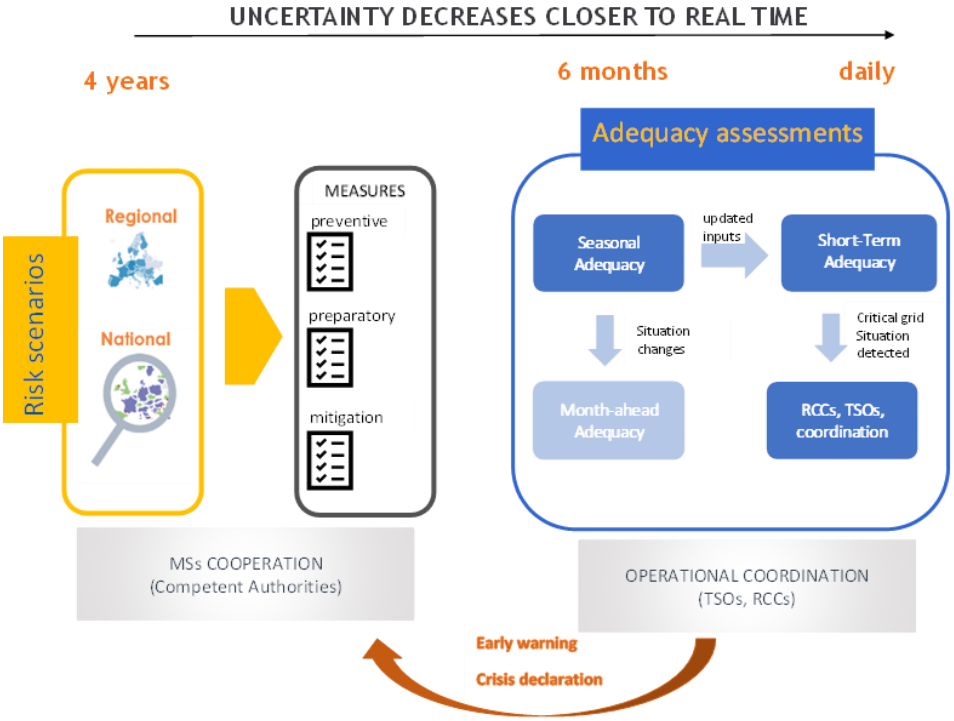
While there are clear interactions between the Risk Preparedness Regulation and the Electricity Regulation, there is limited overlap between the two. The Electricity Regulation looks at medium-to-long term adequacy (up to 10 years ahead) of the electricity system and provides a framework for Member States to be able to introduce schemes to procure capacity for security of supply ('capacity mechanisms'). By contrast the Risk Preparedness Regulation focuses on short-term adequacy ('seasonal outlooks') and the measures that can be taken to tackle imminent electricity crises.

However, for example ACER argued that there is room to strengthen the complementarity between the two frameworks. In its 2023 report on security of electricity supply, ACER recommended "*exploring synergies between the two frameworks, i.e., Electricity Regulation and the Risk Preparedness Regulation, informed inter alia by early lessons drawn from the energy crisis. Such synergies may in turn illustrate the utility or otherwise of further guidance on the types of measures that could be introduced under the latter framework*"[182]. Some participants to the public consultation also expressed concerns regarding the lack of attention to long-term electricity security of supply in the Risk Preparedness Regulation.

[181]See: https://eepublicdownloads.entsoe.eu/clean-documents/SOC%20documents/Nordic/Nordic%20SOA_Annex%20OS.pdf

[182]See:https://acer.europa.eu/sites/default/files/documents/Publications/Security_of_EU_electricity_supply_2023.pdf

***Figure 33: visual representation of Risk Preparedness Regulation interaction with System Operation Guidelines and Emergency and Restoration Network Code***




*Source: European Commission*

Other electricity-specific regulations that have interactions with security of supply notably include the System Operation Guidelines and the Emergency and Restoration network code. In the public consultation, some participants highlighted the unclear links between the two frameworks as a potential loss of effectiveness. However, a cautious assessment tends to show limited overlap. Recital 5 of the Risk Preparedness Regulation asserts that the two network codes are *"a detailed rulebook governing how transmission system operators and other relevant stakeholders should act and cooperate to ensure system security (…) [to] ensure that most electricity incidents are dealt with effectively at operational level".* By contrast, the Risk Preparedness Regulation deals with events with larger scale and impact, for which operational rules no longer suffice, and should fully respect operational rules even in times of electricity crisis. In fact, no inconsistency was experienced during the implementation.

The EU framework on security of electricity and gas supply and energy infrastructure complement each other by ensuring a secure and interconnected energy system. While the TEN-E Regulation supports the development of cross-border energy infrastructure projects to strengthen security of supply, the EU security of electricity and gas supply framework oversees security of supply at Union level and strengthens emergency preparedness.

The Electricity Risk Preparedness Regulation requires Member States to "*include information on related and necessary plans for developing the future grid*" (even if the first RPPs contained little information on this aspect) and ECG to discuss the results of Ten-Year Network

development plan (TYNDP). This is meant to ensure a forward-looking approach to security of supply at EU level. Also, under the TEN-E Regulation[183], "*security of supply*" is included as a specific criterion for the assessment of Projects of Common Interest (PCIs) and Projects of Mutual Interest (PMIs). Supporting such projects – particularly through CEF funding for infrastructure such as interconnectors – strengthens cross-border networks and enhances the security of electricity supply. Article 4 of TEN-E Regulation, which provides general definitions of the "security of supply" criterion for each infrastructure category, notably refers to LOLE indicator. The methodology for assessing electricity projects' contribution to security of supply developed by ENTSO-E in the guidelines for cost-benefit analyses of grid development projects explicitly includes EENS as an indicator. Hence, both Regulations are consistent in their approaches to assess electricity security of supply.

The synergy between the Gas Security of Supply Regulation and the previous version of the TEN-E Regulation was evident until the latter's update in 2022. The Gas Security of Supply Regulation's emphasis on resilient and diversified infrastructure was reinforced by the TEN-E Regulation, granting them highest national priority status and ensuring their inclusion in national network development plans. The European Grids Package proposed on 10 December aims at accelerating the development of grids and other physical infrastructure, while strengthening the security and resilience of cross-border infrastructure. In addition, the TEN-E framework provides regulatory support, guidance on cross-border cost allocation and risk-sharing, and access to CEF funding, thereby enabling the timely development of key energy infrastructure projects. These projects contributed to N-1 and reverse flow standards outlined in the Gas Security of Supply Regulation. However, the current TEN-E framework no longer covers natural gas infrastructure development. Some respondents to the public consultation highlighted this as an inconsistency. While being consistent with the EU's decarbonisation commitments, it makes fulfilling the N-1 indicator more difficult.

*External coherence (other policy areas)*

Both Regulations are coherent with wider EU policy objectives, in particular with the Green Deal and ensuring European competitiveness. The energy crisis showed that without securing the availability of sufficient energy supplies, the competitiveness of the EU is at risk, as also emphasised by the Draghi Report[184]. On this basis, the Commission's Competitiveness Compass[185] has introduced security as one of the three pillars for the Commissions' upcoming activities. As such, security, and energy security more specifically, will be a key element that will be considered in the future Commission activities as announced in the Clean Industrial Deal and Affordable Energy Action Plan.

[183] Regulation (EU) 2022/869.

[184] See: https://commission.europa.eu/document/download/ec1409c1-d4b4-4882-8bdd-3519f86bbb92_en?filename=The%20future%20of%20European%20competitiveness_%20In-depth%20analysis%20and%20recommendations_0.pdf

[185] See: 10017eb1-4722-4333-add2-e0ed18105a34_en

Similarly, the energy transition and energy security are two sides of the same coin. Energy security is needed to facilitate an orderly phase out of fossil fuels and to ensure public acceptance of the energy transition. However, specific provisions of the Gas Security of Supply Regulation may require adaptation to ensure it stays aligned with the EU's climate objectives and to avoid a carbon lock-in. This includes in particular the infrastructure standard and the gas storage target (as further outlined in section 4.3.2.).

Both the evaluated Regulations are coherent with wider EU crisis response mechanisms, notably the EU Civil Protection Mechanism and the Commission's Emergency Response Coordination Centre (ERCC). While the measures in the Electricity Risk-Preparedness Regulation and Gas Security of Supply Regulation are aimed at mitigating root causes of an energy crisis, the ERCC focuses on providing instant (humanitarian, financial or other) relief. The ERCC has to be notified by Member States in case of a declaration of national gas emergency, while the Risk Preparedness Regulation clearly states that the actions for risk prevention, preparedness and planning should be consistent with the risk assessments required under the Union Civil Protection Mechanism.

Both evaluated Regulations are coherent with the EU's wider security and resilience policy. The Gas Security of Supply Regulation includes risk assessments that consider relevant risk factors such as natural disasters, technological, political and other risks. Likewise, the Risk-Preparedness Regulation establishes a methodology for the identification of electricity crisis scenarios based on, among others, risks such as rare and extreme natural events and malicious attacks. The Directive on the Resilience of Critical Entities[186] (CER Directive) is the main piece of EU legislation enhancing the resilience of the operations of critical infrastructure protection, including energy sector infrastructure. The Directive explicitly states that Member States must take into account in their risk assessments other risk assessments carried out in accordance with the requirements of relevant sector-specific legislation. This includes the Gas Security of Supply Regulation and the Risk-Preparedness Regulation, ensuring overall coherence between the frameworks. The CER Directive is in the early stages of implementation[187] and therefore it is yet not possible to assess more concretely the synergies with the energy security framework. Regarding the predecessor of the CER Directive, the European Critical Infrastructure Directive[188] no inconsistency had been detected.

The protection of infrastructure also expanded to the digital space. The EU aims for an energy system that is smarter and more interactive than it is today[189]. This implies a different way of managing the network, relying on more real-time data access and exchange as well as digital technologies. The electrification of end-use sectors, and the more pro-active role that electricity consumers will play in the electricity system, will add many new stakeholders and consequently new entry points for cybersecurity concerns. The digitalisation of the energy system can deliver

[186] Directive (EU) 2022/2557
[187] Most Member States are still in the process of transposing the Directive into national legislation, despite the deadline having passed in October 2024.
[188] Directive 2008/114/EC
[189] See notably the EU Action plan for Digitalising the energy system (COM(2022) 552 final).

a strong contribution to energy security and climate goals but also brings new cybersecurity challenges for EU energy infrastructure.

For the energy sector, the NIS2 Directive[190], covers electricity, district heating and cooling, oil, gas and hydrogen. This includes notably to take all appropriate and proportionate measures to manage the risks posed to the network and information systems that they use for their services, including in relation to their supply chain and to report significant incidents under this Directive. The NIS2 Directive also provides an empowerment for the Commission to adopt implementing acts among other further introducing sectorial requirements. In addition, the Regulation on horizontal cybersecurity requirements for products with digital elements, known as the Cyber Resilience Act, bolsters cybersecurity rules to ensure a more secure hard- and software.

The Network Code on sector specific rules for cybersecurity aspects of cross-border electricity flows[191] builds on the above-mentioned horizontal EU cybersecurity framework. This Network Code entered into force 13 June 2024 and includes rules on common minimum requirements, planning, monitoring, reporting and crisis management. This network code is fully compatible with the horizontal framework and intends to make efficient use of existing reporting obligations. As a rule, the scope of application is aligned with the NIS2 Directive but the Network Code could also include entities that might not fall within the size-cap criteria of the Directive, while being critical or important for electricity. For the gas sector, the amendments to the Gas Security of Supply Regulation introduced by Regulation (EU) 2024/1789 include an empowerment to adopt network codes establishing gas sector-specific cybersecurity rules for cross-border gas flows.

Critical raw materials (CRMs) are indispensable for the EU's clean energy transition, especially for key technologies such as wind turbines, solar panels, and batteries. Their secure and sustainable supply is critical to achieve the EU's climate and energy targets. The EU Critical Raw Materials Act (CRMA) aims to diversify sourcing, boost domestic production, and promote recycling of CRMs to reduce dependency on third countries. The CRMA complements the EU's security of supply framework, as the framework for security of electricity and gas supply underpins the stability of the EU energy system, while the CRMA secures the materials needed for the medium- and long-term development of clean energy infrastructure. Critical raw materials will be increasingly relevant for the future energy system, as will be discussed in section 4.3.2.

## 4.2. How did EU action make a difference and to whom?

The EU-level actions were successful in achieving EU-level coordination, increasing transparency among Member States and jointly addressing risks. This has been demonstrated in particular during the energy crisis of 2021-2023, where measures to address unilateral supply

[190] Directive (EU) 2022/2555 on measures for a high common level of cybersecurity across the Union.
[191] Commission delegated regulation (EU) 2024/1366.

cuts from Russia have been coordinated in a unified way. Coordination through EU-level fora such as the TTE Council, the ECG and GCG proved to be valuable tools and were praised as such in the public consultation answers.

The 2016 Commission's proposal for the Security of Gas Supply Regulation argued that the necessity of EU action was based on:

i. "*The increasing interconnection of the EU gas markets and the 'corridor' approach for enabling the reverse flows on gas interconnectors call for interconnected measures*";
ii. "*Without such coordination, national security of supply measures are likely to adversely affect other Member States or the security of supply at EU level*";
iii. "*The risk of a major disruption of gas supplies to the EU is not restricted to national boundaries and could affect several Member States, whether directly or indirectly*";
iv. "*National approaches both result in sub-optimal measures and aggravate the impact of a crisis*".

Respondents to the public consultation largely agreed that the 2021-2023 energy crisis had confirmed these statements. Some respondents also highlighted that the emergency measures were a demonstration of the need for EU-wide measures to avoid sub-optimal national uncoordinated measures. Both Regulations clearly improved cross-border cooperation. Both Regulations allowed, for example, better identification of regional supply risks and create a shared understanding of security of supply across regions.

In electricity, this was achieved through the two assessments of regional crisis scenarios performed by ENTSO-E, and on which national crisis scenarios had to be based. The exercise was further refined throughout the implementation period, thanks to an update of the methodology, which led to a closer involvement of RCCs for the identification cross-border risks and to more emphasis on simulations at regional level. The improvement of the second regional crisis scenario report was recognised by Member States.

Thanks to the Gas Security of Supply Regulation, Member States developed Common Risk Assessments in regional risk groups. In this framework, Member States jointly assessed relevant risk factors which could lead to the materialisation of a major transnational risk, including disruption of gas supply from the single largest supplier.

Nevertheless, some shortcomings still persist:

- The methodology used for regional electricity crisis scenarios assessment lacked early top-down consistency checks to ensure full consideration of regional aspects.
- The governance structure of regional risk groups in gas is weak. No Member State volunteered to coordinate the North-Eastern risk group, while the Commission's Joint Research Centre had to provide extensive support to multiple groups.

The level of cross-border cooperation was spurred by the pivotal role played by the ECG and the GCG, especially during crises. This is embodied by the dramatic increase of the number of

ECG and GCG meetings during the last years. In its 2022/2023 winter outlook, ENTSO-E asserted that "*cross-border cooperation and close coordination at all levels [would] be key this winter to ensure that the European power system maintains its balance between supply and demand*", stressing the importance of the two coordination groups[192]. Both the GCG and the ECG proved valuable a in case of crisis situations, as the declaration of crisis levels and their reasons were immediately shared and discussed within the groups.

However, in the public consultation, some participants raised the over-reliance of the Risk Preparedness Regulation on national measures. They argued that, by prioritising national plans, the Regulation may inadvertently encourage Member States to overly rely on national measures, hampering regional cooperation. However, many Member States wanted to retain a degree of decision on what severe risks are and whether to protect certain categories of consumers (e.g. risk appetite). Nevertheless, promoting regional plans by Member States (in particular smaller ones) could be explored instead of national ones.

The two Regulations provided a first framework to operationalise the energy solidarity principle in case of emergencies, but implementation did not meet expectations. In gas, only 9 solidarity agreements out of the 40 required have been signed at the time of writing, and when Russia launched its full-scale invasion of Ukraine, there were only three in place. Consequently, emergency cooperation was not operational until default solidarity agreements were introduced by the Solidarity Regulation and later by the Hydrogen and Gas Market Decarbonisation Package. In electricity, where it is referred to as cooperation and assistance, the situation is similar though the Regulation is more recent. The information about regional and bilateral measures to cooperate in the prevention or management of a crisis was deemed incomplete in RPPs: only 9 Member States referred to existing arrangements and had identified measures (even if not complete enough).

However, even if solidarity and assistance provisions were never triggered, they are largely recognised as necessary and useful. Participants of the two "dry run" exercises of 2022 and 2024 concluded that having an operational solidarity framework was necessary in case of a crisis. However, respondents to the public consultation pointed that implementation barriers were experienced, due to e.g. operational complexity. In electricity, there has not been any similar testing of the provisions at EU level (it was not mandatory). However, some areas for improvement of the regulatory framework have been identified during the workshops held at the ECG. In particular, there have been complaints about mandatory 'financial agreements', which was considered too restrictive, as some Member States would prefer non-financial ones. An approach based on wider "economic" agreements could offer more flexibility.

The two "dry run" exercises of 2022 and 2024 represent an important and tangible example of EU added value, in terms of coordination and cooperation. It is instrumental to ensure that non-market-based measures implemented by individual Member States do not have an undue effect on the functioning of the market and do not deteriorate the security of gas supply situation in

[192] See: Winter Outlook 2022-2023_Report.pdf

other Member States. Currently, there are no specific provisions in the Gas Security of Supply Regulation for organising such exercises, but Member States welcomed both exercises and called for the Commission to organise such EU-wide security of gas supply "dry run" exercise every two years.

The framework was arguably successful in preventing cross-border restrictions. This is an important result from an EU perspective, as restrictive national measures can worsen security of supply tensions and are detrimental for building trust between Member States. Continued cooperation, especially during crises, is crucial to reduce the negative impact on the EU's collective welfare and citizens' well-being. Cooperation can help to share the burden and thereby avoid curtailment of the most vulnerable in society. An example of a cross-border restriction occurred in January 2017, before the adoption of the two evaluated Regulations, when Bulgaria imposed a long-term export ban on electricity, leading to substantial price increases on power markets in Greece and Romania[193]. During the implementation period, and while the EU faced one of the most severe energy crises in its history, no Member States implemented measures restricting cross-border trade. For gas, the Solidarity Regulation strengthened the role of the Commission to lift undue cross-border restrictions imposed by Member States on cross-border flows during a crisis, a provision that was praised by participants during the dry run in 2022.

However, in October 2022 Germany introduced a gas neutrality charge to refinance costs incurred when filling gas storages to meet the filling obligations. This levy was charged at all cross-border points and thus had a substantial impact on cross-border gas flows and was harmful for the internal market and the EU security of gas supply. It proved an obstacle to phasing out Russian pipeline gas, as alternative routes for Member States from the Central and Eastern Europe region became more expensive. In this case, the framework proved to be insufficient in preventing and resolving the situation, even if the neutrality charge is not active anymore since 1 January 2025.[194] This may partly explain why, in the public consultation, the performance of the Gas Security of Supply Regulation was deemed the least effective on the objective: "*Enhance regional and EU-wide cooperation, even in times of crisis*" (even if it should be noted that the feedback was still positive, overall).

To combat the 2021-2023 energy crisis, the EU also adopted crisis measures which were more effective to address cross-border risks compared to individual actions from Member States. For example, a 15% gas demand reduction target at EU level, rather than at national level, ensured that demand could be reduced where it was most efficient. Consequently, a wide variety of results between Member States was observed (ranging from -42% in Denmark to +7% in Malta), reflecting different consumption patterns between Member States while not hampering the achievement of the result at the EU-level (demand was cut by 18% between August 2022

[193] See: Managing Critical Grid Situations – a Market Analysis

[194] On 23 December 2024 Germany adopted the "*Drittes Gesetz zur Änderung des Energiewirtschaftsgesetzes*" amending §35e[194] of the "Energiewirtschaftsgesetz", as published on BGBl. 2024 I Nr. 448 vom 30.12.2024. It determines that from 1 Jan 2025 the gas neutrality charge will no longer be levied at cross-border exit points. Therefore, the addressed concern has been solved.

and December 2024, compared to the 5-year reference, saving ca. 176 bcm of gas).[195] Besides, the Storage Regulation included a burden sharing mechanism, obliging that Member States without storage facilities contribute to filling the storages of Member States with storage facilities. This contributed to make the EU response to the crisis more efficient, compared to national and uncoordinated measures.[196]

The two Regulations contributed to improve transparency and information-sharing among Member States and market actors. This was confirmed by the public consultation, with "*Improving transparency and information sharing*" being the objective where respondents rated the Risk Preparedness Regulation highest. The Regulations established 27 PAPs and EPs (with the United Kingdom in 2019, and without Cyprus) and 28 RPPs (with Northern Ireland) that were consulted with domestic market participants and other Member States. For both gas and electricity, it is an obligation to share draft plans with other Member States, to provide them the opportunity to make comments. A three-day session of the ECG was organised to present and discuss the RPPs. The plans being publicly available is valuable for Member States and market participants, as they can now anticipate measures that could be implemented in a crisis. This is a significant contribution to meeting the policy objectives of improving transparency and information sharing.

The Gas Security of Supply Regulation has provisions to foster transparency and avoid security of supply risks stemming from nationally concluded supply contracts at EU level. Article 14 provides an obligation on Member States to notify to the Commission information related to gas supply contracts to assess the security of supply situation. It also allows the Commission to directly receive the gas supply contracts under specific and duly justified circumstances from gas undertakings. However, the enforcement provisions could be further specified to reinforce the EU added value of the measure. This is necessary to ensure effective implementation to strengthen security of supply and diversification while preserving confidentiality of commercial information, also to facilitate the proposed provisions of the REPowerEU roadmap.

The two Regulations provided an adequate framework to share information between Member States after incidents, e.g. during GCG meetings in September 2022 and October 2023 following the Nord Stream and Balticconnector disruptions. ECG meetings were held in January 2021 following a scale 2 incident splitting the European electricity system in two regions[197], and in October 2024 following an incident in the South-East of the Continental Europe power system.[198]

[195] See COM reports on Regulation (EU) 2022/1369 COM(2023) 173, SWD(2023) 63 and COM(2024) 88

[196] See Commission reports reviewing the Storage Regulation COM(2023) 182, COM(2024) 89 and COM(2025) 98

[197] See: https://www.acer.europa.eu/news-and-events/news/continental-europe-electricity-system-separation-incident-8-january-2021-next-steps

[198] The incident resulted in a partial black-out in Albania, Montenegro, Bosnia-Herzegovina and Croatia

## 4.3. Is the EU action still relevant?

This section looks at the relevance of the security of supply framework consisting of:

- Past relevance: the relationship between the needs and problems at the time of introducing the Regulations and during its implementation.
- Future relevance: the relationship between the current and future needs and problems in the EU and the objectives of the Regulations.

### *4.3.1. Past relevance*

The evaluation period was marked by the COVID-19 pandemic, the energy crisis, recurrent geopolitical turbulences and the rise of attacks on EU energy assets (e.g. Nord Stream pipelines, EstLink-2 electricity cable). During these challenging times, the need to ensure a match between supply and demand and make the EU energy system resilient to (external) shocks and putting in place appropriate tools to prepare for and manage crises has remained relevant. However, some needs have either emerged or gained importance during the implementation period. These needs include:

- Diversification of gas suppliers
- Emerging cross-sectoral risks
- Cybersecurity threats
- Critical infrastructure needs, such as cross-border, environmental as well as climate risks

These needs were only partially addressed by the framework, lowering its overall relevance for achieving the general and specific objectives that had been set when it was adopted.

This section examines the relevance of the specific objectives outlined in section 2, in particular:

- Improving regional cooperation and transparency.
- Improving assessment of risks and preparedness.

The objective of improving regional cooperation in gas responded to the lack of solidarity actions between Member States that had been brought to light by the 2009 crisis. In electricity, the objective of spurring information-sharing responded to the lack of transparency of national plans for crisis situations, which hindered cooperation with neighbouring countries and caused uncertainty for businesses. All these objectives remained relevant across the evaluation period until today: information-sharing, adequate infrastructure and crisis management procedures, among others, remain valid principles to ensure the resilience of the EU's energy system. The specific protection granted to households in times of crises became even more relevant, with the proclamation of the European Pillar of Social Rights in December 2017 which recognized

the right of everyone to "*access essential services of good quality, including (...) energy*" (Principle 20)[199].

The current plans and risk assessments (or regional crisis scenarios in electricity) were useful in identifying relevant risks but only to a certain extent. For example, a full Russian supply disruption was simulated in most national gas risk assessments, which was crucial for Member States to prepare for supply cuts that occurred in reality. However, ongoing diversification efforts and phasing out Russian fossil fuels are not adequately covered in these assessments and plans. For electricity, relevant scenarios were identified but their depth was limited (as reflected in the Commission opinions on the Risk Preparedness Plans) and this was later confirmed by the fact that Member States had to re-run scenarios to decide on *ad hoc* measures during the energy crisis.

Therefore, while the plans and risk assessments have largely responded to the needs they were supposed to address, several areas will require further adaptation to assess relevant security of supply risks. In particular, the plans and risk assessments should be adapted to better reflect emerging risks, such as cybersecurity, physical and hybrid threats[200] to critical infrastructure, climate change impacts and cross-sectoral risks between gas and electricity:

- **Cross-sectoral risks** were considered in 18 out of 25 national gas risk assessments, although they mostly concerned short-term failures, which due to their assumed short duration were not considered impactful. Many electricity RPPs submitted during the energy crisis did not sufficiently consider the relevance of a gas shortage affecting the electricity system. At the Commission's request, ENTSO-E calculated in 2022 for the first time "critical gas volumes" for electricity although this was not required by the legal framework.
- **Cybersecurity risks** were identified in 14 out of 25 national gas risk assessments, although in most cases it remains unclear whether sufficient preventive measures are implemented. Similarly, as indicated in several Commission opinions on the electricity RPPs, cybersecurity risks to the electricity system need to be better accounted for[201]. The 2024 gas dry run also showed that in case of a cyber-attack, TSOs were able to switch to backup systems and use alternative communication channels, although coordination between cyber and operational experts within TSOs must be better integrated in response procedures. The EU's 2024 Cyber Posture Risk Assessment[202]

[199] Interinstitutional Proclamation on the European Pillar of Social Rights (2017/C 428/09), 13 December 2017: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017C1213(01)&rid=2

[200] Hybrid threats combine conventional and unconventional, military and non-military activities that can be used in a coordinated manner by state or non-state actors to achieve specific political objectives. See: https://www.eeas.europa.eu/sites/default/files/hybrid_threats_en_final.pdf

[201] In its opinions the Commission suggested elements that should be included in the description of crisis scenarios.

[202] Council, in its May 2022 Conclusions on the EU's cyber posture, requested the Commission, the High Representative, and the NIS Cooperation Group (NIS CG) to carry out a risk evaluation and develop cybersecurity risk scenarios in a situation of threat or possible attack against Member States or partner countries. See Risk assessment report on cyber resilience on EU's telecommunications and electricity sectors | Shaping Europe's digital future

concluded that for electricity, the highest identified risk concerns entities directly connected to the electricity grid. The report concludes that the most salient threats come from insiders who infiltrate organisations or are manipulated, along with cyberattacks using ransomware and malware to disrupt operational technology relied on by gas or electricity producers.

- **Physical threats to critical infrastructure** were identified in 12 out of 25 gas risk assessments, usually terrorist attacks or sabotage. The focus generally lays on the assessment or mitigation of the impact of resulting security of supply disruptions, rather than addressing the risk to infrastructure itself, which affects the ability to define preventive actions and may lead to increased costs for consumers. In its opinions on electricity RPPs, the Commission recommended most Member States to take critical infrastructure better into account. Moreover, the 2024 gas dry run indicates that in case of a crisis, coordination procedures between critical infrastructure protection and energy security Competent Authorities could benefit from further clarification.
- **Environmental threats, climate change and natural disasters** were considered in 13 out of 25 national gas risk assessments, e.g. floods or storms affecting LNG shipments or damaging critical infrastructure. However, climate change aggravating these risks was only briefly mentioned by 1 national risk assessment and was otherwise not considered. The Risk Preparedness Regulation requires the methodology for identifying regional electricity crisis scenarios to consider '*rare and extreme natural hazards*'. The electricity RPPs refer to several weather events, but the depth of the assessment is limited, and the Commission opinions recommended to several Member States to take climate change impacts better into account, as its relevance was demonstrated by e.g. the low hydro and nuclear availability during a drought in summer 2022.

While these risks are included in a non-exhaustive list in the Regulations as the risk categories to assess, Member States are only obliged to assess these risks if they deem them relevant. In other words, there is no obligation for Member States to assess all these risks. Therefore, when Member States do not include such risks, it is not in all instances sufficiently clear whether these risks have been assessed but not considered relevant, or whether they have not been considered at all. The framework may benefit from further clarity about the risks that have been discarded.

#### *4.3.2. Future relevance*

The objectives served by the EU's security of electricity and gas supply framework will remain relevant for future needs and problems, but an adaptation of the Regulations are required to ensure continued relevance in the future. This section identifies the following future developments that should be considered to keep the framework relevant:

1. The role of electricity and natural gas in a decarbonised, electrified and more integrated energy system

2. The protection of consumers and critical energy needs considering electrification and the phase out of natural gas;
3. The role of new energy carriers, like biomethane and hydrogen, in energy security;
4. The importance of diversification due to geopolitical changes and reliance on homegrown clean energy sources;
5. The role of critical raw materials in securing resilient clean energy technology supply chains;
6. The impact of climate change on EU energy security.

The ongoing energy transition will have a profound effect on future security of gas and electricity supply. Phasing out imported fossil fuels and instead relying on homegrown renewable energy sources will have a substantial positive impact on the EU's energy security, as it makes us more resilient to e.g. the supply shocks experienced during the energy crisis of 2022. At the same time, a more electrified and decarbonised energy system requires a different management of the energy system, with more flexibility.

Phasing out natural gas will affect the relevance of the Gas Security of Supply Regulation, as the phase out will likely occur at different speeds across consumer categories. The demand of protected customers will change, as household demand for gases may see the largest absolute decrease of all sectors by 2040, as indicated by the Impact Assessment of the 2040 Climate Targets. Residential gas demand could decrease by 2040 with -70% to -82% between 2020 and 2040.[203] It would mean that the protected customer category may decrease significantly, requiring reconsideration of this provision. A phase out of natural gas may also in the future impact critical gas undertakings financially.

The current design of the gas supply standard, including its storage element, may lose relevance in the future, due to decarbonisation, sectoral integration and electrification. Ongoing sectoral integration and electrification of the energy system means that critical energy uses (e.g. heating, industry) are expected to increasingly change vector from gas to e.g. electric heating. Current gas storage and supply standard policy is designed to have sufficient gas available to cover these critical heating needs in winter, while such policy does not exist for electricity. If heating demand becomes more electrified, this may change the relevance of the supply standard for gas, and it puts in question the relevance of a split approach per vector. In a sectorally integrated energy system, focus may need to be redirected to a cross-vector approach for the supply standard and/or storage policy that considers heating demand irrespective of the carrier. During the consultation activities, for example, suggestions to align EU gas storage policy with decarbonisation goals included the possibility to have dedicated requirements for renewable gases.

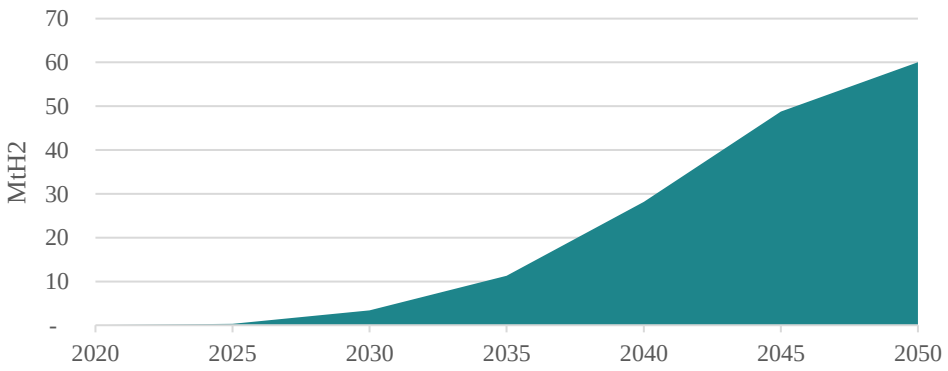
The development of biomethane will become increasingly relevant for energy security. Through the Hydrogen and Decarbonised Gas Package, the definition of 'natural gas' now also means

[203] See: SWD(2024) 63 https://eur-lex.europa.eu/resource.html?uri=cellar:6c154426-c5a6-11ee-95d9-01aa75ed71a1.0001.02/DOC_3&format=PDF

biomethane that can be directly injected in the system. This means that provisions of the Gas Security of Supply Regulation from 2025 onwards directly apply to biomethane. However, the production of biomethane has different particularities compared to natural gas. For example, the production of biomethane is seasonal, mostly distributed due to the high costs of transporting biomass resources, and dependent on availability of local resources. With an expected increase of biomethane in the energy system, it will give a more prominent role to the distribution grid for security of gas supply, where biomethane is often injected into the system. An increased use of biomethane may lead to a strengthened energy-food nexus and means that the sourcing of biomethane will be relevant for e.g. risk assessments. Biomethane used for thermal generation will likely still contribute to security of electricity supply by 2050, as it can provide flexibility for variable renewable energy.

Hydrogen will also become important for the future energy security framework, as it will be used in hard-to-abate applications in industry and transport to replace fossil fuels, and provide flexibility to the power sector. For example, hydrogen can contribute to security of supply by providing flexibility to the electricity grid, through long-term storage, including through the supply of e-gases and e-fuels.[204] However, the role of hydrogen will be different than the current role of natural gas. Furthermore, it will be crucial that the deployment of electrolysers to produce electrolytic hydrogen is well integrated with other decarbonisation processes and grid capacities.[205]

***Figure 34: Commission projection on hydrogen consumption***




*Source: Climate Target Plan 2040 Impact Assessment*

[204] European Commission, Artelys, Trinomics, Enerdata, *Study on energy storage – Contribution to the security of electricity supply in Europe*, March 2020: https://op.europa.eu/en/publication-detail/-/publication/a6eba083-932e-11ea-aac4-01aa75ed71a1/language-en

[205] In a study of June 2022, ENTSO-E stated that, in 2050, the growth of low-carbon hydrogen "would require a power input of 1,951– 2,173 TWh; this alone represents 70 – 78% of current total and more than double current renewable EU power generation". The Commission-funded platform ETIP-SNET recommended that the impact of electrolysers' deployment "on electric grid will be an order of magnitude higher than on gas grid; therefore it is paramount to include electrolysers and other components of hydrogen production in planning process of power system, rather than only tackling them as a connection request"

It also seems useful to consider lessons learnt from the experience with gas security of supply in relation to third-country suppliers. This can help to avoid dependencies on imports from a single dominant supplying third country in the future.

Repurposing natural gas infrastructure will be crucial to a cost-efficient transition. An integrated network planning approach is essential to ensure that the objective of repurposing natural gas transmission, import or storage infrastructure to hydrogen is balanced with the objective of continuing to ensure security of natural gas supply[206]. The Hydrogen and Gas Market Decarbonisation Package contains provisions to address the decommissioning of gas infrastructure and if necessary, repurposing it for the transport of hydrogen. This should take place in a sequenced manner keeping security of supply considerations in mind. The Package also introduces integrated network planning of electricity, hydrogen and gas infrastructure at national level and ensures the appropriate regulatory oversight.

While the Gas Security of Supply Regulation has provisions that are directly relevant for diversification, it will require adaptation to align it with the REPowerEU objective to phase out of the dependency on Russian gas supplies. Provisions that facilitate diversification include the infrastructure standard, which is designed to ensure that a disruption to the single largest piece of infrastructure can be withstood, which enabled a complete shift of flow patterns when Russia cut its gas supplies to the EU in 2022. Moreover, Article 14 of the Regulation also gives the option to Competent Authorities or the Commission, under certain conditions, to request supply contracts concluded with third country suppliers to assess whether it negatively impacts security of supply. Although the Regulation provides for Competent Authorities or undertakings to notify contractual information to the Commission in some cases, more transparency regarding the origin of gas imported would be needed to achieve REPowerEU objectives. As announced in the Roadmap towards ending Russian energy imports adopted on 6 May 2025[207], in the legislative proposal of June 2025[208] new rules for increased transparency, monitoring and traceability of Russian gas were proposed. Following Russia's invasion of Ukraine, the Commission and Member States in the CEE region have also worked diligently to identify diversification routes in light of the end of transit through Ukraine, notably through a regional spin-off working group of the GCG.

However, none of the listed measures are designed to require a pre-defined level of diversification, nor explicitly encourage phasing out Russian gas. To ensure future relevance and to incorporate the lessons learned from the past overreliance on Russian gas, this objective may need to be better incorporated. As the 2021-2023 crisis showed, a lack of diversified supply

[206] See Commission report on energy storage (2020), which states: "*In 2050, gas-fired plants continue to have an important role in the provision of flexibility. Their fuel supply is however totally different than the one of 2030: while in 2030 gas-fired plants were mainly using natural gas[32], in 2050 gas-fired plants are mainly using biogas, and to a lower extent e-gases coming from the power-to-gas-to-power loop.*"

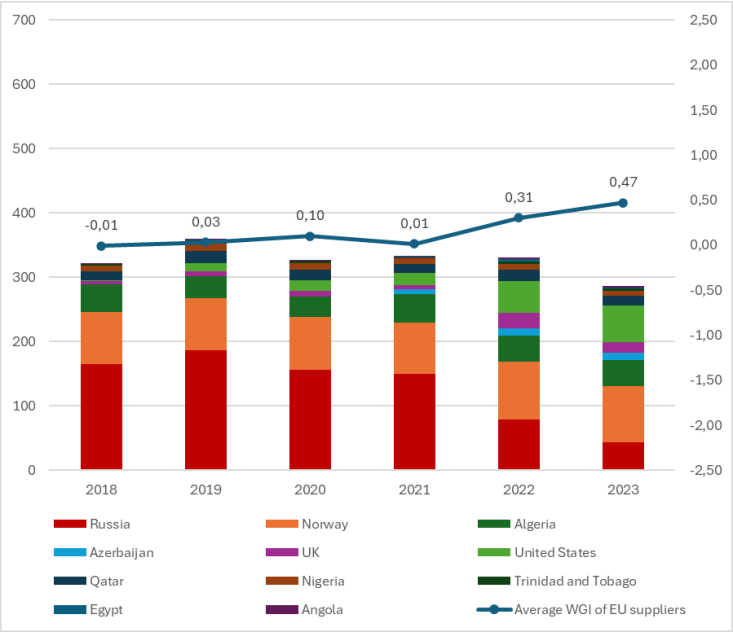
[207] COM(2025) 440 final.

[208] COM(2025) 828 final

sources can be a high security of supply risk that can put in jeopardy the security interests of the EU or its Member States, regardless of the supplier or the energy carrier.

Besides diversification, a sound policy should also look at the reliability of trading partners. Public governance quality indicators[209] is one of the proxies that can be used to evaluate the risk level. Figure 37 shows the changing geography and the improved governance indicator of EU gas suppliers during the evaluation period. Since 2021, the average governance quality of EU gas suppliers has significantly increased from -0.01 to 0.47. This reflects mainly the drop of Russia's share in EU gas imports, largely compensating the parallel decrease of Russia's governance quality grade. This improvement could however be substantially weakened in case other major EU gas suppliers were to see their WGI ratings fall in the coming years.

***Figure 35 – Evolution of EU gas imports portfolio (bcm, left axis) and of the related weighted governance average (right axis)***




*Source: Commission, based on ENTSOG Transparency Platform, Refinitiv and World Bank*

The importance of diversification of gas supplies is increasingly underlined by the current tense geopolitical situation. The state of the current geopolitical situation is challenging to quantify but Figure 36 illustrates the change in relevance of geopolitical risks compared to previous years. This trend is confirmed by other indicators, such as the Geopolitical Annual Trade Risk Index (GATRI) from the Hague Centre for Strategic Studies, which has measured a steady increase of risk between 2020 and 2024 driven by both economic, diplomatic and military

[209] World Bank's Worldwide Governance Indicators (WGI) measure the perceptions of quality of governance across countries and over time. Each country is allocated with a grade between -2,5 and 2,5 for each of these indicators. The higher the grade, the better for governance quality. The EU average grade was computed by multiplying the countries' average grades by their relative share in EU gas imports. Datasets are available at: https://www.worldbank.org/en/publication/worldwide-governance-indicators

aspects[210]. This tumultuous context is also embodied by the dramatic increase of the number of trade restrictions added annually, which tripled between 2019 and 2023[211]. These global tensions may require enhanced monitoring and early warning tools. This is exacerbated by the higher reliance of the EU on a global LNG market (cf. section 3.1) which make geopolitical risks more relevant. Given that LNG is a global market, risks materialising in other parts of the world will become increasingly relevant for EU security of supply. In recent years, events like strikes hindering Australian LNG exports in September 2023 or the Red Sea crisis between Q3 2023 and Q1 2024 have had a tangible impacts on EU energy markets. However, depending on the demand scenario chosen, EU gas consumption may decrease significantly in the future, potentially impacting demand for LNG and gas through pipeline to different extents.[212]

***Figure 36: Geopolitical risk index***

*Source: European Central Bank*[213]

The fact that additional measures were needed to combat the energy crisis reflects that the Gas Security of Supply Regulation was not sufficiently relevant in tackling the crisis the EU faced. The Gas Security of Supply Regulation was designed to tackle time-limited supply crises and was not designed to tackle a prolonged supply disruption from the EU's main supplier. For example, temporary storage solutions were necessary to ensure that storages were filled to 90% by 1 November of each year, after Gazprom's manipulation of the storage market left EU storages filled at only 77% on 1 November 2021. As ENTSOG's Winter Outlook 2021-2022[214] showed, this low storage level would lead to a risk of demand curtailment in Ukraine-route risk group and Baltic States/Finland risk group, in case of cold winter conditions and supply disruptions from Russia (the latter transpired the year after). However, these storage requirements adopted under the Storage Regulation are temporary in nature. Although the storage market does not face the same risks as it did in 2021, with Gazprom no longer having access to EU storage sites, after the expiration of the Storage Regulation there are fewer

[210] GATRI 2025: https://gatri.app.hcss.nl/
[211] International Monetary Fund, 2023: https://www.imf.org/en/Blogs/Articles/2023/08/28/the-high-cost-of-global-economic-fragmentation
[212] See for example ACER's 2025 LNG Market Monitoring Report: ACER 2025 LNG Monitoring Report
[213] Caldara and Iacoviello (2022), included in ECB report on 'geopolitical risk and its implications for macroprudential policy. See: https://www.ecb.europa.eu/press/financial-stability-publications/macroprudential-bulletin/html/ecb.mpbu202504_01~6aa0c34852.en.html
[214] SO0032-21_Winter Supply Outlook_2021-22_Final .pdf

safeguards to ensure storage filling in order for the EU to be sufficiently prepared going into each winter season. At the same time, with the orderly phase out of fossil fuels expected to progress in the coming decades, the relevance of natural gas storage targets as a percentage of storage capacities may decrease in the mid- to long-term. In parallel, storage demand may rise for electricity, hydrogen and CO2.

At the same time, the Regulation focuses mainly on the supply side, and did not sufficiently leverage the demand side of energy security. Reducing demand has been an effective tool to mitigate the energy crisis, as showcased under the 'effectiveness' criteria. However, this is in the current Gas Security of Supply Regulation not sufficiently covered, since the Demand Reduction Regulation expired in March 2024. The experience with the Gas Demand Reduction Regulation shows that to remain relevant, there may be potential to continue to leverage demand reduction and demand response during crises.

Strategic foresight tools were mobilised[215] for this fitness check, with key outcomes being the identification of '*accelerating technological change and hyperconnectivity*', '*aggravating resource scarcity'* and '*climate change and environmental degradation'* as key megatrends relevant for gas and electricity security of supply. This identification is generally consistent with the Megatrends that were identified by respondents to the public consultation, when asked for which of the Megatrends the EU security of electricity and gas supply architecture is least prepared (see Figure 53 in Annex VI). Particular risks identified during the workshop include the increased likelihood of cyber-attacks on the energy system in case of further geopolitical competition, which due to increased system complexity may be increasingly relevant. Furthermore, increased competition for CRMs and scarcity of basic resources such as water may have an impact on electrification efforts. Lastly, climate change may aggravate water scarcity (impacting nuclear, thermal or hydro generation), energy demand (e.g. heatwaves), or affect weather patterns impacting wind generation in certain regions or affect coastal power plants due to rising sea levels.

Currently, the EU faces a high dependency on imports of CRMs, often from a limited number of suppliers, which poses significant geopolitical and supply chain risks. For instance, the EU relies on China for approximately 98% of its rare earth elements, essential for manufacturing high-efficiency magnets used in wind turbine generators. As demand for clean energy technologies grows, the EU's need for these materials is expected to multiply fivefold by 2030. In the battery sector, EU demand for lithium, crucial for electric vehicle and energy storage batteries, is projected to surge up by 12 times by 2030. Currently, the EU imports around 79% of its lithium from Chile, rendering it vulnerable to supply disruptions. Similarly, the EU is reliant on imports for other key battery materials such as nickel, cobalt, and graphite, with China controlling a significant portion of the global supply chain. In 2024, it accounted for 70-75%

[215] As per tool #20 of the Better Regulation Toolbox, an analysis using the Megatrends method developed by the Commission's Joint Research Centre, assessed how long-term driving forces may affect future relevance of the EU energy security architecture. This was achieved by the means of an internal workshop and of a question included in the public consultation. See Annex VI for more information.

of lithium and cobalt processing, and more than 90% of graphite refined battery-grade supply active materials and rare earth refining supply[216]. Therefore, the EU adopted in 2024 both the Critical Raw Materials Act[217] and the Net Zero Industry Act[218] in order to reduce the risks associated with CRMs and critical energy transition technologies.

Furthermore, there is a growing importance of CRMs for the energy security framework due to their central role in the deployment of renewable energy technologies and the expected rapid electrification of the EU's energy system. The current security of supply framework is not equipped to address these future problems. For instance, the IEA[219] estimates that clean energy technologies will account for over 40% of total copper and rare earth elements demand, 60-70% of total demand for cobalt and nickel, and almost 90% for lithium by 2040. Electrification, particularly in sectors like transport, heating, and industry, is expected to drive a significant share of this demand, with the number of electric vehicles in the EU projected to reach 30 million by 2030. This rising demand coincides with ongoing geopolitical shifts, which expose vulnerabilities of highly concentrated supply chains, particularly for e.g. graphite, where more than 90% of the EU's imports currently come from a single third country. These dynamics underscore the need to integrate CRMs more explicitly into the EU's energy security framework, ensuring that the availability of materials keeps pace with the accelerated deployment of clean energy infrastructure.

The number of extreme weather events had already dramatically increased, as shown in section 3.1, and the energy sector is projected to be most impacted by climate-induced infrastructure damages in the years to come. Extreme weather hazards which may disrupt energy assets are becoming more frequent and more diverse. Climate change may impact not only the supply-side of the energy system, but also demand patterns, in particular for the building sector. Future heating needs are expected to decrease, while cooling requirements are projected to rise, further stressing the energy system in summer periods[220]. Improvements will be needed on risk assessments to support better risk preparedness, while some provisions may also need to be updated to match the future reality of the energy system, e.g. the supply standard.

[216] IEA (2025) Global Critical Minerals Outlook 2025: https://iea.blob.core.windows.net/assets/ef5e9b70-3374-4caa-ba9d-19c72253bfc4/GlobalCriticalMineralsOutlook2025.pd
[217] Regulation (EU) 2024/1252
[218] Regulation (EU) 2024/1735
[219] See: The Role of Critical Minerals in Clean Energy Transitions – Analysis - IEA
[220] Cf. e.g. Commission's impact assessment report on Europe's 2040 climate target, SWD(2024) 63 final.

*Figure 37: Climate risk exposure of electricity generation, network and supply chains*

*Source: IRENA*

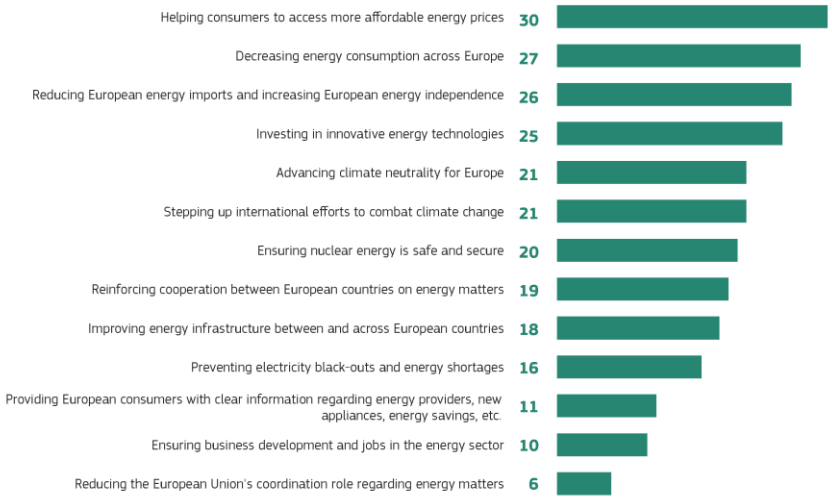
Climate change may also lead to a deteriorating business case for certain companies operating in the energy sector. This could result in financial risks for undertakings that are critical to security of energy supply. These types of risks are currently not addressed by the evaluated regulations.

In general, the results of the energy Eurobarometer[221] of September 2024 confirm the continuous relevance of energy security of supply policies. The energy Eurobarometer showed that reducing energy imports and increasing energy independence was considered by 26% of respondents the main future priority of energy policy (third highest). The second highest was 'decreasing energy consumption' (27%), which supports the relevance of measures that were instrumental to address the energy crisis, such as the Gas Demand Reduction Regulation. Moreover, for 22% of respondents EU energy policy means preventing electricity black-outs and energy shortages, which jumped up from just 7% in 2019.[222]

[221] European's attitudes towards energy policies - September 2024 - - Eurobarometer survey

[222] Other policy areas directly relevant to energy security also saw a big jump from 2019 to 2024, such as improving energy infrastructure (from 8% to 27%), decreasing energy consumption (from 2% to 30%).

***Figure 38: responses to the question: 'in your opinion, which of the following energy-realated issues should the European Union tackle as a priority over the next five years'***




*Source: Special Eurobarometer 555, September 2024*

# 5. WHAT ARE THE CONCLUSIONS AND LESSONS LEARNED?

## 5.1. Conclusions

Since the beginning of the 21st century, the EU has progressively developed a comprehensive legislative framework on security of gas and electricity supplies. This fitness check has evaluated the latest legislation from 2017 until 2024. The evaluation period was marked by the Covid-19 pandemic and Russia's full-scale invasion of Ukraine, resulting in one of the most severe energy crises in the history of the EU.

The evaluated framework, including the emergency regulations established in the context of the energy crisis, has ensured a stable, secure and uninterrupted energy supply, and protected vulnerable and critical consumers, and has therefore been overall successful. The analysis has also shown that the evaluated regulations have delivered benefits compared to what could have been achieved without EU-level action, by ensuring a degree of coordination between Member States. This report also demonstrated the framework's relevance, with persistent risks to EU's security of electricity and gas supply. However, this real-life stress-testing and the fact that additional emergency regulations were needed showed that there are areas for improvement and that new risks should be covered in more depth as they are increasingly wide reaching and frequent.

More specifically, the assessment has looked at the effectiveness, efficiency, EU added value, coherence, and relevance of the framework, in line with the Better Regulation guidelines.

1. With regard to **effectiveness**, this fitness check found that the Gas Security of Supply Regulation and the Electricity Risk-Preparedness Regulation were effective in achieving their objectives to a certain extent, increasing the EU's overall preparedness and making the EU more resilient to gas supply disruptions and electricity blackouts.

- The framework achieved its specific objective of enhancing transparency and coordination, even in times of crisis. This was achieved through the Coordination Groups and by sharing plans and risk assessments among Member States, based on security of supply simulations and common methodologies set up by the Regulations. The specific objectives of the Gas Security of Supply Regulation to have adequate and flexible infrastructure and to ensure supplies to protected customers in case of disruptions was met, through the infrastructure standard and supply standard. No curtailment of gas protected customers took place in the evaluation period.
- However, the fitness check also highlighted clear weaknesses of the framework regarding upfront preparedness for the 2021-2023 energy crisis. The fact that the EU required additional emergency regulations to combat the energy crisis, points to the need for more robust risk assessments and scenario planning, also considering emerging risks such as cybersecurity, hybrid threats, access to critical energy transition minerals and climate change. It also shows that the specific objective of ensuring preparedness through a risk-based approach was not sufficiently met. Moreover, solidarity between

Member States was not operational during the energy crisis (only 9 out of 40 agreements are signed), until the default solidarity rules adopted in 2023 were introduced.

2. On **efficiency**, the fitness check found that the framework's implementation costs consist of administrative and infrastructure costs. The case study results indicate that absolute costs are low (in the order of a few hundreds of millions over the assessment period) compared to the extraordinary costs of potential supply crises (which is in the order of billions).

- However, the data collection and public consultation shows that the burden on national administration and Competent Authorities can be high in terms of manpower. The compliance costs for energy undertakings are on the other hand low.
- Furthermore, the analysis shows that there is room for improvement in terms of simplifying and streamlining the regulatory framework, especially regarding the various reporting obligations (e.g. risk assessments and plans) on Member States and administrative procedures. This needs to be balanced with the important role that these reporting requirements have in preserving a high level of security of supply.
- Further monitoring tools might be needed in the future, to fill the current data gaps to monitor security of supply, and to enable an accurate assessment of the costs and benefits of the framework in the future. Key performance indicators could be developed, e.g. to assess the administrative burden caused by reporting obligations.

3. In terms of **coherence**, the Gas Security of Supply Regulation and Electricity Risk-Preparedness Regulation were mostly consistent with each other and other EU policies and legislation during the evaluation period. The evaluated Regulations build on the well-functioning internal market and a highly interconnected energy system, supported by EU Regulations and funding.

- There is nevertheless a need for a more coordinated approach to security of supply in the electricity and gas sectors, especially regarding spillover effects from one sector to the other. While the Regulations were generally coherent, more coordination regarding future cross-sectoral crises is fundamental. In particular, the concept of ‘protected customers’ is not aligned between gas and electricity, leading potentially to lower overall protection of critical or vulnerable consumers.
- The EU’s security of electricity and gas supply framework draws from and complements the recently adopted horizontal EU legislation on cybersecurity and critical infrastructure protection. However, the increased electrification of end-use sectors and newly emerging geopolitical risks might warrant additional sectoral measures to be implemented to ensure the coherence in the future. At the same time, synergies between the security of supply framework and the framework for energy infrastructure can be further strengthened.
- The Regulations are in line with wider EU policy objectives, such as ensuring European competitiveness and the decarbonisation objectives. However, due to accelerated decarbonisation, sectoral integration and electrification, there is room for improvement

to enhance the synergies within the framework, and specific provisions may require further review to avoid the risk of carbon lock-in.

4. The evaluated Regulations have generated significant **EU added value**.

- The Regulations provided EU added value by starting regional and EU-wide cooperation, enhancing security of electricity and gas supply, and reducing the risks associated with supply disruptions. The framework's ability to facilitate the sharing of best practices and expertise among Member States was highlighted as a key benefit.
- However, there is room for improvement to enhance the framework's ability to address cross-border risks in much more depth and operationalise the energy solidarity principle.

5. The Gas Security of Supply Regulation and the Electricity Risk-Preparedness Regulation has been and will remain **relevant** for the EU's current security of supply challenges. However, there are new realities that the current regulation does not address yet, and that will need to be considered in any upcoming revision.

- The Gas Security of Supply Regulation has been and will remain relevant for current EU policy objectives, where energy security is a prerequisite for EU economic competitiveness in the current geopolitical context.
- The ongoing energy transition to a decarbonised and more electrified energy system will improve security of supply by reducing the need to import fossil fuels from third countries. At the same time, the energy system of the future requires a different management of the energy system, with a growing need for flexibility through storage, demand response and cross-border infrastructure.
- However, the framework requires adaptation to ensure future relevance in the context of changing energy markets and a changing external context. For example, the Gas Security of Supply Regulation was designed for short-term supply disruptions and not a prolonged disruption of the EU’s main supplier. At the same time, stakeholder feedback and a megatrend workshop indicate that there are emerging challenges that require further review, adapting to the transition to a low-carbon economy which fundamentally changes energy markets and the sectoral integration of the gas and electricity systems. Moreover, geopolitical challenges increase the relevance of having a robust long-term diversification policy at EU level, as demonstrated by the recent adoption of an EU roadmap to end Russian energy imports. A robust long-term diversification policy may require enhanced transparency and traceability to ensure a diversified supply mix.
- Cybersecurity risks, physical and hybrid threats to infrastructure and environmental threats due to climate change will be increasingly important for a future energy security framework. While horizontal regulation on cybersecurity and critical entities resilience have been put in place, the analysis shows that additional sectoral measures or a revision of existing provisions would be needed to support the implementation of the horizontal regulation.

- Additionally, growing demand for CRMs, driven by the energy transition and increasing electrification, presents new vulnerabilities. The horizontal legislation is insufficient to address the specificities for the energy system, and additional measures are needed to ensure resilient and secure energy systems.

### 5.2. Lessons learned

Without prejudice to future Commission action, the lessons learned from this fitness check point to the following areas for improvement regarding the EU framework on security of gas and electricity supplies, which could be further analysed:

- ***Simplification:*** while the performance framework has been relatively cost-efficient in the achievement of its objectives, there is room for simplification and for reducing administrative burden, making the whole framework more operational and actionable. Simplification can be achieved through streamlining the reporting obligations for national authorities, reducing the amount of regional risk groups and simplifying the procedure to request an exemption for the bidirectionality obligation.
- ***Adaptation*****:** the EU energy system as a whole has been stable during the evaluation period, but the electricity sector is already experiencing a massive transformation. This notably involves the decarbonisation, digitalisation, electrification and sectoral integration of our energy system. It can be anticipated that the EU energy system in 2030 and then 2040 will be radically different from the one of 2017 or even of today, with increased renewable energy penetration and a more marginal role for natural gas. The particularities of "*energy security*" and "*security of supply*" will evolve along with this transformation, requiring adaptation. Among others, flexibility will become more critical for security of energy supply in the future, by having sufficient energy storage, demand response and interconnection available. It also calls for a deeper and consolidated cross-border assessment of existing and emerging risks, given the regional dimension of such risks and the interconnectedness of the electricity system. Moreover, emerging risks needs to be better incorporated in risk assessments at EU and national level, e.g. critical infrastructure protection, cybersecurity, extreme weather events.
- ***Integration:*** the gas and electricity sectors are very closely interlinked, and they may become even more integrated in the future. While some important differences persist between the two markets, there is room to significantly align the two Regulations. For example, risk scenarios in gas and electricity are not always consistent (e.g. a gas shortage was initially not sufficiently considered as a risk in electricity plans in 2022) and the timing of the planning process is not aligned. The areas in which the synergies between the two Regulations could be enhanced notably include crisis management, risk assessments and plans.
- ***Transparency and supervision:*** this fitness check report underlined both the added value of transparency provisions which spur coordination, and the lack of data on certain areas of security of electricity and gas supply (e.g., transparency and traceability of gas imports, timely availability of key data). In particular, the REPowerEU Roadmap and

legislative proposal to end Russian energy imports adopted in May and June 2025 points at new rules for increased transparency, monitoring and traceability of Russian gas will inspire the future EU energy security architecture.

In this perspective, the new Commissioner for Energy and Housing has been tasked in his mission letter to "*review the security of supply framework*"[223]. This review provides an opportunity for the EU to build on the findings and lessons learnt from the fitness check exercise and to ensure that the framework remains effective in ensuring a stable and secure energy supply for Europeans also in the future.

[223] https://commission.europa.eu/document/download/1c203799-0137-482e-bd18-4f6813535986_en?filename=Mission%20letter%20-%20JORGENSEN.pdf

## ANNEX I: PROCEDURAL INFORMATION

**Lead DG**

The European Commission's Directorate-General (DG) for Energy is the lead DG for this fitness check (PLAN/2024/1444).

**Organisation and timing**

The Commission published a call for evidence on the fitness check on 3 September 2024, together with a public consultation. They were open for feedback until 26 November 2024.

An Inter-Service Steering Group (ISG) was set up in July 2024, involving representatives from the following Commission's Directorate General: Secretariat General (SG), European External Action Service (EEAS), DG Climate Action (CLIMA), DG Communications Networks, Content and Technology (CNECT), DG Competition (COMP), DG Defence Industry and Space (DEFIS), DG European Civil Protection and Humanitarian Aid Operations (ECHO), DG Environment (DG ENV), DG Internal Market, Industry, Entrepreneurship and SMEs (GROW), DG Migration and Home Affairs (HOME) DG Mobility and Transport (MOVE), DG Neighbourhood and Enlargement Negotiations (NEAR), Joint Research Centre (JRC), Eurostat (ESTAT). The meetings were held on 10 July 2024, 20 November 2024 and 4 February 2025. In addition, a cross-DG strategic foresight workshop (to which all the ISG members were invited) was organized on 17 October 2024.

**Consultation of the Regulatory Scrutiny Board**

The RSB was consulted in an upstream meeting on 6 January 2025. The draft Fitness Check report and all supporting documents were submitted to the RSB on 19 February 2025 and a hearing was held on 19 April 2024. In the hearing, the RSB made the following recommendations:

| RSB recommendations | Modifications to the fitness check report |
|---|---|
| The scope of the fitness check should be clarified upfront and its purpose of feeding into the wider impact assessment for the revision of the EU energy security of supply legislation should be clearly stated. While the fitness check focuses on gas and electricity security of supply, the general EU framework on energy security of supply is much wider. The report thus needs to clearly justify which elements are in the scope of the exercise (in particular as regards the emergency measures) and which have been excluded from the analysis and why. Once the scope is clarified, the analysis should stay within those limits and other elements of the energy security framework should be consistently covered in the analysis of coherence. | In the introduction, the scope of the fitness check has been clarified. It notably clarifies that the report primarily focuses on the Gas Security of Supply Regulation and Electricity Risk Preparedness Regulation, but that the emergency measures whose objective was to remedy the security of supply issues in 2022-2023 are also within scope. Horizontal elements that are relevant for wider energy security have been assessed in terms of coherence and future relevance. However, the Gas Security of Supply Regulation and Electricity Risk-Preparedness contain (limited) measures on e.g. cybersecurity and critical energy infrastructure protection, which have been assessed against all five criteria. A visual has been added to further aid the understanding of the scope. |
| The analysis of effectiveness should be performed in line with the defined scope of the fitness check. It should be more unambiguous in its conclusions | The analysis of effectiveness follows the clarification of the scope, reflecting effectiveness of the Gas Security of Supply Regulation, Electricity Risk |

| | |
|---|---|
| on the achievement of specific objectives and on the various elements of the two regulations, including on the emergency measures. It should also cover all the key elements of the toolkit, including for example the N-1 rule, the simulations, or the solidarity agreements. The conclusions on effectiveness should not only be limited to the process / procedural part of the framework but also relate to whether the framework had any attributable impact on the energy markets / reality. | Preparedness Regulation and the emergency measures. The conclusions on effectiveness have been qualified, taking more explicitly stock of the achievement (or lack thereof) of the specific objectives, not just the general objectives. More specific conclusion have been provided, notably regarding the emergency measures, as well as the solidarity agreement and infrastructure standard (N-1). |
| The conclusions about efficiency should be more nuanced in particular reflecting the limitations of the information on the costs and benefits. As the provided evidence on the costs and benefits is limited, the claim made in the report about 'reasonable costs' is not well substantiated. | The conclusions on efficiency have been nuanced, reflecting the uncertainty of the findings on costs and benefits given the lack of key performance indicators (c.f. next point). The comparison has been made more explicitly with the costs of potential supply crises, by assessing the potential costs of such incidents. Additional information on the costs of the Regulation has been added, both in Annex IV and in the efficiency section, on e.g. the costs of infrastructure development (c.f. next point), the cost of the organization of mandatory exercises and reporting requirements. |
| The report could usefully provide additional information on the functioning of the energy markets in relation to the security of supply framework to provide further insights into the real benefits and total costs for different stakeholders, including the costs of infrastructure. Since the report acknowledges difficulties with evidence/data availability to assess the performance of the framework, the conclusions should point to the need to develop appropriate monitoring system for the future, including key performance indicators. | The report has been strengthened by adding a paragraph in the efficiency section on the price and market developments after a supply crisis. In particular, the market effects of the various cuts in Russian gas supplies in 2022 has been included. Additional information on the costs of infrastructure development that is directly attributable to the Gas Security of Supply Regulation, notably the bidirectionality requirement, has been added in the efficiency section. The need for further key performance indicators has been added in the conclusions, in particular to assess the future administrative costs of the Regulations. |
| The analysis of relevance should be revisited in the report and provide for both backward- and forward-looking parts. The backward-looking analysis should focus on the needs the interventions were supposed to address, i.e. ensuring a constant match between energy demand and energy supply in a stable and secure manner, while protecting vulnerable and critical consumers. It should reflect whether the achievement of the specific objectives of the evaluated regulations could contribute to the matching of supply and demand on the relevant energy markets. The forward-looking part should further analyse the evolution of the needs and changing context, considering for instance the | The backward-looking part has been redrafted, to analyse whether the needs that the Regulations set out to address have in reality been tackled, focusing on among others the adequacy of the relevant risks to security of supply that are to be addressed in the risk assessments. The forward-looking part has been reinforced with further elements substantiating the state of the geopolitical context, e.g. through reports from reports of the European Central Bank, the World Bank and the International Monetary Fund. |

| | |
|---|---|
| ongoing transformation of EU energy system and the geopolitical situation. | |
| The conclusions from the analysis on each of the specific objectives and different evaluation criteria should be systematically brought forward to the concluding section. As the fitness check covers the security of supply in two distinct, though interrelated markets for gas and electricity, the conclusions and lessons learned should be more nuanced. Both the conclusions and lessons learned should be more specific to be useful for the future revision of the EU energy security of supply framework, for instance on the alignment of how vulnerable consumers should be treated or the issues related to the transformation of the EU energy landscape | The specific objectives have been more explicitly covered in the conclusions, in particular as regards the effectiveness of the evaluated Regulations in achieving their specific objectives. The lessons learned for a future revision have been further highlighted, addressing the importance of reacting to the geopolitical situation through e.g. a sound diversification policy, adapting to the increasing importance of 'dunkelflaute' situations and improving the cross-border assessments of key emerging and or cross-sectoral risks (e.g. cybersecurity, critical infrastructure protection, extreme weather events). It highlights where the two Regulations can be further aligned (e.g. risk assessments, plans) and where it can be further simplified (e.g. request for exemptions for bidirectional capacity). |

**Evidence, sources and quality**

The Fitness Check was supported by an evidence base developed in line with the Better Regulation Guidelines, through a methodology encompassing a broad range of different qualitative and quantitative data. DG ENER benefitted from the support of JRC by the means of an administrative arrangement, notably for the design and the analysis of the public consultation, but also for the identification of key indicators.

**Use of external expertise**

This fitness check report was not supported by an external study.

## ANNEX II. METHODOLOGY AND ANALYTICAL MODELS USED

**Methodology, sources of information and data analysis**

This fitness check has been carried out based on a number of wide-ranging activities and data sources. The primary activities that this fitness check is based on include:

- In-house expertise derived from e.g. the experience gained from implementing the Regulations.
- A 12-week call for evidence and public consultation, as well as other consultation activities.
- Two table-top exercises ("dry runs") to stress-test the EU framework against crisis situations.
- Extensive desk research, with the support of the Commission's Joint Research Centre.
- Exchanges with Member States and other key actors.
- A strategic foresight workshop, based on the Megatrends tool developed by the Joint Research Centre.

*In-house expertise based on implementation of the Regulations*

DG ENER has gained experience from implementing the Gas Security of Supply Regulation in its current form since 2017 and the Risk-Preparedness Regulation in its current form since 2019.

This experience includes two cycles of common risk assessments, national risk assessments, preventive action plans and emergency plans developed by Member States and three Union-wide security of supply simulations done by ENTSOG for gas. The risk assessments and plans contained a large amount of information and data on the specific security of supply situations in the Member States, such as the main national and transboundary risk factors (political, technological, commercial/financial/market, social, or natural risks), detailed descriptions of the national and regional gas systems, compliance with the infrastructure and supply standards, measures imposed at national level to prevent and mitigate crises (both market-based and non-market based), tests of the emergency plans that were carried out, as well as roles and responsibilities during different crisis levels and information on regional crisis cooperation and solidarity. The Commission has assessed these deliverables and provided opinions on the preventive action plans and emergency plans, which are published online[224]. These were indispensable sources of information for writing this fitness check report. However, the quality of some of the risk assessments and plans was not in all cases sufficient to allow for meaningful comparisons or to get an adequate view of the preparedness to such risks. In addition, some late submissions also made a comparison more challenging, as the plans were in that case not done in the same moment in time. The Commission's

[224] See: Commission's opinions on the preventive action plans and emergency plans

Joint Research Centre also had to step in to provide modelling support to several of the Common Risk Assessments.

Experience was also gained from one full cycle of regional electricity crisis scenarios, national electricity crisis scenarios and Risk Preparedness Plans (including Commission's opinions). The second cycle is still ongoing: the first step, with the identification of regional electricity scenarios was performed by ENTSO-E in September 2024. Like for gas, these documents were a rich source of very useful information on the security of electricity supply situation of the EU as a whole and of Member States specifically. The publicly available Commission's opinions[225], stemming from the internal assessment performed by DG ENER with the support of JRC, were also used as a source of information on the quality of those reports and plans.

A total of 41 of ECG meetings (since July 2019) and 27 GCG meetings (since October 2017) were held in full format and several meetings in the restricted Member State only format. Here, issues as well as best practice measures for implementing the Electricity Risk-Preparedness Regulation and Gas Security of Supply Regulation have been discussed respectively. In addition, two joint Electricity and Gas Coordination Group meetings have been organised in 2022, in case of cross-cutting issues such as the critical gas volumes for electricity which were computed as part of ENTSO-E's Winter Outlook. These meetings are organised and chaired by the Commission's Directorate-General for Energy. Members of the GCG include the Competent Authorities of all 27 Member States (usually ministries for energy, or National Regulatory Authorities), ENTSOG, ACER, the Energy Community Secretariat and the representatives of industry and consumer associations (BEUC, Eurelectric, Eurogas, Euroheat & Power, Energy Traders Europe, GIE, IOGP and IFIEC). Apart from meetings organised, there is regular correspondence through the functional mailbox and the mailing list in case of security of supply incidents, the activation or deactivation of crisis levels, or in case of the notification of legally required deliverables (e.g. risk assessments, plans).

Two Commission reports were issued on the implementation of the evaluated Regulations. This includes Commission report COM(2023) 572 and the accompanying Staff Working Document SWD(2023) 323, which reviewed the application of the Gas Security of Supply Regulation (EU) 2017/1938. This report was based on a dedicated questionnaire circulated to members of the Gas Coordination Group via EUSurvey, implementation of the Regulation (among others during the energy crisis) and the assessment of Member States' risk assessments, preventive action plans and emergency plans. In addition, the report reviewing the Electricity Risk-Preparedness Regulation is legally due by September 2025 (which was therefore elaborated in parallel to this fitness check report) was essential to feed the gained experience of implementing this Regulation into this fitness check[226]. Both the reports on the Gas Security of Supply Regulation and Electricity Risk-Preparedness Regulation were key inputs for this fitness check report.

The experience gained from addressing the energy crisis informed this report, as the energy crisis served as a real-life test of the adequacy of the legislative framework. This includes the daily

[225] https://energy.ec.europa.eu/topics/energy-security/security-electricity-supply/risk-preparedness-plans-electricity-sector-national-competent-authorities-and-commissions-opinions_en

[226] COM(2025) 539 final.

management, coordination and communication during crisis situations, such as the unilateral suspensions of supplies by Gazprom during 2022, as well as the Nord Stream and Balticconnector sabotage. In addition, this includes the drafting of the annual reports on the Gas Storage Regulation[227] and the adoption of the annual implementing acts to set the intermediary filling targets[228], the reports on the Gas Demand Reduction Regulation[229] and the report on the Solidarity Regulation[230]. The reports on the Gas Storage Regulation, the Gas Demand Reduction Regulation and the Solidarity Regulation were key inputs and data sources for this fitness check report. The development of an Interactive Gas Monitoring Dashboard to Boost EU Security of Gas Supply[231] has helped following the Security of Gas Supply situation and provided also input to the fitness check report.

*Consultation activities*

As is further detailed in Annex V containing the synopsis report, a 12-week Call for Evidence and Public Consultation were carried out to gather views of citizens and stakeholders. A total of 86 respondents provided feedback to the Call for Evidence and 114 respondents replied to the public consultation.

The call for evidence and public consultation were part of the consultation strategy, which was approved by the ISG on 10 July 2024. All goals and consultation activities set out in the consultation strategy were carried out and/or used for this fitness check (call for evidence, public consultation, Commission expert group meetings, regulatory roundtable, Eurobarometer).

The public consultation was designed to consist of five sections, of which the last three respondents had to actively chose to answer, as they contained questions targeted to a more expert audience.

A generic energy security section with mostly open question for a wide audience (including non-expert audience) to give their views on their perception of the EU's energy security framework.

Optional: a specific section on the wider energy security framework, that contained more detailed questions on matters related to energy security at large, or issues that matter to both gas and electricity.

Optional: a specific section on the functioning of the gas security of supply framework, mostly targeting the provisions on the Gas Security of Supply Regulation, and to a lesser extent also the provisions of the Gas Storage Regulation and the emergency Regulations adopted during the energy crisis.

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227 COM(2023) 182, COM(2024) 89, COM(2025) 98

228 Regulation (EU) 2022/2301, Regulation (EU) 2023/2633 and REGULATION (EU) 2024/2995

229 COM(2023) 173, SWD(2023) 63 and COM(2024) 88

230 COM(2023) 547

231 See: Interactive gas monitoring dashboard to boost EU energy security - European Commission

Optional: a specific section on the functioning of the electricity security of supply framework, mostly covering the provisions of the Electricity Risk-Preparedness Regulation.

The specific sections on gas and electricity security of supply each contained questions aimed to assess the respondents' perception of the five criteria used to evaluate the Regulations (effectiveness, efficiency, coherence, EU added value and relevance). A mix of closed questions (to evaluate a set of pre-defined existing provisions) and open questions (to try to eliminate potential biases or information gaps) were used. A particular effort was made to raise awareness of this consultation among stakeholders and in the general public, beyond the sole publication on the Europa website. The Commission advertised it by the means of several publications on social networks[232] and of multiple presentations to various audiences.

In addition, several forward-looking questions were included in order to gauge respondents' perception of which areas of improvement there could be for the Regulations within the scope of this fitness check. These forward-looking questions also helped to evaluate the future relevance of the Regulations.

The public consultation contributions were analysed by the Commission's Joint Research Centre, using a mixed-methods approach. Statistical tools were applied to closed questions, with results presented both at the overall level and by stakeholder category. Open questions were categorised by stakeholder group and evaluated qualitatively, allowing for a more in-depth understanding of the responses and detailed insights into respondents' views.

The call for evidence and public consultation were useful exercises to inform the Commission of views from stakeholders and citizens alike, but the sample is by no means representative of the EU population at large. While a significant number of stakeholders that are directly affected by the Regulation responded, the views of citizens on EU energy security are still comparatively undetected. In addition, the public consultation in particular was a rather long and complex questionnaire, which may have discouraged participants from filling in the questionnaire, especially the less directly concerned stakeholders and citizens. To combat respondents' fatigue, at the beginning of the questionnaire the option was given to only answer the first section, which drastically shortened the questionnaire.

More information on the details of the call for evidence and the public consultation can be found in Annex V.

*Table-top exercises ("dry runs")*

Two table-top exercises ("dry runs") to stress-test the EU framework against crisis situations were organised in December 2022 and November 2024 by the Commission. These simulation exercises made it possible to test: (i) the emergency procedures and system resilience of the EU's gas system; and (ii) the interlinkages between the EU's gas system and its electricity system. The vast majority of Member States participated in both exercises, as well as the European Network of Transmission System Operators for Gas (ENTSOG) and relevant national transmission system operators (TSOs).

[232] E.g. on Twitter on 17 October (https://x.com/Energy4Europe/status/1846809954205708611) and 9 November (https://x.com/Energy4Europe/status/1855251496578757106).

For the 2024 exercise, Ukraine, Moldova, the Energy Community Secretariat, the European Network of Transmission System Operators for Electricity (ENTSO-E), and certain national electricity TSOs also participated.

These *dry runs* were designed as a discussion-based exercise in which participants met in a "classroom" setting to address the actions they would take in response to a series of events. Participants received information about a scenario affecting the gas supply in Central and Eastern Europe where a series of events trigger emergency declaration. A facilitator helped guiding the discussion by asking questions designed to address the exercise's objectives. In addition, participants were invited to fill in templates for answering the specific questions.

Participants came to the exercise ready to discuss the national and regional measures foreseen under emergency level as well as the actions to take in case of solidarity need or solidarity request. The rules of the exercise were:

- Work within the framework of the Gas Security of Supply Regulation (Regulation (EU) 2017/1938) and Regulation (EU) 2022/2576 on enhancing solidarity;
- Participants needed to bring with them all material deemed necessary for addressing a crisis situation (mobile phone, laptop, moderate quantity of printed material, e.g., emergency plan of the country they represented);
- Participants were to adhere to the scenarios and work with the information provided and available in their organizations;
- Participants should interact with other colleagues and discuss actions as they would do in a real emergency situation;
- Participants were required to act assuming that they had all the necessary information. Only if this information does not exist in their organization, they must report this fact;
- There are no "wrong" answers, everyone's opinion is valid;
- Time slots allocated were to be respected and instructions of the facilitator were to be followed.

In the meeting, the Chatham House Rule applied (participants were free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, might be revealed).

The overall goal of the exercise was to draw a number of lessons learnt and to formulate suggestions for improving the capacity of national authorities, gas (and electricity) Transmission System Operators (TSOs) of the Member States, and the Commission in reacting adequately to gas emergencies and mitigating as much as possible their effects through the application of their Emergency Plans and solidarity cooperation mechanisms.

For the 2022 exercise, all Member States and the European Network of Transmission System Operators for gas (ENTSOG) were invited to participate in the exercise. Eleven Member States (Austria, Bulgaria, Czech Republic, Greece, Germany, Hungary, Italy, Romania, Slovenia,

Slovakia, and Spain), the Commission and ENTSOG had an active role, while most other Member States attended as observers.

The specific objectives for the 2022 exercise were as follows:

- Assess the EU preparedness in case of a gas emergency and the functioning of the solidarity mechanism;
- Test the regional coordination among Member States;
- Enhance regional decision making and response capacity;
- Share experience and exchange lessons learnt.

The exercise was conducted by means of a scenario that develops in two phases. During the first phase, a series of events affect the gas supply in Central Eastern Europe triggering the emergency declaration of several Member States. The scenario sets the framework to assess the response to the emergency declaration under the Gas SoS Regulation. The scenario progressed towards a succession of events that unchained the need of solidarity by some Member States. The solidarity mechanism is assessed in the second phase of the scenario.

Participants were divided in two groups (A & B) during the session dedicated to emergency to promote discussion and benefit from the interaction of a smaller group. As for the second phase, due to the need of assessing the solidarity mechanisms at EU level, the participants met in a common group during the session dedicated to solidarity.

For the 2024 exercise, all Member States, as well as Ukraine and Moldova, the Energy Community Secretariat, ENTSOG and ENTSO-E were invited to participate in the exercise. Twelve Member States (Austria, Bulgaria, Croatia, Czech Republic, Greece, Germany, Hungary, Italy, Poland, Romania, Slovenia, and Slovakia), Ukraine and Moldova, the Commission and ENTSOG had an active role, while the other 13 Member States and participants attended as contributors.

The 2024 exercise was similar in format to the 2022 exercise. The key difference was the emphasis on testing the joint preparedness with Ukraine and Moldova for the expiry of the gas transit agreement through Ukraine. In addition, the interaction between the gas and electricity systems in case of a cross-sectoral crisis was tested, as well as the preparedness in case of a cybersecurity incident in the gas sector.

While the dry run exercises were crucial to test the emergency procedures in case of a crisis, they cannot cover all types of crises. This means that despite their comprehensive nature and the positive feedback received from participants, more exercises are needed to adequately test all the various procedures and provisions relevant to different crisis situations. In addition, they are simulation exercises, meaning that there may be a discrepancy between how participants react during the simulation and how participants would react during a real crisis. It also means that assumptions had to be made regarding the nature and severity of the crisis, which in real life of course may differ.

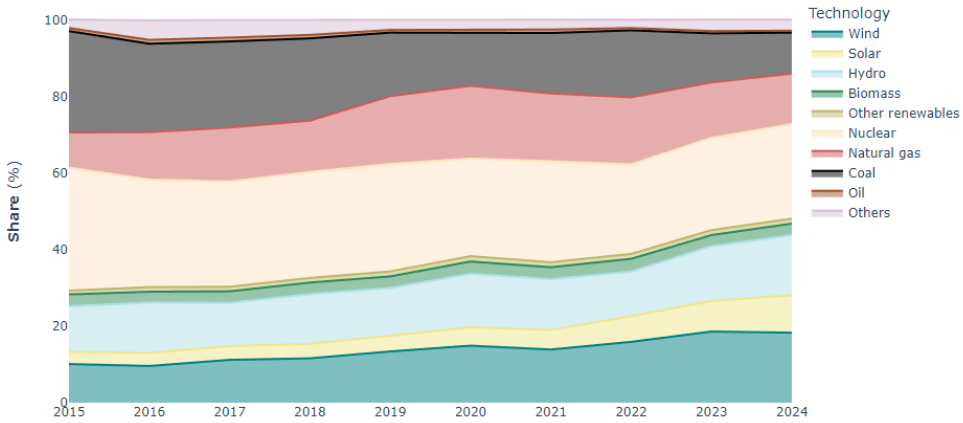
*Desk research*

Extensive desk research was carried out, with the support of the Commission's Joint Research Centre, to give scientific and analytical backing to this fitness check. This desk research was based on a set of indicators that predominantly featured in the chapter 3 "how has the situation evolved over the evaluation period" and chapter 4 "evaluation findings".

Indicators used to assess the Regulations as well as the overall security of gas and electricity supply situations in the EU include:

Overarching energy indicators, such as the EU energy mix (gross inland consumption), electricity power generation per technology (see graph below), EU annual gas consumption and the electrification rate of final consumption in the EU. These indicators were chosen to provide a comprehensive picture of the energy landscape, which serve as the foundation for evaluating security of electricity and gas supply as they shed light on how diverse and resilient the energy sources are, influencing the stability and sustainability of energy supply. The bulk of data for these indicators is publicly available on Eurostat, the ENTSOG, ENTSO-E and GIE AGSI+ and ALSI+ transparency platforms.

***Figure 42: Electricity power generation per technology***




*Source: ENER Chief Economist Unit, based on Fraunhofer and ENTSO-E data*

EU natural gas imports, the share of natural gas imports (LNG vs pipeline) and the Herfindahl-Hirschmann index (HHI) were used to evaluate the risk landscape related to natural gas imports. The EU natural gas imports give an overview of how the EU's gas imports have changed over the years and show on which third countries there may be a potential dependency and the order of magnitude of such a potential dependency. The share of pipeline vs LNG of natural gas imports was chosen in order to assess the change in reliance on the global LNG market vs the reliance on suppliers on the other side of pipeline import routes. This is important because since the Russian invasion of Ukraine, the EU has moved towards importing more natural gas via LNG, which brings risks (geopolitical or otherwise) and for which there are different infrastructure needs. The HHI index was used to provide a measure of diversification of EU natural gas supplies, which is imperative for assessing the security of gas supply in the EU. Energy import origin concentration index shows in one figure, how varied import origins of energy sources are. It is based on the Herfindahl-Hirschman index (HHI) principle, i.e. adding the square of the shares of every origin

in the total import. This indicator lies in the interval [0, 1]. Lower values of this index mean more diversified origins, higher values mean more concentrated origins. Calculations are based on EUROSTAT data nrg_ti_gas and nrg_te_gas. An unspecified origin is also included for the HHI indicators.

To paint the picture of the degree of interconnectedness between the gas and electricity systems, the percentage of electricity produced with gas and the percentage of gas used for producing electricity have been calculated. This has been done based on Eurostat data, by dividing gross electricity production with natural gas in TWh (PE_NG) by final consumption of electricity in TWh (FCE), and transformation input of NG for electricity and combined heat and power in TWh (TI_EHG) by inland consumption of natural gas in TWh (IC_NG). This is an oversimplification of the situation and is merely indicative. In reality, the interconnectedness also depends on e.g. how critical the gas volumes are to the adequacy of the electricity system, not just the volumes of gas used for electricity. The latter also depends on the role that gas-fired power plants have in an electricity system (e.g. whether it is used as back-up generation).

For electricity, the Loss of Load Expectation (LOLE) and Expected Energy Not Served (EENS) are key indicators. LOLE in a given geographical zone and for a given period is the expected number of hours during which a lack of market-based resources is expected to cover the demand needs with sufficient transmission grid operational security limits. This indicator is very useful to give an overview of adequacy over longer periods and is commonly used in adequacy assessments such as the European Resource Adequacy Assessment. It is expressed in hours per year. EENS in a given geographical zone and for a given period is the energy (MWh) which is expected not to be supplied due to a lack of market-based resources retaining sufficient transmission grid operational security limits. This indicator describes the magnitude of adequacy issues expressed in energy for an analysed season. It is expressed in GWh(MWh)/year.
The share of centralised and decentralised electricity generation is an important indicator, as a more decentralised system is more resilient to market volatility and disruptions on the transmission system. The figures used in this fitness (see table below) are estimations based on ENTSO-E statistical factsheet 2023 and CETO 2024. It should be noted however that there are some uncertainties regarding the exactitude of the below figures, because of high discrepancies across databases.

***Table 2: Installed centralized and decentralized electricity generation capacities in 2024 (nominal)***

| Centralised | GW |
|---|---|
| **Nuclear** | **94** |
| **Fossil fuels** | **307** |
| **Waste** | **6** |
| **Other non-renewable** | **13** |
| **Hydro pumped storage** | **39** |
| **Hydro ror and reservoir** | **108** |
| **Wind** | **285** |
| **Solar Thermal** | **2** |

| | |
|---|---|
| **Solar PV** | **146** |
| **TOTAL** | **1000** |

| **Decentralised** | **GW** |
|---|---|
| **Hydro run-of-river** | **3** |
| **Solar PV** | **201** |
| **Biogas** | **12(*)** |
| **TOTAL** | **216** |

*Source: JRC estimations, ENTSO-E statistical Factsheet 2024 and CETO 2025 data[233]. Biogas data refers to 2023.*

Assessing the vulnerability of the EU's energy system to cyberattacks is challenging due to a lack of official statistics at EU level. However, the number of successful cyberattacks per year against European energy and utility companies has been used, in order to provide an indication of the threat level face by European energy undertakings. Data stems from a Energicert report of September 2022, from the Danish critical sectors' cybersecurity centre, which monitors the cyber threat to Danish critical sectors. The report is based on public sources only, for security reasons, meaning that the accuracy of the data may not always be guaranteed by Energicert as they rely on third sources, as indicated in their 2022 report.

Extreme weather events are affecting the EU's energy system (electricity system in particular), and protection of critical energy infrastructure against extreme weather events is of paramount importance to EU security of electricity and gas supply. Therefore, the number of extreme weather events in Europe (including a split per type of extreme weather events for 2019-2022) has been included. The graph and data come from the European Environment Agency, Climate Change, impacts and vulnerability in Europe 2022, European Severe Weather Database (ESWD), Copernicus Emergency Management Service (CEMS) 2022 Annual report and International Disaster Database (EM-DAT). (2022). EM-DAT Data.

Governance quality was assessed by using the World Bank's Worldwide Governance Indicators (WGI). WGI reports on six broad dimensions of governance for over 200 countries and territories over the period 1996-2023: 1) voice and accountability, 2) regulatory quality, 3) political stability and absence of violence/terrorism, 4) rule of law, 5) government effectiveness, 6) control of corruption. It is based on over 30 underlying data sources, and six aggregate indicators are created by using a statistical methodology known as an Unobserved Components Model (UCM).[234] For this report, the eleven top supplying third countries were selected, using the allocated WGI grade between -2,5 and 2,5 for each of six indicators. The higher the grade, the better for governance quality. The EU average grade was computed by multiplying the countries' average grades by their

[233] JRC Clean Energy Technology Observatory (CETO) Technology Reports, available at: https://setis.ec.europa.eu/publications-and-documents/clean-energy-technology-observatory/ceto-reports-2025_en

[234] The methodology is fully available online: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099005210162424110

relative share in EU gas imports. Datasets are available at: https://www.worldbank.org/en/publication/worldwide-governance-indicators

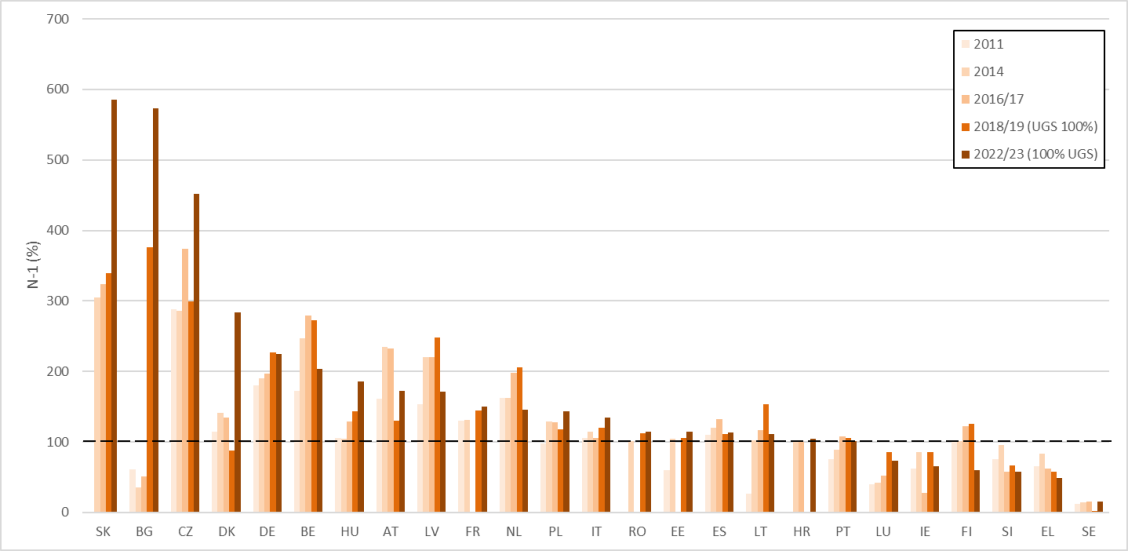
To assess the state of play of the implementation of the evaluated Regulations, the amount of submissions of deliverables due under the evaluated Regulations (and their timeliness), the amount of Gas and Electricity Coordination Group meetings, the amount of crisis levels declared, the amount of storage certifications adopted and pending, the amount of solidarity agreements and the amount of infringement procedures have been included as indicators. This paints a picture of whether there are any issues with implementation for Member States, which could either indicate a high administrative burden, or a lacklustre implementation. Data comes from the European Commission's Directorate-General for Energy, based on Member States' submissions of the various deliverables (risk assessments, plans and/or methodologies) or Gas and Electricity Coordination Group meetings. However, evaluating the exact state-of-play of implementation goes beyond assessing these indicators and can at times be more intangible. For example, the level of preparedness to a gas or electricity crisis does not merely depend on having adequate plans or risk assessments, but also on human factors and behaviour during an actual crisis.

For the infrastructure standard indicator data has been provided by Member States' preventive action plans and the Commission's Joint Research Centre has collected them. The N-1 indicator is calculated according to the formula set out in Annex II in Regulation (EU) 2017/1938, which is:

$$N-1\,[\%] = \frac{EP_m + P_m + S_m + LNG_m - I_m}{D_{max}} \times 100,\ N-1 \geq 100\ \%$$

The exact definitions of the parameters are provided in Annex II of Regulation (EU) 2017/1938. This indicator measures the technical capacity of a national gas network to satisfy an exceptional daily gas demand when losing its largest infrastructure. The parameters in the formula are the addition of the technical capacity of entry points in mcm/d ($EP_m$) maximal technical production capability in mcm/d ($P_m$), the maximal technical storage deliverability in mcm/d ($S_m$), the maximal technical send-out capacity of all LNG regasification facilities in mcm/d ($LNG_m$), the technical capacity of the single largest gas infrastructure in mcm/d ($I_m$) and the total daily gas demand during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years ($D_{max}$). Some Member States have provided two values for storage deliverability either at 30% filling or 100% storage filling levels which affects the withdrawal capacity of underground gas storages (affecting parameters $S_m$ and potentially $I_m$). In this case, 100% storage filling has been chosen, as this value was provided by all Member States and for comparison purposes with years before 2017 (in the old Regulation (EU) 994/2010 the indicator was requested only at 100% storage filling level). Additionally, a box plot of the bi-directionality indicator of all borders inside the EU from 2017 to 2023 has been included, with 1 being full bi-directionality of all pipeline interconnection points and 0 meaning all pipeline interconnection points being unidirectional. For each border, the smallest capacity is divided by the largest (values between 0 and 1). The maximum number of possible values is the number of borders. Capacities are taken from ENTSOG's transparency platform. While both indicators are indispensable to assess the EU's security of gas supply and while it is certainly likely that the Gas Security of Supply Regulation provided incentives to comply with the Regulation, the causal relationship between the two is difficult to establish.

*Figure 43: Infrastructure standard (N-1) per Member State*




*Source: Commission's Joint Research Centre, based on Member States' plans*[235]

For the energy crisis, several indicators were included in this report. The storage filling during 2021-2022 of underground gas storages that were owned by Gazprom (or where Gazprom had user rights to the storage facility) and the non-Gazprom storages was included, produced by the Commission's Joint Research Centre based on GIE AGSI data. This indicator is useful to highlight the market behaviour of Gazprom that was one of the main causes of the energy crisis. In addition, the wholesale electricity prices (in €/MWh) across the EU, as well as the average lowest (Sweden) and highest (Italy) during the crisis were shown. This shows the impact of the energy crisis, since the main impact of the supply cuts were an increase in prices. One of the main ways the energy crisis was tackled, was by reducing gas demand to re-establish the supply-demand balance after the gas supply cuts from Russia. Therefore, the monthly natural gas demand reduction compared to the 5-year reference period included in the Gas Demand Reduction Regulation (EU) 2022/1369 has been used as an indicator, to track the progress of this response to the energy crisis. The reference period is defined as the average of the previous 5 years for the period August 2022 to May 2023 (as laid out in the demand reduction regulation). Therefore, for August-December it refers to 2017-2021, but for January-May to 2018-2022. Data comes from Eurostat's nrg_cb_gasm.

It is difficult to find reliable data on blackouts as many authors have reported[236]. Most data comes from the US that is more used to extreme weather events. An exception is the Nordic and Baltic regions which publish a detailed annual report on faults, disturbances and energy not supplied (ENS) in their transmission alternating current (ac) power grids, including a detailed analysis on individual components of the grid.

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235 Three Member States with small and isolated gas markets (SE, LU, SI) are exempted from the N-1 rule, due to Article 5(9) of the Gas Security of Supply Regulation.

236 See for example, Sanja Duvnjak Žarković, Xavier Weiss, and Patrik Hilber, 'Addressing Data Deficiencies in Outage Reports: A Qualitative and Machine Learning Approach', *Electric Power Systems Research* 236 (1 November 2024): 110901, https://doi.org/10.1016/j.epsr.2024.110901.

The estimation of cost incurred due to a blackout is typically built considering the following two indicators:

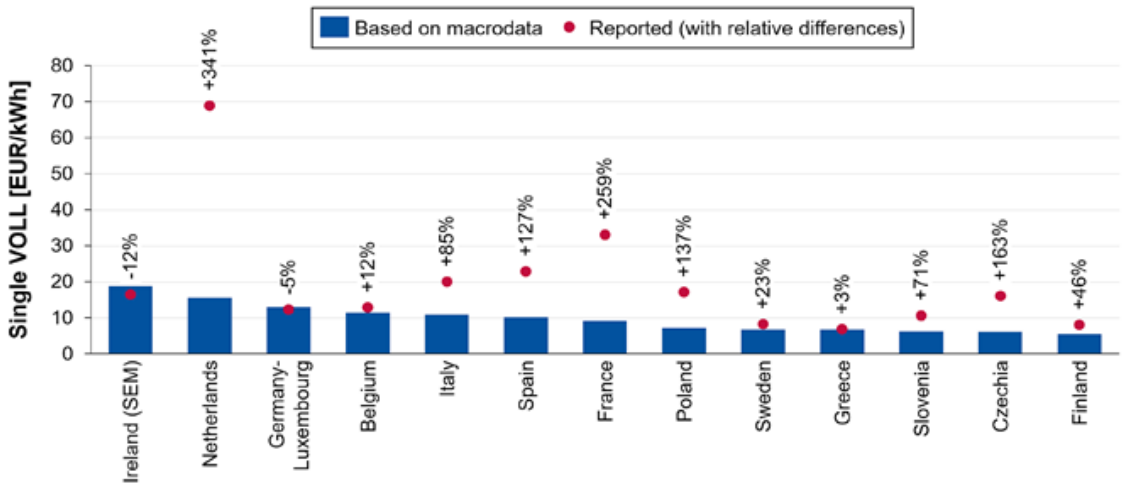
Energy not supplied (ENS): an estimation of the amount of energy which would have been supplied to end-users if no interruption of electricity had occurred. Each operator estimates its value following different procedures[237].

Value of Lost Load (VoLL). It is a measure used to quantify the damage caused by interruptions of electricity supply (€/MWh). There are several methods for determining its value based on surveys, macro-economic data, or revealed preferences. The use of surveys is a very common approach, in particular when the focus is on households. There are three different survey-based approaches for estimating the VoLL: willingness-to-pay (WTP), willingness-to-accept (WTA) and direct worth. Several factors influence the estimation of VoLL by end-users: specific power interruption scenario, specific sector, outage duration (few hours are acceptable for many consumers, but unit cost increases exponentially with the duration of the disruption of electricity), period of occurrence (day/night, season), societal cost, if there is a pre-notification or not, etc. Figure 35 represents the discrepancy of VoLL values depending on the method used for its estimation. It should be noted that ACER has adopted in 2020 a methodology for calculating the VoLL, the cost of new entry and the reliability standard[238].

[237] ENTSOE, 'HVAC Nordic and Baltic Grid Distrubance Statistics 2023', 11 December 2024, https://eepublicdownloads.entsoe.eu/clean-documents/SOC%20documents/Nordic/2024/HVAC_NORDIC_AND_BALTIC_GRID_DISTURBANCE_STATISTICS_2023.pdf.

[238] https://acer.europa.eu/sites/default/files/documents/Decisions_annex/ACER%20Decision%2023-2020%20on%20VOLL%20CONE%20RS%20-%20Annex%20I.pdf

***Figure 44: VoLL value estimation based on macro data (blue bar) or survey-based (red point).***




*Source: ACER webinar on the implementation of the EU methodology for electricity adequacy metrics. 5 June 2024*

The cost of short-term, limited geographic-scale power disruptions has been studied for many years, but there is a lack of studies and methods to estimate the cost of long duration disruptions (typically more than one day) and large geographical scope[239]. One of the main barriers is the difficulty of assessing the social impacts of large outages.

To the best of our knowledge there are currently three tools to assess the cost of outages: two tools focus on the US: i) the interruption cost estimate calculator[240], ii) the power outage economic tool (POET), not yet published. The third tool is the blackout-simulator[241], which focuses on Europe. It is worth mentioning that as the main input data of these tools is based on surveys (at least for the households' segment), it is not adequate to use the tools developed in the US due to the significant differences in electricity prices between the US and Europe. A summary of the main characteristics of the blackout simulator tool is provided, cofounded by the Commission under FP7 with grant number 261696, including its main limitations[242]:

Blackout simulator considers the economic costs for companies, institutions and establishments, and households' willingness to pay (WTP) to avoid power cuts.

The tool was developed to estimate power outage costs for the period from 2000 to 2017. In particular, the data for the estimation of household sector costs is based on a survey conducted in 2012 considering information from 8300 households.

239 'Frontiers in the Economics of Widespread, Long-Duration Power Interruptions. Proceedings from an Expert Workshop' (Lawrence Berkeley National Laboratory, January 2019).
240 https://www.icecalculator.com
241 http://blackout-simulator.com/
242 http://blackout-simulator.com/methodology/

The economic cost estimation does not consider long-term costs of macroeconomic relevance as this cannot be assigned to individual events.

The cost due to damage to, or destruction of the electricity infrastructure is not considered.

The tool cannot be used to estimate outages lasting longer than 48 hours.

For this report, the socio-economic impacts of a second historical black-out were simulated. A dataset on power blackouts in Europe was analysed, and a blackout that occurred in the Balearic Islands on 13 November 2008 was selected as a second case study. This choice was based on availability of information, modelling convenience and the difference with the first example. GDP data for 2008 for the Balearic Island case study was taken from Instituto Nacional de Estadística.[243]

Regarding data on interrupted energy (ENS), the following databases have been considered:
Nordic and Baltic region annual outage reporting[244]

Power blackouts in Europe[245]

**Nordic and Baltic region annual outage reporting system**

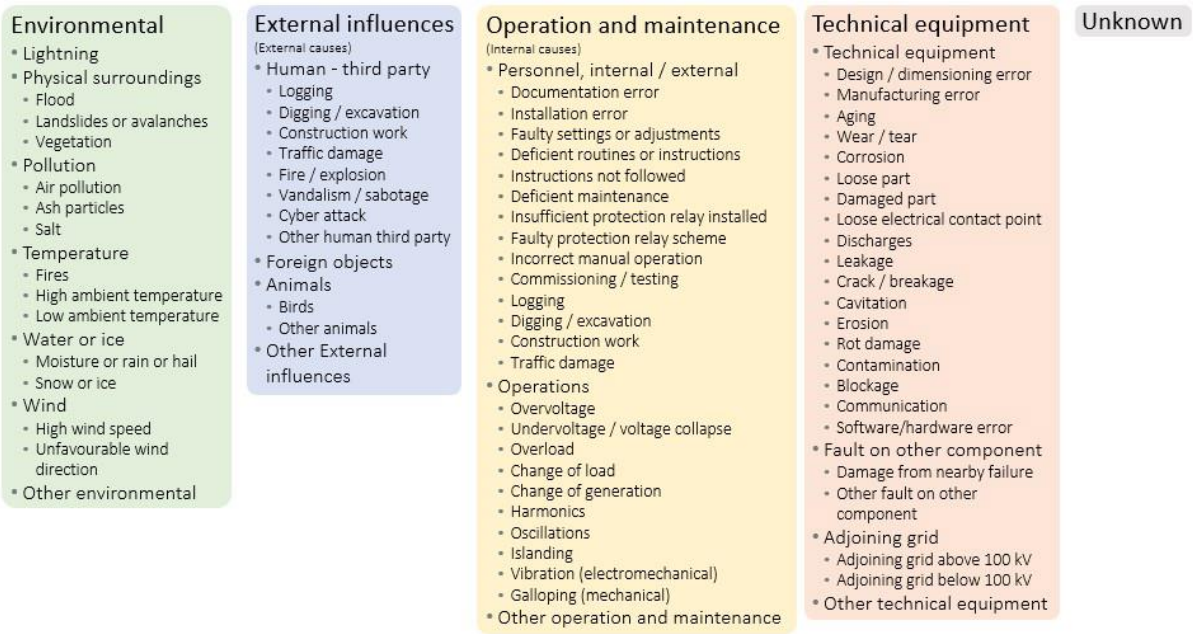
This annual report provides an overview of faults, disturbances and ENS in the Nordic and Baltic 100-420 kV power grids. Out of scope are faults in generation units, faults in grids below 100 kV (most of the distribution grids and local grids), faults during testing or maintenance, or faults in HVDC power lines. Faults are classified according to the criteria shown in the table below.

243 See: https://ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736167628&menu=resultados&idp=1254735576581

244 https://www.entsoe.eu/publications/system-operations-reports/#nordic

245 Andrej Stankovski et al., 'Power Blackouts in Europe: Analyses, Key Insights, and Recommendations from Empirical Evidence', *Joule* 7, no. 11 (15 November 2023): 2468–84, https://doi.org/10.1016/j.joule.2023.09.005.

*Figure 45: Causes of grid faults*




*Source: HVAC Nordic and Baltic grid disturbance statistics 2023. 11 December 2024*

**Power blackouts in Europe**

The authors of this work have compiled 478 severe events from the European transmission system, between 1972 and 2021. The main sources of information are publicly available data, so there is information missing in the database. To summarize, the most common initiator of the failures are weather events, in 32% of all events. Cascading occurrences are the biggest threat due to the highly interconnected European power system. The impact of cascading failures contributes to more than 91% of the total ENS. Seasonality affects the recovery time which is significantly longer in winter due to the high number of physically damaged components. Recovery times are shorter for events with a high impact, which can be explained by the available resources that TSO commit during these extreme events.

While the utmost effort has been made to be comprehensive and to have meaningful and robust results, there are several shortcomings. In particular, there are exogenous factors that influence EU energy security. Energy security is a complex interplay of global dynamics, including geopolitical shifts, international market fluctuations, and the actions of external suppliers. While this report acknowledges these factors, it proved challenging to quantify their actual impacts on both EU security of electricity and gas supply and the results of the evaluated interventions. Establishing causality between provisions of the two Regulations and the subsequent outcomes is therefore in most cases not possible.

In addition, data and streamlined key performance indicators (KPIs) were not always sufficiently available to monitor and evaluate the Regulations, in particular given the large number of hypothetical scenarios for which the Regulation prepares. This may need to be addressed in the future, by adding clear monitoring parameters to assess the performance of the Regulations. Due

to the 'preparedness-paradox', a counterfactual is absent, meaning that it is not possible to determine which crises have been prevented and what their impact would have been.

*Other activities*

In addition to the aforementioned activities, informal exchanges have been held with Member States and stakeholders that have tasks assigned to them by the Regulations. In particular, the Commission's Directorate-General for Energy inquired about costs incurred directly attributable to the provisions of the Regulations, which were used for the costs and benefits overview in Annex IV and the efficiency criteria. Most Member States and/or stakeholders indicated the costs in FTE or hours worked. When the costs reflected administrative costs, they have been kept in units of time and have not been monetised (unless the monetary value was not already provided directly) by using the hourly rate (+25% overhead) of the OIOO tariffs standard cost model. This approach was chosen because the OIOO tariffs at our disposal were outdated (2018) meaning that they likely do not reflect the current rates and because the time spent was not reported for management level or non-management level. All of this means that time spent is a more accurate proxy. Nevertheless, the numbers provided in the Annex are clearly an oversimplification and most likely do not actually reflect the cost incurred for a number of reasons. Firstly, several Member States and/or stakeholders indicated that they found it difficult to estimate the hours or FTE attributable to the Regulations. Secondly, not all Member States and/or stakeholders provided the data needed to give a comprehensive overview. Lastly, due to a lack of data availability, it was not possible to triangulate the data received from Member States and stakeholders, meaning that the numbers may not be robust. The absolute values of the costs therefore should not be taken as absolute truths but are only indicative and should only be used to compare the order of magnitude of costs of the different provisions with one another. For this reason, the approach was taken to provide ranges of reported costs, rather than provide a specific number, which reflects the uncertainty associated with the costs of the Regulations.

In addition, there is a general difficulty of putting a monetary value on (and even quantifying in other ways) the benefits associated with security of supply, due in particular to the absence of an accurate counterfactual. Security of supply policy functions in many cases as insurance for severe but unlikely events. Several of the provisions in the two Regulations will hopefully never have to be used, making their related benefits difficult to assess. Due to the 'preparedness-paradox', a counterfactual is absent, meaning that it is not possible to determine which crises have been prevented and what their impact would have been. Aforementioned simulation exercises such as the blackout simulator, or dry run exercises can give an indicative picture for hypothetical crises but cannot say which events have in fact been prevented (which is the ultimate benefit of the Regulations).

Another activity carried out to inform this fitness check was a strategic foresight workshop, organised by three junior professionals of the Commission's Junior Professional Program, sponsored by Directorate-General for Energy's Unit F4. This workshop was mostly relevant to inform the evaluation based on the 'relevance' criteria, in particular to see whether the current framework is fit for future challenges. While the strategic foresight workshop based on the JRC's Megatrends tool was in informative exercise, the exercise has its limitations. In particular, the Megatrends tool is useful to understand general direction of broader developments that are relevant for EU energy security. However, to translate this into specific policy-relevant insights or

recommendations proved challenging. In addition, the participants consisted of both members from the ISG, representatives from other DGs or agencies that indirectly are affected by energy policy, as well as energy experts from DG ENER. While this provided an appropriate balance between experts and non-experts, discussions often remained at macro-level and recommendations were therefore mostly generic in nature. In order to provide more meaningful strategic foresight, more follow-up workshops would need to be organised. However, given resource constraints, this was out of the scope for this fitness check. More details on the strategic foresight workshop can be found in Annex VI.

## ANNEX III. EVALUATION MATRIX

| EFFECTIVENESS<br>To what extent were the Regulations successful in achieving their key objectives? | | | | |
|---|---|---|---|---|
| **Evaluation questions** | **Sub-questions** | **Judgement criteria** | **Indicators and information requirements** | **Data sources** |
| • **EQ1** – To what extent have the Gas SoS and the Electricity Risk Preparedness Regulations contributed to an increase in security of supply, preparedness and resilience of the EU energy system? | • **EQ1.1** - How well have the Gas SoS and the Electricity Risk Preparedness Regulations protected vulnerable consumers from possible supply disruptions?<br>• **EQ1.2** – Have the assessments of risks improved, in particular with regard to the protection of infrastructure to cyber, physical and ownership risks?<br>• **EQ1.3 -** Have the preventive and emergency measures improved and did they increase the EU's preparedness for supply shocks?<br>• **EQ1.4** – Have infrastructure needs been adequately assessed and addressed to ensure security of supply even during disruption scenarios? | • Continuity of the balance between supply and demand, meaning no shortages, disruptions or blackouts in the face of the risk covered by the Regulations. (**EQ1**).<br>• Sufficiency of the measures together to protect vulnerable customers against supply disruptions (**EQ1.1**).<br>• Quality, realism, completeness and the update frequency of risk assessments and of electricity crisis scenarios (**EQ1.2**).<br>• Robustness of national assessments of physical, cyber and ownership risks related to the pieces of energy infrastructure critical for security of energy supply. (**E.Q1.2)**<br>• Compliance with the SSOs certification obligation. (**E.Q1.2)**<br>• Adequacy of the measures contained in the plans to mitigate the risks identified in the assessments (**EQ1.3**). | **Quantitative indicators**<br>• Number of declarations of crisis levels (**EQ1**)<br>• LOLE/EENS (**EQ1**)<br>• Amount of supply disruptions/ blackouts (**EQ1**)<br>• Diversification of gas supplies (HHI)) (**EQ1**)<br>• Storage filling - percentage of capacity & percentage of protected customer demand (**EQ1**)<br>• Amount of infringement procedures/EU pilots (**all sub-questions**)<br>• Number of SSOs certified (**EQ1.2)**<br>• N-1 (**EQ1.4**)<br>• Bi-directional capacity increase (**EQ1.4**)<br>• Gas supply disruption simulations – (**EQ1**, **EQ1.2**, **EQ1.3, EQ1.4**)<br><br>**Qualitative indicators**<br>• Extent to which supply standard has been implemented by MSs (**EQ1.1**). | **Desk research:**<br>• PAPs/EPs/RPPs<br>• Common and national risk assessments, cyber posture risk assessment<br>• Commission opinions on the Plans (all)<br>• GCG / ECG meetings<br>• Reports reviewing the Regulations, ACER reports, JRC studies.<br><br>**Data sources:**<br>• Eurostat (e.g., nrg_cb_gas(m))<br>• ENTSO-E transparency platform<br>• ENTSOG transparency platform<br>• GIE AGSI transparency platform<br><br>**Other sources:**<br>• ENTSOG simulations and outlooks<br>• ENTSO-E simulations and outlooks<br>• Dry runs, table-top exercises.<br>• Public consultation |

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| | | • Compliance with the infrastructure standards, including bi-directionality requirements (**EQ1.4**).<br>• Sufficiency, availability and actual use of infrastructure to deal with supply cut scenarios, infrastructure disruption scenarios or periods of exceptionally high demand (**EQ1.4**). | • Timeliness and completeness of risk assessments and plans (**EQ1.2**, **EQ1.3**).<br>• Extent to which the Commission's opinions were followed by MS (**EQ1.3**)<br>• Preventive and mitigative measures included in PAPs/EPs/RPPs are consistent with the identified risks (**EQ1.3**). | |

**Answers:**

- **EQ1.1**
  - No instances of mandatory curtailment occurred during the implementation period, neither in gas nor in electricity, which makes the effectiveness of the measures difficult to assess.
  - **Electricity SoS:** there is no protection of vulnerable customers as such. Member States can establish users entitled to receive special protection against disconnection, with regard to public safety and personal security. Usually they include health facilities, essential social services, critical processes in industries: the approaches taken by Member States were quite varied, and the Commission had to request clarifications in several instances. One of the positive outcomes of this measure is that MSs were forced to review their manual load shedding plan; it is questionable whether the *fairness* criteria is sufficiently taken into account in those plans even if it is not a mandatory requirement).
  - **Gas SoS:** protected customers have not been curtailed during the implementation period. In addition, no major issues reported by respondents in implementing or enforcing the supply standard, which is specifically designed to protect the protected customers from supply disruptions. However, in the public consultation, some respondents highlighted the vagueness and the difficult monitoring the supply standard as potential issues. The report reviewing the Gas SoS Regulation pointed towards difficulties estimating protected customers' demand, in particular when it is not on annual basis. Particularly, estimating demand in the two first cases of the supply standard is a challenge when daily metering is not available, as is the case in many countries for small consumers like households.

- **EQ1.2**
  - Overall, the assessment of risks has significantly improved during the implementation period.
  - **Electricity SoS:**
    - Compared to a no-intervention scenario (the 2016 Impact assessment considered that, without an EU-intervention, "risks would still be assessed and addressed on the basis of very different methods, and from a national perspective only"), there is a huge improvement: 1) two regional crisis scenarios report were elaborated ii) there is a common methodology for the identification of scenarios that was developed and approved. This was an important step to improve collective risk assessment. At the same time, the policy objective of improving and harmonising risk assessments and preparedness were not completely met.
    - According to Commission's assessment of the plans, most of them did not provide a sufficient description of the scenarios: scenarios in the first iteration of the RPPs were very shallow, in particular those about gas crisis spillover. When the energy crisis started, some MS had to elaborate ad-hoc scenarios while others had to perform stress test to complement their preparedness.
    - Not all concerned Member States adequately considered outermost regions in the definition of their national electricity crisis scenarios in their RPPs, while recital 20 of the Regulation requires to do so.
    - Overall, the first cycle of regional crisis scenarios was not completely satisfactory (cf. EQ2.1): this led to a recommendation from the ECG and to an update of the methodology.
    - **Ownership risks:** Member States assessed the risks related to the ownership relevant to electricity security of supply and notified the Commission in January 2021. No major risks were identified, and most MS have preventive and preparedness measures in place. But assessment focused on grids (transmission/distribution assets): not much on generation, and no consideration of risks related to the ownership of relevant infrastructure in the gas sector, despite their importance for security of electricity supply, without any clarification on whether that would be relevant for the MS in question or not, which is not always evident.

- **Cybersecurity risks:** For several of the RPPs received, the Commission made recommendations specifically for scenarios on cyber-risks. These scenarios were not addressed in much detail in the plans. The Commission recommended to include a reference to a framework with minimum and advanced cybersecurity requirements, procedures to follow in case of an incident, a description of the roles and interactions between the competent authority and the cyber-specific actors, such as CSIRT, CERT and cyber-specific authorities (considering the link between sectorial response and national level and EU cyber response), including during a crisis, and the links with cyber specific legislation.
- **Physical risks:** RPR requires Member States to assess risks to the security of supply arising from man-made events and to consider appropriate preventive and mitigating measures in their RPPs. However, when it comes to national electricity crisis scenarios, most plans lack a detailed and concrete assessment of threats related to physical attacks, despite their potential to significantly disrupt electricity supply. Strengthening these scenarios is essential to ensure a more robust response framework, particularly in light of the increasing targeting of critical energy infrastructure. Enhanced cross-border coordination and information sharing among Member States are also crucial to effectively anticipate and mitigate such risks. This information is however considered as very sensitive by MSs.

- **Gas SoS:**
  - ENTSOG carried out three EU-wide simulation (2017, 2021, 2025) on which CRAs had to be based.
  - CRAs have been developed in regional risk groups, which did not exist prior to the implementation of the Gas SoS Regulation. National risk assessments were not reported to the Commission prior to an EU intervention being in place.
  - Without the Gas SoS Regulation, the situation would most likely be similar to the one described in the 2016 IA's baseline scenario, i.e. e risk assessments and plans will continue to be national and uncoordinated. The implementation pre-2016 has shown that they had very different focuses and paid little attention to common or coordinated scenarios and actions in the case of a supply disruption and the cross-border impact of national measures were not taken into account to the necessary extent. At the same time, the policy objective of enhancing preparedness through assessing risks has mostly been met, although there are still areas that do not fully meet this objective.
  - **Ownership risks:** Member States are required (if relevant) to take risks relating to the control of infrastructure in the national risk assessment (e.g. due to third country ownership of infrastructure), as well as cybersecurity risks and threats to critical infrastructure, especially if it can become an N-1 situation. Yet in only 5 out of 25 national risk assessments that were submitted to the Commission, the risk related to control of critical infrastructure was assessed. No significant impacts resulting from control of infrastructure were identified. While a number of certifications of storage system operators are still pending, there is currently no available evidence that storage ownership or storage operators could put the security of gas supply of the EU at immediate risk.
    - **Cybersecurity risks**: were identified in 14 out of 25 national risk assessments, usually in the form of a cyberattack on infrastructure.
  - **Physical risks**: physical threats to infrastructure were identified in 12 out of 25 risk assessments, usually due to terrorist attacks or sabotage of critical infrastructure.

- **EQ1.3**
- **Electricity SoS:**
  - The RPPs exercise obliged Member States to establish procedures and mechanisms to inform the public in case of an electricity crisis (the European Commission requested additional information in only 2 cases) as well as to review their manual load shedding plans, thereby reinforcing preparedness throughout the EU.
  - However, the overall level of RPPs could be improved, and in 16 cases the Commission considered that the plans have to be amended to include further information on some national measures, including on procedures and corresponding information flows, triggers, and conditions or their application (especially for non-market-based measures).
  - However, the quality of national measures in the plans was satisfactory (e.g., double fuel obligation for gas-fired power plants) and the link with national crisis scenarios was well-established.
  - On emergency tests, most of the plans lacked concrete information to actually carry out the tests. During the RPPs exercise, the Commission requested additional information about those tests in 18 cases. In most cases, the calendar was missing; 3 plans were not referring at all to the mandatory tests.
- **Gas SoS**:
  - The Commission opinions recognised the overall quality and completeness of the Member States' plans, in particular as regards the description of the specificities of the national gas systems. Thanks to this provision, Member States are obliged to make the necessary crisis arrangements, take into account their neighbouring Member States when designing them and ultimately also consult them on the measures they are intending to take in case of a crisis. Having plans in place brings a predictable and transparent framework for action.
  - All Member States now have preventive and crisis measures in place, which is a positive outcome of the Regulation. Usually the process, the appointed crisis managers, as well as the roles and responsibilities during a crisis are well described, which brings added value as it helps to identify the relevant actors during a crisis, for stakeholders and for neighbouring Member States.

- In addition, the description of the national gas system that is required by the templates, is usually of high quality and brings a better understanding of the national system, as well as their interlinkages with neighbouring systems.
- As indicated in the Commission opinions, both in the plans of 2019 and 2023, the preventive measures described in the PAP and the crisis mitigation measures described in the EP are generally measures that are adequate to tackle or prevent crisis. However, the weakness is that they are often not tied to the risks identified in the risk assessments. There is a logical sequence in deliverables in the Regulation, with first providing risk assessments and then producing the plans. While it is a requirement of the Regulation, in practice this has not sufficiently been applied by Member States, making this sequence of deliverables less effective and less coherent.
- Areas of improvement identified in the Commission's opinions were:
- PAPs in the 2023: (1) insufficient regional dimension, (2) inadequate identification of critical gas-fired power plants, (3) lack of clear definition and estimation of volumes of (solidarity) protected customers, (4) inadequate preventive measures that are not associated with identified risks and (5) lack of distinction between market-based and non-market-based measures.
- EPs in the 2023: (1) lack of clear definition of parameters used to declare crisis levels, (2) unclarity regarding the measures to be adopted per crisis level, (3) insufficient consideration of measures to protect electricity generation and district heating and (4) a lack of an adequate regional dimension with insufficient description of cooperation mechanisms.
- PAPs in 2019: (1) details on stakeholder consultation, (2) information on the (enforcement of) the supply standard and lack of information on the infrastructure standard, (3) inaccurate information on (solidarity) protected customers, (4) details on the regional and national gas systems, (5) insufficient assessments of the impact of preventive measures on the economy, the internal market, consumers and the environment.
- EPs in 2019: (1) lack of regional chapters due to lack of solidarity agreements, (2) plans don't mention the quantitative impacts of measures and often no explicit priority orders are defined, (3) interruptible contracts and fuel switching are often mentioned but not clear when it would be activated and what their expected impact would be.
- All in all, it means that the policy objectives to have (1) adequate levels of regional and EU-wide cooperation and information sharing, (2) establish clear roles and responsibilities for crisis situations, and (3) enhance preparedness and transparency of measures have largely been met. However, there is room for improvement to adequately enhance preparedness through a risk-based approach through the risk assessments and plans.

**EQ1.4**

- **Electricity SoS:**
  - No infrastructure standard as such. Article 5 only requires ENTSO-E to consider "*accidental hazards going beyond the N-1 security criterion and exceptional contingencies*" in the identification of regional crisis scenarios.
  - Article 11(1)(k) requires Member States to include in their RPPs "*information on related and necessary plans for developing the future grid that will help to cope with the consequences of identified electricity crisis scenarios*". But most of the Member States did not include such information. As part of the RPPs exercise, the Commission requested more information on this point in 14 cases.
- **Gas SoS:**
  - N-1 has significantly improved over the years, with only Greece and Ireland not meeting the N-1 standard (apart from those exempted). In 2023, Finland also temporarily did not meet the N-1 requirement due to the Balticconnector disruption, which is now back in operation. The Finnish example demonstrated the relevance of such criteria, as without a situation where it complied with the N-1 standard, it would have had severe difficulties to cope with such a disruption.
  - Reverse flows due to bi-directional capacity, helped shifting flows from West to East after RU supply cuts in 2022. Bi-directional capacities have significantly increased over the evaluated period.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
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| • **EQ2 –** To what extent have the Gas Security of Supply and the Electricity Risk Preparedness Regulations | • **EQ2.1** – To what extent have the Electricity Risk Preparedness and the Gas SoS Regulations | • Embedding of cross-border risks within common risk assessments and | **Quantitative indicators**<br>• Amount of ECG, GCG, regional risk group and Crisis Management Group meetings (**EQ2**, **EQ2.1**, **EQ2.3**, **EQ2.4, EQ2.5**)<br>• Amount of infringement procedures/EU pilots (**all**) | **Desk research:**<br>• PAPs/EPs/RPPs |

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| contributed to enhanced coordination among Member States, as well as EU-wide and regional cooperation, especially during crises? | contributed to improving regional risk assessments, reducing cross-border risks, or to reducing national measures that negatively affect neighbouring countries?<br>• **EQ2.2** – To what extent have the Electricity Risk Preparedness and the Gas SoS Regulations contributed to the adoption of regional measures by Member States?<br>• **EQ2.3** – To what extent have the Electricity Risk Preparedness and the Gas SoS Regulations increased transparency and information sharing among Member States, and between Member States and the Commission?<br>• **EQ2.4** – Has regional and EU-wide cooperation been effective over the implementation period?<br>• **EQ2.5 –** To what extent have emergency cooperation and joint crisis management been effectively implemented? | regional crisis scenarios (**EQ2.1)**<br>• Absence of restrictive measures with adverse effects on neighbouring countries in PAPs/EPs/RPPs (**EQ2.1**)<br>• Non-implementation of restrictive measures with adverse impacts on neighbouring countries during a crisis (**EQ2.1** & **EQ 2.5**).<br>• Joint elaboration of risk assessments in risk groups (**EQ2.1** & **EQ2.3**).<br>• Consultation of plans with neighbouring MSs (**EQ2.1** & **EQ2.3**).<br>• Functional information exchange, coordination and cooperation through ECG, GCG, Regional risk groups, RCCs (**EQ2.3 & EQ2.4**).<br>• Operationality and effectiveness of ECG, GCG and the Crisis Management | • Amount of solidarity agreements (**EQ2.5**)<br>• Gas supply disruption simulations – ( **EQ2.1**)<br>• Amount of times EU/MSs tested crisis management procedures and provisions in their plans, e.g. via TTXs (**EQ2.4**, **EQ2.5**).<br>• Number of measures to restrict cross-border energy trade included in RPPs/PAPs/EPs. (**EQ2.1)**<br>• Number of measures to restrict cross-border energy trade implemented during crisis situations. (**EQ2.1)**<br>• Number of regional measures includes in RPPs/PAPs/EPs (**EQ2.2**)<br><br>**Qualitative indicators**<br>• Timeliness and completeness of risk assessments and plans (**EQ2**, **EQ2.1**, **EQ2.2**, **EQ2.3**, **EQ2.4**).<br>• MSs were sufficiently consulted on each other's plans and risk assessments (**EQ2.1, EQ2.3**). | • Common and national risk assessments<br>• Commission opinions on the Plans (all)<br>• GCG / ECG meetings<br>• Reports reviewing the Regulations, ACER reports, JRC studies.<br><br>**Data sources:**<br>• Eurostat (e.g., nrg_cb_gas(m))<br>• ENTSO-E transparency platform<br>• ENTSOG transparency platform<br>• GIE AGSI transparency platform<br><br>**Other sources:**<br>• ENTSOG simulations and outlooks<br>• ENTSO-E simulations and outlooks<br>• Dry runs, table-top exercises.<br>• Public consultation |

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| | | Group to coordinate during crises (**EQ 2.3** & **EQ2.5**).<br>• Operationality of solidarity to ensure that MSs can offer assistance to another MS in emergency (**EQ 2.3 & EQ2.**5). | | |

- **EQ2.1**
- **Electricity SoS:**
  - In 2017 Bulgaria had put in place an export ban on electricity; the Commission commissioned a study to assess the impacts of the ban, which concluded that it had resulted in a loss of approximately EUR 27 million for Bulgarian generators. The Commission imposed a fine of EUR 77 million on Bulgaria in 2019 and Bulgaria had to pay compensation to neighbouring countries due to the electricity export ban. This type of measure was not implemented since the entry into force of the regulation.
  - On risk assessment:
    - ENTSO-E was tasked to develop regional crisis scenarios. However, these regional scenarios were, in reality, assessed at pan-European level. Sufficient details on certain scenarios and on their particular relevance for certain regions were not provided. Overall, the first cycle provided a good baseline for improvement, but also showed that the methodology had some limitations. The methodology was thus updated, and ENTSO-E presented a new regional scenarios assessment in 2024. For the first time, two scenaFor the first time, two scenarios (out of 23) were simulated to better assess the cross-border affects in the evaluation of the scenarios. ENTSO-E concluded in their report that 'the first effort to simulate impact of regional crisis scenarios show promising potential to improve the risk preparedness in the electricity sector'.[ii]According to the regulation, only ENTSO-E can trigger an update of the regional scenarios (not the ECG nor the Commission). In addition, while the regulation requires ENTSO-E to update the regional scenarios at least every four years, it does not define the exact scope of an update. Lastly, while the regulation allows the ECG to suggest some amendments to the scenarios, these are not binding. However, following the recommendation issued by the ECG following the first identification of regional scenarios, ENTSO-E decided to carry out a revision of the methodology to address the shortcomings identified and best practices. Such revision of the methodology can be also requested by ACER and the Commission.
    - According to the regulation, national crisis scenarios have to be consistent with regional crisis scenarios: however, in a limited number of cases there was a divergence between both.
    - The instruments envisaged by the Regulation have helped improve cross-border coordination, and consequently reduce risks by being better prepared in real cases. For example, following the full-scale invasion of Ukraine by Russia, work was enhanced and accelerated to have the Winter supply Outlook earlier. In its 2022/2023 winter outlook, ENTSO-E stressed the importance of coordination tools to ensure the continued balance between supply and demand in the European power system.
- **Gas SoS:**
  - Before the Regulation, there was no framework to identify (let alone address) cross-border risks. The Regulation created the obligation for MSs to create common risk assessments in regional risk groups. In the latest CRAs, a series of risks were identified often taking a full Russian supply disruption as the baseline scenario. On top of a full Russian supply disruption among others individual pipeline disruptions, liquefaction trains being out of service, or cold-spells were simulated. This means that the common risk assessments have mostly met the policy objective of enhancing preparedness and transparency of measures through a risk-based approach, although there are areas that require further work to ensure that this objective is completely met.
  - 6 MSs have included measures in their emergency plans of 2023 that restrict cross-border flows, which is the same as in the 2019 version of the EPs. This does not necessarily mean that these restrictions are undue during a crisis, as the justification of activating such measures will depend on the situation at hand. No cross-border restriction has been implemented thus far during a crisis. The regulation also provides for the Commission to act as a safeguard in case restrictive measures are implemented (this role was recognised and appreciated during the dry run).

- A gas neutrality charge was introduced by Germany, which was seen as a hindrance to cross-border trade, was implemented during the crisis to refinance the costs incurred to fill storages. It proved an obstacle to phasing out Russian pipeline gas, as alternative routes for Member States from the Central and Eastern Europe region became more expensive. In this particular case, the framework proved to be not successful in preventing and resolving the situation, even if the measure is not active anymore since 1 January 20251

- **EQ2.2**
  - **Electricity SoS:** In RPR, the regional measures are aimed at implementing the so-called cooperation mechanism that consists of the provision of assistance among MS in a spirit of solidarity to prevent or manage a crisis within a particular region (as defined in the Regulation),
    - On regional measures, work remains in progress and has not been completed. Some MS are more advanced, especially Penta which was the first to sign a MoU. Czechia, Austria, Germany, Hungary, Poland and Slovakia also signed a MoU in 2022.
    - Consequently, most of the RPPs lacked information about the measures necessary to implement and enforce regional and bilateral measures to comply with the cooperation and assistance mechanism.
    - As part of the RPPs exercise, clarifications regarding the definition of region were requested in 6 cases.
  - **Gas SoS:**
    - Regional risk groups have developed common risk assessments but no measures to address such regional risks are required by the Gas SoS Regulation and the Plans and associated measures are consulted within the group. In addition, the regional chapters of the PAPs and EPs where e.g. cooperation mechanisms between Member States within a region are required to be described by the Regulation, are often incomplete, as flagged in the Commission's opinions of the plans. Description of regional measures are often missing.
    - However, cooperation has actually gone beyond the regional dimension. The most recent developments and exchanges with MS concluded to the need for a single European risk group for LNG, reflecting the importance of wider regional cooperation and efficient integration of the market all over the EU.

- **EQ2.3**
  - **Electricity SoS:**
    - Member States had to consult relevant regional Member States, other relevant directly connected Member States and the ECG on draft versions of their national plans to ensure consistency. The Commission provided for a platform to exchange and consult draft Plans, moreover, a dedicated 3-day meeting of the ECG was convened to present and discuss each plan.
    - A number of draft plans were not exchanged by the end of the deadline, but the Commission took swift enforcement actions to ensure all plans would be available ahead of the ECG expert meeting.
    - While the ECG and MS can make comments following the consultation, only one Member State (Sweden) officially provided comments to its neighbours.
    - All the plans are now available on Europa website, making it much more transparent than it used to be (in the old electricity SoS directive, plans were not even notified).
    - ECG acted as monitoring and cooperation platform, that was enhanced by the Regulation.
  - **Gas SoS:**
    - Member States have to consult their national plans within the regional risk groups and had to jointly develop a Common Risk Assessment for which they share relevant national data. National risk assessments do not have to be consulted with neighbouring Member States.
    - According to MSs' updated PAPs of 2023, 23 out of 26 plans were consulted with (domestic) stakeholders and 13 out of 24 (not relevant for MT and IE) were consulted with neighbouring Member States and the Commission, according to MSs' PAPs. All plans are available to stakeholders and neighbouring Member States, given that they are required to be published on the Europa webpage by the Regulation.
    - GCG is adaptable and flexible. Best practice measures were exchanged in particular during the crisis and next steps for EU-wide measures to enhance preparedness during the energy crisis were discussed, which played a key role in informing the Commission in order to propose new legislative proposals.

- **EQ2.4**
  - **Electricity SoS:**
    - On regional cooperation, RCCs perform several SoS-related tasks. ENTSO-E has to identify the regional crisis scenarios in close cooperation with RCCs. In the first RPPs cycle their involvement was very limited due to their recent set up (5 July 2020). The revised methodology explicitly defines RCCs' role. RCCs have been fully involved in the second assessment. Nevertheless, the Regulation establishes that ENTSO-E may delegate the identification of regional electricity crisis scenarios to the RCCs.
    - Some regions have a very high level of cooperation (e.g., PENTA), but it is very unequal across regions. On EU-wide cooperation, ECG has proved to be a very useful platform for monitoring and cooperation.

- **Gas SoS**: Regional cooperation process was established via the 13 regional risk groups, albeit with varying degrees of activity. Overall, regional cooperation through the regional risk groups was not always satisfactory. In addition, 2 risk groups were not active (Mediterranean) or did not have a coordinator (North-Eastern). This means that the policy objective of ensuring adequate levels of regional cooperation has not been completely achieved.
  - In 2022/2023 Commission's Joint Research Centre had to step in to provide modelling support to 7 out of 13 risk groups (Caspian, Ukraine, Libya, Belarus, Baltic Sea, Denmark and Trans Balkan) because of which the remaining risk assessments could be delivered. The current regional approach to the risk groups is no longer fit for purpose, given the changed geopolitical landscape, the risen prominence of LNG in the EU's supply mix and the reduced role of some of the pipeline supply corridors. Less infrastructure bottlenecks exist than in the past, reducing in most cases the regional effects. A delegated act is therefore in preparation for the update of the risk groups.
  - However, a regional spin-off of the GCG was created specifically to discuss the end of transit through Ukraine specifically for the CEE region, which proved effective to exchange on the possible consequences of the end of transit, which left the region well-prepared for this development. EU wide cooperation on the other hand is effective and active. In particular, the GCG is adaptable and flexible and can guarantee all voices are heard when members engage equally. The GCG proved a useful platform to coordinate during the crisis, but also to exchange information and best practices. This cooperation includes Member States, stakeholders and the Energy Community, with chairmanship of the Commission.

- **EQ2.5**
  - **Electricity SoS:**
    - Definition of electricity crisis quite diverse between MS. As part of the RPPs exercise, the Commission requested additional information on this definition in 16 cases.c4 Early warnings declared (Cyprus in May 2020, Greece in August 2021, France in December 2021, Ireland in October 2022). No electricity crisis declared. cIt should be noted that it may be politically difficult for Member States to actually declare an electricity crisis.
    - All the RPPs lacked information about the technical, legal and financial arrangements for the implementation of the regional or bilateral measures before assistance is offered.
    - Assistance can be provided only if an electricity crisis is declared, which remains very difficult politically (never happened). Also, according to Article 15(2), assistance should be offered only with the purpose of "*protecting public safety and personal security*", which is very restrictive. This may hamper the operationality of the provision.
    - There have been some complaints about mandatory 'financial agreements' as some MSs would have preferred to have non-financial agreements. An approach based on "economic" agreements could offer more flexibility.
    - Article 15 of the Regulation limits assistance to the delivery of electricity, leaving out the delivery of equipment or technical staff.
  - **Gas SoS:**
    - 13 Early Warnings, 2 Alerts and 1 emergency declared since 2017. Majority of crisis levels were declared during the energy crisis in 2022. The emergency was declared by IT in 2017 due to the Baumgarten explosion.
    - Unclarity on the criteria and coordination of de-activating national crisis levels, as well as unclarity of transitioning from market to non-market-based measures
- During the energy crisis and during the 'dry run' of 2022, it was considered by participants that the EU emergency level is insufficiently defined, in particular the difference between EU and regional emergency and the role of the Commission in an emergency. During the dry run, participants indicated that an EU-wide emergency would be more effective, as it would include those Member States that may still be in a position to help those in need. However, Member States indicated that the declaration of an EU emergency would not necessarily result in the declaration of a national emergency level, which in some Member States would allow for introducing non-market measures. The EU emergency level was confirmed by the dry-run 2024, where the solidarity extended to non-directly connected MS, including with LNG, was tested. The role of the Commission in an EU emergency is ambiguous beyond its coordinating tasks. This contrasts with the role of the Commission in the recently expired EU alert, where the role of the Commission in monitoring, coordinating and enforcing demand reduction is clearer. This related to the lack of EU emergency plan in contrast to national emergency plans. The expired EU alert was considered a useful provision for the longer term by respondents to the questionnaire, as were the additional safeguards for cross-border flows. In case a Member State receives two solidarity requests, the procedure was considered unclear. If the market does not allow to satisfy both requests, there are several options: using a pro-rata allocation, based on the order of reception of the requests (first-served) or depending on the amount received as compensation (lowest cost). Several Member States foresaw complications with the changed solidarity request submission time to at least 72 hours before indicated delivery time. Participants expressed the wish that a 24-hour period would be applicable for solidarity through pipelines.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
|---|---|---|---|---|
| • **EQ3** – Have the regulatory interventions been effective in | • **EQ3.1** – To what extent did the Electricity Risk | | **Quantitative indicators** | **Desk research:**<br>• PAPs/EPs/RPPs |

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|---|---|---|---|---|
| addressing the energy crisis in the EU in 2022/2023? | Preparedness and the Gas SoS Regulations help to prepare the EU for the energy crisis of 2022/2023?<br>• **EQ3.2** – To what extent did the crisis measures help mitigate the energy crisis in 2022/2023?<br>• **EQ3.3** - Were the emergency cooperation provisions adequate to respond to possible supply shocks? | • Sufficiency of the evaluated framework to offer adequate preparedness in case of protracted supply crises (**EQ3.1**).<br>• Effective restoration of storage filling and supply-demand balance to mitigate the imminent risks of gas shortages (**EQ3.2**).<br>• Operationalisation of solidarity and effectiveness of crisis cooperation in case of an emergency (**EQ3.3**).<br>• Degree to which there has been a united response of the EU to supply crises (**EQ3, EQ3.2**) | • Storage filling - percentage of capacity & percentage of protected customer demand (**EQ3.2**)<br>• Demand reduction (**EQ3.2**)<br>• Amount of ECG, GCG, regional risk group and Crisis Management Group meetings (**EQ3, EQ3.2**)<br>• Amount of infringement procedures/EU pilots (**all**)<br>• Amount of solidarity agreements (**.3**)<br>• Gas supply disruption simulations – (**EQ3**, **EQ3.1** & **EQ3.2**)<br>• Amount of times EU/MSs tested crisis management procedures and provisions in their plans, e.g. via TTXs (**EQ3.1**, **EQ3.2**, **EQ3.3**).<br><br>**Qualitative indicators**<br>• Extent to which the Commission's opinions were followed by MS (**EQ3.1).**<br>• Preventive and mitigative measures included in PAPs/EPs/RPPs are consistent with the identified risks (**EQ3.1**).<br>• Speed of adoption of EU measures to combat the energy crisis (**EQ3**, **EQ3.2**).<br>• National measures implemented to ensure storage filling (**EQ3**, **EQ3.2**)<br>• National measures implemented to ensure demand reduction (**EQ3, EQ3.2**). | • Common and national risk assessments<br>• Commission opinions on the Plans (all)<br>• GCG / ECG meetings<br>• Reports reviewing the Regulations, ACER reports, JRC studies.<br>**Data sources:**<br>• Eurostat (e.g., nrg_cb_gas(m))<br>• ENTSO-E transparency platform<br>• ENTSOG transparency platform<br>• GIE AGSI transparency platform<br>**Other sources:**<br>• ENTSOG simulations and outlooks<br>• ENTSO-E simulations and outlooks<br>• Dry runs, table-top exercises.<br>• Public consultation |
| • **EQ3.1**<br>○ **Electricity SoS:** | | | | |

        - ECG proved very useful to ensure regular and up to date information on MS perspectives ahead of winter (supply sources, stocks, outages, alternative measures, etc) and coordination on measures.
        - RPPs' Scenarios proved to be too shallow, in particular with regard to gas crisis spillover risk: some MS had to do ad hoc assessments in the midst of the crisis.
        - The nuclear corrosion crisis demonstrated the importance of transparent information for neighbouring Member States.
    - **Gas SoS**: the 2022/2023 energy crisis was largely a crisis caused by a geopolitical factor, namely Russian supply disruptions. The national risk assessments and common risk assessments did require Member States (where relevant) to consider geopolitical risks, ranging from commercial disputes with supplying companies, political unrest in supplying countries or total supply disruptions from third countries.
        - In the latest update of the national risk assessments, 24 out of 25 national risk assessments considered geopolitical risks, mostly related to a Russian supply disruption. It should be noted that the timing of this update coincided with the energy crisis, which may explain the high number of MSs that considered a Russian supply disruption.
        - This is similar to the first iteration of the national risk assessments (due 1 October 2018), as 23 out of 26 considered (geo)political risks – majority of which were RU supply disruption or end to UA transit. It should be noted that the timing of the risk assessment was just before the expected expiry of the transit contract between RU and UA on 31 December 2019. While the risk was considered by most Member States, the likelihood of the risk occurring was not considered likely by all Member States.
    - However, despite the risk of Russian supply disruptions being recognised in most risk assessments, the Gas SoS Regulation was not designed to mitigate protracted supply disruptions from the EU's main supplier. Therefore, the regulatory framework had to be complemented with a series of emergency measures to fill storages, reduce demand and improve our solidarity mechanism.
    - Available bidirectional capacities supported the redirection of flows when Russia cut supplies in 2022.
    - But the regulation failed to prevent market manipulation with historically low storage levels in October 2021, which led to SoS concerns and price increase. Hence the introduction of SSOs' certification.
- **EQ3.2**
    - **Electricity SoS:** not relevant.
    - **Gas SoS:**
        - The significant reduction in demand for natural gas (-18% between August 2022 and December 2023) has been essential to preserving the delicate gas balance in the EU. A continuous gas demand reduction throughout the injection season of 2023 was a primary driver of achieving record high storage filling by 1 November 2023 (99%) which together helped keep prices to lower levels and contain volatility. This demand reduction has also contributed significantly to sensible storage management throughout the first part of the winter season 2023/2024, still 70% full by 1 February.
        - The 2024 dry run exercise confirmed that demand reduction measures play a key role in the early stage of a potential future crisis.
        - Concept of default rules and LNG solidarity completed EU's crisis management architecture. Critical gas volumes for electricity were useful but alternative ways could be explored. Limiting non-essential consumption of protected customers and additional safeguards for cross-border flows were useful additions.
        - Achieving the objectives set by storage regulation helped strengthen the security of supply in winter 2023/24, which in turn reduced the risk premium in the gas market at the end of the year. The certification process is well advanced for a substantial share of the storage operators and sites. While a number of certifications are still pending, there is currently no available evidence that storage ownership or storage operators could put the security of gas supply of the EU at immediate risk.
- **EQ3.3**
    - **Electricity SoS:**
        - Not really tested at EU-level, as there has not been an electricity crisis. MSs had to describe in their RPPs the measures to implement the regional/bilateral measures to provide assistance: but the Commission's assessment of the plans showed that these were largely missing. To better understand the barriers, the Commission organized technical workshops with MSs experts. Another workshop was organized to propose solutions based on best practices and academic literature.
        - In the future it could be useful to have mandatory regular tests coordinated by ENTSO-E, to assess the validity of assistance provisions (once they will be fully implemented). Yet, RPR requires Member States to carry out biennial regional crisis exercises
    - **Gas SoS:** the Commission organised two table-top exercises ('dry runs') to test the emergency provisions, one in 2022 and one in 2024.
        - The 2022 exercise showed that in particular questions remained regarding the implementation of the solidarity mechanism. due to:
            - A lack of bilateral solidarity agreements.
            - Complexity of establishing fair compensation for solidarity.
            - Timing of solidarity (24h for pipeline and 72 hours for LNG).

- LNG solidarity could provide additional flexibility but there may be contractual issues for diverting cargoes.
- The lack of legal framework for indirectly connected Member States to provide solidarity.

- The 2022 exercise concluded on the non-solidarity parts that:
  - Mutual consultation of MSs on their national plans and the Commission's monitoring thereof is crucial to avoid undue restrictions.
  - Quality and accessibility of data on protected customers is not sufficient to have proper transparency during an emergency.
  - GCG and the crisis management group might overlap.
  - The criteria for when to declare EU or regional emergency is not always clear, as well as the role of the Commission during an EU emergency.
- The 2024 exercise concluded that:
  - The solidarity provisions extending the mechanisms to indirectly connected Member States, allow access to larger and supposedly cheaper market-based solidarity when the directly connected neighbours are in emergency. However, the effectiveness of the mechanism would benefit from a clearer identification of procedure and from the existence of an entity responsible for collecting and transferring gas to another Member State. It would also benefit from clearer guidelines on monitoring all actions taken before requesting solidarity.
  - LNG can play a key role in case of a solidarity request. It was acknowledged that Member States don't have legal tools to force LNG companies to participate in the solidarity mechanism. However, Member States can facilitate LNG solidarity with ad hoc communication channels and outreach to relevant involved parties. The effectiveness of LNG solidarity eventually depends on contractual arrangements between concerned parties.

| **Efficiency**<br>**To what extent were the Regulations cost-efficient in achieving their key objectives?** | | | | |
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| **Evaluation questions** | **Sub-questions** | **Judgement criteria** | **Indicators and information requirements** | **Data sources** |
| • **EQ4** – Is the net financial cost of the implementation of the evaluated interventions justified? | ▪ **EQ4.1** - What have been the estimated financial costs, if any, tied with the implementation of the evaluated interventions (if possible, broken down by type of actors)?<br>▪ **EQ4.2** - What have been the estimated financial benefits, if any, tied with the implementation of the evaluated interventions (if possible, broken down by type of actors)?<br>▪ **EQ4.3** – Were these benefits and costs in line with the projections when the interventions were adopted?<br>▪ **EQ4.4** – Was the distribution of costs fair among actors? | • Reasonableness of the net implementation costs, in view of the initial expectations, of the distribution between actors and of the results achieved (**EQ4**)<br>• Cost of the 2021-2023 energy crisis vs expected cost without the measures (**EQ4.2**, **EQ4.3**)<br>• Difference between the expected implementation costs/benefits at the time of the adoption, and the actual implementation costs/benefits (**EQ4.3**)<br>• Fairness of the distribution of implementation costs between actors (between Member States, between private and public, big and small actors) (**EQ4.4**) | **Quantitative indicators**<br>• Investments realized to make cross-border interconnections bi-directional (**EQ4**).<br>• Estimated financial costs (in particular human resources) needed for the drafting, the assessment and the update of the various plans and risk assessments (**EQ4**).<br>• Estimated costs (in particular human resources) for ACER, ENTSO-E, ENTSOG and RCCs to perform their regulated tasks (**EQ4**)<br>• Estimated costs associated with storage filling obligations (**EQ4**)<br>• Estimated costs associated with gas demand reduction measures (**EQ4**)<br>• Estimated costs for gas undertakings to meet the supply standard (**EQ4**) | • Desk Research<br>• Old impact assessments<br>• Public consultation<br>• Call for evidence<br>• Commission Reports reviewing the Regulations<br>• Commission's evaluation of the Governance Regulation<br>• ACER reports (storage)<br>• GCG / ECG<br>• Exchanges with MS and other key stakeholders<br>• CEF applications<br>• Blackout simulator<br>• Nordic and Baltic region annual outage reporting system<br>• Power blackouts in Europe<br>• Feedback from MSs and key actors on administrative costs |

**Answers:**

- **EQ4**: Security of supply is by definition is an insurance. This implies that there are always costs involved while the benefits are hopefully never truly quantifiable, since that would mean that there is an actual supply disruption.

- **EQ4.1**
  - **Electricity SoS:**
    - **ACER:** Human resources for the approval of the methodologies for the identification of regional crisis scenarios and for the short-term and seasonal adequacy assessments; for the monitoring of SoS measures;
    - **Commission:** Human resources for providing ECG secretariat and for the organization of ECG meetings; for the drafting of Commission's opinions on RPPs; for the drafting of the report on the implementation of the Regulation.
    - **ENTSO-E:** Human resources for the drafting of the methodologies for the identification of regional crisis scenarios and for the short-term and seasonal adequacy assessments; for the drafting of the regional crisis scenarios reports; for the drafting of the seasonal adequacy outlooks;
    - **MSs:** Human resources for the drafting of RPPs; for the negotiations on regional and bilateral measures to provide assistance; for the organization of emergency tests.

- **RCCs:** for the drafting of the short-term adequacy outlooks;

- **Gas SoS:**
  - **ACER:** Human resources for the drafting of opinions on reverse flows exemptions
  - **Commission:** Human resources needed for the drafting of opinions on PAPs and EPs; for the drafting of the opinions on the SSOs certification decisions; the support provided for the drafting of CRAs; the drafting of the reports on the implementation of Gas SoS regulation and on the emergency regulations; the monitoring of SoS measures; for providing GCG secretariat and organizing GCG meetings.
  - **ENTSOG:** Human resources needed for the drafting EU-wide SoS simulation reports;
  - **Gas undertakings:** Financial cost of meeting the supply standard and the storage obligations; of developing new infrastructure to meet N-1 and reverse flow requirements and of keeping non-commercially viable infrastructure operating (only for TSOs)
  - **MSs:** Human resources for the drafting of coordinated decisions to grant exemptions to the reverse flow requirements; for the certification of SSOs; for the drafting of national risk assessments and common risk assessments; for the drafting of PAPs and EPs; for the negotiation of solidarity agreements;

- **EQ4.2**
  - The benefits are not truly quantifiable, as the regulations are designed with the hope that they will never be used. Also, it is not possible to assess the potential costs of crises that were avoided, and how much the framework contributed to avoid those crises.
  - Thus, the assessment of the benefits requires to use proxies (e.g., past crises), but only in a qualitative way.

- **EQ4.3**
  - There were no projections of costs and benefits at the time of the adoption (in the respective impact assessments).

- **EQ4.4**
  - The costs linked to the implementation of the regulation are mainly administrative, tied with reporting obligations. They are mainly born by Member States' administrations.
  - Among energy undertakings, the costs are mainly born by TSOs.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
|---|---|---|---|---|
| **EQ5** – To what extent have the Regulations contributed to streamlined planning, reporting and monitoring including through further digitalisation or consolidation? | ▪ **EQ5.1** – To what extent are the timing and periodicity of the different planning and reporting obligations, both within the Regulations and outside, consistent (e.g., to avoid peak reporting periods, deliver up-to-date information)?<br>▪ **EQ5.2** – Is there evidence of unnecessary procedural and administrative burden due to overlaps with other EU or national planning and reporting procedures? | ▪ Consistency of the planning and reporting obligations stemming from the interventions among themselves as well as with the obligations stemming from other EU interventions (e.g., Governance Regulation) (**EQ5.1**, **EQ5.2**).<br>▪ Identified inefficiencies caused by obsolete or redundant requirements (**EQ5.2**)<br>▪ Helpfulness of the common templates for the plans and the risk assessments provided | **Quantitative indicators**<br>• Amount of overlapping planning and reporting obligations, under EU legislation (**EQ5.1, EQ5.2**)<br>• Amount of digital tools used by Member States and Commission to draft and evaluate the plans and the risk assessments, compared to the amount of digital tools that are available for this kind of tasks, as of today (**EQ5.4**)<br><br>**Qualitative indicators**<br>• Percentage of MS compliant with reporting obligations (**EQ5**) | • Desk Research<br>• Old impact assessments<br>• Public consultation<br>• Call for evidence<br>• Commission Reports reviewing the Regulations<br>• Commission's evaluation of the Governance Regulation<br>• ACER reports (storage)<br>• GCG / ECG<br>• Feedback from MSs and key actors on administrative costs |

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| | ▪ **EQ5.3** – Regarding progress reporting, to what extent does the availability of common templates (for RPPs, PAPs, EPs, Common Risk Assessments, National Risk Assessments) decrease the administrative burden and costs of Member States and/or make it easier for the Commission to evaluate and use the information and data provided?<br>▪ **EQ5.4 –** Are the current Member States' and Commission's planning and reporting obligations designed in such a way that they make efficient use of developments in the fields of digital technologies? | by the regulations for Member States when performing their planning and reporting obligations, and for the Commission when evaluating those documents (**EQ5.3**).<br>▪ Extent to which Member States and the Commission use available digital tools in a way that reduces the administrative burden, for the design and for the assessment of the plans and of the risk assessments (**EQ5.4**).<br>▪ | • Indicative schedule of the various reporting obligations for Member States, during the implementation period (**EQ5.1**, **EQ5.2**)<br>• Typology of digital tools used by Member States and Commission to draft and evaluate the plans and the risk assessments, compared to the typology of digital tools that are available for this kind of tasks, as of today (**EQ5.4)** | |

**Answers**

- **EQ5.1**
  - DDLs gas SoS and electricity RP:
    - **ENTSOG -** Union-wide SoS simulation: 1 November 2017 (and every four years thereafter – unless more frequent updates are warranted)
    - **MSs -** National risk assessment & common risk assessment: 1 October 2018 (and every four years thereafter – unless more frequent updates are warranted)
    - **MSs -** PAP & EP: 1 March 2019 (and every four years thereafter – unless more frequent updates are warranted)
    - **COM -** Commission assessment and opinion: 1 July 2019 (assessment within 4 months after the PAP/EP).
    - **MSs -** Updated PAPs/EPs taking account of Commission's recommendation: 1 October 2019 (3 months after the receipt of the Commission's opinion).
    - **ENTSO-E** – methodology for regional electricity crisis scenarios & methodology seasonal/short-term adequacy: 5 January 2020
    - **ENTSO-E –** regional electricity crisis scenarios 5 July 2020 (and every four years thereafter – unless more frequent updates are warranted)
    - **ENTSO-E –** seasonal adequacy outlooks assessments: every 1 December and 1 June.
    - **MSs -** national electricity crisis scenarios: 5 November 2020 (and every four years thereafter – unless more frequent updates are warranted)
    - **MSs -** draft RPPs: 5 April 2021 (implicit deadline, as the Regulation foresees a minimum 9-month consultation period for other MSs).
    - **MSs -** risk-preparedness plans: 5 January 2022 (and every four years thereafter – unless more frequent updates are warranted).
    - **COM -** Opinions on RPPs: 4 months after the submission of the final RPPs.
    - **MSs -** Updated RPPs taking account of Commission's recommendation: 3 months after the receipt of the Commission's opinion.

- **MSs -** draft NECPs: 30 June 2023.
- **COM -** opinion on draft NECPs: 30 December 2023.
- **MSs -** draft certifications for gas SSOs: 2 January 2024.
- **COM -** opinions on the draft certifications for gas SSOs: 25 working days after the submission.
- **MSs -** final NECPs: 30 June 2024.
- **TSOs/MS/NRAs/ACER/EC**: gas reverse flows exemptions every 4 years.

- The deadlines stemming from the Gas SoS Regulation and Risk Preparedness Regulation lead to a logical sequence in deliverables (first simulations, assessments and risk assessments, based on which plans are developed). The deadlines largely do not overlap, unless this is necessary to ensure consistency between the deliverables (e.g. national and common risk assessments being delivered at the same time).
- The lack of timely submissions of these deliverables by Member States may indicate that these deadlines are too short, especially given the size of the reporting obligations. This is particularly relevant for the certification of storage system operators, where in some instances the deadlines are notably short (
- There is no distinct overlap in timing of reporting requirements between the Gas SoS Regulation and electricity Risk-Preparedness Regulation. However, the updates of the PAPs/EPs come shortly before the draft NECPs have to be issued. Both the Plans and the NECPs, even if the topics are different, are extensive reporting requirements for MSs and while the required deliverables are not exactly the same, there may be room for simplification.
- The Gas Demand Reduction Regulation required Member States to issue a one-off update of its emergency plan to reflect voluntary demand-reduction measures by 31 October 2022, which should have been repeated in case a Union alert would have been declared (quid non). This update was shortly before the regular 4-year update of the plans by 1 March 2023, which led to duplication and therefore unnecessary administrative burden.

- **EQ5.2**
  - **Electricity SoS:**
    - Member States have to submit 3 versions of their plans (1: draft; 2: final; 3: updated following Commission's recommendation) – the process could probably be lightened.
  - **Gas SoS:** the fact that two separate plans (PAP and EP) and two separate types of risk assessments (national and common risk assessments) have to be developed, leads to high administrative burden among Competent Authorities. Whether the number of deliverables that require not only time and resources to elaborate, but also to require lengthy internal validation, can be reduced could be explored.
  - The number of risk groups (12), corresponding to each supply disruption scenario leads to some duplication. The risk assessment of the Belarus risk group has even been merged with the North-Eastern risk group due to a lack of coordinator.
  - **Gas SoS report:** Leading the risk groups and developing the Common Risk Assessment was considered a large administrative burden by Member States, especially in times of crises with competing priorities. Some MSs argue for reducing the number of regional risk groups.
- **EQ5.3**
  - **Cross-sectoral:**
    - Overall, the use of templates makes it easier for Member States to understand exactly what is required and in which section. However, the templates are extensive and in some cases there is an overlap in the requirements included in the templates, between the various deliverables.
    - For example, the infrastructure standard calculation has to be provided in the PAP, while it has already been calculated in the common and national risk assessments as well. This is also the case for the description of the regional gas systems. While it is important that Member States take both elements into account both when drafting the risk assessments and the plans, it is a duplication of efforts.

- **EQ5.4**
  - **Cross-sectoral:** while some digital technologies are used for reporting obligations (e.g. CIRCABC, EUSurvey), their use could be further leveraged. Certain data requirements that are currently in the national risk assessments and PAPs could be reported on through less burdensome ways (e.g. by filling in an online template). This may include the factual data requirements, such as protected customers demand, gas consumption figures, domestic production, gas import sources per country of origin. This may alleviate the burden of lengthy internal approval processes in Member States. E-reporting platform managed by DG ENER could be a source of inspiration. Some reporting (flows, demand, storage levels) is undertaken by ENTSO-E, ENTSOG and GIE via their transparency platforms. This reporting could be further enhanced since data reporting from MS generally comes from electricity and gas TSOs.

| RELEVANCE<br>How have the scope and objectives of the regulations remained relevant in addressing the past and current problems across the implementation period from 2017 and 2019 until now? | | | | |
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| **Evaluation questions** | **Sub-questions** | **Judgement criteria** | **Indicators and information requirements** | **Data sources** |
| **EQ6 -** To what extent are the various plans (preventive action plans, emergency plans, risk preparedness plans) relevant in addressing actual risks and preventing, preparing, managing and mitigating actual energy supply crises? What could be improved? | • **N/a** | • Timeliness and responsiveness of provisions to crisis events (COVID-19, energy crisis) and the ability of these measures to mitigate disruptions in energy supply (**EQ6**). | • **Quantitative indicators**<br>• Frequency, duration and volumes of supply disruptions during crises and extreme weather events (storms, heatwaves, cold snaps, droughts, etc.) (**EQ6**)<br>• Supply-demand balance in 2021-2024 (**EQ6**).<br>• Storage filling in 2021-2024 (**EQ6**).<br>• Demand reduction in 2021-2024 (**EQ6**).<br>•<br>• **Qualitative indicators**<br>• Degree to which the type of crisis events that actually occurred since 2017 had been identified as risk in risk assessments **(EQ6)**<br>• Areas that current energy security standards (infrastructure standard, supply standard) do not address (**EQ6).** | • Strategic foresight workshop<br>• Desk research: assessment of regulatory requirements, risk assessments and plans.<br>• GIE AGSI transparency platform (storage)<br>• Eurostat (e.g. nrg_cb_gasm)<br>• Commission's 2040 climate target plan (and its impact assessment). |

**Answer:**

- **EQ6**
  - **Gas SoS:**
    - The Commission opinions recognised the overall quality and completeness of the Member States' plans, and relevant risks that actually materialised, such as a full Russian supply disruption were actually assessed in the risk assessments. The risk of a full Russian supply disruption has in fact been assessed in 24 out of 25 national risk assessments, while in the latest CRAs, a series of risks were identified often taking a full Russian supply disruption as the baseline scenario.
    - As indicated in the Commission opinions, both in the plans of 2019 and 2023, the preventive measures described in the PAP are often not tied to the risks identified in the risk assessments. There is a logical sequence in deliverables, with first providing risk assessments and then producing the plans. While it is a requirement of the Regulation, in practice this has not sufficiently been applied by Member States, which has a negative effect on the relevance of the risk assessments.
    - A breakdown of gas import sources per country of origin is already required by Annex VI. However, this may not reflect an accurate picture, in case a Member State is undertaking efforts to diversify away from a certain supplier, or if certain long-term contracts are expiring. Therefore, a description or projections of ongoing diversification efforts may be needed.

- If a Member State knows that in the period before the next update of the PAP natural gas will be phased out, and it knows this may affect the composition of the breakdown of gas demand (e.g. certain sectors may phase out gas quicker than others), no quantitative estimate of this development is currently provided. This may also include the impact of ongoing electrification efforts and the role that gas would play in the adequacy of the electricity system.
- Apart from the role that domestic production, including biomethane, plays in the national gas system, there is no requirement on whether national hydrogen strategies should be included in the plans. This is of particular importance if it impacts security of gas supply or the replacement of gas demand in specific sectors.

- **Electricity SoS:** the Commission's assessment based on the opinions is that the RPPs are shallow in this department. While the RPPs have had a role in preventing, preparing for, managing and mitigating crises, when a crisis hit more had to be done. This may not be a shortcoming of the Regulation even given that it was explicitly envisaged in the Regulation though left at MS discretion.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
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| **EQ7 -** How well adapted are the evaluated regulations to technologic or scientific progress, and to the environmental/climatic challenges the EU will face? | **EQ7** – To what extent and how each of the 14 Megatrends[246] identified by the Commission's JRC may impact the evaluated regulatory framework in the future? | • Appropriateness of plans in responding to and preventing real crises. Flexibility of plans to adjust to emerging risks (**EQ7**).<br>• Incorporation of the impact of expected decline of natural gas consumption and increase in biomethane consumption in the various risk assessments and plans (**EQ7**)<br>• Degree to which financial risks are included in risk assessments and plans (**EQ7**).<br>• Fitness of the current energy security framework for long-term driving forces that may have a global impact in the future (**EQ7**). | • **Quantitative indicators**<br>• Amount of cross-sectoral risks identified in risk assessments (**EQ7**).<br>• Amount of emerging risks identified in risk assessments (**EQ7**).<br><br>• **Qualitative indicators**<br>• Degree to which the type of crisis events that actually occurred since 2017 had been identified as risk in risk assessments **(EQ7)**<br>• Areas that current energy security standards (infrastructure standard, supply standard) do not address **(EQ7).**<br>• Degree to which realistic cross-sectoral risks are identified in risk assessments and addressed via measures in the plans (**EQ7**).<br>• Degree to which emerging risks are identified in risk assessments and addressed via measures in the plans (**EQ7**)<br>• | • Strategic foresight workshop<br>• Desk research: assessment of regulatory requirements, risk assessments and plans.<br>• GIE AGSI transparency platform (storage)<br>• Eurostat (e.g. nrg_cb_gasm)<br>• Commission's 2040 climate target plan (and its impact assessment).<br>• Commission study on energy storage's contribution to electricity SoS |

- **EQ7**
  - **Gas SoS:**

[246] https://knowledge4policy.ec.europa.eu/foresight/tool/megatrends-hub_en

- Natural disasters or environmental threats were considered in 13 out of 25 national risk assessments. Most common risks include floods or extreme weather conditions such as storms affecting e.g. LNG shipments either in the producing country or at the regasification terminal in the EU. However, the risk of climate change aggravating these risks was only briefly mentioned by 1 national risk assessment and was otherwise not taken into account.
- Given that household gas demand may in some Member States be phased out sooner than in other sectors, a reconsideration of the protected customers definition may in the future be required. This way, an adjustment can be made to a changing demand profile, while ensuring that residential needs are met, in particular as regards the gas consumption of vulnerable consumers.
- The expected phase out of natural gas may lead to a deteriorating business case for certain companies operating in the gas sector. This could result in financial risks throughout the transition for undertakings that are critical to security of gas supply.
- Infrastructure standard and gas storage targets need to be balanced with the need to avoid creating stranded assets and avoiding carbon lock-in to support decarbonisation objectives. Infrastructure standard incentivises development of fossil infrastructure, which is necessary for security of supply and system flexibility, but in the future may require adaptation.

- **Electricity SoS:**
  - Decarbonisation will be achieved mainly through electrification, thus power consumption patterns will change a lot, which may require some adaptation of the architecture.
  - Similarly, the current architecture does not fully factor in climate change adaptation, and the European Commission recommended in its RPPs opinions to include climate change considerations, such as climate vulnerability and risks. And an estimation of GHG emissions in cases some emergency measures appeared to have a potential input. These were however recommendations made by the Commission and not related to obligations in the Regulation.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
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| **EQ8** - Are the Member States' and Commission's planning, reporting and monitoring obligations under the Regulation still relevant in view of legislative developments? | • **EQ8.1** - Are there planning, reporting and monitoring obligations missing from the evaluated Regulations in view of recent legislative developments?<br>• **EQ8.2** - Are there planning, reporting and monitoring obligations under the evaluated Regulations that have become obsolete, e.g. because digital solutions make the reporting by MS no longer necessary?<br>• | • Incorporation of the impact of expected decline of natural gas consumption and increase in biomethane consumption in the various risk assessments and plans (**EQ8.1,**)<br>• Degree to which financial risks are included in risk assessments and plans (**EQ8.1**).<br>• Assessment of redundant or outdated reporting and/or monitoring obligations. (**EQ8, EQ8.2**).<br>• Assessment of missing reporting and/or monitoring obligations (**EQ8**, **EQ8.1**).<br>• Adaptation to emerging and complex risks (e.g. cybersecurity, hybrid threats) and the flexibility of the Regulations to incorporate emerging risks such as climate change (**EQ8**) | • **Quantitative indicators**<br>• Amount of cross-sectoral risks identified in risk assessments (**EQ8**).<br>• Amount of emerging risks identified in risk assessments (**EQ8**).<br>• **Qualitative indicators**<br>• Degree to which realistic cross-sectoral and emerging risks are addressed via regulatory provisions (**EQ8).**<br>• Degree to which supply standard integrates a changing climate reality (**EQ8).** | • Strategic foresight workshop<br>• Desk research: assessment of regulatory requirements, risk assessments and plans.<br>• GIE AGSI transparency platform (storage)<br>• Eurostat (e.g. nrg_cb_gasm)<br>• Commission's 2040 climate target plan (and its impact assessment).<br>• Commission study on energy storage's contribution to electricity SoS |

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| • **EQ8**<br>○ **EQ8.1**<br>▪ **Electricity SoS:** on the RPPs opinions, the Commission's asked several times MSs to quantify impacts on climate change of the envisaged measures (e.g., estimated GHG emissions) and to strengthen security dimension.<br>▪ **Gas SoS:** financial risks (e.g. bankruptcies) of critical gas undertakings are not considered, which may become more relevant if the expected phase out of natural gas leads to a less solid business case for these undertakings. This could impact electricity as well, if it affects gas-fired power plants.<br>○ **EQ8.2**<br>▪ **Electricity SoS:**<br>• Reporting of plans has been digitalised because of the use of CIRCABC.<br>▪ **Gas SoS:** the fact that two separate plans (PAP and EP) and two separate types of risk assessments (national and common risk assessments) have to be developed, leads to high administrative burden among Competent Authorities.<br>▪ **Gas SoS:** There is room for simplification between the national risk assessments and the plans. Both the risk assessments and the PAP require a description of the regional gas system of each risk group the Member State participates in. Same goes for the compliance with the infrastructure standard, which is both required in the national risk assessments and the PAPs. The risk assessments again have to be summarised in the PAPs.<br>▪ **Gas SoS:** crisis levels and corresponding measures have to be developed in the EP on national level and then have to be repeated at regional level (despite the fact that some of these regional crisis levels don't exist). The regional dimension of this obligation is not clear and could be simplified. | | | | |
| **Evaluation questions** | **Sub-questions** | **Judgement criteria** | **Indicators and information requirements** | **Data sources** |
| **EQ9 -** To what extent is the current framework relevant in addressing cross-sectoral or cascading risks between the gas and electricity sectors? | N/a | • Effectiveness in addressing interdependencies between gas and electricity. Relevance to real-world cross-sectoral disruptions, such as gas shortages impacting electricity generation (**EQ9**). | • **<u>Quantitative indicators</u>**<br>• Timing and amount of updates required under current Regulations (**EQ9**, **EQ9.2**).<br>• Percentage of MS compliant with reporting obligations (**EQ9**, **EQ9.2**)<br>•<br>• **<u>Qualitative indicators</u>**<br>• Duplications and redundancy in reporting and monitoring obligations (**EQ9, EQ9.2**).<br>• Missing information requirements in plans and risk assessments (**EQ9, EQ9.1).**<br>• Degree to which the type of crisis events that actually occurred since 2017 had been identified as risk in risk assessments **(EQ9.1)** | • Strategic foresight workshop<br>• Desk research: assessment of regulatory requirements, risk assessments and plans.<br>• GIE AGSI transparency platform (storage)<br>• Eurostat (e.g. nrg_cb_gasm)<br>• Commission's 2040 climate target plan (and its impact assessment).<br>• Commission study on energy storage's contribution to electricity SoS |
| • **EQ9** | | | | |

- **Gas SoS:** MSs are required (if relevant) to assess the risk of a lack of electricity or other energy source as a risk for gas security of supply. Critical gas-fired power plants also have to be identified, along with the potential volumes needed for these power plants.
  - A total of 18/25 national risk assessments consider such 'cross-sectoral risks' but most MSs only considered short-term failures and therefore did not consider it impactful. One MSs considered the risk of a gas shortage for electricity security of supply, although that risk was not considered impactful.
  - As part of PAPs, the critical gas-fired power plants are to be clearly identified, along with their necessary volumes. However, as indicated in the Commission's opinions, these power plants have often not been identified by Member States. In addition, the plans often do not adequately consider the impact of a gas supply disruption on electricity generation, or district heating, which is a requirement of the Regulation. This is likely due to the fact that this is a requirement stemming from Article 11 (dictating the crisis levels and procedures) but is not included in the templates in the annex, nor in the Articles stipulating the content of the plans.
- **Electricity SoS**: Article 5 requires ENTSO-E to identify regional electricity crisis scenarios in relation to system adequacy, system security **and fuel security**, and "fuel shortages" is mentioned as one of three risks which must be considered.
  - However, many of the Commission's opinions on the RPPs asked MS to at least clarify why there would not be a spillover impact of a gas crisis in the electricity sector as this was neither addressed in the plans nor explained. The Commission opinions asked many MS specifically to add further details to this x-sector assessment as the details in their plans were very limited.

At Commission's request, in summer outlook 2022, ENTSO-E calculated for the first time the so-called "critical gas volumes", which contributed to a shared understanding of the impact of gas shortages on electricity generation.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
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| **EQ10 -** How well adapted are the current Regulations to tackle geopolitical and emerging risks, like cybersecurity, hybrid threats, or critical infrastructure risks? | **N/a** | • Effectiveness in addressing interdependencies between gas and electricity. Relevance to real-world cross-sectoral disruptions, such as gas shortages impacting electricity generation (**EQ10**).<br>• Adaptation to emerging and complex risks (e.g. cybersecurity, hybrid threats) and the flexibility of the Regulations to incorporate emerging risks such as climate change (**EQ10**) | **Quantitative indicators**<br>• Amount of cross-sectoral risks identified in risk assessments (**EQ10**).<br><br>**Qualitative indicators**<br>• Degree to which the type of crisis events that actually occurred since 2017 had been identified as risk in risk assessments **(EQ10)**<br>• Degree to which realistic cross-sectoral and emerging risks are addressed via regulatory provisions **(EQ10).**<br>• Degree to which protected customers definition is aligned in electricity and gas and degree to which it is compatible with changing demand structure (**EQ10**).<br>• Degree to which realistic cross-sectoral risks are identified in risk | • Strategic foresight workshop<br>• Desk research: assessment of regulatory requirements, risk assessments and plans.<br>• GIE AGSI transparency platform (storage)<br>• Eurostat (e.g. nrg_cb_gasm)<br>• Commission's 2040 climate target plan (and its impact assessment). |

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| | | | assessments and addressed via measures in the plans (**EQ10**). | |

- **EQ10**
  - **Gas SoS:** Member States are required (if relevant) to take risks related to cybersecurity risks and threats to critical infrastructure (physical but also natural disaster or environmental risks), especially if it can become an N-1 situation.
    - The recently adopted horizontal cybersecurity legislation (NIS2, CRA) aims to address these issues. However, at this early stage of the transposition process, it is too early to assess these provisions. Moreover, cybersecurity risks were identified in 14 out of 25 national risk assessments, usually in the form of a cyberattack on infrastructure. However, in most cases it is unclear whether preventive measures are sufficient to address the risks.
    - The 2024 dry run exercise showed that in case of a cyber-attack, most Transmission System Operators (TSOs) had the possibility to switch to backup systems and use alternative communications channels to overcome the impact. It was identified that in case of a cyber-attack on the energy system, coordination between cyber and operational experts within the TSOs must be integrated in the response procedures.
    - Physical threats to infrastructure were identified in 12 out of 25 risk assessments, usually due to terrorist attacks or sabotage of critical infrastructure. However, usually the focus lays on the assessing or mitigating the impact of the resulting disruption for security of supply, rather than addressing the risk to critical infrastructure itself. The dry run of 2024 showed that in case of a crisis, some coordination procedures between critical infrastructure protection and energy security Competent Authorities could also benefit from further clarification.
    - Diversification is not adequately covered by the Regulation.
  - **Electricity SoS:**
    - Electricity Risk-Preparedness does not cover diversification, similar to the Gas Security of Supply Regulation.
    - The consequences of malicious attacks do need to be considered as they are a requirement of the Electricity Risk-Preparedness Regulation
    - The Commission recommended to several Member States in its RPP opinions, to take better and more into account cybersecurity, critical infrastructure risks and climate change impacts in their risk scenarios. Overall, the architecture could better factor in these dimensions.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
|---|---|---|---|---|
| **EQ11 -** To what extent can the current storage policy (incl. liquid fuels) in the EU from a security of supply perspective be expected to continue to satisfy critical end-use of energy, independently of the energy vector? (e.g. heating when electrified) | **N/a** | • Adaptation to emerging and complex risks (e.g. cybersecurity, hybrid threats) and the flexibility of the Regulations to incorporate emerging risks such as climate change (**EQ11**) | • **Qualitative indicators**<br>• Degree to which realistic cross-sectoral and emerging risks are addressed via regulatory provisions (**EQ11).**<br>• Degree to which supply standard integrates a changing climate reality (**EQ11**).<br>• Degree to which emerging risks are identified in risk assessments and addressed via measures in the plans (**EQ11**). | • Strategic foresight workshop<br>• Desk research: assessment of regulatory requirements, risk assessments and plans.<br>• GIE AGSI transparency platform (storage)<br>• Eurostat (e.g. nrg_cb_gasm)<br>• Commission's 2040 climate target plan (and its impact assessment).<br>• Commission study on energy storage's contribution to electricity SoS |

**EQ11**
- The ongoing sectoral integration and electrification of the energy system means that critical energy consumption needs are expected to increasingly change vector (from natural gas/liquid fuels to electric heating). Current gas storage/supply standard policy is to a large extent designed to store gas to cover these critical needs in winter.

- If heating demand becomes more electrified, this may change the relevance of such storage policy for gas, and it puts in question the relevance of supply standard/storage policy split per vector. In the past, the objective of satisfying critical demand in winter was met via gas supply/storage requirements. In a sectorally integrated energy system, the focus may need to be redirected to a cross-vector supply standard/storage policy that covers heating demand irrespective of the carrier.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
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| **EQ12 -** To what extent is the Gas SoS framework fit for the development of renewable gases (biomethane, biogas, hydrogen)? | • **EQ12.1 –** To what extent and which ways the ramp-up of biomethane production in the EU will affect the security of gas supply framework?<br>• **EQ12.2 –** To what extent and in which ways will the ramp-up of renewable and low-carbon hydrogen impact the EU security of gas and supply frameworks? | • Sufficiency of the safeguards of current storage policy (electricity, gas and possibly liquid storage) to satisfy future heating demand (irrespective of the energy carrier used for heating), considering ongoing electrification and climate change (**EQ12**).<br>• Incorporation of the impact of expected decline of natural gas consumption and increase in biomethane consumption in the various risk assessments and plans (**EQ12.1)** | • **Quantitative indicators:**<br>• Expected evolution of natural gas demand for the period 2025-2040 (**EQ12**)<br>• Expected evolution of domestic biogas and biomethane production for the period 2025-2040 (**EQ12**).<br>• Expected evolution of hydrogen consumption for the period 2025-2040 (**EQ12**).<br>• **Qualitative indicators:**<br>• Areas that current energy security standards (infrastructure standard, supply standard) do not address (**EQ12).**<br>• Degree to which protected customers definition is aligned in electricity and gas and degree to which it is compatible with changing demand structure (**EQ12**).<br>• Degree to which supply standard integrates a changing climate reality (**EQ12).** | • Strategic foresight workshop<br>• Desk research: assessment of regulatory requirements, risk assessments and plans.<br>• GIE AGSI transparency platform (storage)<br>• Eurostat (e.g. nrg_cb_gasm)<br>• Commission's 2040 climate target plan (and its impact assessment).<br>• Commission study on energy storage's contribution to electricity SoS |

- **EQ12:**
  - **EQ12.1**
    - **Electricity SoS:** Biomethane (like other renewable gases) used for thermal generation will likely still contribute to security of electricity supply by 2050, as it can provide necessary flexibility for variable renewable energy sources.
    - **Gas SoS:**
      - Through the Hydrogen and Decarbonised Gas Package the definition of 'natural gas' also means biomethane that can be directly injected through the natural gas system (i.e. no biogas that has not been upgraded to biomethane). This means that the provisions of the Gas SoS Regulation also directly apply to biomethane.
      - However, the production of biomethane has different particularities compared to fossil natural gas. With an expected increase of biomethane, it will give a more prominent role to the distribution grid for security of supply, where biomethane is often injected into the system. This will also increase the share of off-grid usages (outside the transmission system).

- The increase in the use of biomethane may lead to a strengthened energy-food nexus. This might mean that the sourcing of biomethane (i.e. agricultural particularities) may need to be considered in e.g. risk assessments for security of gas supply.

- **EQ12.2**
  - **Electricity SoS:**
    - It is important that the pace of deployment of electrolysers to produce green hydrogen does not result in a cannibalisation of other decarbonisation processes or in a destabilization of the electricity grid, by exceeding the renewable generation capacities additions.
    - However, there is also a role to play for hydrogen as seasonal storage or to help stabilise the grid, as indicated in the study on the SoS contribution of energy storage.[247]
  - **Gas SoS:**
    - Future import of hydrogen will create new supply routes from different third country suppliers. The lessons learned of avoiding dependencies on single third country natural gas suppliers should be incorporated in the future hydrogen supply structure.
    - Repurposing of natural gas transmission, import or storage infrastructure will be crucial to a cost-efficient facilitation of the energy transition. However, this may have negative impacts on security of natural gas supply. An integrated approach is needed to ensure that the objective of repurposing infrastructure for hydrogen is balanced with the objective of ensuring security of gas supply.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
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| **EQ 13** - To what extent is the Gas SoS framework fit for ending EU's dependency on Russian gas as laid down in the REPowerEU and interlinked end of RU gas transit via Ukraine? | **N/a** | • Sufficiency of the provisions aimed at promoting diversification in the gas SoS Regulation (**EQ13**) | **Quantitative indicators:**<br>• HHI indicator<br>Number of reporting requirements related to diversification in the RAs, PAPs, and EPs. | • Eurostat<br>• Commission's opinions<br>• Public consultation |

- **EQ13**
  - Gas SoS Regulation has provisions that are directly relevant for the phase out of Russian gas supplies. However, the Regulation was designed to answer to short-term disruptions and not designed for prolonged supply disruptions from the EU's main supplier, nor were its objectives to diversify away from Russian gas, which is the objective of REPowerEU adopted in 2022.
  - The possibility to adopt measures fostering diversification or ending a particular contract lies primarily with Member States.
  - There are very few provisions that have an indirect impact on diversification:
    - In the risk assessments, the control or ownership of infrastructure that could hamper diversification efforts needs to be assessed.
    - The template for the risk assessments stipulates that risks related to third-country suppliers have to be assessed. The risk of a full Russian supply disruption has in fact been assessed in 24 out of 25 national risk assessments, while in the latest CRAs, a series of risks were identified often taking a full Russian supply disruption as the baseline scenario. Since the preventive measures outlined in the PAPs should be linked to the risk assessments, preventive measures related to a full Russian supply disruptions had to be adopted in those instances. Some preventive measures in the member states' plans were therefore related to diversification, development of renewable energy and gases or fuel switching.
    - National diversification measures taken have to be reported in the preventive action plan.
    - In the template for the preventive action plan, a breakdown (to the extent possible) of gas import sources per country of origin have to be provided.

[247] Study on energy storage - Publications Office of the EU

- Article 14 of the Regulation gives the option to the Commission to request the supply contracts concluded with a third country supplier, under certain conditions, in order to assess whether it negatively impacts the security of supply situation at national, regional or Union level. This is also the case if a concluded contract would constitute the equivalent to 28 % or more of yearly gas consumption. Although the Regulation provides for CAs or undertakings to notify some contractual information to the Commission, more transparency regarding the origin of the gas imported would be needed to further support achieving REPowerEU objectives.
- In the Preventive action plan, MS have the obligation to identify the main infrastructure relevant to security of supply. This has led many MSs to identify infrastructure linked to the supply of Russian gas (prior to 2022). The infrastructure standard obliges MSs to maintain a minimum level of redundancy in the system in the event of a disruption of the single largest gas infrastructure, and thereby to diversify the routes. It therefore obliges them to identify options to diversify in case of disruption of the main infrastructure (which in a number of cases was related to Russian gas supply). the N-1 was essential for SoS as it enabled a complete shift of flow pattern, when the main EU supplier cut its flow.
- In addition, resulting from the regional risk assessments, a Union-level assessment of the emergency supply corridors should be done, identifying emergency diversification routes for the regions. This work has for instance been done by the Commission and the CEE regional risk group in preparation for the end of the transit via Ukraine.

- In addition, the Gas Coordination Group and a spin-off regional working group for the CEE region provided useful to discuss the end of the gas transit through Ukraine. The group met regularly to exchange views on the possible security of supply impact of the end of transit and proved essential in order to ensure that no security of supply incident occurred, facilitating the further phase out of Russian gas.
- However, none of these measures are designed to actively encourage or require a pre-defined level of diversification of supplies. To ensure future relevance in light of the REPowerEU objectives to phase out Russian gas, this objective may need to be better incorporated in the Gas SoS Regulation.

**COHERENCE**

**How well did the regulations work with other policy interventions and how well did specific measures in the regulations work together?**

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
|---|---|---|---|---|
| • **EQ13 -** To what extent was the EU security of electricity and gas supply framework internally coherent? | • **EQ13.1**. – Which provisions within the Electricity Risk-Preparedness and the Gas SoS Regulation were particularly consistent or inconsistent with one another?<br>• **EQ13.2**. – Which provisions within the crisis measures to address the energy crisis were particularly consistent or inconsistent with one another?<br>• **EQ13.3.** – Which provisions proved to be particularly consistent or inconsistent between the Gas SoS Regulation, the Electricity Risk-Preparedness Regulation and the crisis Regulations? | • Consistency in risk management approaches across the electricity and gas sectors (**EQ13**).<br>• Alignment of different provisions within the Gas SoS Regulation (**EQ13**, **EQ13.1**).<br>• Alignment of different provisions within the Electricity Risk-Preparedness Regulation (**EQ13**, **EQ13.1**).<br>• Alignment of different provisions within the crisis regulations (**EQ13**, **EQ13.2**).<br>• Alignment of similar provisions between the Gas SoS Regulation, the Electricity Risk-Preparedness Regulation and the crisis regulations (**EQ13**, **EQ13.3**). | **Quantitative indicators**<br>• Electricity demand for heating, gas demand for heating, gas demand for electricity generation (**EQ13.3**).<br>• Amount of similar provisions applied differently in gas SoS and electricity risk-preparedness (**EQ13.3**).<br>**Qualitative indicators**<br>• Coherence between measures in national plans of Member States (**EQ13.1**, **EQ13.1**).<br>• Alignment of electricity storage and gas storage from an SoS perspective (**EQ13.3**).<br>• Instances of redundant or conflicting provisions within the Gas SoS (**EQ13.1**) | • ECG/GCG<br>• NECPs, PAPs, EPs, RPPs<br>• ENTSOE-E, ENTSOG, GIE transparency platforms.<br>• ACER 2023 report on electricity SoS<br>• Public consultation |

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| | | • Alignment and interchangeability of electricity storage and gas storage (and if relevant, heating storage) to satisfy critical end-use demand, such as heating (**EQ13**, **EQ13.3**).<br>• Alignment of gas storage policy and the supply standard (**EQ13, EQ13.2**) | • Instances of redundant or conflicting provisions within the Electricity Risk Preparedness (**EQ13.1)**<br><br>**Further information requirements**<br>Feedback from Member States and stakeholders on perceived coherence, as well as implementation challenges due to inconsistencies or overlaps (**EQ13)** | |

**Answers**

**EQ13.1 - Which provisions within the Electricity Risk-Preparedness and the Gas SoS Regulation were particularly consistent or inconsistent with one another?**

- **Gas SoS**
  - There were no major internal inconsistencies noted within the Gas SoS Regulation.
  - However, there is an overlap between the Crisis Management Group and the Gas Coordination Group. There is room for clarification and simplification as regards which group would be used to which ends during a crisis.
- **Electricity SoS**:
  - There are no particular internal inconsistencies observed.

**EQ13.2 - Which provisions within the crisis measures to address the energy crisis were particularly consistent or inconsistent with one another?**

- The crisis measures were designed to complement each other and therefore show a high degree of coherence. The 15% gas demand reduction target was needed to re-establish a healthy supply-demand balance after RU's supply cuts, but it was also needed to meet the 90% storage target. As reports COM(2023) 173 and COM(2024) 88 show, the 90% storage targets could only be met through continued subdued gas demand after the RU supplies were reduced.
- While the storage and demand reduction targets aimed to address immediate security of supply concerns, the default solidarity provisions introduced by Regulation (EU) 2022/2576 complemented these measures. They ensured that if these targets were not enough to combat the crisis, the crisis management and solidarity mechanisms would be operational to address a severe emergency.

**EQ13.3 - Which provisions proved to be particularly consistent or inconsistent between the Gas SoS Regulation, the Electricity Risk-Preparedness Regulation and the crisis Regulations?**

- The Gas Security of Supply Regulation and Electricity Risk-Preparedness Regulation were designed in a similar way, so they both follow a risk-based approach. Both Regulations use risk assessments and establish plans, while transparency and cooperation are fostered through coordination groups. Both Regulations have crisis management provisions containing crisis levels and emergency cooperation procedures. Therefore, they show a large degree of coherence with each other.
- Participants to the public consultation expressed varied views on the coherence between the Gas SoS Regulation and Electricity Risk-Preparedness Regulation. Around 30% of the respondents to this particular question answered "yes", 20 % answered "no", while around half of the respondents did not express any opinion. Participants notably stressed that interdependence between the gas and electricity sectors was insufficiently addressed in the existing Regulations, and that an increased focus on cross-sectoral integration would create a more cohesive and efficient energy system. Integrated risk assessments, harmonised crisis declaration procedures, and cross-sectoral exercises were notably mentioned as possible areas for improvement. Participants also stressed that the analysis of critical gas volumes within electricity adequacy outlooks was an improvement for the building of cross-sectoral scenarios and should be maintained in the future.
- There is a certain natural overlap between the supply standard and the gas storage target, even though they are not inconsistent with one another. To meet the supply standard, some undertakings will use underground storage facilities to ensure supplies to protected customers during the required climatic/infrastructure disruption scenarios. While they lead to similar outcomes (storing gas in UGS) albeit to different degrees, they have slightly different objectives (storage target aims to be prepare for the winter season by filling storages, while the supply standard aims to have a certain level of supply to protected customers guaranteed under pre-defined conditions.

- The definition of protected customers between gas and electricity are not aligned. Logic behind protected customers in gas is to protect customers that cannot protect themselves (e.g. households) and protect an essential energy need (heating). In electricity, the concept of special protection against disconnection is meant to protect public safety and personal security. There is a risk that gas protected customer concept becomes un-operational in case of cascading crisis (gas boilers usually need electricity).
- The fact that households do not necessarily qualify as 'protected customers' in electricity, while they do in gas, could arguably constitute a hurdle to electrification in the longer term: customer may feel less protected, and could be more reluctant to change.
- There is a slight incoherence in the composition of the coordination groups. The Regulation requires the Gas Coordination Group to be composed also of representative bodies of the industry concerned and those of relevant consumers, the Electricity Coordination Group's composition is limited to Member States' representatives, NRAs, ACER and ENTSO-E. There is no particular reason explaining this difference. An alignment in the composition of the two expert groups could be considered in the future.
- Two joint Electricity-Gas Coordination Groups were held in 2022 to discuss cross-cutting issues such as critical gas volumes for electricity, which were computed as part of ENTSO-E's winter outlook. These joint meetings brought further alignment and a joint understanding of a challenging situation on both the gas and electricity market in 2022, which occurred due to reduced availability of Russian gas supplies at the same time as reduced hydro and nuclear availability for electricity generation.
- There are differences between solidarity (gas) and assistance (electricity) provisions.
- There are different crisis levels between electricity and crisis: early warning, alert and emergency in gas, compared to early warning and crisis in electricity.
- While in the Gas SoS Regulation, the monitoring of security of gas supply measures is a task of the Commission, in RPR it was given to ACER.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
|---|---|---|---|---|
| • **EQ14. -** To what extent was the EU security of electricity and gas supply framework externally coherent? | • **EQ14.1 -** Which provisions of the Gas SoS Regulation, the Electricity Risk-Preparedness Regulation and the crisis measures proved to be particularly consistent or inconsistent with other measures from wider EU energy acquis?<br>• **EQ14.2 -** Which provisions of the Gas SoS Regulation, the Electricity Risk-Preparedness Regulation and the crisis measures proved to be particularly consistent or inconsistent with other measures from wider EU non-energy acquis? | • Alignment with other legislations from the EU energy acquis (e.g., Electricity Regulation, CEF, etc.). **(EQ14.1)**<br>• Alignment with legislations from EU non-energy acquis (Civil Protection Mechanism, NIS-2 Directive, CER Directive, etc.) **(EQ14.2)** | **Quantitative indicators**<br>• Number of provisions that that demonstrably do not align with climate targets (**EQ14**).<br>**Qualitative indicators**<br>• Degree of compatibility of regulatory provisions (e.g. infrastructure standard, storage target) with the EU's climate objectives (Fit-for-55, e.g. REPowerEU) and phase out of fossil fuels (**EQ14**).<br>• Instances of redundant or conflicting provisions with both Regulations and the NECPs (**EQ14.1**)<br>• **Further information requirements**<br>• Feedback from Member States and stakeholders on perceived coherence, as well as implementation challenges | • ECG/GCG<br>• NECPs, PAPs, EPs, RPPs<br>• ENTSOE-E, ENTSOG, GIE transparency platforms.<br>• ACER 2023 report on electricity SoS<br>• Public consultation |

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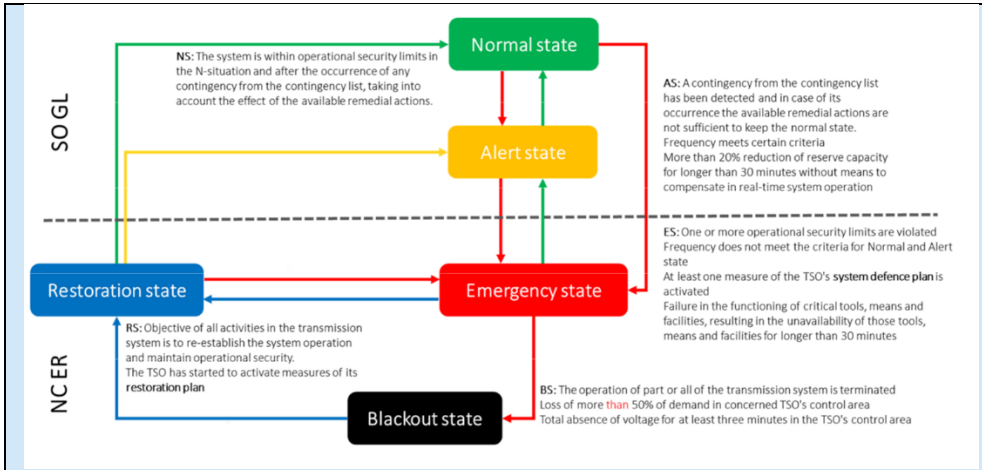
| | | | due to inconsistencies or overlaps (**EQ14**) | |

**EQ14.1 - Which provisions of the Gas SoS Regulation, Electricity Risk-Preparedness Regulation and crisis measures proved to be particularly (in)consistent with other measures from wider EU energy acquis?**

- **Trans-sectoral:**
  - **NECPs**: as further detailed under efficiency, there is no distinct overlap in timing of reporting requirements between the Gas SoS Regulation and electricity Risk-Preparedness Regulation. However, the updates of the PAPs/EPs come shortly before the draft NECPs have to be issued. Both the Plans and the NECPs are extensive reporting requirements for MSs and while the required deliverables are not exactly the same, there may be room for simplification.
- **Gas SoS:**
  - **TEN-E:** Gas infrastructure used to be supported by the TEN-E Regulation and CEF funding, which contributed to the N-1 standard and reverse flow requirements of the Gas SoS Regulation. However, the TEN-E Regulation no longer covers natural gas infrastructure development. While this is not fully coherent with the N-1 requirement, it is consistent with the EU's decarbonisation commitments.
- **Electricity SoS:**
  - **Electricity Regulation:** in 2023, "ACER recommended to explore the synergies between the Electricity Regulation and the Risk Preparedness Regulation and to clarify the measures involving the procurement of capacity for the electricity system for emergency situations that can and cannot be introduced under the latter". Extreme weather events are the main risk that could lead to an overlap of both regulations. The RPR cannot be a tool to bypass the Electricity Regulation.
  - **TEN-E:** They can be considered as significantly consistent. The Electricity Risk Preparedness Regulation requires MSs to "*include information on related and necessary plans for developing the future grid*" (even if the first RPPs contained little information on this aspect) and ECG to discuss the results of TYNDP. Also, under the revised TEN-E regulation (2022)[8], "security of supply" is included as a specific criterion for the assessment of Projects of Common Interest and Projects of Mutual Interest. Article 4 of TEN-E Regulation, which provides general definitions of the "security of supply" criterion for each infrastructure category, notably refers to LOLE indicator. The methodology for assessing electricity project's contribution to SoS developed by ENTSO-E in the guidelines for cost-benefit analyses of grid development projects explicitly includes EENS as an indicator to evaluate security of supply. Hence, both Regulations are consistent in their approaches to assess electricity security of supply.

**Network codes**: in the public consultation, some participants highlighted unclear links between the network codes and the Risk-Preparedness Regulation as a potential loss of effectiveness. However, a cautious assessment tends to show limited overlap between the various regulations. Recital 5 of the Risk Preparedness Regulation asserts that the two network codes *"a detailed rulebook governing how transmission system operators and other relevant stakeholders should act and cooperate to ensure system security (…) [to] ensure that most electricity incidents are dealt with effectively at operational level".* The Risk Preparedness Regulation deals with events with larger scale and impact, for which operational rules no longer suffice, and should fully respect operation rules even in times of electricity crisis. There are specific situations that may create interactions between the Risk Preparedness Regulation and the Emergency and Restoration Network Code, e.g., extreme weather events with extensive damage to the electrical infrastructure or severe disruption of fuel supplies. No particular inconsistency was noticed during the implementation (see figure below for details about the interplay between the two).

**Visual representation of System Operation Guidelines and Emergency and Restoration Network Code**




*Source: ENTSO-E*[248]

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
|---|---|---|---|---|
| • **EQ15.** – To what extent are the Risk-Preparedness Regulation and the Gas SoS Regulation aligned with high-level EU policy goals (e.g., EU Green Deal, Economic security & open strategic autonomy, competitiveness)? | **N/a** | • Alignment with e.g. EU Green Deal, Economic security and competitiveness goals (**EQ15**). | **Further information requirements**<br>Feedback from Member States and stakeholders on perceived coherence, as well as implementation challenges due to inconsistencies or overlaps (**EQ3**) | • ECG/GCG<br>• NECPs, PAPs, EPs, RPPs<br>• ENTSOE-E, ENTSOG, GIE transparency platforms.<br>• ACER 2023 report on electricity SoS<br>• Public consultation |

**EQ15 - To what extent are the Risk-Preparedness Regulation and the Gas SoS Regulation aligned with high-level EU policy goals (e.g., EU Green Deal, Economic security & open strategic autonomy, competitiveness)?**

- **Trans-sectoral:**
  - **Competitiveness:** The energy crisis showed that without SoS, the competitiveness of the EU is at risk, as also emphasised by the Draghi Report. While ensuring security of electricity and gas supplies has a cost, which may be perceived by some actors as detrimental for EU short-term competitiveness, this needs to be balanced with the benefits for competitiveness associated with energy security, achieved by preventing supply crises or by mitigating the impacts of the actual crises which in turn prevents or mitigates high and volatile energy prices. Reporting is an administrative burden for MS but are low for energy undertakings, so they don't harm competitiveness.

248 See: https://eepublicdownloads.entsoe.eu/clean-documents/SOC%20documents/Nordic/Nordic%20SOA_Annex%20OS.pdf

- **EU Green Deal:** the energy transition and energy security are two sides of the same coin. Energy security is needed to facilitate an orderly phase out of fossil fuels and to ensure public acceptance of the energy transition.
- **European Pillar for social rights (EPSR):** the concept of 'protected customers' is in line with point 20 "*everyone has the right to access essential services of good quality, including (...) energy*".

- **Gas SoS:**
  - Infrastructure standard and gas storage targets need to be balanced with the need to avoid creating stranded assets and avoiding carbon lock-in to support decarbonisation objectives. Infrastructure standard incentivises development of fossil infrastructure, which is necessary for security of supply and system flexibility, but in the future may require adaptation.

**EU Added Value**

**To what extent did the regulations better reach the objectives, compared to what could have been reasonably expected from regional, national or local actions?**

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
|---|---|---|---|---|
| • **EQ16 -** To what extent has the EU's security of electricity and gas supply framework provided more security of supply and resilience compared to what could have reasonably been achieved at national, regional or local level? | • **EQ16.1.** – How well did the EU-level intervention perform in improving cross-border cooperation and crisis coordination?<br>• **EQ16.2.** – To what extent did the EU's security of electricity and gas supply framework prevent cross-border restrictions by Member States that would affect other Member States, aggravating the impact of crises?<br>• **EQ16.3.** - To what extent were the crisis measures adopted in 2022/2023 more or less adequate to address cross-border security of supply risks in a united manner, compared to individual actions at national, regional or local level? | rovement of cross-border/regional peration and crisis coordination over the lementation period (**EQ16**, **EQ16.1**).<br>ree of coordination regarding declaration or ering of national crisis levels (**EQ16.1**).<br>k of cross-border restrictions imposed by nber States during a crisis (**EQ16**, **EQ16.2, 16.3**).<br>k of cross-border restrictions included in nber States' PAPs/EPs/RPPs (**EQ16**, **16.2**). | **<u>Quantitative indicators</u>**<br>• Amount of ECG and GCG meetings (**EQ16.1**).<br>• Number of gas solidarity agreements and of electricity technical, legal and financial arrangements for the provision of assistance (**EQ16.1**)<br>• Amount of solidarity/assistance procedures actually triggered during the implementation period (**EQ16.1**)<br><br>**<u>Qualitative indicators</u>**<br>Discussions in ECG/GCG meetings | • Desk Research<br>• Report reviewing the Gas SoS Regulation<br>• Report reviewing the Storage Regulation<br>• Report reviewing the emergency Regulations (demand reduction & solidarity)<br>• Table-top (dry run) exercises |

**Answer:**

- **EQ16.1 - How well did the EU-level intervention perform in improving cross-border cooperation and crisis coordination?**
  - **Gas SoS:**
    - Best practice measures were exchanged in the GCG in particular during the energy crisis and next steps for EU-wide measures to enhance preparedness during the energy crisis were discussed, which played a key role in informing the Commission in order to propose new legislative proposals.
    - The declaration of national crisis levels during the energy crisis went in a fairly coordinated manner, which can largely be explained by the fact that MSs reacted to the same or similar incidents (e.g. RU cutting supplies to multiple MSs in the same period) and because the EU energy market is well-interconnected. The GCG proved a valuable tool to coordinate, as the declaration of a

crisis level and the reasoning thereof was immediately shared and discussed. However, discussions in the GCG pointed to the fact that more guidance is needed on when a crisis level should be lowered in a coordinated manner.

- Cross-border cooperation has been facilitated due to the fact that the EU energy market is well-interconnected. This has in part been improved because of the infrastructure standard and the bi-directionality requirement, which obliged Member States to have a pre-defined level of redundancy in infrastructure which made energy infrastructure more flexible especially in case of supply disruptions.
- Insufficient solidarity agreements were signed (9 out of 40), meaning that emergency cooperation was not operational until default solidarity agreements were introduced by the Solidarity Regulation and later enshrined in permanent legislation by the Hydrogen and Decarbonised Gas Package.
- While the overall content of the PAPs and EPs was often satisfactory, the regional chapter was often underdeveloped, largely due to the fact that the required bilateral solidarity agreements were not signed.
- The Common Risk Assessments were not submitted on time and the Commission had to step in for the majority of risk groups to help with modelling and the overall assessment. Despite the significant shortcomings experienced in the process, common risks facing a region were identified leading to a shared understanding of the security of supply situation in the EU.

- **Electricity SoS:**
  - Identification of regional crisis scenarios by ENTSO-E, on which national scenarios had to be based. In the second round of the identification of regional crisis scenario, ENTSO-E involved RCCs to improve the assessment of cross-border risks. However, assessment of regional risks is still not fully satisfactory (remains a pan-European assessment). But very substantial improvements achieved in the second cycle.
  - Very few information in RPPs about regional exercises.
  - Information about regional and bilateral measures (solidarity) to cooperation in the prevention or management of a crisis was very incomplete in RPPs. Only 9 MS referred to existing arrangements and identified a number of measures but were not considered complete enough. While, according to the regulation, ACER should technical assistance to Member States with a view to facilitating regional/bilateral agreements, this option was never triggered during the implementation period.
  - Information about cooperation and coordination with Member States out of their regions for the establishment of the RPPs was also considered as insufficient.
  - RCCs have been performing more SoS-related tasks but could do more (cf. JRC report).
  - Huge increase of ECG meetings compared to the period before the entry into force of the Regulation. ECG has become a very useful cooperation & monitoring platform.
  - Assistance measures were never actually triggered.

- **EQ16.2 - To what extent did the EU's security of electricity and gas supply framework prevent cross-border restrictions by Member States that would affect other Member States, aggravating the impact of crises?**
  - **Gas SoS:**
    - 6 Member States included cross-border restrictions in the PAPs/EPs, no cross-border restrictions were implemented during a crisis. This does not necessarily mean that these restrictions are undue during a crisis, as the justification of activating such measures will depend on the situation at hand. The Solidarity Regulation strengthened the role of the Commission to lift undue cross-border restrictions imposed by Member States on cross-border flows during a crisis.
  - **Electricity SoS:**
    - No unjustified measures restricting cross-border flows actually implemented during the implementation period (mention BG 2017 export ban: https://eepublicdownloads.entsoe.eu/clean-documents/news/entso-e_Managing_Critical_Grid_Situations_web.pdf)

- **EQ16.3 - To what extent were the crisis measures adopted in 2022/2023 more or less adequate to address cross-border security of supply risks in a united manner, compared to individual actions at national, regional or local level?**
  - **Gas SoS:**
    - Unilateral supply cuts from Russia required EU level action, due to the scale of the supply cuts that affected the majority of MSs. The gas market is an integrated market, meaning that a supply cut to one MS also affects security of supply in a neighbouring MS, either through price increase/volatility or the need to acquire alternative volumes on neighbouring markets.

- By having the 15% demand reduction target at EU level, rather than at national level, demand could be reduced there were it was most efficient to reduce. Wide variety in reduction between Member States was observed (ranging from -42% in DK to +7% in MT), which reflects different consumption patterns between MSs. Therefore, the fact that one MSs can voluntarily reduce so that there were it is more difficult (e.g. because of a coal-to-gas switch, which happened among others for district heating in Ljubljana), helped lower the joint cost of the energy crisis.
- The Solidarity Regulation introduced default solidarity rules that operationalised the emergency cooperation among Member States in case of a severe gas shortage. These measures never had to be implemented but the 'dry run' exercise of 2022 showed that these provisions improved the crisis management architecture of the EU. Without an operationalised solidarity mechanism at EU level, MSs would not be ensured to have access to volumes of neighbouring MSs in case of a national gas emergency, if it means that consumers in the neighbouring MS would have to be curtailed.
- The Storage Regulation set a common 90% storage target, which improved the collective winter preparedness of the EU by ensuring that winter demand is met with sufficient supply, as highlighted in report COM(2024) 89. The Storage Regulation includes a burden sharing mechanism and obliges that MSs without storage facilities contribute to filling the storages of MSs with storage facilities. However, burden sharing remains a contentious issue among MSs, especially for MSs with larger storage facilities.
- In October 2022, DE introduced a gas neutrality charge to refinance storage filling costs incurred, charged at all cross-border points. It substantially impacted cross-border flows and was harmful for the EU internal market and SoS. It hampered phasing out RU pipeline gas, as alternative routes for MSs in the CEE region became more expensive. In this particular case, the framework was not successful in preventing and resolving the situation, even if the measure is not active anymore since 1 January 2025. This may contribute to why, in the public consultation, the performance of the Gas SoS Regulation was deemed the least effective on the following objective: "Enhance regional and EU-wide cooperation, even in times of crisis". Feedback, however, was overall still positive.

- **Electricity SoS:**
  - No unjustified cross-border restrictive measure was introduced strictly on electricity SoS grounds. Instead, there was an increased coordination and exchanged of info through the ECG that was very welcome and pointed to the way forward to pass the winter (e.g. through the ENTSO-E outlook). In addition, ENTSO-E did extra critical gas volumes calculations that helped MS to take their own measures having in mind the situation in neighbouring countries.

| Evaluation questions | Sub-questions | Judgement criteria | Indicators and information requirements | Data sources |
|---|---|---|---|---|
| • **EQ17 -** To what extent has the EU's security of electricity and gas supply framework improved the EU's collective preparedness for crisis situations? | • **EQ17.1.** – To what extent did the EU's security of electricity and gas supply framework help identify and jointly address cross-border risks that could affect several Member States?<br>• **EQ17.2.** – To what extent did the EU-level intervention improve transparency and information sharing among Member States and market actors?<br>• | ree and quality of cross-border risks tified in risk assessments/regional-national tricity crisis scenarios (**EQ17**, **EQ17.1**).<br>ree of cross-border risks addressed in s/EPs/RPPs (**EQ17**, **EQ17.1**).<br>rovement in transparency of crisis measures (neighbouring) MSs could implement ng a crisis (**EQ17**, **EQ17.2**).<br>rovement in transparency for stakeholders er which circumstances non-market-based sures may be implemented by authorities 17, **EQ17.2**). | **<u>Quantitative indicators</u>**<br>• Amount of MSs that consulted neighbouring MSs and stakeholders on their plans (**EQ17.2**).<br>• Amount of ECG and GCG meetings (**EQ17.2**).<br>• Number of plans and opinions published on the Europa website (**EQ17.2**).<br><br>**<u>Qualitative indicators</u>**<br>Discussions in ECG/GCG meetings. | • Desk Research<br>• Report reviewing the Gas SoS Regulation<br>• Report reviewing the Storage Regulation<br>• Report reviewing the emergency Regulations (demand reduction & solidarity)<br>• Table-top (dry run) exercises |

- **EQ17.1 - To what extent did the EU's security of electricity and gas supply framework help identify and jointly address cross-border risks that could affect several Member States?**
  - **Gas SoS**:

- Before the Regulation, there was no framework to identify (let alone address) cross-border risks. The Regulation created the obligation for MSs to create common risk assessments in regional risk groups. In the latest CRAs, a series of risks were identified often taking a full Russian supply disruption as the baseline scenario. On top of a full Russian supply disruption among others individual pipeline disruptions, liquefaction trains being out of service, or cold spells were simulated. This means that the common risk assessments have mostly met the policy objective of enhancing preparedness and transparency of measures through a risk-based approach, although there are areas that require further work to ensure that this objective is completely met.
- During the 'dry run' of 2022, it was considered by participants that the EU emergency level is insufficiently defined, in particular the difference between EU and regional emergency and the role of the Commission in an emergency. Participants indicated that an EU-wide emergency would be more effective than regional emergency, as it would include those Member States that may still be in a position to help those in need. However, Member States indicated that the declaration of an EU emergency would not necessarily result in the declaration of a national emergency level, which in some Member States would allow for introducing non-market measures.
- The two 'dry run' exercises that were organised proved to be tangible examples of EU added value to foster coordination and cooperation. This is in particular the case since it confirmed the key coordinating role of the Commission and the importance of that non-market-based measures implemented nationally do not deteriorate the SoS situation in neighbouring MSs.
- The role of the Commission in an EU emergency is ambiguous beyond its coordinating tasks, as indicated in the report reviewing the Gas SoS Regulation. This is in contrast to the role of the Commission in the newly established EU alert, where the role of the Commission in monitoring, coordinating and enforcing demand reduction is clearer. Relates to having a lack of EU emergency plan in contrast to national emergency plans.

- **Electricity SoS**:
  - Identification of regional crisis scenarios by ENTSO-E, on which national scenarios had to be based. In the second round of the identification of regional crisis scenario, ENTSO-E involved RCCs to improve the assessment of cross-border risks. Despite some flaws, the second cycle of the assessment of regional crisis scenarios displayed very substantial improvements (cf. section on effectiveness).
  - Shallow assessment of cross-border risks in electricity. However, work is ongoing with a revision of the methodology to put more emphasis on simulations at regional level Work ongoing, revision of methodology to put more emphasis on simulations at regional level

- **EQ17.2 - To what extent did the EU-level intervention improve transparency and information sharing among Member States and market actors?**
- **Gas SoS:**
  - According to MSs PAPs, all but 1 plan were consulted with (domestic) stakeholders (1 plan did not specify whether it was consulted with stakeholders) and 14 were before publication consulted with neighbouring Member States and the Commission. All plans are available to stakeholders and neighbouring Member States, given that they are required to be published on the Europa webpage by the Regulation.
  - 27 GCG meetings in full format (including market participants) since 2017 and a sharp increase in the amount of GCG meetings during the crisis (mostly restricted to MSs only). Exchange of best practice measures and coordination of next steps was greatly facilitated by the GCG's flexible and adaptable format.
  - The Gas SoS Regulation's Article 14 fosters transparency and avoid security of supply risks stemming from nationally concluded supply contracts at EU level. It provides an obligation on MSs to notify to the Commission commercial information related to gas supply contracts in order to assess the security of supply situation at national, regional, and Union level. Moreover, it allows the Commission to directly address the gas undertakings to receive the gas supply contracts under specific and duly justified circumstances. However, the enforcement provisions could benefit from further specification to reinforce the effectiveness and thereby the EU added value of the measure, which is necessary to ensure an effective implementation to strengthen security of gas supply while preserving the confidentiality of commercial information.
- **Electricity SoS:**
  - A key outcome of the Regulation was increased information exchange after security of supply incident occurred, which fostered coordination and a shared understanding and sensemaking of the situation.
  - The Regulation increases transparency as the Risk-Preparedness Regulation requests MSs to describe their national crisis measures in the plans. Typically, the crisis measures used to be described only in national laws and countries were not aware of the national measures in their neighbouring countries and the potential effect on their own country.
  - MSs were officially consulted on other MSs' RPPs. But only one MS officially did so (SE provided comments on plans from DK, FI, DE, LT, PL)
  - 28 RPPs (and corresponding Commission's opinion) that are public on Europa website.

- The frequency of ECG meetings dramatically increased since the adoption of the Regulation. Most Member States met their obligation (even if with some delay) to share their draft RPP with their neighbours, giving them the opportunity to provide feedback. Only one Member State made official comments on other MSs' plans (SE). For example, a 3-day session was dedicated to discussing the RPPs in June 2021.

| Annex IV. Overview of benefits and costs ***Table 1. Overview of costs and benefits identified in the evaluation*** | | | | | | | | | | |
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| | | | Citizens/Consumers | | Businesses | | Administrations[249] | | Commission and Agencies | |
| | | | Quantitative | Comment | Quantitative | Comment | Quantitative | Comment | Quantitative | Comment |
| **Direct compliance costs** (adjustment costs, administrative costs, regulatory charges) | **Adjustment costs** | **One-off** | The costs for infrastructure development is ultimately mostly passed on to consumers through regulated tariffs. However, these tariffs are influenced by all infrastructure developments, most of which are unrelated to the Gas Security of Supply Regulation or Electricity Risk-Preparedness Regulation. | | **Infrastructure standard:** For Bilciurești project, total eligible costs were estimated at EUR 110 million (of which EUR 38 million were covered by CEF funding)**.** | **Infrastructure standard:** cost for TSOs of developing infrastructure to meet the N-1 and the reverse flow obligation. It is not possible to have an exact estimation for this provision, because of causality issues. But some case studies can give an idea of the order of magnitude. | **Infrastructure standard:** N/A | **Infrastructure standard:** N/A | **Infrastructure standard:** e.g., Bilciurești benefitted from EUR 38 million of CEF funding. | **Infrastructure standard:** some projects benefitted from EU funding to meet the obligation - some case studies can give an idea of the order of magnitude (e.g., Bilciurești). |
| | | | | | **Reverse flows obligations:** In ENTSOG's TYNDPs, 6 reverse flow projects were | **Reverse flows obligations:** TSOs investing to meet the requirement – some case studies can give an idea of | **Reverse flows obligations:** N/a. | **Reverse flows obligations:** N/a. | **Reverse flows obligations:** Karksi received EUR 18.7 mln EUR of CEF | **Reverse flows obligations:** Two projects benefitted from EU funding to |

[249] The quantitative figures provided for the costs borne by Member States are based on the feedback received directly from them (cf. methodology section). They should be treated with caution, as the replies received do not constitute a representative sample. Due to the low number of responses received and their disparate nature the robustness of the data presented proved difficult to assess. This is exacarbated by the fact that it was not possible to triangulate the data received with independent third sources. Nevertheless, they constitute the best available estimate.

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| | | | | identified that were commissioned in the evaluation period that included CAPEX costs, which totalled 286 mln EUR. For example, Karksi project cost EUR 37.4 million to make the IP bidirectional (half of these costs were covered by CEF funding).<br><br>**Certification of SSOs**: N/a. | the order of magnitude.<br><br>**Certification of SSOs**: It is conceivable that there are costs borne by the UGS operators that had to be certified, e.g. due to reporting requirements but no such costs have been notified. | **Certification of SSOs:** Figures provided range from 180 total hours spent, to 2.5 FTE (both for the period of 2022-2024). | **Certification of SSOs:** The figures provided by MSs indicated a wide range, partly explained by the difference in amount of UGS sites on their territory. | funding to make the IP bidirectional. The reverse flow project TENP received 9.11 mln EUR in CEF funding (0.4 mln EUR for studies, 8.7 mln EUR in support for procurement and execution of the works<br><br>**Certification of SSOs:** 0.5 FTEs | meet the obligation.<br><br>**Certification of SSOs:** Commission: for the drafting of the opinions on the storage certification |
| | **Administrative Costs** | **Recurrent** | N/a | **GCG/ECG:** Negligible<br><br>**Reverse flows exemptions:** Negligible, given the low number of exemption requests. | **GCG / ECG:** Participation to meetings (through ENTSOs)<br><br>**Reverse flows exemptions:** TSOs drafting of the request for exemption. | **ECG/GCG:** negligible.<br><br>**Reverse flows exemptions:** Negligible, given the low number of exemption requests. | **GCG / ECG:** Participation to meetings<br><br>**Reverse flows exemptions:** CAs rafting of the coordinated decision. | **All administrative provisions:** DG ENER devotes 3.5 FTEs to perform its tasks (1.5 for electricity and 2 for gas) + administrative arrangement with JRC (for | **GCG / ECG:** secretariat<br><br>**Reverse flows exemptions:** ACER's opinion on reverse flows exemptions + Commission's decisions. |

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| | | | | **Supply standard:** Negligible cost (cf. efficiency section)<br><br>**Plans and risk assessments:** N/a<br><br>**Solidarity/Assistance:** 40 hours/y – 130 hours/y | **Supply Standard:** Cost for gas undertakings to meet the supply standard obligation.<br><br>**Plans and risk assessments:** N/a<br><br>**Solidarity/Assistance:** Two MSs indicated that their TSOs had borne costs in relation to the negotiation or conclusion of solidarity agreements. | **Supply standard:** N/a<br><br>**Plans and risk assessments:** for gas, the estimates provided by MSs range from EUR 30k and EUR 300k, and from 0.3 to 33 FTEs. For electricity, the only feedback received on this particular task mentioned 320 hours/y<br><br>**Solidarity/Assistance:** On gas, estimates received ranged between 40 hours/y - 25 days/y. One MS indicated it spent a total of 100.000 EUR negotiating solidarity agreements during the evaluation period. | **Supply standard:** N/a<br><br>**Plans and risk assessments:** cost of drafting the various plans required by the regulations (RPPs/PAPs/EPs)<br><br>**Solidarity/Assistance:** costs of the negotiations to reach agreements with the neighbours. Three MSs reported the time spent negotiating solidarity agreements, one Member | the period 2022-2025, EUR 647 000 for gas and EUR 536 000 for electricity)<br><br>ACER estimates that it devotes 2.5 FTE to perform all the tasks from the Gas SoS and Electricity Risk-Preparedness regulations. | **Supply standard:** N/a<br><br>**Plans and risk assessments:** Drafting of Commission's opinions.<br><br>**Solidarity/Assistance:** N/a |

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| | | | | | | On electricity, only one MS provided feedback on this particular provision, estimating it spent a total of 200 hours/y. | State provided a number in Euros per year. The majority of Member States has not concluded, and in some instances not negotiated, solidarity agreements. The actual time spent, overall, is therefore contained. | | |
| | | | | **Supply-outlooks, Methodologies, Risk assessments and SoS simulations:** ENTSOG devotes a total of 2 FTEs to their tasks mandated by the Gas SoS Regulation.<br><br>ENTSO-E devotes a total of 2 FTEs and EUR 50k (in 2024) of other costs for the performance of | **Supply-outlooks, Methodologies, Risk assessments and SoS simulations:** ENTSOs regulated tasks. The gas supply outlooks are not within the remit of the Gas SoS Regulation and are therefore out of the scope of this fitness check. | **Supply outlooks:** N/a | **Supply outlooks:** N/a | | **Supply outlooks:** N/a |

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| | | | | the seasonal supply adequacy outlooks; a total of 2 FTEs and approximately EUR 4.4 million (in 2024) of other costs for the performance of short-term adequacy assessments; a total of 0.8 FTEs for each regional crisis scenarios report (in 2020 and in 2024). All this comes on top of 0.6 FTEs for the regular implementation of the Regulation. | | | | | |
| | | | | **Storage filling measures:** ACER study, which assessed that certain national measures in three Member States to establish strategic reserves cost €19 billion in purchase. However, the | **Storage filling measures:** as the commodity is generally purchased and sold simultaneously at a premium, the cost of storage is generally covered by the gains. However, by setting mandatory targets, operators | **Storage filling measures:** ACER study, which assessed that certain national measures in three Member States to establish strategic reserves cost €19 billion in purchase. However, the total cost of the measure | **Storage filling measures:** as the commodity can be resold later, the cost of the measure is primarily the cost of storage. However, by forcing | | **Storage filling measures:** N/a |

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| | | | | total cost of the measure depends on the difference with the price at which the gas has been or will be sold and the duration of the storage.<br><br>**Demand reduction measures:** N/A. | may fill storages even in unfavourable market conditions, ultimately increasing the supply costs.<br><br>**Demand reduction measures:** N/A. | depends on the difference with the price at which the gas has been or will be sold and the duration of the storage.<br><br>**Demand reduction measures:** N/A.<br><br>**Bi-annual electricity exercises:** a group of Member States | operators to fill storages regardless of market conditions, the measure can ultimately increase the costs.<br><br>**Demand reduction measures:** Since the 'EU alert' was never declared, the provisions of the regulation always remained voluntary, so any costs are unlikely to be directly attributable to their implementation.<br><br>**Bi-annual electricity exercises:** costs associated | | **Demand reduction measures:** N/a |

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| | | | | | | reported costs of EUR 85 000 – 125 000 (+ travel expenses) for the organisation of a regional crisis exercise (two exercises were organized by this specific region during the evaluation period).<br><br>**Others:** For electricity RPR, MSs' estimations of the administrative costs ranged from 645 hours/y to 1.6 FTE. One Member State reported administrative costs of €262 928 for the implementation of both regulations. | with the organization of such bi-annual regional exercises. | | |
| **Enforcement Costs** (costs associated with activities linked to the implementation of an initiative such as monitoring, | **Recurrent (ACER monitoring reports) / One-Off (pilots and infringements + Commission reports)** | | N/a | N/a | | N/a | DG ENER devotes 3.5 FTEs to perform its tasks.<br><br>ACER estimates that it devotes 2.5 FTE to perform all the tasks from the Gas SoS and Electricity Risk-Preparedness regulations. | | Commission reports (Solidarity, Storage, SoS, RPR)<br><br>ACER SoS monitoring reports |

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| inspections and adjudication/ litigation) | | | | | | Pilots and infringements |
| **Direct Benefits** | **Recurrent** | N/a | | | | |
| **Indirect Benefits** | **Recurrent** | As explained in the section on efficiency, the benefits of the framework are difficult to quantify because of the "preparedness paradox": security of supply works as an insurance, and the benefits are not truly quantifiable. The whole society benefits from the avoided crises (whose impacts by definition are not measurable) and from the mitigation of actual crises. It is however possible to use proxies. E.g., the total economic cost of the 2003 Italian blackout (which lasted some hours) can be estimated at EUR 1.182 billion (source: blackout simulator). Other examples can be found in the section 4.1 on efficiency. | | | | |

| ***TABLE 2: Simplification and burden reduction (savings already achieved)***<br>*Report any simplification, burden reduction and cost savings* ***achieved already*** *by the intervention evaluated, including the points of comparison/ where available (e.g. REFIT savings predicted in the IA or other sources).* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Citizens/Consumers/Workers | | Businesses | | Administrations | | EU Institutions/Agencies | |
| | Quantitative | Comment | Quantitative | Comment | Quantitative | Comment | Quantitative | Comment |
| **Title**[250] *(i) direct compliance cost savings* | | | | | | | | |
| **Type: One-off / recurrent (select)** | N/a | N/a/ | N/a | N/a | N/a | The Regional architecture of the Gas SoS Regulation has already been simplified in 2025 by reducing the number of regional risk groups to four. Monetisation is not possible, because (i) the reduction was only recently implemented[251] (ii) the costs linked to the previous regional architecture were already difficult to assess. | N/a | N/a |

| ***PART II: II Potential simplification and burden reduction (savings)***<br>*Identify further potential simplification and savings* ***that could be achieved*** *with a view to make the initiative more effective and efficient without prejudice to its policy objectives*[252]*.* | | | | |
|---|---|---|---|---|
| | Citizens/Consumers/Workers | Businesses | Administrations | EU institutions/agencies |

| | Quantitative | Comment | Quantitative | Comment | Quantitative | Comment | Quantitative | Comment |
|---|---|---|---|---|---|---|---|---|
| **Description: Direct compliance cost savings** | | | | | | | | |
| **Type: One-off / recurrent** (select) | N/a | N/a | N/a | **Reverse flows exemptions (TSOs):** the procedure to request an exemption from the reverse flow obligations could be lightened, given its current high complexity and the progress already achieved throughout the EU. | N/a | **Reverse flows exemptions (NRAs):** the procedure to request an exemption from the reverse flows obligations could be lightened, given its current high complexity and the progress already achieved throughout the EU.<br><br>**Plans:** reporting requirements for Member States could be lightened by merging some planning obligations and by better leveraging digital tools. | N/a | **Reverse flows exemptions (ACER/Commission):** the procedure to grant an exemption from the reverse flow obligations could be lightened, given its current high complexity and the progress already achieved throughout the EU. |

250 Each simplification/saving should be included on a separate line.

251 As of March 2025, the delegated act is still in the process of adoption.

252 This assessment is without prejudice to a possible future Impact Assessment.

## ANNEX V. STAKEHOLDERS CONSULTATION - SYNOPSIS REPORT

The **objective** set out in the consultation strategy was to better understand the views of stakeholders and citizens on the effectiveness, efficiency, EU added value, coherence and relevance of the existing security of electricity and gas supply policy interventions, in line with the Better Regulation guidelines. The views of stakeholders and citizens were also sought on the future issues and priorities of energy security policy.

The **purpose** of the consultation strategy of this fitness check was to reach a wide set of stakeholders, including the traditional stakeholders that are represented in Commission's expert groups, e.g. the Gas Coordination Group and Electricity Coordination Group. These stakeholders can be considered as having a high interest in the evaluation effort.

The aim, however, was also to go beyond the usual stakeholders and reach possibly 'underserved' stakeholders and citizens. While their direct interest or experience may not be on a par with the usual stakeholders, their inputs and perspectives are valuable to ensure a comprehensive view on energy security in society while minimising possible biases. Allowing everyone to express their views on energy security is also a way to improve democratic legitimacy of the exercise.

The consultations carried out for this fitness check consisted of a number of activities:

**Commission expert group meetings**, in particular the Gas Coordination Group and Electricity Coordination Group.

**A 12-week public consultation and call for evidence** that ran from 3 September 2024 until 26 November 2024.

**Other individual stakeholder events**, such as the Regulatory Roundtable as part of the Citizen's Energy Forum on 6 December 2024, or an event organised by Energies@Bruxelles on 15 November 2024.

**An energy Eurobarometer** was carried out and published in September 2024 to gauge citizen's general perceptions regarding wider energy policy matters.

In addition, several bilateral exchanges were held with a wide variety of stakeholders, outside of the aforementioned events.

*Commission expert group meetings*

The fitness check and the wider review of the EU security of electricity and gas supply framework were presented and/or have been discussed at several Commission expert group meetings.

This included notably several Gas Coordination Group (GCG) and Electricity Coordination Group (ECG) meetings, where the matter was discussed in more detail. This notably includes meetings of the GCG on 27 November 2024, 9 July 2024 and 19 June 2024, as well as the ECG on 5 December 2024 and 15 October 2024. A discussion and a short presentation of some first preliminary results of the public consultations were also held in the Offshore Activities Coordination Group and the Oil Coordination Group on 3 December and 5 December respectively. These discussions notably provided updates on the public consultation and provided Member States' authorities and stakeholders the opportunity to highlight points that should be reflected in this report.

In addition, stakeholders were also reached and the public consultation was advertised through the Oil Coordination Group, the Offshore Safety Group, the Critical Entities Resilience Group, and the CESEC Plenary Working Group.

*Call for Evidence*

A total of 90 organisations and citizens provided feedback to the **Call for Evidence**, of which four responses were taken offline due to their incompliance with the feedback rules of the Commission's 'Have your Say' portal, resulting in 86 remaining responses from 18 different countries (3 non-EU).

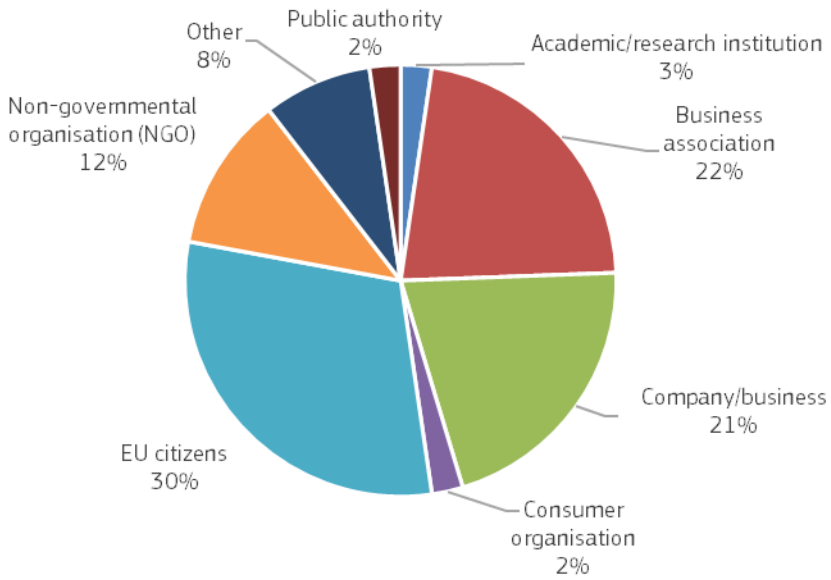
The contributions received in the context of the call for evidence that are published on the 'Have Your Say' web portal cannot be regarded as the official position of the Commission and its services and thus does not bind the Commission. In addition, the contributions cannot be considered as a representative sample of the EU population.

The four responses to the call for evidence that were taken offline concerned four Slovak citizens, whose responses were incompliant with the following rule: *"abusive, obscene, vulgar, slanderous, hateful, xenophobic, threatening or sexually-oriented comments."*[253]

The call for evidence received feedback from a wide variety of stakeholders, as further detailed in Figure 47. In particular, it was noteworthy that the largest category was EU citizens, with 30%. This is important, since other consultation activities did not manage to reach EU citizens to the same extent, as will be further outlined in subsequent sections. Of EU citizens, half of the respondents came from Slovakia, who generally voiced their opposition to e.g. the phase out of Russian gas.

[253] Rules for feedback and suggestions

***Figure 46: Feedback received on Call for Evidence by category of respondent***




*Source: EC-JRC, 2024*

Other categories of respondents came from a wide variety of countries (18 in total), although a large share of respondents originated from Belgium (25 out of 86), which can largely be explained by the responses stemming from Brussels-based associations. Other countries of origins with a relatively larger share include Austria (9%), Germany (8%) and France (7%), as further detailed in Figure 48.

***Figure 46: Respondents per country***

*Source: EC-JRC, 2024*

In terms of feedback received, **academic and research institutions** called for a comprehensive regulatory framework that integrates energy, environment, climate, and biodiversity objectives, stressing the importance of cybersecurity and the phase-out of fossil fuels for an equitable transition. They also emphasised the potential of demand-side solutions to improve energy security through building energy efficiency and sufficiency.

According to **business associations**, the EU should establish baseline energy security standards for Member States, allowing flexibility in implementation while ensuring compliance. As the EU transitions to clean energy, supply resilience must be improved, despite potential cost increases, to ensure an affordable and uninterrupted supply for consumers. Business associations emphasised the need for a shift in the EU's energy security strategy from supply-side to demand-side measures, reducing reliance on energy imports. They also stressed the importance of securing heat supply, alongside electricity and gas, and the need for building renovations to achieve climate targets, provide cost savings, and ensure grid stability. Associations advocated for increased electrification and renewable integration, emphasising resilience, affordability, and flexibility. They proposed enhanced strategic energy storage solutions, such as hydrogen, and waste-to-energy systems, to mitigate geopolitical risks. Additionally, they suggested policy revisions to incorporate nuclear energy, diversify supply sources, and support local renewable energy projects to reduce import dependencies and achieve climate goals.

**Companies and businesses** called for a comprehensive approach to transition to a sustainable energy system, focusing on sector integration and energy vector coupling. They emphasised the need for robust risk preparedness, energy efficiency, diversified energy sources, and infrastructure protection. To enhance energy security, they suggested leveraging Ukrainian gas storage, improving EU cooperation, and implementing measures like bilateral gas solidarity agreements. They also stressed the importance of maintaining undistorted price signals, mitigating price volatility, and integrating renewable gases into the power sector. Companies urged the EU to prioritise renewable resources, develop investment schemes for storage solutions, and remove regulatory barriers to optimise Ukrainian gas storage use. They suggested revising EU gas tariffs and promoting cooperation with the UK, Norway, and Switzerland to enhance grid stability and address energy challenges. Ultimately, Europe should aim to build self-sufficient infrastructures to ensure a stable energy supply and avoid coercive pricing across borders.

**Public authorities**, specifically the Hungarian Ministry of Energy, focused on expanding supply sources and routes, stressing the importance of long-term contracts and balancing energy security with competitiveness. The Ukrainian Ministry of Energy called for strengthened EU-Ukraine cooperation, advocating for amendments to regulations to enhance energy security and cross-border collaboration.

**Consumer organisations** emphasised the strategic and ethical importance of energy, advocating for social responsibility over profit. They highlighted the need for regulatory compliance and sustainable practices, stressing adherence to the NEC Directive and securing EU funding.

**Non-governmental organisations (NGOs)** called for a transition to a 100% renewable energy system by 2040, emphasising energy efficiency and demand reduction. They supported local and decentralised energy production, infrastructure strengthening, and a socially just energy transition.

**Other organisations** encouraged a comprehensive EU energy security strategy that integrates renewables, modernises infrastructure, and diversifies supply chains. They stressed the importance of renewable energy and electrification, and the need for resilient supply chains and green hydrogen deployment.

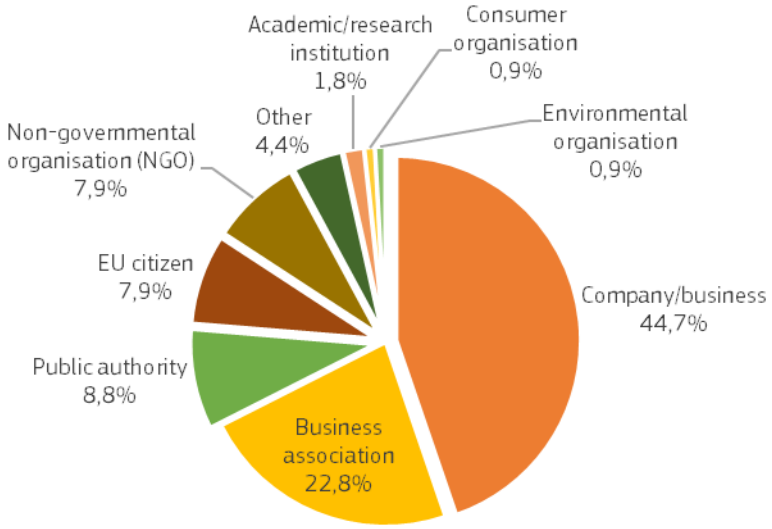
Finally, **EU citizens** expressed diverse views on energy security, with support for renewable energy but concerns about its current limitations. They advocated for energy diversification, nuclear investment, and long-term storage solutions, highlighting geopolitical risks and the need for transparency.

*Public consultation*

The **public consultation** received a total of 114 responses. Compared to the Call for Evidence, a slightly different picture can be observed in terms of the identity of respondents. Whereas the Call for Evidence received a large share of feedback from citizens, the responses largely came from businesses (44.7%) and business associations (22.8%), while only 7.9% came from EU citizens. Another noteworthy category includes public authorities (8.8%), of which half (5 out of 10) were national authorities and the remainder being local, regional or agencies. Very few contributions were submitted by academic/research institutions (2), consumer (1) and environmental (1) organisations, and other entities (5). No contributions were provided by non-EU citizens and Trade Unions.

The vast majority of the respondents (99 out of 114) declared to be active in the energy sector, with 60 out of 114 respondents being active in the gas sector, 56 active in the electricity sector and 16 being active in the oil sector. Around 20% of the respondents (23 out of 114) are Transmission System Operators.

*Figure 47: Share of contributions submitted by category of stakeholders*



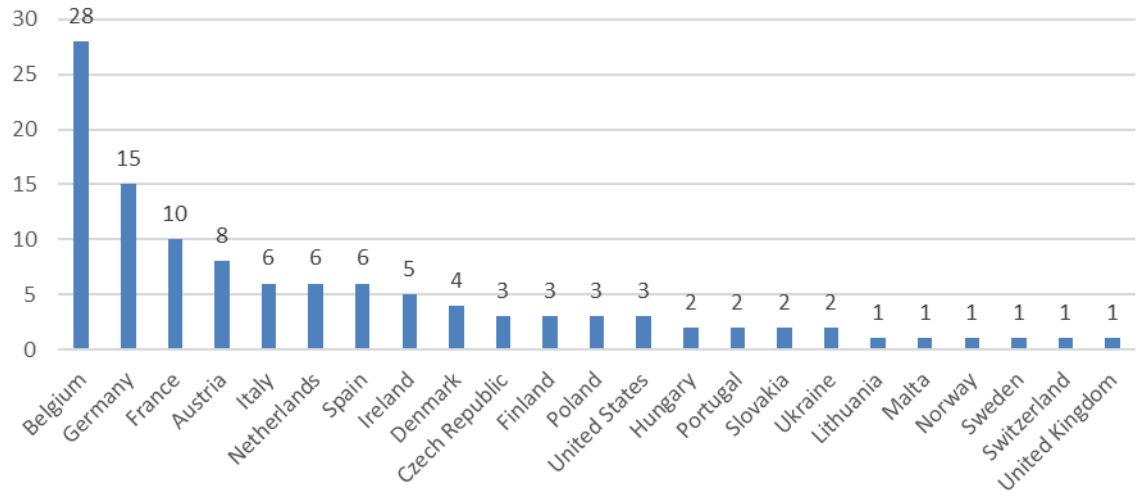

*Source: EC-JRC, 2024*

A total of 105 out of 114 respondents are considered to be organisations. Amongst them, around 50% are large organisations, 14.3% are medium-size organisations, 18.1% are small and 16.2% are micro-organisations. Of the responding businesses, 43 out of 51 are large organisations while the vast majority of the business associations (23 out of 26) are either micro or small organisations.

The country of origin of respondents shows a variety of countries (23 countries in total, 5 non-EU), as is further detailed in Figure 50. The highest number of replies (28 out of 114) came from Belgium. This is due to the fact that most of the responding business associations (18 out 27), and NGOs (5 out of 9) are based in Belgium.

The contributions received in the context of the public consultation published on the 'Have Your Say' web portal cannot be regarded as the official position of the Commission and its services and thus does not bind the Commission. In addition, the contributions cannot be considered as a representative sample of the EU population.

*Figure 48: All respondents by country of origin*




*Source: EC-JRC, 2024*

**GENERAL QUESTIONS ON ENERGY SECURITY**

The EU Energy Security Framework received mixed evaluation from 114 respondents. While 30 respondents viewed it positively, 43 expressed neutral opinions. Some respondents acknowledged its robustness and coordinated response to recent crises, whereas others highlighted areas requiring improvement, such as the need for regulatory harmonisation across national and EU levels and over-reliance on fossil fuels.

**Need for Framework Revision**

In the respondents' views, a revision of the current EU's energy security framework is necessary. Strengthening the role of **domestically produced renewables**, **flexibility**, and **energy sufficiency** and **efficiency** are considered important. The revised framework should also focus more on **energy consumption reduction measures** and consider **climate mitigation and adaptation measures**.

A majority of respondents (53.5%, 61 out of 114) believe the current framework does not adequately incorporate **climate risks**. It is highlighted the need of transitioning to climate-resilient infrastructure through long-term investments and planning, such as developing underground transmission and storage systems, enhancing electrical networks to withstand severe weather, and replacing overhead power lines with underground cables. The modernisation of aging infrastructure is also seen as crucial. In addition to infrastructure enhancements, there is a strong call for improved risk assessment and resilience planning, considering long-term climate effects, and involving climate experts in energy security planning.

The consultation shows that the majority of respondents favour **EU legislation as adding significant value to energy security** through coordination, standardisation, investment in infrastructure, and collective action, which surpass the capabilities of individual Member States acting alone. There is a general trend towards recognising the **increased importance of EU-level action and coordination** in energy security (74 out of 114, or 65%), especially in light of recent developments, such as the phase-out of Russian gas and the growing significance of LNG. Some respondents maintained that the importance remains equal (21%) given the existing rules and infrastructure, while a few others suggested a decreased importance (2%) due to the rise of

decentralised renewable energy production or environmental concerns. 12% of respondents had no opinion (14 out of 114).

The answers highlight that while Member States should retain flexibility, certain measures require a regional or Union-wide approach to be effective. Such measures include **gas storage obligations, voluntary gas demand reduction, provision of solidarity, and voluntary joint procurement**. EU-wide coordination is deemed essential to create efficiencies, avoid redundant infrastructure, and ensure a coordinated and cost-effective system. The interconnected nature of the energy network in the EU means that the lack of security measures in one Member State can impact others, underscoring the need for common minimum standards. However, it is also noted that local measures are crucial for addressing region-specific needs and complementing the broader strategy.

Based on feedback from 105 respondents, **electrification has had mixed impacts on EU energy security**. On one hand, it has reduced reliance on imported fossil fuels and facilitated the integration of renewable energy sources. On the other hand, it has increased electricity demand and dependence on intermittent renewables, posing challenges such as grid stability and infrastructure demands. Respondents agree that while electrification is pivotal for energy transition and security enhancement, the current EU framework is insufficient to address their challenges, with improvements required in energy system integration, infrastructure, flexibility and storage solutions, energy source diversification, and regulatory and market mechanisms.

A significant majority (103 out of 114, or 90.4%) of respondents agree that the EU energy security framework needs enhancements to effectively support a more electrified, renewable-based, and integrated energy system thus indicating **strong consensus on the need for improvements to the current framework**, and specifically **for a comprehensive and forward-looking approach**, which should **address infrastructure, regulatory, and technological needs.**

Key recommendations from respondents include developing and modernising infrastructure, such as expanding grid capacity and integrating renewable energy sources, as well as diversifying energy sources and suppliers to reduce dependence. Implementing stable regulatory frameworks to attract investment, enhancing cybersecurity and digital resilience, and improving energy efficiency and risk preparedness planning are also emphasised. Decentralised renewable production and energy storage were also highlighted.

**Future Risks and Challenges**

The main objective deemed important for the EU energy security architecture is to **accelerate investments into a domestic decarbonized energy system** with 61% of the respondents supporting this goal. This is seen as crucial for achieving the EU's energy independence and meeting climate objectives. Respondents advocate for accelerating the deployment of renewable energy sources, including wind, solar, and geothermal, along with the development of infrastructure necessary for electrification. The expansion of such systems is recognised not only for its environmental benefits but also for reducing the vulnerability to geopolitical risks and market volatilities associated with fossil fuel imports. The second objective identified by 55% of the respondents is the **diversification of energy sources, suppliers and routes** to create a more resilient energy system so the EU can circumvent the risks associated with reliance on any single supplier. **Strengthening the use of energy storage** (49%) is identified as a key enabler for renewable energy integration and a buffer against supply shocks. Investments in diverse forms of energy storage, including batteries, pumped hydro, and thermal storage, are crucial for balancing supply and demand and providing backup power during peak periods. Additionally, the **enhancement of interconnections and smartening of infrastructure between Member States** are seen by 40% of respondents as necessary steps to improve grid efficiency, responsiveness, and stability, while also

supporting the large-scale integration of renewable energy sources. Same level of support (40%) has the **efficient use of existing infrastructure.** These involves repurposing and upgrading current systems, such as gas networks, electricity grids, and LNG terminals to accommodate renewable energies, and new technologies like hydrogen, which is crucial for minimizing costs and accelerating the transition. **Cybersecurity**, identified by 36% of respondents, has emerged as a critical concern due to the increasing digitalization of energy systems. Stringent security measures are needed to protect against cyber-attacks, ensuring the integrity and reliability of the energy grid.

The consultation highlights concerns regarding potential risks associated with **increased reliance on liquified natural gas** (LNG) and global market fluctuations. Concerns include exposure to adverse weather events affecting LNG cargo arrivals, intra-EU competition for LNG leading to high prices, and the political instability of producers. These factors necessitate a diversified LNG infrastructure and careful planning to mitigate risks associated with global market dependencies.

The majority of respondents (70 out of 114, or 61.4%) believe that **future electricity imports from third countries could pose energy security risks to the EU**. This concern was shared across the various categories of stakeholders, indicating a widespread apprehension about the security implications of relying on external electricity sources.
Many respondents emphasised the need to **differentiate non-European countries based on political stability and their ties to the EU.**

Concerns were also raised about the **vulnerability of infrastructure, particularly interconnectors, to cyber and physical attacks**. To address these issues, respondents recommended diversifying electricity sources, forming long-term partnerships with aligned countries, increasing reliance on domestic renewables, and enhancing the internal market through better interconnections. Investing in resilience and implementing capacity markets and flexibility services were also suggested.

The consultation reveals a primarily **positive outlook on the role of decarbonised and renewable hydrogen in the EU's energy security** strategy, with 68% (78 out of 114 respondents) emphasizing its potential benefits such as diversifying energy sources, supporting renewable integration, and aiding in decarbonizing hard-to-abate sectors. Nonetheless, concerns about hydrogen's cost, efficiency, environmental impacts, scalability, and potential import dependencies were noted, with some advocating for a technology-neutral approach prioritizing renewable hydrogen. Meanwhile, 21 respondents (19%) perceived hydrogen's role as limited, suitable only for specific sectors where electrification is not feasible, expressing scepticism about its economic viability. Regarding hydrogen supply security, risks identified include the underdevelopment of the renewable hydrogen market and infrastructure, import dependencies, and supply chain vulnerabilities.

Additionally, a significant majority of respondents (83 out of 114, or 72.8%) believe that **enhancing international cooperation with close partners would be beneficial for the EU's energy security.** In terms of key strategies for cooperation, respondents emphasised the importance of diversifying energy sources to reduce dependency on single suppliers and mitigate supply risks. Additionally, ensuring regulatory compliance with EU standards and avoiding trade distortions was seen as essential for maintaining stable supply chains. Building long-term partnerships with countries such as the US, Norway, and Middle East and North Africa (MENA) region, as well as strengthening interconnectivity among EU Member States and prioritising domestic production of clean energy, while also importing from reliable partners, were also recommended.

**SPECIFIC QUESTIONS ON ENERGY SECURITY FRAMEWORK**

Out of 114 respondents, 90 chose to answer the specific questions on energy security framework. The majority of contributors (87.8%, 79 out of 90) are active in the energy sector, while 12.8% are not. Participants that dropped out are primarily citizens and NGOs.

**EU-Level Action and Coordination**

The consultation revealed a **generally positive perception of EU-level actions concerning preparedness and security of supply** in the energy sector, with over half of the respondents (52 out of 90) agreeing or strongly agreeing that these actions have been beneficial. A small minority, 8.8%, disagreed/strongly disagreed, while a notable 24.4% abstained, indicating some uncertainty or lack of opinion on the matter. Similarly, **EU-level actions are viewed favourably in terms of increasing coordination and transparency** among Member States, with 56.8% (43 out of 90) expressing agreement or strong agreement. However, 10% disagreed, and again, 24.4% did not respond. By contrast, the perception of EU-level action's impact on **reducing market distortions and spill-over effects in neighbouring countries** is less favourable. Only 16.7% of respondents agreed that such actions have been effective, while the largest group, 35.6%, neither agreed nor disagreed, reflecting a significant level of ambivalence or uncertainty. Additionally, 27.8% did not provide a response, indicating a possible lack of clarity or understanding regarding the EU's role in addressing these complex market issues. This highlights an area where further efforts might be needed to enhance the perceived effectiveness and awareness of EU actions in mitigating market-related challenges.

**Regulatory Coherence and Gaps**

The consultation reveals diverse opinions regarding **inconsistencies between the Gas Security of Supply and Storage Regulation and the Electricity Risk Preparedness Regulation**. While 22.2% (20 out of 90) of respondents perceive emerging inconsistencies hindering the achievement of regulatory objectives, 15.6% (14 out of 90) believe the regulations are consistent and complementary. A notable portion, 38.9% (35 out of 90), did not express a specific opinion, and 23.3% (21 out of 90) provided no response. For improving coherence, respondents suggested creating a joint energy security framework, integrating and harmonizing risk assessments, and adapting regulations to reflect the growing prominence of electricity and decarbonisation efforts. Emphasizing cross-sectoral integration, reducing administrative burdens, and enhancing cooperation among stakeholders were also recommended.

Nearly half of the respondents (42 out of 90) indicated that strategies exist in their industry or countries to mitigate the **impact of electricity crises on gas supply and vice versa**, while a small percentage (5.6%) disagreed. 43 out of 90 respondents either did not have an opinion or abstained. Many respondents, particularly from 13 Member States detailed existing strategies, varying in the level of deployment, like having in place emergency plans, sectoral coordination, renewable energy investments, measures to protect households and critical infrastructure, and cybersecurity measures.

The survey also found that one-third of respondents (30 out of 90) believe that the **roles and responsibilities, as well as the coordination mechanisms between the electricity and gas sectors**, are effective during crises, while 11 (12.2%) respondents did not. However, most of the respondents (49, 54.4%) were either undecided or abstained. Some respondents believed that national efforts are more efficient than EU-level efforts, others argue that EU-level mechanisms, such as information exchange and coordination among ENTSO-E and ENTSO-G, are effective.

Effective coordination is hindered by the independent treatment of the gas and electricity sectors, limiting real-time cross-sectoral responses during disruptions. Furthermore, regulatory authorities and TSOs are considered to have limited powers in addressing longer-term challenges, and emergency plans lack testing, creating uncertainty about their effectiveness. To address these challenges, it is essential to develop integrated governance frameworks that address interdependencies between gas and electricity sectors. Long-term measures beyond immediate crisis interventions, such as sector coupling and infrastructure development, are also considered necessary.

**Future directions**

Out of 90 survey respondents, at least 50% see that **regulatory synergies** could be sought for the increasingly intertwined electricity and gas markets, in particular in the areas of risk assessments, preventive action, definitions and levels of crises, crisis management procedures, protected customers and special protection against disconnection, storage measures for energy security and regional cooperation and solidarity assistance. A minority of respondents (14 out of 90, 15.6%) have the opposite opinion, while the remainder of respondents either have no specific opinion or abstained.

The integration of various energy sources and sectors is becoming increasingly important as the world transitions towards a more sustainable and efficient energy system. A coordinated approach to energy planning, taking into account the interdependencies between different energy sectors and sources, is essential for ensuring a secure and efficient energy supply. Improvements to the EU energy security framework are needed to tackle in particular cybersecurity risks associated with the further digitalization and smartening of energy networks and ensure the continuity of supply and security of supply.

Out of 90 survey respondents, 38 (42.2%) see an additional or increasing role for **demand-side measures** in the future EU energy security architecture, on top of the already existing framework under the recently adopted Electricity Market Design. Most respondents acknowledged the crucial role of Demand-Side Response (DSR) in enhancing the energy system's flexibility and efficiency. A minority of respondents (11 out of 90, 12.2%) have the opposite opinion, while 41 respondents either have no specific opinion or abstained. Key proposals emphasised the importance of integrating various technologies and strategies to optimise energy use. These included leveraging storage solutions and Power-to-X technologies, implementing voluntary and automated demand-side measures in areas with high electricity consumption, fostering distributed generation, supporting energy communities, and enhancing interconnection capacity. Improving energy efficiency and consumer engagement were also proposed, alongside ensuring the full implementation of the Electricity Directive to establish consistent demand-side measures across all Member States. Respondents also advocated for implementing the Demand Response Network Code and dynamic pricing models, and the widespread adoption of advanced metering infrastructure.

Although no respondents opposed demand-side measures, they did highlight several potential challenges, including cybersecurity risks, technological hurdles, market distortions, and the limitations of demand-side management in addressing periods of low renewable energy generation, such as "dunkelflaute" situations.

**SPECIFIC QUESTIONS ON GAS SECURITY OF SUPPLY**

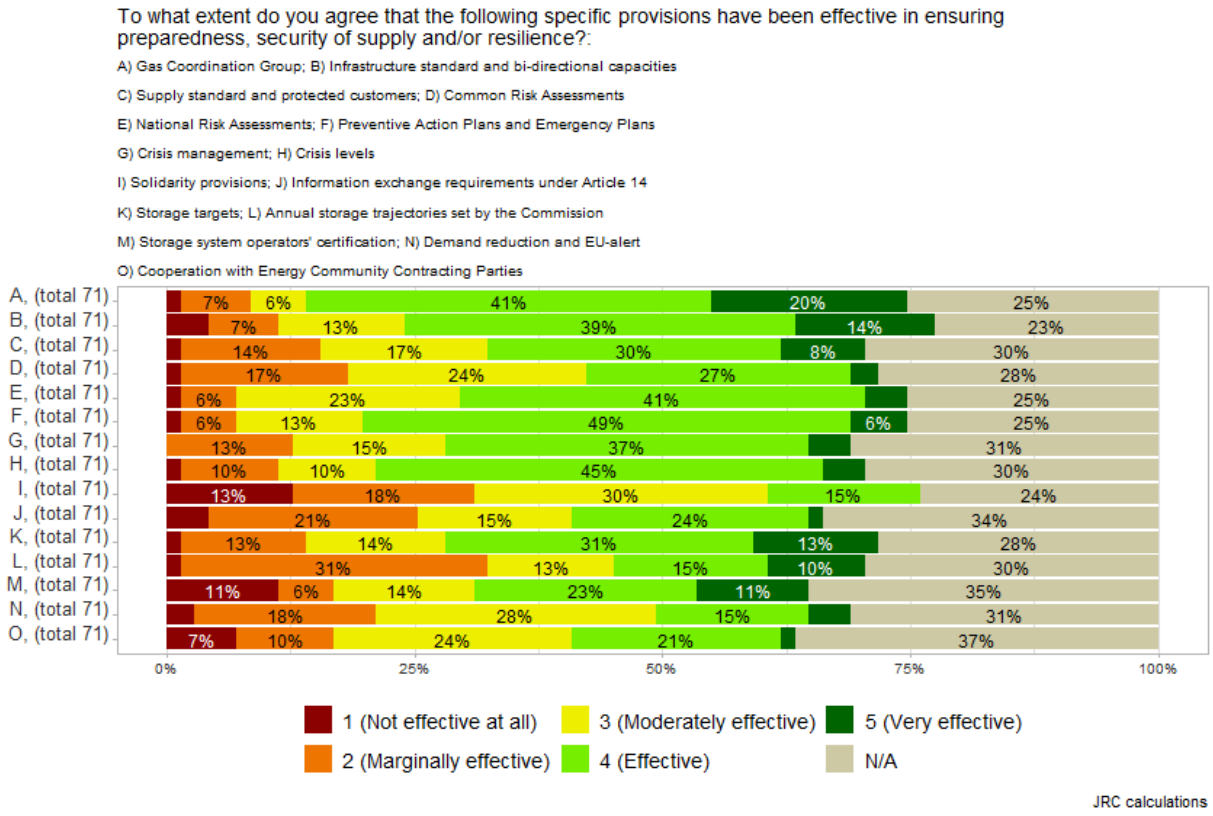
**Regulation evaluation**

Out of 114 respondents, 71 chose to answer the specific questions on gas security of supply. Out of the 71 contributors, 64 are active in the energy sector, while 7 are not.

The evaluation of Regulation (EU) 2017/1938 (Gas SoS Regulation) presented mixed satisfaction levels regarding its effectiveness in ensuring security of gas supply. Of the 71 respondents, a notable portion (ranging from 18% to 23%) did not respond to the questions regarding the **regulation's performance**, suggesting some level of uncertainty or lack of familiarity with the Regulation's impact. The Regulation's performance in securing adequate preparedness for gas supply disruptions and enhancing regional and EU-wide cooperation was rated as good or excellent by 46% (33 out of 71) and 50% (36). This indicates a **reasonable level of satisfaction with how the regulation is perceived to assess risks, ensure sufficient infrastructure, and foster collaboration** across regions and the EU, particularly in times of supply emergencies. However, when it comes to the performance in safeguarding an uninterrupted gas supply to protected customers, only 31% (22 out of 71) respondents rated the performance as at least good. This lower rating suggests that respondents may perceive **gaps or challenges in the regulation's effectiveness** in implementing necessary measures **to ensure continuous gas supply to protected customers**.

The consultation reveals mixed perspectives on **the relevance of the Gas SoS Regulation in addressing the EU's gas supply challenges**, particularly during the 2022/2023 energy crisis. Some respondents acknowledged that the regulation's provisions, such as emergency plans, crisis teams, and minimum gas storage levels, contributed significantly to preparedness and market stabilization. However, they also noted limitations, such as the regulation's inability to fully address EU-wide supply crises or anticipate market manipulation by major suppliers. The Regulation's support for cross-border infrastructure and the Gas Coordination Group's role in fostering cooperation were seen as positive. Criticisms included the ineffectiveness of joint purchasing procedures and the need for further diversification away from Russian gas. While solidarity mechanisms and risk assessments were considered beneficial, some respondents found them insufficient for the crisis's unique challenges. Calls for increased harmonization, infrastructure investments, and a shift towards renewable energy sources were emphasized as necessary steps for enhancing resilience and reducing dependency on volatile gas markets.

*Figure 50: Effectiveness of specific provisions of the Gas SoS Regulation*




*Source: EC-JRC, 2024*

The consultation respondents marked the majority of the specific provisions of the Regulation as effective or very effective in **ensuring preparedness, security of supply and/or resilience**. The provisions better rated were the Gas Coordination Group (by 61% of respondents), the Preventive Action Plans and Emergency Plans (55%), the infrastructure standard and bi-directional capacities (53%), and the crisis levels (50%). On the opposite side, the annual storage trajectories set by the Commission (rated as marginally effective or not effective at all by 32% of the respondents) and the solidarity provisions (31%) are the provisions perceived as less effective.

**Implementation Challenges and Unintended Effects**

53.5% (38 out of 71 respondents) declared having experienced **barriers or difficulties in implementing and enforcing the provisions of the Regulation**. Respondents identified difficulties particularly in the areas of solidarity provisions, storage filling targets, gas supply standards, and bi-directional capacities. **Solidarity provisions** are hindered by implementation difficulties, operational complexity, and unclear procedures, highlighting the need for more defined mechanisms. Respondents argued that **storage filling targets**, set hastily, have disrupted markets and raised costs, prompting calls for more flexible, regionally coordinated approaches. The **gas supply standard** is criticized for its vagueness, with suggestions to extend protections beyond the current definition of protected customers. **Bi-directional capacities** lack clarity, especially concerning virtual interconnection points. Additional concerns include gaps in preparedness and emergency plans, market

disruptions from uncoordinated measures, infrastructure deficiencies, administrative burdens, and misalignment with decarbonisation goals.

The majority of respondents, 36.6% (26 out of 71), indicated no **unexpected and/or unintended effects caused by the implementation of the Regulation**, while 23.9% (17 out of 71) pointed out the opposite. The majority of the views identified the **gas storage level targets**, noting that the abrupt implementation of these led to reduction of market flexibility, price spikes, and administrative burdens, calling for more coordinated, market-aligned solutions. Other views pointed out at **differences in risk assessments** and regulatory standards across countries, causing delays due to the need of extensive bilateral agreements. It was voiced that the **narrow definition of protected customers'** needs revision because it could lead to exclude essential industries from access to gas during crises.

Only 9 out of 71 respondents indicated that some provisions within the Gas SoS Regulation proved to be inconsistent with one another. The majority of respondents, 22 out of 71, did not found provisions inconsistent. The general evaluation highlighted the challenges in balancing energy security with climate goals and the need for more coherent and transparent regulatory frameworks.

**Cost-Benefit Analysis and Burden:**

The **Storage Regulation** has been generally praised for enhancing the EU's gas supply security by establishing clear, measurable targets and fostering cooperation among Member States. This has helped mitigate market volatility during energy crises and ensured a stable supply to citizens. However, the regulation's rigid 90% **storage targets and filling trajectories** are criticized for potentially leading to high costs, limiting storage flexibility, and not accounting for regional differences. The sunset clause in 2025 has sparked debate, with some advocating for its extension to ensure long-term supply stability, while others call for more market-based approaches to avoid competitive distortions and inflationary pressures.
Concerns also revolve around the complexity of the **certification procedure** for Storage System Operators and the need for fair burden-sharing mechanisms to avoid placing unfair costs on specific countries. There is a call for more flexibility for Member States during national emergencies and for addressing the lack of measures to compel entities to meet storage mandates.

Respondents recognise the Gas SoS Regulation's role in enhancing overall energy security and robust crisis management processes across the EU, although they emphasize the need for **improvements in cost allocation** and regulatory clarity to fully realize its benefits. By establishing storage targets and mechanisms, the regulation has reduced the risk of supply disruptions, contributing to the stability of industries and minimizing the impact of energy supply cuts on citizens. Tools like the Security Platform Gas (Trading Hub Europe) and the ReCo system (ENTSOG) have facilitated transparent information flow and coordinated responses to critical supply situations. However, these benefits come with challenges, such as increased operational costs and market distortions. The high costs associated with filling storage targets, especially in response to geopolitical tensions, have led to significant economic burdens and price increases, sparking calls for more sustainable cost recovery mechanisms.

On the downside, the regulation's implementation has faced criticism over the **administrative burden** it places on organizations and the **lack of clear guidelines in the Solidarity Mechanism**, leading to potential market inefficiencies and competition hindrances. **Market correction mechanisms** remain untested and controversial,

with concerns about their effectiveness during supply chain disruptions. Additionally, regulatory uncertainty and infrastructure gaps pose challenges to the development of hydrogen storage.

**Regulatory Adaptation and Future Directions:**

Respondents proposed several **measures to simplify the Gas SoS Regulation's reporting and monitoring requirements**. A key suggestion is the creation of a centralized digital platform for submitting all required documentation, which would standardize formats, facilitate information sharing, and prevent duplication by enabling data reuse. Simplifying the content of preventive action plans to focus on essential data for risk assessment and establishing standardized templates for reports are considered crucial steps. Respondents also emphasize eliminating redundancy, particularly where reporting overlaps with obligations under Security of Supply and REMIT regulations. Simplifying the process for reverse flow exemptions and revaluating public disclosure of some documents to avoid inadvertently increasing security risks are additional recommendations. While some respondents support reducing the frequency of common risk assessments and making preventive action plans voluntary, others argue for maintaining current 4-year frequency to provide time for necessary improvements.

In the consultation, the regulation is praised for enhancing energy security and market integration, with provisions like emergency plans and storage targets contributing to preparedness against supply disruptions. However, there are challenges, such as the need for updates to **better align with the EU's decarbonization objectives**, including the phasing out of fossil fuels and increasing the role of decarbonized gases like biomethane and renewable hydrogen. This includes adapting the regulation to support the decreasing use of natural gas while maintaining a high level of security of supply during the transition phase. Suggestions are to consider establishing a common EU strategic gas reserve and integrating biomethane production targets.

Respondents emphasize the need for **efficient use of infrastructure**, **improved cost-sharing mechanisms** among Member States, and addressing challenges related to infrastructure sabotage and geopolitical influences. Some respondents propose the establishment of a common EU strategic gas reserve.

Additionally, respondents indicated that more efforts are needed to strengthening **solidarity and coordination mechanisms**, clarifying roles and responsibilities during crises, and ensuring cooperation among Member States to ensure the application of non-market emergency measures occur under clear define conditions to avoid market fragmentation. Furthermore, there is a need for **cybersecurity** enhancements to protect energy infrastructure.

## SPECIFIC QUESTIONS ON ELECTRICITY SECURITY OF SUPPLY

Out of - 114 respondents, 50 chose to answer specific questions on Electricity Security of Supply. Among them, 45 (90%) are active in energy sector while five (10%) are not.

**Regulation evaluation**

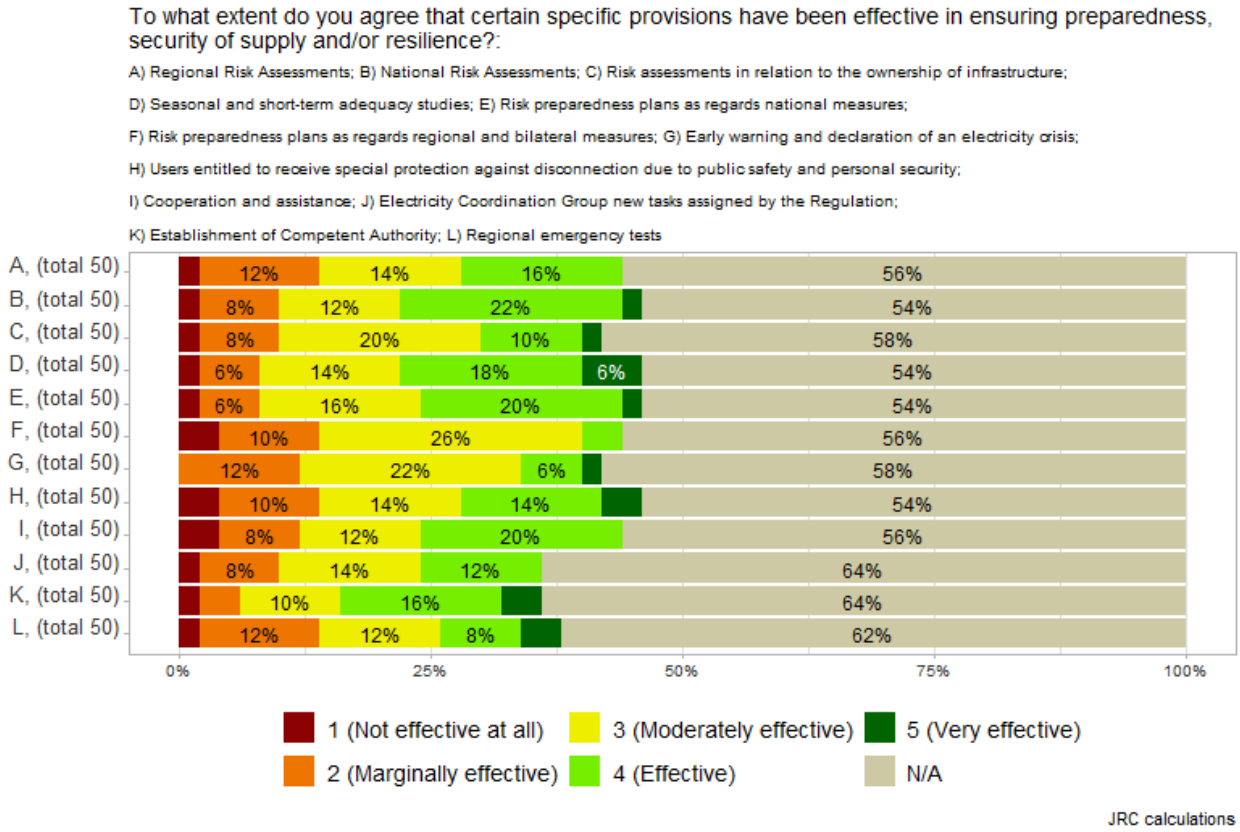
Respondents believe that Electricity Risk Preparedness Regulation (Regulation (EU) 2019/941) proved relevant in addressing energy crises, with its provisions on detection, alert, and coordination being effective in responding to crises such as the COVID pandemic and the 2022-2023 energy crisis. It has strengthened cross-border interconnections, integrated renewables, and enhanced risk assessment and planning, enabling quicker disruption responses.

Respondents generally view the Regulation’s performance in meeting its objectives as positive, with varying degrees of success. The Regulation's performance on improving transparency and information sharing, and coordination in electricity crises, received the most positive feedback. It also received a generally positive assessment on improving prevention and preparedness, albeit with a slightly more neutral tendency. On the contrary, the Regulation's performance on reducing the risk of negative spillover effects was viewed as mostly neutral, with a slight negative inclination. . Its inflexibility and gaps in cross-border cooperation were also highlighted, with some respondents proposing a midterm reassessment every two years to adapt it to changing risks. To enhance crisis management, respondents suggest improvements such as harmonized EU-level actions, clearer guidelines, stronger cross-border coordination, incorporating local capacity measures, scenarios for prolonged conflicts, and addressing blackout risks. They also recommend enhancing communication, transparency, and cooperation between Member States, and linking Risk Preparedness Plans with other initiatives.

Overall, the Regulation's effectiveness depends on Member States' actions. While it has facilitated internal energy balancing and regional coordination, it has not fully mitigated the impacts of the energy crisis on electricity prices and consumer financial burdens. EU intervention is seen as crucial for enhancing security of supply, promoting cross-border coordination, and fostering integration, with a unified EU strategy needed to address the interconnected European electricity system, and coordinated regional scenarios, joint responses, and a common crisis approach.

On the specific provisions of the Electricity Risk Preparedness Regulation, some are seen as more effective than others in ensuring preparedness, security of supply, and resilience. Provisions such as National Risk Assessments and Risk preparedness plans as regards national measures were considered quite positive, while those related to regional and bilateral measures were viewed as rather negative.

*Figure 51: Effectiveness of specific provisions of the Electricity Risk-Preparedness Regulation*




*Source: EC-JRC, 2024*

Respondents emphasised the need for a more integrated and transparent Regulation, improved crisis management, and enhanced cooperation among Member States to address the complexities of the energy market. They highlighted areas for improvement, including the definition of an electricity crisis, resource adequacy, system sustainability, and managing renewable intermittency. Respondents also criticised the Regulation for unclear integration of Risk Preparedness Plans, limited operational impact, and lack of alignment with other regulations.

Regarding Article 15's framework for cooperation and assistance, the general opinion was neutral, with respondents suggesting that the framework is fundamentally adequate but in need of more harmonization and expanded applicability. They advocated for improved cooperation, solidarity, and mutual assistance among Member States, and suggested various improvements, including binding mutual assistance, clearer emergency coordination procedures, and strengthened local decrees. Overall, the respondents emphasized the importance of balancing cooperation and self-reliance in crises, and suggested formalizing regional agreements, enhancing cross-border interconnections, and regular framework updates to enhance the effectiveness of the Regulation.

**Implementation Challenges and Unintended Effects**

The majority of respondents (75%) reported no unexpected negative effects from the Regulation's implementation, indicating a positive impact on achieving its objectives. However, the implementation of the Regulation has been hindered by national emergency measures, which have fragmented the Internal Energy Market, disrupted trade, and impacted liquidity and renewable energy investments. Respondents highlighted

inconsistencies, distortion of trade, and strain on grid stability resulting from the rapid growth of renewable energy. To address these challenges, respondents recommend increasing transparency and dialogue among EU Member States, improving information sharing, and prioritising significant risks to inform better policy and risk management.

The Regulation is generally seen as aligned with other EU policy goals, such as the EU Green Deal and Fit for 55 initiatives, but some respondents note that it may not fully align with all EU policy goals, particularly regarding decarbonisation, system resilience, and climate neutrality. A slight majority of respondents see no inconsistencies between the Regulation and other EU legislation, although some identify inconsistencies with the Electricity Market Design (EMD) and other EU laws. Some of those identified are related to the Article 66a of the EMD - *Access to affordable energy during an electricity price crisis* and 70% requirement for cross-border trade, including the issue that some non-EU countries, although quite interconnected such as Switzerland, can face ambiguity in the treatment of the 70% rule. Most respondents do not see any inconsistencies between provisions in the Regulation, although some identify inconsistencies between short-term crisis rules and long-term capacity planning needs.

Respondents suggest improving the Risk Preparedness Plans (RPPs) by enhancing transparency, stakeholder engagement, and incorporating detailed assessments of emerging threats. They recommend a flexible framework for quick updates, simplified reporting, and clearer guidelines, while cautioning against a "one size fits all" approach. Comprehensive scenarios, including blackouts, should be covered with thorough analysis and mitigation strategies. Ensuring confidentiality, learning from international experiences, and maintaining stable methodologies for consistent risk assessment comparisons are also emphasized.

The Regulation is considered relevant, but respondents emphasize the need for it to adapt to the evolving threats landscape, EU's electricity supply, and energy mix. They highlight the importance of addressing climate change, technological advances, decentralization, cybersecurity, and demand-side management in planning. Respondents also stress the need for comprehensive capacity evaluations, pan-European actions to manage crises, and a more significant role for transmission system operators, power generators, and distribution system operators in planning. Overall, respondents agree that the Regulation remains relevant but needs to be updated to address the changing energy landscape and emerging risks, and to ensure full alignment with EU policy goals and legislation.

**Cost-Benefit Analysis and Burden**

The implementation of the Electricity Risk Preparedness Regulation has had varying costs and benefits, with some respondents reporting minimal operational impact and cost burden, while others required significant resources to implement Risk Preparedness Plans. The estimated costs ranged from 0.2 FTE workload to 1 FTE for 1.5 years, with additional costs for regional scenarios and studies. However, the Regulation also brought benefits, including a structured framework for measures, consistency, resilience, and enhanced EU coordination. Security of Supply, cooperation, market stability, reputation, trust, better risk strategy learning, and information exchange were also mentioned as Regulation’s benefits.

Respondents generally considered the Regulation's provisions to have a low to average impact on creating disproportionate burdens. Most provisions were deemed to have a "Negligible" or "Low" burden. However, some provisions, such as "Risk preparedness plans as regards national measures" and "Risk preparedness plans as regards regional and bilateral measures", were considered to have a slightly more significant impact.

Respondents also emphasised the importance of streamlining processes, ensuring fair compensation, and improving regional cooperation to enhance the effectiveness of the Regulation and reduce the burden on companies and authorities. They suggested simplifying National Risk Assessments and Preparedness Plans to improve efficiency and reduce strain on resources and advocated for simplifying 'early warning and crisis declaration' processes for quicker emergency responses. Overall, the respondents acknowledged that the Regulation has increased energy security awareness, but the cost-benefit analysis is still premature. Further quality improvements are needed to assess the Regulation's effectiveness.

**Regulatory Adaptation and Future Directions**

Respondents expressed neutral opinions on the timeliness and efficiency of the Risk Preparedness Plans (RPP) administrative process, but generally agreed that a four-year update cycle for RPPs is appropriate. The process could be improved by adopting a more tailored approach to scenario planning, extending the lead time for calculations, and aligning procedural requirements with other risk analyses. They emphasised the need for clearer guidelines for ad-hoc updates, better alignment between EU and national timelines, and stable crisis scenarios for consistent monitoring and evaluation.

The respondents largely agreed that the RPP administrative process that could be improved. To streamline and enhance the process, they proposed several enhancements, including the use of digital tools to facilitate collaboration, the establishment of stable crisis scenarios for consistent monitoring, and the alignment of the update cycle with other plans. They additionally emphasised the importance of adopting a more decentralized and participatory approach, involving national power generators and reflecting national specifics.

The was a general consensus on among respondents that the Electricity Risk Preparedness Regulation needs to be better adapted to the technological, scientific, environmental, and climatic challenges facing the EU. They emphasised the need for a more dynamic and flexible approach to risk preparedness, with a shift from a top-down to a bottom-up planning approach that incorporates regional and national specifics. They highlighted the importance of keeping pace with rapid technological advancements, evolving environmental challenges, and integrating new technologies.

The respondents largely supported the idea of establishing a common definition of electricity crisis applicable to all Member States. This definition should be based on common criteria such as the severity and duration of supply disruptions, impacts on essential services, and cross-border implications. A standardized definition would ensure EU-wide harmonisation and coordination, while allowing Member States the flexibility to address specific situations.

A slight majority of respondents supported a revision of the definition of regions in Article 2 of the Regulation. They suggested that the current definition, based on Regional Coordination Centres (RCCs), could be improved by incorporating additional criteria such as System Operation Regions (SORs), technical, geographical, and climatological characteristics, TSO cooperation, and historical ties with third countries. They emphasised the need for a more adaptable approach to account for energy sector changes, technological progress, and geographical interconnections.

Overall, the respondents agreed that improvements to the RPP administrative process are necessary to enhance its effectiveness and efficiency, and that the Regulation needs to be more proactive and adaptive to address the emerging challenges and ensure the resilience of the electricity grid. They highlighted the importance of a common definition of electricity crisis, a more flexible and inclusive definition of regions, and a more decentralised and participatory approach to risk preparedness.

**Additional comments**

The respondents provided additional comments on the general functioning and future evolution of the Electricity Risk Preparedness Regulation, emphasizing the need for dynamic and adaptable regulations that prioritize climate risks and emerging threats. They stressed the importance of stronger collaboration between Member States and industry stakeholders to enhance energy system resilience and develop proactive strategies to mitigate climate-related risks. The respondents also highlighted the need for increased reliance on domestic and European energy sources, transitioning to 100% renewables, and digitalizing electricity supply. They criticized the current legislation for insufficiently addressing energy infrastructure security and advocated for clear guidelines, collaborative frameworks, and robust cooperation protocols among Member States. The respondents also emphasised the necessity of including countries and municipalities in electricity risk preparedness, focusing on large storage facilities and aged power plants, and highlighted the importance of integration with new technologies, smart grids, and enhanced cybersecurity. Overall, the respondents agreed that the Regulation needs to be more proactive and adaptive to address emerging challenges and ensure the resilience of the electricity grid, and that continuous monitoring and assessment are necessary to keep the regulation aligned with evolving threats.

*Individual stakeholder events*

At the **Regulatory Roundtable** organised by DG ENER in Budapest on 6 December 2024, a dedicated session was held on 'crisis management and access to affordable energy'. The session concluded[254]:

> *"The EU energy security framework aims to ensure a stable and secure energy supply, with a clear focus on protecting consumers. The Roundtable takes note of the Commission's plan to review the framework to ensure it offers adequate protection to both citizens and industries in a more decarbonised, electrified and integrated energy system. This includes updating the concept of protected customers so that it is adapted to changing consumption patterns, while demand response should be better incorporated in energy security policy."*

In addition, on 15 November 2024, DG ENER was invited to speak at a breakfast organized by Energie@Bxl, a French-speaking network of energy policy experts, to exchange on the Security of Supply public consultation. DG ENER made a presentation about the process to review the energy security framework, and then exchanged with the participants about the functioning of the framework and the possible future challenges.

**DG ENER also participated to the following events**, where the fitness check was discussed: Pentalateral Energy Forum's workshop on 16 January 2025 on "The future coordination of reliable capacities".

*Eurobarometer*

In September 2024, a new energy Eurobarometer was published, asking about the past and future of EU energy policy. While this Eurobarometer was not tailored to all the specific questions that this fitness check seeks to answer, it is a useful tool to gauge the general views among citizens.

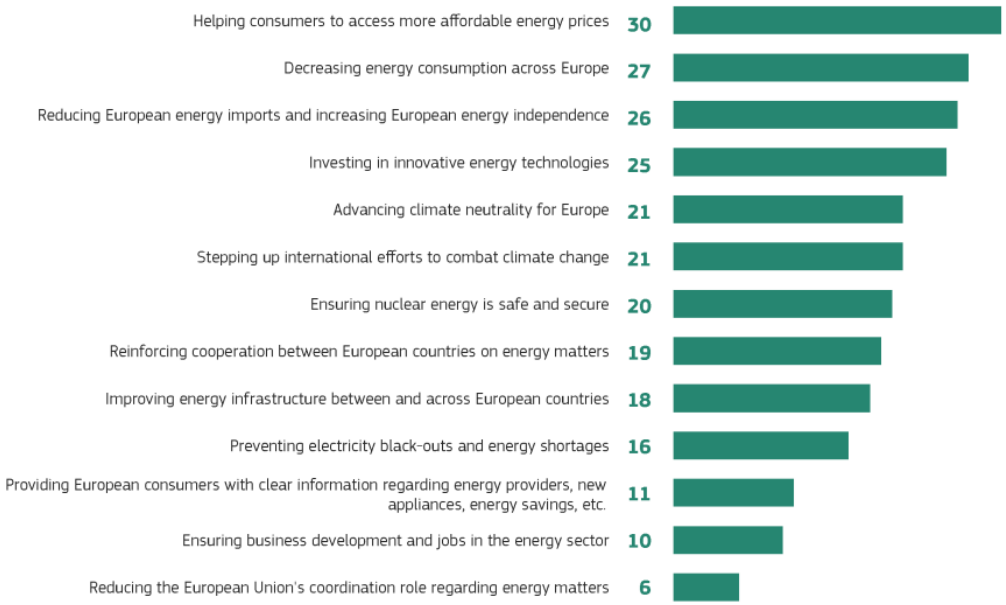
Interesting examples from the Eurobarometer include:

Reducing energy imports and increasing energy independence was considered by 26% of respondents the main future priority of energy policy, which was third highest. The second highest was 'decreasing energy consumption' (27%), which in fact was one of the policy instruments used to address the energy crisis.

When asked about what EU energy policy means to respondents, 22% said preventing electricity black-outs and energy shortages, which jumped up from just 7% in 2019. Other policy areas directly relevant to energy security also saw a big jump from 2019 to 2024, such as improving energy infrastructure (from 8% to 27%), decreasing energy consumption (from 2% to 30%).

[254] Work begins on the Citizens Energy Package to ensure a fair and inclusive energy transition

***Figure 52: responses to the question: 'in your opinion, which of the following energy-related issues should the European Union tackle as a priority over the next five years***




*Source: Special Eurobarometer 555, September 2024.*

## ANNEX VI. STRATEGIC FORESIGHT - MEGATRENDS WORKSHOP

The EU's energy security is facing unprecedented challenges, exacerbated by recent shocks and crises such as the Covid-19 pandemic and the war in Ukraine. In response, the Commission's Directorate-General for Energy (DG ENER) has launched a fitness check of the EU's energy security of gas and electricity supply (evaluating in particular Regulation (EU) 2017/1938 concerning measures to safeguard the security of gas supply and a Regulation (EU) 2019/941 on risk-preparedness in the electricity sector). In this context, it is relevant to identify potential risks and opportunities for energy security arising from long-term megatrends. The JRC has identified 14 Megatrends that are likely to have profound impact on the EU's society in the medium to long-term future (i.e. 2040 and beyond)[255]. Those Megatrends were the methodology used in the foresight workshop that took place on 17 October 2024.

The foresight workshop was structured in three parts. Participants were split in six groups for the discussions. First, the participants mapped all Megatrends based on their relevance and awareness. In a second step, Megatrends in the high relevance/low awareness quadrant were selected for more detailed discussions to explore the potential consequences of the trends on the EU's energy security. The selection criteria were relevance, paired with lack of awareness among the energy security expert community. Although results differed per group, the megatrends that were ranked as having the most relevance and least awareness by participants overall, were i) increasing pace of technological change, ii) aggravating resource scarcity and iii) the increasing significance of migration. The third part of the workshop focused on analysing the policy implications of these megatrends. Some of the key results were:

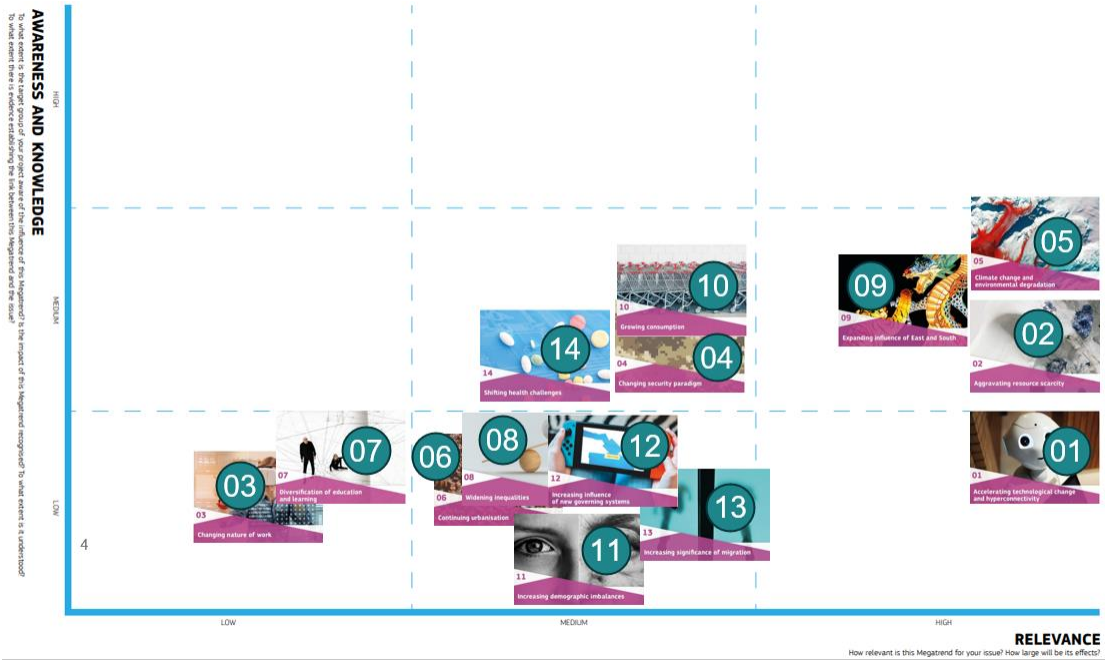
Workshop participants highlighted the potential risks related to an accelerating pace of technological change and the potential consequences of it on the EU's energy security, such as the risks stemming from the use of AI. As a policy response, participants noted that the EU should be prepared for such instances and have adequate monitoring mechanisms developed that reduce these risks.

Increasing instability of global geopolitics and EU's dependence on technology and critical raw material imports, but also fossil fuels (e.g., LNG), from third countries may increase risks to security of energy supply. As a policy response, participants highlighted the need to invest in strategic autonomy, including through circularity. At the same time, there is a need to strengthen relations with strategic partners around the world. In context of the changing security paradigm, also strengthening defence for protection of critical infrastructure was mentioned.

Another aspect highlighted by participants was the access of the most vulnerable groups to energy in times of crisis. Those groups are the least likely to invest in independent energy backup solutions (e.g. solar panels, batteries, heat pumps) to offset more exposure to energy supply disruptions and energy price fluctuations.

[255] https://knowledge4policy.ec.europa.eu/sites/default/files/Megatrends%20briefing%20file.pdf

**Figure 52: Relevance and awareness of the 14 megatrends (consolidated outcome of all six groups)**[256]




The Megatrends workshop has mapped the most prominent risks, consequences and potential policy implications of the underexposed Megatrends on EU's energy security. However, the approach was holistic and more focused analysis is needed in order to derive more concrete policy recommendations. Further foresight exercises could, for instance, deploy the JRC Foresight Scenarios tool[257].

In addition, to triangulate the results, in the public consultation a question was asked to respondents to rank the most relevant megatrends for security of gas and electricity supply. The results of this ranking can be found in the figure below.

256 Figure 53 is a consolidation of the Megatrends mappings done by the six groups during the workshop. For each group, each megatrend had a numerical value assigned to it (one value for *Relevance* and another for *Awareness*, based on the position in the map. The values ranged from 1-3, with 1 signifying *Low Relevance/Awareness*, 2 for *Medium Relevance/Awareness*, and 3 for *High Relevance/Awareness*. For example, for Group 1, *Shifting health challenges* had values (2,2) assigned (see the Annex to view Group 1's map). After every Megatrend per Group had a value assigned, the values of the two axes were averaged out. For example, the final outcome for the aforementioned Megatrend was (2;2.17). Subsequently, all Megatrends were mapped onto the consolidated map according to the consolidated values.

257 https://publications.jrc.ec.europa.eu/repository/handle/JRC132943

**Figure 53: Megatrends for which the EU energy security architecture is considered to be least prepared for** (N = 76)

*Source: Joint Research Centre, based on the public consultation*