Security of EU electricity supply

2024 Monitoring Report

16 December 2024

European Union Agency for the Cooperation of Energy Regulators

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Find us at:

ACER

E press@acer.europa.eu

Trg republike 3

1000 Ljubljana

Slovenia

www.acer.europa.eu

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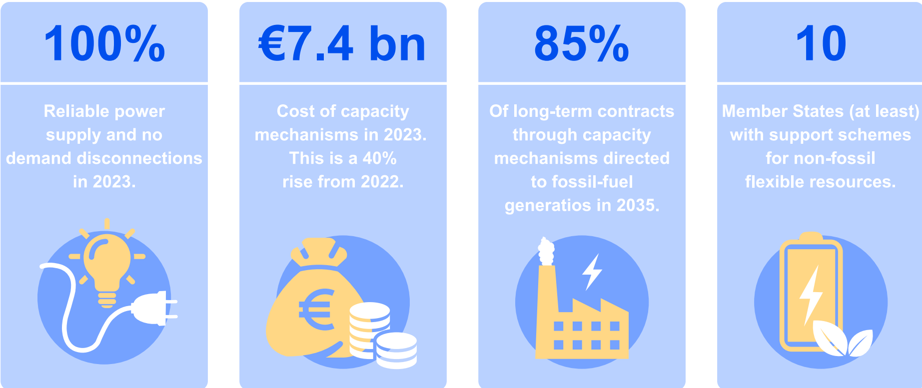
Executive summary



Moderating whole-system costs, including for capacity and other security of supply support schemes, will be key for affordable electricity prices in the EU

Despite adverse conditions, the electricity system maintained reliable supply in 2022 and 2023

1 Security of electricity supply depends on having adequate resources in the power system to meet demand. The unprecedented energy crisis of 2022, caused primarily by the steep reduction in Russian gas supplies and compounded by the increased unavailability of nuclear and hydro resources, significantly worsened the outlook for the security of Europe's electricity supply. Ultimately, European citizens did not face any involuntary demand disconnections related to insufficient supplies. This was due to coordinated efforts at the EU level, including emergency measures implemented by EU Member States, and the integrated and highly interconnected European energy market.

2 In 2023, the balance between natural gas supply and demand remained healthy, while the availability of nuclear and hydro resources improved. Combined with the accelerated deployment of renewable energy sources and subdued electricity demand, the EU interconnected electricity market kept the lights on and houses warm in 2023.

3 Looking ahead, these trends are expected to broadly persist. The outlook for the natural gas market is projected to remain healthy and improve further in the future. This is because global liquefied natural gas production capacity increases vastly, and the role of the liquefied natural gas supply, backed by expanded import infrastructure, becomes more prominent in Europe. Nevertheless, some risks remain in less interconnected areas, particularly in the short term. Considering the lessons learnt from the energy crisis, it is important to assess the interactions between the electricity and gas security of supply going forward. The supply of renewables is increasing at pace, while demand is gradually returning towards pre-energy crisis levels, supported by the EU's economic recovery and electrification of the economy. The outlook for the security of Europe's electricity supply is positive in the short term, but risks are projected to increase further out in the future, based on the resource adequacy assessments at the European and national levels. These assessments determine if there are sufficient supplies to meet future demand.

ENTSO-E and Member States are not yet fully adhering to the EU resource adequacy framework

4 Adequacy metrics indicate the level of security of electricity supply that Member States need[1]. Prompted by the significant differences in the adequacy metrics across Member States, the EU Agency for the Cooperation of Energy Regulators (ACER) commissioned a study on the detailed implementation of the associated methodology. The study concluded that the implementation of the methodology is often heterogeneous, especially when assessing the value of lost load, and incomplete. The choice of certain parameters, such as the method for assessing the value placed by consumers on an uninterrupted service, can have a significant impact on the outcome of the calculations. This choice alone can mean a fivefold difference in the estimated value of lost load.

1 The adequacy metrics refer to the value of lost load, cost of new entry and the reliability standard.

5 ACER approved the European Network of Transmission System Operators for Electricity's (ENTSO-E's) 2023 European Resource Adequacy Assessment (ERAA). ENTSO-E is required to assess, annually, the risks to EU security of supply in its ERAA, based on the pan-European methodology for adequacy assessments. This was the first approval in three years of ENTSO-E's assessment, marking a milestone for security of electricity supply across the EU. ACER considered that the improvements applied in the ERAA 2023 were sufficient. At the same time, ACER called for further improvements in the ERAA 2024 to ensure the adoption of robust security of supply decisions by Member States, such as the introduction of national capacity mechanisms.

6 2024 marked the first year that regional coordination centres provided recommendations on the participation of foreign resources in national capacity mechanisms. Specifically, regional coordination centres estimated the maximum entry capacity available for the participation of foreign capacity, or simply the expected contribution of foreign resources to a Member State's security of supply, based on the ERAA 2023 results. This represents an important step towards a more harmonised operation of capacity mechanisms. The incomplete implementation of the ERAA, however, hinders the smooth direct participation of foreign resources in capacity mechanisms.

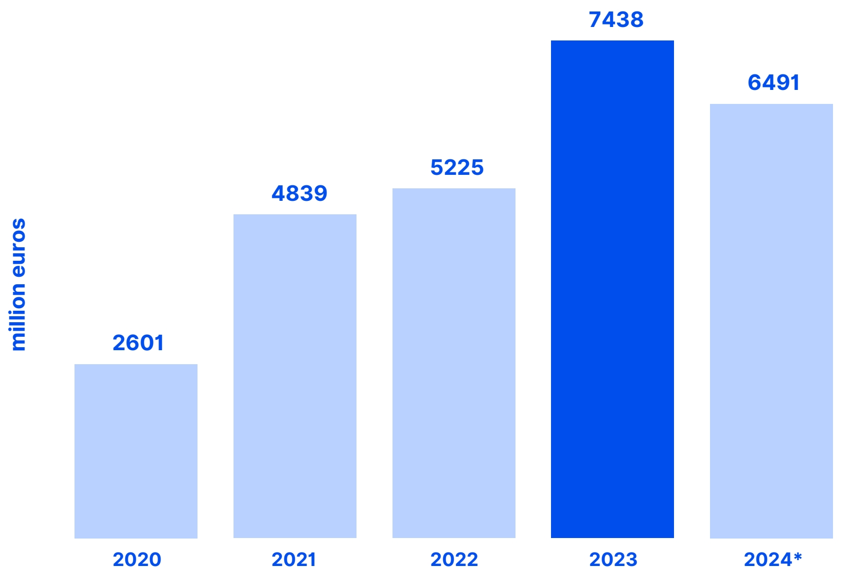
National capacity mechanisms need to be better designed to achieve affordable electricity prices and decarbonisation goals

7 Although the number of capacity mechanisms in Europe remained unchanged in 2023 (eight Member States had a capacity mechanism), the costs increased significantly year on year relative to 2022, by around 40 % (or EUR 2 billion). This increase was driven primarily by the French capacity mechanism, where the costs of contracting capacity increased as the supply side continued to face relative tightness due to the lower availability of nuclear capacity. On the one hand, the costs increased across all market-wide capacity mechanisms, while, on the other hand, the costs of strategic reserves remained negligible. Moderating whole-system costs, including capacity mechanisms, will be key to safeguarding affordable electricity prices in the EU.

8 One way to moderate the costs of capacity mechanisms is by smoothening peak demand through providing better signals to consumers. Cost recovery methods (i.e. the means of recouping the costs of capacity mechanisms through consumers' bills) are key to achieving this goal. ACER's analysis shows that current cost recovery methods do not charge consumers based on their consumption during periods of system tightness and thereby largely fail to send adequate signals.

The costs of capacity mechanisms have constantly increased over the past years

Incurred and expected(*) costs of capacity mechanisms in the EU – 2020–2024 (million euros)



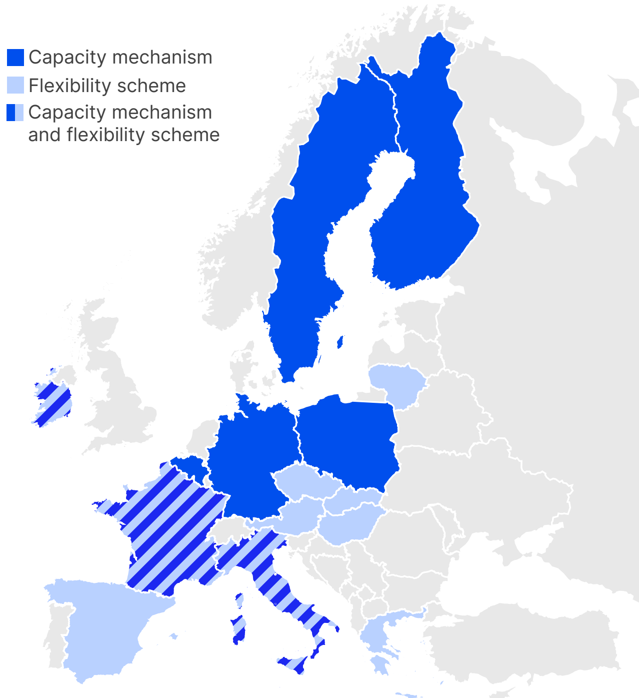
9 ACER has highlighted in its past monitoring reports that the main beneficiaries of capacity payments are fossil fuel generators. This picture hardly changed in 2023. Fossil fuel generators have been awarded 85 % of long-term contracts for 2035. Clean energy resources, however, play a marginal role. The current capacity mechanism designs could threaten the timely decarbonisation of the power sector and increase its costs.

Some Member States are providing support for non-fossil flexible resources

10 In 2023, flexibility surfaced as a key challenge for the European electricity market. ACER finds that at least 10 Member States are implementing, or are in the process of setting up, support schemes for non-fossil flexible resources. Most of these flexibility support schemes target the development of electricity storage technologies, primarily battery storage, and to a lesser extent demand side response.

11 As well as enhancing the flexibility of the power system, the objectives of flexibility support schemes can vary. Some schemes aim to integrate renewables at either the transmission or the distribution level, including addressing congestion management. Other schemes focus more on security of electricity supply, and particularly on resource adequacy or operational security. Moreover, the design of flexibility support schemes varies significantly across the EU.

At least 10 Member States have support schemes targeting the development of non-fossil flexible resources. Some Member States have both capacity mechanisms and flexibility support schemes



Significant potential to enhance security of electricity supply and moderate electricity costs across Europe

12 Policymakers can use various reforms, actions and measures to achieve resource adequacy and flexibility cost-efficiently. Further integration of the European electricity market can bring significant benefits and cost savings on both fronts. This requires improvements in the single electricity market operations across all time frames and better use and development of interconnectors. A more integrated approach between Member States to securing supplies could further increase these benefits, requiring stronger governance, trust and cooperation. A positive example of this is the regional calculation of the availability of cross-border capacities to support neighbouring countries at times of system stress in national capacity mechanisms. Furthermore, ACER notes it is important to closely monitor and assess the interplay between the electricity and gas security of supply outlooks, given the interdependencies between the two.

13 Recent wholesale electricity market trends, with a significant rise in the number of low to negative prices and volatility, highlight opportunities for flexible resources. The EU power system's flexibility needs will double by 2030. Removing barriers to market participants and resources, such as demand response, can help unlock significant potential and moderate system costs.

14 It is important that ENTSO-E and Member States further progress and properly implement the resource adequacy framework. ACER's analysis shows room for improvement across several areas: adequacy metrics, resource adequacy assessments and cross-border participation in capacity mechanisms. ACER notes that the upcoming exercise by the European Commission, ENTSO-E and ACER for streamlining the capacity mechanisms application process and the methodology for the ERAA will offer an opportunity to improve the existing framework. For example, the findings of ACER's consultants' study on the adequacy metrics suggest there is scope to streamline the underlying methodology.

15 Given the current status of and interest in support schemes for resource adequacy and flexibility, ACER considers that there is scope to examine current practices and develop best practices on their design. Such best practices can improve current and future designs, in terms of their primary goals and the broader goals of affordability, competitiveness and sustainability. For example, cost recovery structures should provide better incentives to consumers to adapt their behaviour, thereby reducing the costs of securing supplies. This can be achieved through enhanced targeting of system stress periods and improved communication of cost saving opportunities to consumers.

16 Where Member States implement both capacity mechanisms and flexibility support schemes, it is important to explore the synergies between them to lower the costs to consumers and ensure smooth interaction between them and with the wholesale market. Failing to do so could lead to over-procurement, undesirable market distortions and ultimately higher costs for consumers and businesses.

17 Lastly, ACER observes that the greatest challenge ahead is about ensuring a managed transition from fossil fuels to clean energy under high levels of uncertainty. As the energy transition progresses and the use of fossil fuel generators continues to decline, ensuring that fossil fuel generators are phased out at the 'right' point in time, meaning when enough clean and flexible alternatives are in place, would be sufficient to secure supplies. In this context, strategic reserves could be a particularly suitable complement to the energy transition, considering national circumstances. Strategic reserves tend to cost a fraction of the costs of market-wide capacity mechanisms. They have the additional benefit of lying outside the market, and therefore do not distort wholesale markets. Market-wide capacity markets may induce investments in traditional generation that may in turn hinder the potential for market-based investment in non-fossil flexible resources. This could perversely affect perceived needs for double subsidisation (first, for capacity needs and, second, for flexibility needs not met via the market). Established strategic reserves could also be a suitable instrument for mitigating risks and managing contingencies.

1. Introduction

18 The clean energy for all Europeans package (clean energy package) tasked the EU Agency for the Cooperation of Energy Regulators (ACER) with monitoring developments related to the topic of resource adequacy and security of electricity supply. This report presents the third edition of ACER's security of supply monitoring report. It contains some of the recurring monitoring topics, as well as some new ones.

19 As in the first two editions, the report examines the implementation of the adequacy framework (Chapter 2). In 2024, ACER commissioned a study on the implementation of the methodology for the calculation of the adequacy metrics – the value of lost load (VOLL), the cost of new entry (CONE) and the reliability standard. This report summarises the key findings of the detailed study. In addition, the report examines the expected resource adequacy concerns based on national assessments and delves into a topical question related to the framework: the type of scenarios and sensitivities considered in national resource adequacy assessments (NRAAs).

20 The report provides updates on the implementation of measures aimed at securing electricity supplies (i.e. capacity mechanisms) (Chapter 3). As the deployment of renewables continues apace, policymakers have shifted attention to the flexibility of the power system. The recently adopted electricity market design reform has introduced a number of provisions to enhance the flexibility of the power system through the development of non-fossil flexible resources, such as storage and demand side response[2]. These include the application of schemes to support their development. In this context, the present edition provides a first high-level overview of flexibility support schemes across the EU.

21 Lastly, for the second year in a row, the monitoring report dives deeper into certain design features of national capacity mechanisms (Chapter 4). The report examines the alignment of capacity mechanisms aiming to achieve security of supply with the other two objectives of the 'energy trilemma' (i.e. sustainability and affordability). Specifically, the report examines the alignment of capacity mechanisms with decarbonisation targets and the topic of cost recovery, which is one part of the affordability issue. Given the increased focus on the functioning of capacity mechanisms, also seen during the discussions on electricity market design reform, ACER examines current practices and draws lessons for future discussion on the streamlining of the framework.

22 The geographical scope of this report is the 27 Member States of the EU, as well as Norway, where data were available[3]. Unless otherwise specified, the information presented in this report refers to 2023.

2 The electricity market design reform was adopted on 21 May 2024 and entered into force on 16 July 2024. Regulation (EU) 2024/1747 contains key provisions related to the goal of enhancing the flexibility of the power system (Articles 19e–19h). For more information, see, for example, the European Commission's Electricity market design.

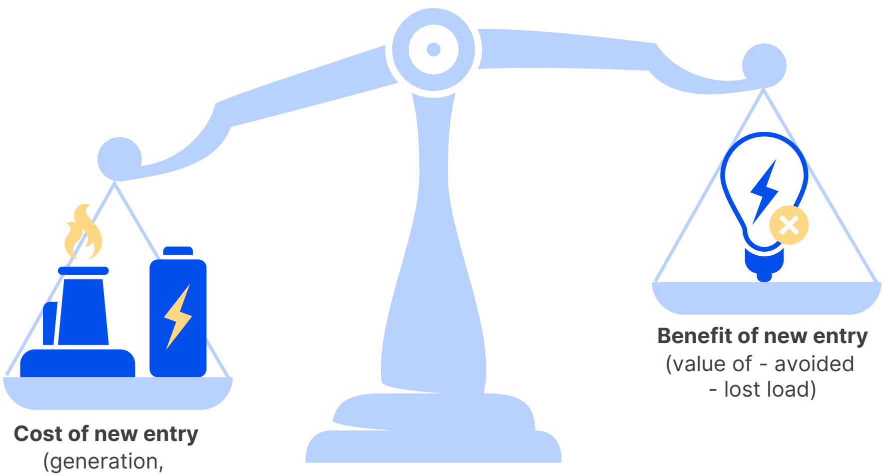
3 For simplicity, the scope of the analysis is referred to as 'the EU' or 'Europe'. Norway enforces most of the EU energy legislation, including legislation on the internal energy market, and is included in the data reported in several sections of this report. Consequently, the terms 'countries' and 'Member States' are used interchangeably throughout this report, depending on whether the particular section also covers Norway. Several maps included in this report show Kosovo. In this context, the following statement applies: 'This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the International Court of Justice Advisory Opinion on the Kosovo declaration of independence'.

2. Implementation of the adequacy framework

2.1. Adequacy metrics

23 The adequacy metrics discussed in this chapter are VOLL, CONE and the reliability standard[4]. A socioeconomically efficient reliability standard is calculated based on VOLL and CONE. The reliability standard essentially strikes a balance between the cost of having additional capacity in the system against the benefits of having fewer demand disconnections (or energy not served). Member States set their own electricity reliability standard to indicate the level of security of electricity supply they need (Figure 1).

Figure 1: Costs and benefits of new entry



4 For a comprehensive introduction to the topic, see Section 2 of the 2021 security of supply monitoring report.

2.1.1. Updates

24 This section describes developments in the calculation of adequacy metrics) in Member States. In 2023, adequacy metrics were updated in Czechia, Ireland and Sweden[5]. In Poland, the reliability standard was set in 2024. The updates are described below and presented in Table 1.

- In Czechia, the reliability standard has been recalculated and lowered to 6.7 hours loss of load expected (LOLE) (from 15 hours). The VOLL increased by a factor of 4 and CONE by a factor of 2.
- In Ireland, the single VOLL has been determined and the reliability standard has been calculated as 6.5 hours. The Irish government has decided to set the reliability standard at 3 hours LOLE.
- In Poland, the single VOLL has been calculated and the fixed CONE and the potential for new entry have been determined for seven technologies. The reliability standard was set as 3 hours.
- In Sweden, the adequacy metrics were recalculated in 2023, but the reliability standard remains 1 hour LOLE[6].

5 Unless this section indicates otherwise, the adequacy metrics presented in last year's report (Table 10) remain valid. In Czechia, the study has not yet been published. For Ireland, the calculation is available here. For Poland, see the VOLL calculation here and the CONE calculation here. For Sweden, see here. In Spain, the government proposed new values for the adequacy metrics in 2023 (see link to the public consultation here), but the new values are not yet in force..

6 The output of the reliability standard calculation was 1.16 hours, but the reliability standard in force was not updated. Swedish authorities are expected to recalculate the adequacy metrics again in 2024.

Table 1: Adequacy metrics in Member States where updates have taken place in 2023

Member State	VOLL (EUR/MWh)	Fixed CONE		RS (hours/year)
		Value (EUR/MW)	Technology	
Czechia	16 003	105 800	Open cycle gas turbine	6.7
Ireland	17 909	115 990	Open cycle gas turbine	3
Poland	17 173	30 183	Demand response	3
		119 256	Open cycle gas turbine	
Sweden	7 065	7 873	Demand response	1

Source: ACER based on NRA data.

Note: In Poland, the reliability standard is based on two CONE technologies.

2.1.2. Results of the study on the implementation of the methodology for the calculation of the adequacy metrics

2.1.2.1. Introduction

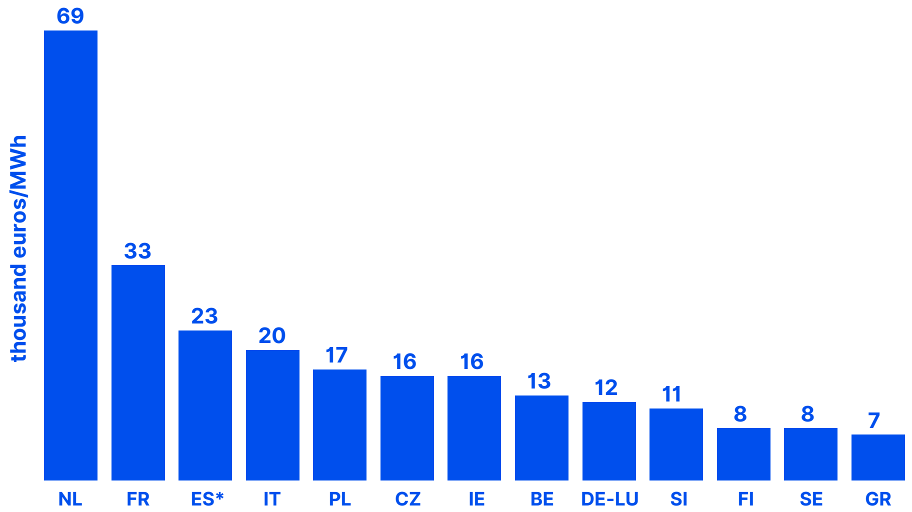
25 In past monitoring reports, ACER observed that Member States implemented the methodology for the calculation of the adequacy metrics[7] in a non-uniform manner. In particular, substantial differences were observed in the estimations of the VOLL. As presented in Figure 2, the results of the calculations differ substantially between Member States.

26 In 2023, ACER commissioned a study to better understand the underlying factors behind the divergences. The study aimed to identify the components of the methodology that most strongly affect the results and propose ways to facilitate the calculation of the metrics. The study comprised assessing the national reports setting the adequacy metrics and conducting structured interviews with the entities that performed the calculations and was finalised in May 2024[8].

7 The methodology for calculating the VOLL, CONE and the reliability standard is available here.

8 The scope of the study included Member States that either had capacity mechanisms in place or recalculated their adequacy metrics in the time since the methodology entered into force.

Figure 2: Variation in the VOLL in Member States



Source: ACER based on the presentation slides for the ACER webinar on implementation of the EU methodology for electricity adequacy metrics.

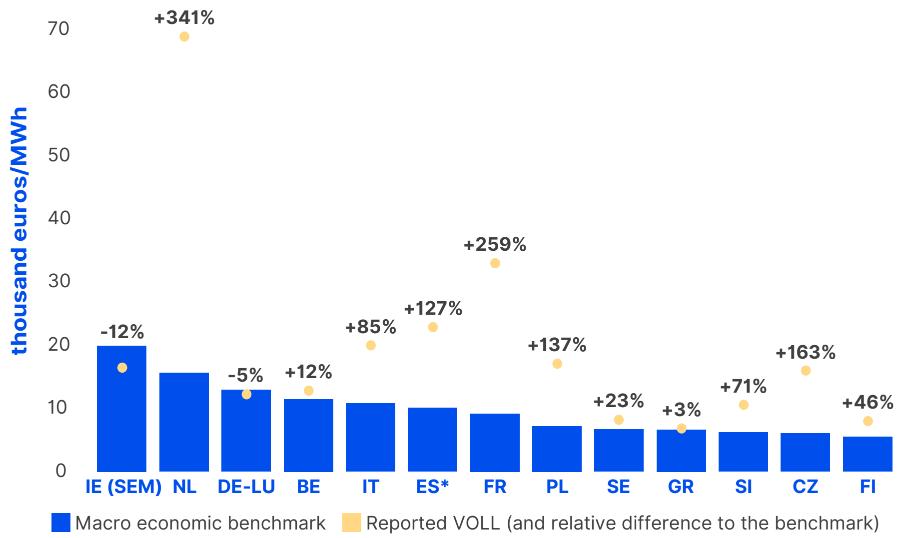
Note: The values are rounded. The values for Spain had not been approved when the study was being conducted.

2.1.2.2. Calculations of the value of lost load

Comparison of reported value of lost load with the structure of the economy

27 The methodology requires that the VOLL is assessed using a survey-based approach. In principle, the VOLL estimate should vary between countries, reflecting structural differences in their economies. To understand to what extent the variation in the reported VOLL can be attributed to these differences, the study used a benchmark based on macroeconomic data[9]. The study found that the benchmark VOLL shows a more consistent and coherent pattern than the survey-based VOLLs, as shown in Figure 3. This implies that some of the differences between the reported VOLL and the benchmark stem from the differences in implementation decisions and the diversity of outcomes that are inherent in a survey approach. It appears that the macroeconomic benchmark can provide a consistent set of indicators for each Member State.

Figure 3: Comparison of reported VOLLs with a benchmark based on macroeconomic data



Source: ACER based on the presentation slides for the ACER webinar on implementation of the EU methodology for electricity adequacy metrics.

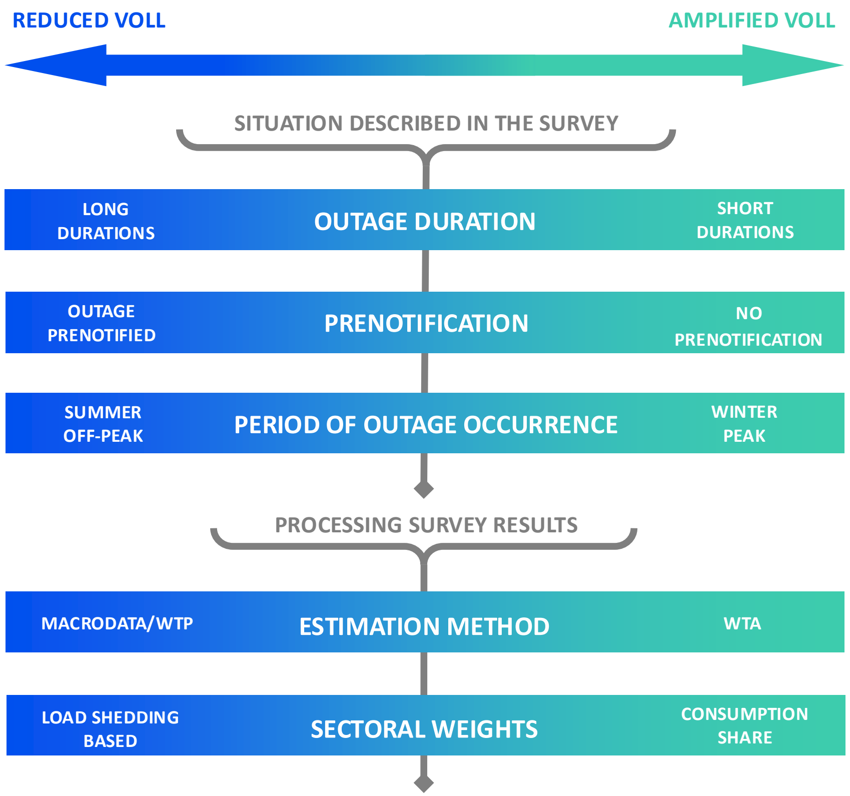
A variety of decisions influences the single value of lost load

28 The methodology provides the minimum requirements for the survey-based approach to calculate the single VOLL. At the same time, it leaves several implementation decisions to be made by the entity performing the calculations. Some of these factors and their likely impact on the results[10] are shown in Figure 4.

9 The benchmark estimates the VOLL, considering the value of leisure of residential consumers (considering net wages) and the sectoral gross value added for other sectors (data sources: Eurostat and the Organisation for Economic Co-operation and Development). The benchmark corresponds to the approach used to estimate VOLL in Germany and Luxembourg.

10 Another factor for which the direction of the impact cannot be ascertained is whether or not statistically representative samples are used.

Figure 4: Main factors influencing the VOLL



Source: ACER based on the presentation slides for the ACER webinar on implementation of the EU methodology for electricity adequacy metrics.

Note: WTA, willingness to accept; WTP, willingness to pay.

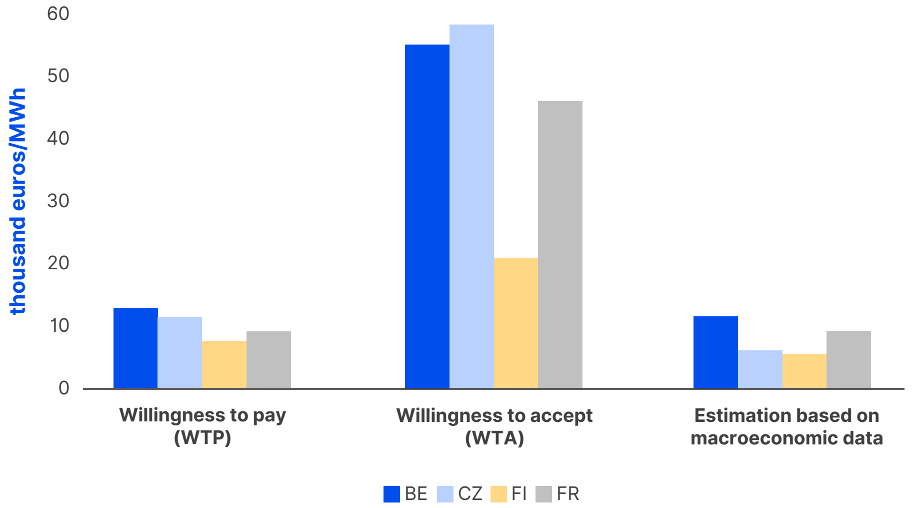
29 The study concluded that the factors shown in Figure 4 drive, to a large extent, the differences between the reported VOLL and the benchmark shown in Figure 3. The study categorised these factors into:

- decisions related to the **degrees of freedom of the methodology** (e.g. the choice of the estimation method or the choice of the sectors surveyed);
- the potential **lack of implementation of the methodology** (e.g. weighing of sectoral VOLLs based on shares of electricity consumption or using a non-representative sample of survey answers).

30 An example of a methodological choice with a substantial impact on the result is the way in which the survey question is phrased – or otherwise the cost estimation method. The cost estimation methods allowed by the methodology are the willingness to pay (WTP), willingness to accept (WTA) and direct worth[11]. All three methods aim to measure the same variable – the cost of an electricity supply interruption. However, respondents' answers tend to differ substantially depending on how the question is framed. Notably, for the four Member States where both the WTP and WTA surveys were conducted, the outcomes differ by up to 520 % (430 % on average) depending on the approach, as shown in Figure 5. The figure also shows that the WTP method (the main cost estimation method prescribed by the methodology) results in values substantially closer to the macroeconomic data benchmark.

11 Examples of survey questions corresponding to the estimation methods: WTP – 'How much are you willing to pay to avoid an interruption?'; WTA – 'How much would you want to be paid to incur an interruption?'; Direct worth – 'Estimate the actual costs you would incur because of the interruption'.

Figure 5: VOLL depending on the approach to assessing it



Source: ACER based on the pre-reading material for the ACER webinar on implementation of the EU methodology for electricity adequacy metrics.

2.1.2.3. Calculations of the cost of new entry and the reliability standard

31 In assessing the CONE calculations, the study concluded that the implementation of the methodology is acceptable, albeit incomplete. Notably, in some Member States, the potential for some capacity resources was not identified, meaning that the reliability standard could not be set as envisaged by the methodology. The study also found that, while there are divergences in CONE calculations across Member States, the reports generally did not allow meaningful conclusions on the underlying reasons to be drawn. This is in part due to lack of detailed data regarding the costs of demand side response, storage and solar. The study identified that there is scope to improve the transparency of reporting the technical characteristics and cost components.

32 The methodology envisages that the reliability standard is set based on the need for additional capacity to reach the reliability standard (the 'minimum capacity need') and the potential of the different additional capacity resources to fulfil that need. The study concluded that some national entities found the corresponding part of the methodology unclear and did not apply it correctly. Furthermore, the minimum capacity need should be defined based on the most recent resource adequacy assessment. Some national entities pointed to the lack of an appropriate national assessment as an issue impeding the implementation of the methodology. After the 2023 European Resource Adequacy Assessment (ERAA) has been approved, the minimum capacity need can be derived by processing its results.

Box 1: Consultants' recommendations

The study commissioned by ACER provided recommendations on the possibilities to address the main issues experienced when implementing the methodology – the degrees of freedom and the lack of implementation, especially relating to the calculation of the VOLL. The study identified the following options.

- Option 1. Providing clearer rules instead of a range of options in the methodology. For example, this would mean determining WTP as the only estimation method for the VOLL survey.
- Option 2. Coordinating the data collection. The calculation of adequacy metrics (e.g. designing and running a VOLL survey) could be more coordinated, instead of the current practice in which most Member States perform the surveys and calculations in isolation.
- Option 3. Assessing the VOLL using macroeconomic indicators. Sectoral VOLLs could be calculated using available statistical data and economic parameters.

ACER notes that the options are not fully mutually exclusive. The options also require different changes in the methodology.

2.2. Resource adequacy assessments

33 According to the Electricity Regulation, the ERAA is the basis for Member States to monitor resource adequacy risks. On top of that, Member States may also conduct NRAAs to complement the ERAA.

34 Since the first edition of the ERAA (in 2021), the European Network of Transmission System Operators for Electricity (ENTSO-E) has implemented gradual methodological improvements in the assessment. In 2024, ACER, for the first time, approved the ERAA 2023, concluding that the assessment has reached a level of robustness that allows decision-makers to rely on its results.

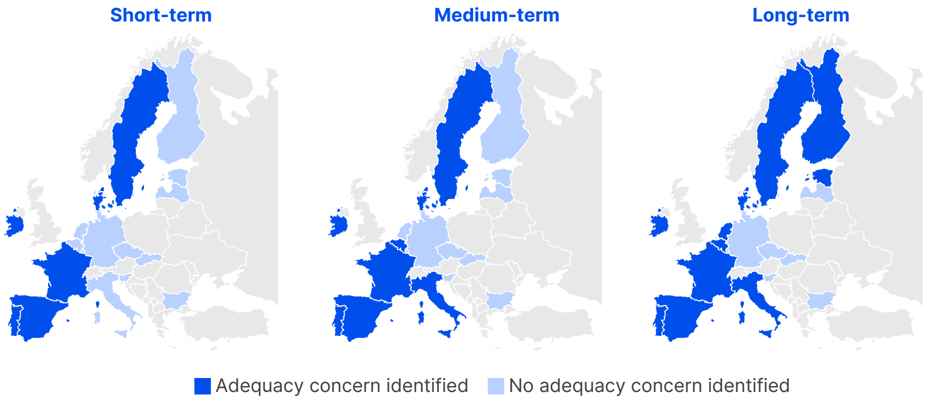
35 According to the ERAA methodology, it is ERAA's central reference scenario that should be used to identify adequacy concerns. In the ERAA 2023, ENTSO-E included a sensitivity with a changed representation of the climate in the economic viability assessment (EVA). ACER found that the sensitivity undermined the consistency across the assessment and demonstrated that the selection of climate years in the EVA can have a high impact on the results. Furthermore, the sensitivity was added without having been subject to a public consultation. In its Decision on the ERAA 2023, ACER concluded that the sensitivity used in the ERAA 2023 has only a complementary value and should not be read on equal terms as the central reference scenario[12].

36 To inform future decision-making regarding the choice of scenarios and sensitivities in resource adequacy assessments, ACER examined the choices made in this regard in recent NRAAs. This section presents the results of the central reference scenario of NRAAs and the additional scenarios and sensitivities that NRAAs consider.

2.2.1. Results of national resource adequacy assessments

37 Figure 6 shows whether or not a Member State is expected to have a resource adequacy concern in the short (2024–2025), medium (2026–2029) or long terms (2030-2033), based on the most recent NRAA[13]. Out of 17 NRAAs for which data were available to ACER, 11 identified an adequacy concern in at least one of the next 10 years, as reported by the national regulatory authorities. ACER observes that the number of Member States projecting a resource adequacy concern increases further out in the future (from 6 Member States in the short term to 11 in the long term).

Figure 6: Adequacy concerns identified in NRAAs for different time frames



Source: ACER based on NRA data.

Note: The figure shows whether adequacy concerns have been identified in the central reference scenario of the most recent NRAA, as reported by the national regulatory authorities.

12 See ACER Decision No 06/2024, in particular recitals 147 and 160–164.

13 The figure shows adequacy concerns as indicated by NRAAs. Some Member States shown do not have a reliability standard set in line with the methodology for the calculation of adequacy metrics.

2.2.2. Scenarios and sensitivities in national resource adequacy assessments

38 This section describes the choices made in NRAAs regarding scenarios and sensitivities. The analysis is based on information collected from NRAAs conducted in the period between 2022 and 2024.

39 According to the ERAA methodology, a 'scenario' refers to a quantitative description of a plausible future of the power system, while a 'sensitivity' means a change in a scenario that results from the variation in one or a few input parameters.

40 According to the Electricity Regulation, NRAAs should contain central reference scenarios of projected demand and supply as described in the ERAA methodology, and they should include an economic viability assessment. NRAAs may contain additional scenarios, as well as sensitivities related to the particularities of national electricity demand and supply.

41 The vast majority of NRAAs include various additional scenarios and/or sensitivities. Of the 18 EU NRAAs for which data were provided, 16 NRAAs contain at least one additional scenario or sensitivity.

2.2.2.1. Additional scenarios in national resource adequacy assessments

42 ACER observes that the additional scenarios[14] can be categorised into four broad categories. The scenarios generally consider differences in:

- the pace of the energy transition;
- the availability of resources or grid capacities;
- climate conditions;
- economic trends and demand and supply dynamics.

14 Even if listed as scenarios by NRAAs, some of the examples labelled as scenarios in this section may in fact better fit the definition of a sensitivity.

Pace of the energy transition

43 Six NRAAs (the Belgian, Bulgarian, Czech, Spanish, French and Portuguese) include additional scenarios modelling a different pace of the energy transition. In Czechia, France and Portugal, these scenarios vary the timeline of reaching the policy objectives (including national energy and climate plan targets). In all three cases, NRAAs vary both the supply (e.g. installed renewable energy sources (RES) capacity) and demand sides (e.g. uptake of electric vehicles or energy efficiency measures) in the same scenario[15]. A scenario in the Belgian NRAA models a different behaviour of prosumers, a factor related to the energy transition[16]. The Bulgarian NRAA contains an additional scenario varying the level of installed renewable energy capacity only, and the Spanish NRAA contains a scenario assuming no commissioning of new storage.

Availability of resources or grid capacities

44 Four NRAAs include additional scenarios that model situations related to the availability of resources or grid capacities[17]. Such scenarios include simultaneous failures of multiple grid elements (in the Estonian NRAA), or a lower availability of domestic or foreign nuclear power plants (in the Belgian, Finnish and Swedish assessments)[18]. These scenarios consider deterministic downside risks as opposed to the probabilistic approach envisaged by the Electricity Regulation that attaches likelihoods to uncertain future events[19]. As a rule of thumb, such a deterministic approach, capturing the impact of select adverse future shocks, may not fit best in the adequacy framework.

15 In the scenario considered, the national energy and climate plan targets or similar policy objectives are reached earlier (Czechia, Portugal) or later (Czechia, France, Portugal) than in the central reference scenario. The Portuguese NRAA does not have a central reference scenario.

16 The scenario includes, on the one hand, changed demand patterns (as a result of electrification) but also includes an increased flexibility of this demand.

17 'Availability' refers to whether the element is assumed to be operating in the system.

18 In Finland, the scenario assumes a delayed commissioning of a new nuclear power plant. In Sweden, the additional scenario models one nuclear power plant as permanently unavailable.

19 For example, the scenario in the Swedish NRAA assumes that a nuclear power plant experiences a year-long outage.

Climate conditions

45 The Electricity Regulation envisages that resource adequacy assessments may consider sensitivities on extreme weather events[20]. Four NRAAs (in Germany, Ireland, Italy and Sweden) model an additional scenario with different climate conditions. In the German NRAA, the additional scenario considers a warmer climate year compared with the reference in the EVA[21]. The Italian NRAA includes a scenario in which a heatwave is combined with a drought, implying changes in both demand and supply[22]. The 2023 Irish NRAA considers two additional scenarios combining different climate conditions (a warmer and colder winter) together with economic factors to produce high and low demand scenarios[23]. The Swedish NRAA models an additional scenario reflecting drier weather conditions.

Economic trends and demand and supply dynamics

46 Macroeconomic factors are to some extent reflected in the input assumptions of resource adequacy assessments, such as demand projections and CONE parameters (e.g. through the weighted average cost of capital). Some NRAAs (the Belgian and the French) include a scenario that models a different macroeconomic or supply chain context that implies a stagnant economy, resulting in the deceleration of the deployment of new generation capacity.

2.2.2.2. Sensitivities in national resource adequacy assessments

47 Moreover, ACER collected information about sensitivities included in NRAAs. The most common sensitivities considered in NRAAs concern outages of domestic or foreign generation capacity and higher projected demand. The following list shows five types of sensitivities and the number of NRAAs where the sensitivity features:

- outages of domestic generation (features in nine NRAAs),
- higher demand (features in eight NRAAs),
- outages of foreign generation (features in seven NRAAs),
- varying amounts of cross-zonal capacity (features in five NRAAs),
- lower demand (features in four NRAAs).

20 Article 23(5)(b).

21 Instead of the reference weather year of 2012, a warmer year of 2019 is used, also including more electricity produced from wind.

22 The Italian assessment also considers that the results of the EVA constitute a separate scenario.

23 These scenarios also fit into the following category, which considers variations in economic trends and demand and supply dynamics.

2.2.2.3. Conclusions

48 ACER examined the additional scenarios and sensitivities considered in NRAAs. ACER observes that the majority of national assessments consider additional scenarios and sensitivities and that the terms scenario and sensitivity are often used interchangeably. A clearer distinction in line with the ERAA methodology would be beneficial for solid decision-making.

49 Several Member States include scenarios representing a slower or faster energy transition. Such scenarios should ideally take a holistic view of the future, reflecting different dynamics on both the supply and demand sides. As the energy transition concerns the entire interconnected system, there is scope to develop a common European understanding of such scenarios. This could be informative for the general public and help to illustrate the impact of the energy transition both on climate goals and on security of electricity supply.

50 Some scenarios (modelling a reduced availability of resources or different climate conditions) assess the impact of unlikely conditions with high impacts on the electricity system. These situations include simultaneous failures of multiple gird elements or a heatwave. The deterministic assessment of such extreme situations does not fit well in the adequacy framework. Some of the risks included in such scenarios are in any case captured in the central reference scenarios through probabilistic inputs, such as outage patterns and climate years.

51 Some NRAAs model potential impactful situations in a deterministic manner. This may reflect the aim of gaining a detailed understanding of the associated impacts. However, some input data, such as commissioning dates of power plants, could potentially also be included as probabilistic inputs to the central reference scenario, for example by associating different likelihoods with potential commissioning dates. In this case, the impactful situation would be assessed through a full probabilistic analysis.

52 Overall, ACER finds that the additional scenarios and sensitivities in NRAAs more often model situations that represent, in terms of adequacy, a less favourable evolution of the system. While the central reference scenarios should be the basis for identifying adequacy concerns, additional scenarios and sensitivities can offer a complementary understanding, as long as they are chosen and designed carefully.

3. Security of supply measures

53 This chapter primarily examines measures that Member States implement to address security of supply concerns. It includes ACER's recurring monitoring of capacity mechanisms. In addition, it provides an overview of support schemes for non-fossil flexible resources for the first time.

3.1. Capacity mechanisms

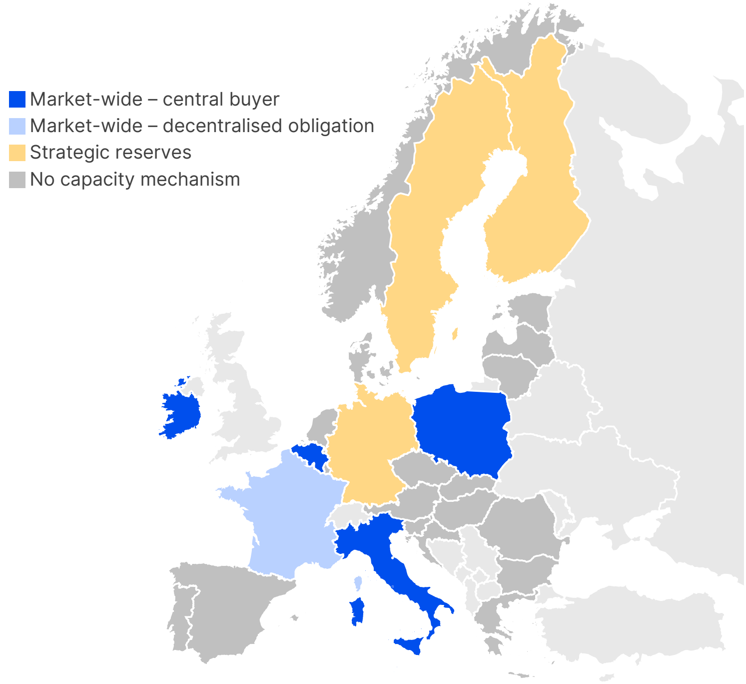
54 Capacity mechanisms are support schemes that remunerate capacity resources (e.g. generators, demand-response or storage units) to be available in return of providing security of supply services[24]. The electricity market design reform removed the temporary nature of capacity mechanisms with the intention of making them a more structural element of the electricity market. It also requires an assessment of measures to streamline the process of applying for a capacity mechanism.

55 This section discusses the status and costs of capacity mechanisms across Europe, and the technologies remunerated through them. It provides an update on cross-border participation in capacity mechanisms.

3.1.1. Status and costs of capacity mechanisms

56 The status of capacity mechanisms remained unchanged compared with last year's monitoring report. As in 2022, eight Member States had active capacity mechanisms in place in 2023: Belgium, Ireland (Single Energy Market), France, Italy and Poland implemented market-wide capacity mechanisms, while Germany, Finland and Sweden applied strategic reserves[25]. Figure 7 presents the current status of active capacity mechanisms. ACER notes that more Member States are currently planning or considering the introduction of a capacity mechanism[26].

Figure 7: Status of capacity mechanisms in the EU – 2023



Source: Created by ACER based on NRA data.

24 For more information on capacity mechanisms, refer to ACER's 2023 Security of EU electricity supply monitoring report.

25 As described in last year's monitoring report, Finland implemented a new strategic reserve in 2022. The first auction of the scheme took place in summer 2022 and awarded no capacity, that remained the case in 2023 too.

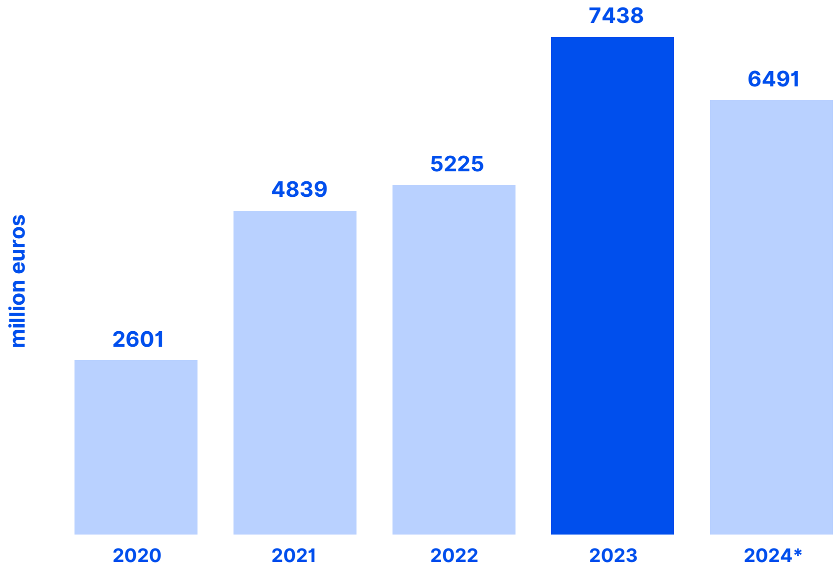
26 For example, the German government has communicated its intention to implement a capacity mechanism, and the Spanish government has commenced the process for establishing one.

57 Figure 8 presents the realised capacity mechanism costs across Europe for recent years and expected costs for 2024. As anticipated in last year's report, the costs of capacity mechanisms rose significantly in 2023 (compared with 2022), by over EUR 2 billion (or around 40 %). The main drivers of this trend were increased costs, primarily in France and to a lesser extent in other capacity mechanisms; the costs increased in all market-wide capacity mechanisms from 2022 to 2023[27]. In the case of the French capacity mechanism, the increased costs can be attributed to the unavailability of nuclear capacity that led to a reduction in available supply volumes and, subsequently, an increase in the prices of procured capacity. Looking ahead, the overall costs of capacity mechanisms in Europe may drop largely due to the expected reduction in the French capacity mechanism's costs as the availability of nuclear capacity in the country continues to improve, while electricity demand remains subdued.

58 Figure 9 presents the costs of capacity mechanisms per unit of electricity demand and provides an indication of the relevance of these costs in the electricity bill. The percentage values in this figure show these costs expressed as a percentage of the average day-ahead price in the bidding zone(s) where the respective capacity mechanism applies[28].

59 As wholesale prices in 2023 subsided to some extent from the soaring prices experienced in 2022, the relative costs of capacity mechanisms increased significantly between the two years. For example, in the case of the French capacity mechanism, the combination of higher absolute costs of the capacity mechanism and lower wholesale prices led to a fivefold increase in relative costs (from around 2 % to around 10 %). As expected, the relative costs of market-wide capacity mechanisms are many times higher than those of strategic reserves, which are negligible.

Figure 8: Incurred and projected costs of capacity mechanisms in the EU – 2020–2024 (million euros)



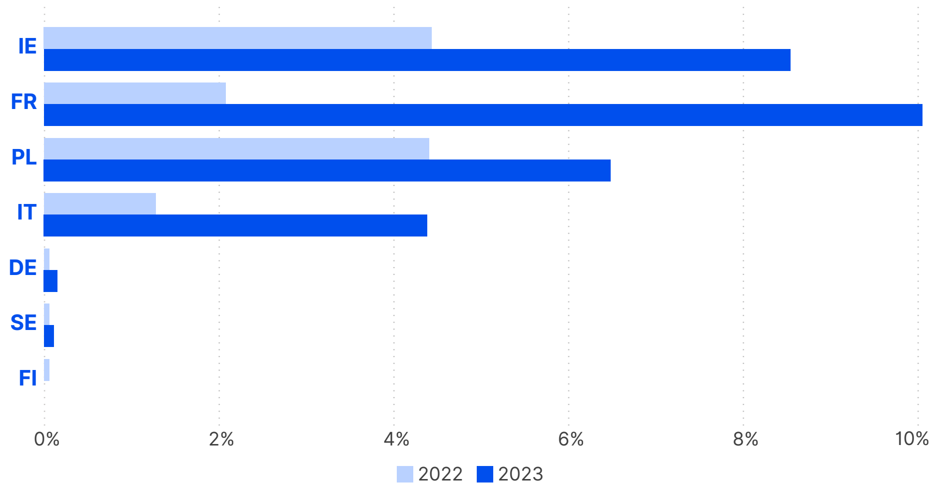
Source: ACER calculation based on NRA data.

Note: Costs for 2024 reflect the expected costs. The figure includes the costs of legacy contracts in Spain and Portugal.

27 For information on the specific costs of national capacity mechanisms, see Figure 15 of Annex I.

28 The value (e.g. 10% for France) compares the cost of security of supply as a service with the average price of electricity as a commodity.

Figure 9: Costs incurred in financing capacity mechanisms per unit demand expressed as a percentage of the annual average day-ahead price in the respective Member States – 2022–2023 (%)



Source: ACER calculation based on NRA, ENTSO-E and Eurostat data.

Note: See the Note under Figure 15.

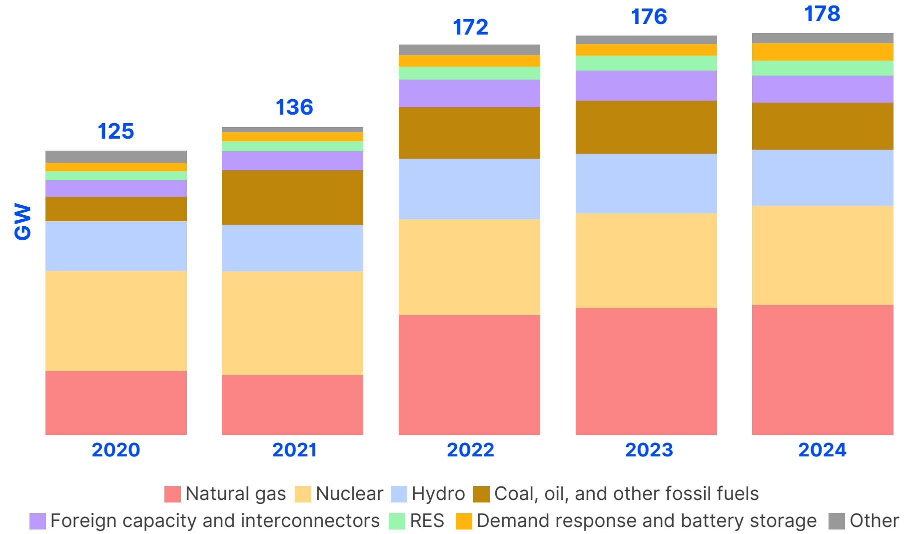
3.1.2. Technologies remunerated under capacity mechanisms

60 Figure 10 shows the breakdown of technologies remunerated through capacity mechanisms across the EU from 2020 to 2024. The figure shows the prevailing trend observed in past years, whereby traditional capacity providers are the main beneficiaries of support. Specifically, natural gas power plants are the main beneficiaries of capacity mechanisms from 2022 onwards, followed by nuclear and hydro capacity[29]. As the emissions performance standard takes effect from 2025 onwards for existing power plants, ACER expects that the share of coal and oil power plants will drop significantly, although not entirely (see also Section 4.1 on the alignment of capacity mechanisms with decarbonisation targets). At the same time, the capacity awarded to non-traditional providers, such as renewables, storage and demand side response, remains at low relative levels, although it follows a positive growth trend.

3.1.3. Cross-border participation in capacity mechanisms

61 The Electricity Regulation requires that Member States enable direct participation of foreign capacity providers in capacity mechanisms[30]. In December 2020, ACER approved the common rules and methodologies governing such direct participation (the Technical specifications for cross-border participation in capacity mechanisms). In last year's report, ACER examined the implementation of this framework in detail[31]. This section describes the key developments since last year.

Figure 10: Total capacity remunerated in EU capacity mechanisms, per type of technology – 2020–2024 (GW)



Source: ACER calculation based on NRA and ENTSO-E Transparency Platform data.

29 Their relative shares in 2023 were around 32%, 24% and 15%, respectively.

30 See Section 5.2.1 of last year's report.

31 In last year's report, ACER assessed the implementation status of direct foreign participation in national capacity mechanisms, the approaches that Member States use to determine the contribution of foreign capacity to their security of supply, and the national rules for participation and remuneration of foreign capacity.

3.1.3.1. Developments in Member States

62 At the Member State level, some developments have taken place, primarily in 2024[32]. The main ones are the following.

- In Belgium, national authorities have established the legal framework to enable direct foreign participation in the national capacity mechanism. As a result, foreign capacity was able to participate in the latest T-1 auction[33]. As it stands, direct foreign participation is eligible in T-1 auctions only[34].

- In the Polish capacity mechanism, direct cross-border participation is now possible not only in the main auctions, but also in the additional (T-1) auctions[35]. As already anticipated last year, the Polish transmission system operator (TSO) has updated its agreements with the affected neighbouring TSOs. As a result, the participation of German foreign providers from across the country is now possible[36].

3.1.3.2. Cross-border participation in recent auctions

63 This section provides an overview of the participation of foreign resources in the recent auctions in all four capacity mechanisms that allow cross-border participation, either direct (through the participation of foreign resources) or indirect (through the participation of interconnectors).

- In Belgium, the T-1 auction for delivery in 2025/2026 took place in October 2024, and foreign participation was possible for the first time[37]. Capacity providers in two foreign bidding zones (Germany and the Netherlands) were able to participate, while the contribution of foreign providers (the maximum entry capacity or MEC) from France was assessed at zero[38].

- In France, the remuneration for interconnectors for delivery in 2024 is 10 times lower than for delivery in 2023 (their remuneration is determined in the last auction of the year preceding the delivery year).

- In Italy[39], the auction for delivery year 2025 took place in 2024. The maximum contribution of foreign capacity was fulfilled on all borders[40]. The remuneration of foreign capacity was significantly lower, by around a factor of 10, than for domestic capacity[41].

- In Poland, the T-5 auction for delivery in 2028 took place in 2023. The calculated MECs were not reached in any of the borders (i.e. the awarded foreign capacity in the eligible zones was lower than the corresponding MECs). This means that either the bids from the eligible foreign capacity were too high or bids were not submitted. In the T-1 auction, no foreign capacity was awarded.

64 Figure 11 presents the parameters and results of most recent auctions in capacity mechanisms that allow direct or indirect foreign participation[42]. The figure shows the MECs and contracted capacity from each of the foreign bidding zones, as well as the remuneration of foreign and domestic resources, if applicable.

32 As described in Section 5.2.1 of last year's report, as of 2022, direct foreign participation has been in development in Belgium, enabled in a simplified manner in Italy and implemented in Poland. In France, cross-border participation was possible for interconnectors.

33 The latest T-1 auction took place in October 2024 for delivery in 2025/2026.

34 Foreign capacity is not eligible to participate in T-4 auctions. Still, the contribution of foreign resources is considered in the T-4 auction – the MECs are calculated, and the corresponding capacity is reserved for the T-1 auction. Participation of foreign resources in the T-4 auctions may change in the future.

35 Four auctions take place each year, corresponding to the four quarters of the delivery year. No foreign capacity was awarded contracts in 2024 auctions for delivery in 2025.

36 There are still active agreements between Polskie Sieci Elektroenergetyczne (the Polish TSO) and TSOs from Czechia, Lithuania, Slovakia and Sweden. The agreement with the German TSO 50Hertz now applies to the main auctions for 2027 and 2028, and the additional auctions for 2025. There is ongoing work to conclude agreements with all German TSOs in time for the main auction for 2029 and the additional auctions in 2025.

37 The MECs were reserved at the time of the T-4 auction in 2021 and recalculated by the Belgian TSO Elia before the T-1 auction, based on the most up-to-date information.

38 The auction results are available here.

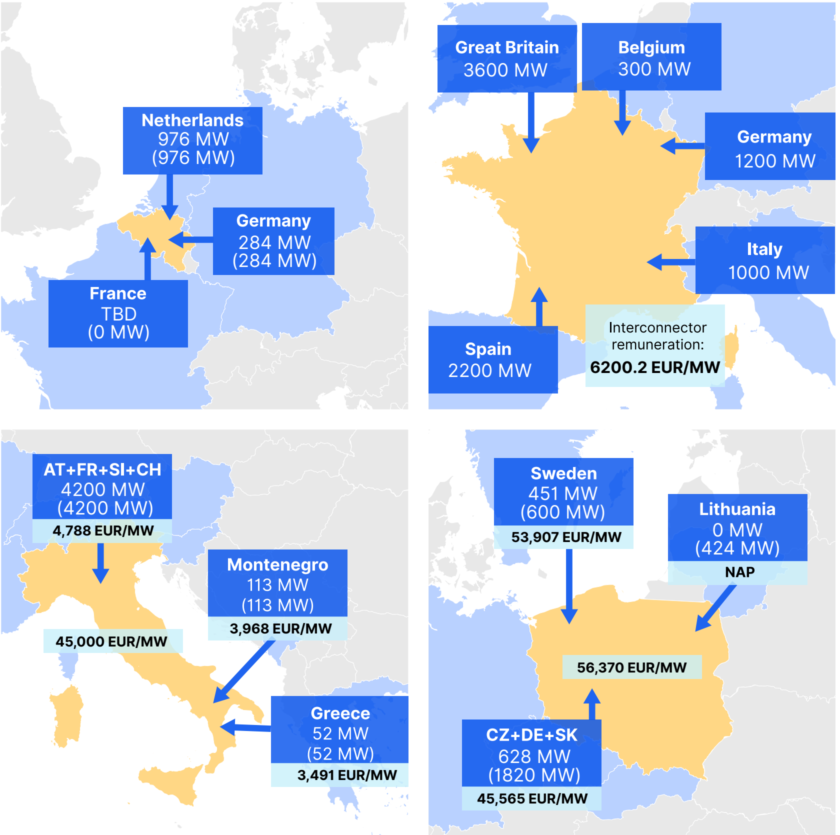
39 Results of the 2024 auction for 2025 are available here.

40 The Italian TSO Terna calculates the MECs on the basis on historical data and not per the EU methodology.

41 Existing domestic resources (corresponding to the bulk of awarded capacity) received a remuneration of EUR 45 000/MW/year, while foreign resources received between EUR 3 491 and EUR 4 788/MW/year.

42 Except for Belgium, see Figure 11 note. Results are shown where they were available at the time of drafting this report.

Figure 11: MEC and contracted capacity in the most recent auctions



Source: Calculated by ACER based on NRA data and publicly available auction results.

Note 1: Each arrow corresponds to participation of one bidding zone (or a group thereof). The first numerical value is the actual capacity contracted, while the second value (in brackets) is the MEC (or its analogue) assigned to the (group of) bidding zone(s). Where applicable, the remuneration for each (group of) bidding zone(s) or interconnectors is shown in light blue rectangles.

Note 2: For Belgium, the MECs on the figure represent the MECs for the T-1 auction for delivery in winter 2025/2026. The remuneration principle for resources in the Belgian capacity mechanism is pay-as-bid. For France, the values correspond to the MECs and remuneration in the T-1 auction for 2024 delivery. The MEC from Great Britain comprises the ElecLink interconnection, which is not regulated. Total actual capacity awarded (7 870 MW) is lower than the sum of the MECs (8 300 MW), but no further information is available on the capacity awarded on each border. For Italy, the values correspond to the maximum levels of foreign capacity that could be contracted for delivery year 2025 and the results of the corresponding auction that took place in 2024. For the purpose of foreign capacity participation, the Italian TSO considers the four bidding zones connected to Italy North (Austria, France, Slovenia and Switzerland) as a single zone, and calculates a single corresponding maximum import value. For Poland, the values shown correspond to the MECs for delivery year 2028 and the corresponding T-5 auction results for this year. Poland considers the synchronous zone comprising Czechia, Germany and Slovakia as one zone for the purpose of foreign participation in its capacity mechanism.

3.1.3.3. Further implementation of the framework

65 The Electricity Regulation stipulates that the MECs should be calculated by the regional coordination centres (RCCs). Up until 2023, Member States calculated the MECs themselves (as the calculation process in the RCCs were not established and ERAA results were not available). In 2024, RCCs produced MEC recommendations for the first time, based on the results of the approved ERAA 2023.

66 RCCs produced the MEC recommendations for three capacity mechanisms (RCC TSCNET received a request for recommendations from the Polish TSO, and the RCC Coreso received requests from the Belgian and French TSOs). The RCC TCSNET has published its MEC recommendations[43].

67 While the RCCs' recommendations represent an important step, delays in the implementation of the ERAA methodology impede the full implementation of the framework for cross-border participation (as envisaged in the technical specifications). The MEC recommendations this year were delivered only partially and are subject to several irregularities that reduce the robustness of the values calculated. The following issues remain open with regard to the RCCs' calculation of the MECs.

- Missing ERAA target years. The ERAA 2023 modelled only four target years (2026, 2028, 2030 and 2033), while some capacity mechanism auctions cover delivery periods outside these four calendar years. In some cases of such a mismatch, the TSOs requested that the RCCs use an adjacent ERAA target year, while, in other cases, the MEC recommendations were not produced at all.

43 No such publication by Coreso was available at the time of writing this report.

- ERAA does not include a central reference scenario with capacity mechanisms[44]. This is the scenario that the RCCs should use for calculating the MEC, according to the technical specifications[45]. As the ERAA 2023 did not include this scenario, the RCCs were able to use only scenarios without capacity mechanisms for the MEC calculations.

- The non-consulted ERAA sensitivity was used for the calculations. All three TSOs requested MEC recommendations based on the results of the ERAA 2023 sensitivity, instead of the central reference scenario. The former was introduced by ENTSO-E in the ERAA 2023 without an appropriate consultation with stakeholders, as observed by ACER in its related decision[46]. Using the sensitivity (with less capacity available in the system) for the calculations might have resulted in lower MECs.

- ERAA re-run. MEC recommendations in 2024 were produced using the results of the ERAA before the cost parameters for gas power plants were corrected. The exact impact of not considering the final ERAA results is unclear.

68 The Electricity Regulation requires that the TSOs take the MEC recommendations into account. If the TSO decides to deviate from the RCC's recommendation, then it should submit the reasons for its decisions to the relevant RCC and to the TSOs of the same system operation region[47]. In this monitoring report, ACER did not examine whether or not the TSOs followed the RCC's MEC recommendations.

69 Another step in the implementation of the framework is ENTSO-E's publication of its report on cross-border participation in capacity mechanisms, based on Article 25(1) of the technical specifications. The report was published for the first time in 2024 and covers the rules regarding cross-border participation in the capacity mechanisms, the approach for calculating MECs and the resulting values, and sets out the status of the registry of eligible foreign capacity providers[48].

44 Article 3(5)(a) of the ERAA methodology.

45 Article 6(4)(a) of the technical specifications.

46 See ACER Decision No 06/2024, in particular recitals 147.

47 Article 42(3) of the Electricity Regulation.

48 The future form of the report will ideally differ from the current question–answer structure.

3.2. Flexibility support schemes

70 As the deployment of variable RES continues apace, policymakers have shifted their attention to the flexibility of the electricity system. The recently approved electricity market design reform puts a strong focus on flexibility and the development of non-fossil flexibility resources to integrate renewables and ensure the reliability of the power system[49]. This is happening against the backdrop of a commitment from Member States to reduce dependence on fossil fuels, including in power production, and the gradual phase-out of thermal generation technologies (e.g. coal and nuclear power plants). Such power plants constitute a key source of flexibility at present.

71 The Temporary Crisis and Transition Framework introduced by the European Commission, following the Russian invasion of Ukraine, in conjunction with REPowerEU and the European Green Deal placed increased focus on the deployment of non-fossil flexible resources to accommodate the deployment of renewables and address the energy crisis. In this context, several Member States implemented support schemes and measures to increase the deployment of non-fossil flexible resources, such as storage and demand side response[50].

49 For more information on the electricity market design reform, see footnote 2.

50 For example, the temporary crisis and transition framework allows Member States to grant temporary support to facilitate the roll-out of storage and other technologies since July 2022. To address the energy crisis and reduce electricity prices, Member States agreed to a binding 5 % reduction of peak electricity demand between December 2022 and March 2023. For more information on the temporary crisis and transition framework, see, for example, the European Commission's web page dedicated to it.

72 To this end, the electricity market design reform established a requirement for Member States to undertake a flexibility needs assessment, based on which they can determine indicative objectives for the development of non-fossil flexible resources. To meet these objectives, Member States can implement flexibility support schemes for non-fossil resources if available and expected resources are insufficient to meet future flexibility needs. To complement national assessments and evaluate needs across the EU, ACER will undertake a pan-European flexibility needs assessment, alongside other tasks[51].

73 The purpose of this section is to provide a first high-level overview of flexibility support mechanisms, particularly support schemes for the development of storage technologies and demand side response, in anticipation of the growing importance of such schemes. The analysis presented is based on information collected from national regulatory authorities and other publicly available resources, such as the European Commission's State Aid register. This section is not meant to provide a complete list of all support schemes currently implemented in the EU[52].

74 Figure 12 provides an overview of support schemes for non-fossil flexible resources. The analysis shows that there is a multitude of support schemes in place, with at least 10 Member States having a support scheme in place[53]. The majority of these schemes target storage technologies, primarily battery technologies, and less frequently demand side response. The support schemes for storage technologies can be further split into schemes targeting the development of centralised or grid-scale storage (e.g. Greece, Italy) and those targeting the development of decentralised or behind-the-meter battery storage (e.g. Czechia, Austria).

75 In terms of objectives, support schemes for non-fossil flexible resources generally aim to integrate RES and ensure reliability. The exact scope of such support schemes varies between Member States:

- In Greece, Spain, Italy, Hungary and Slovakia, support schemes target primarily flexibility at the whole-system level (e.g. reducing the curtailment of renewable energy). Such systems also aim to increase the availability of resources in the balancing and ancillary services markets. TSOs could also use resources supported by such schemes to address network congestion.

- In Czechia and Austria, the implemented support schemes target the deployment of decentralised storage, with the goal of facilitating the integration of decentralised solar power. For example, the Czech support scheme incentivises the reduction of peak solar generation injection to the grid through decentralised and co-located battery systems.

- The French support scheme for demand side response and storage aims primarily to ensure resource adequacy and is closely interlinked with the market-wide capacity mechanism. The goal of the Lithuanian scheme supporting centralised storage is to safeguard the secure operation of the power system under emergency island operations until the synchronisation of the Baltic region with the Continental European network, expected in 2025. Lastly, the Irish support scheme differs from the rest in that it applies at the distribution network level with the objective of addressing congestion[54].

76 The support provided by these schemes can take different forms, including (i) grants aiming to cover investment and other costs (e.g. Spain, Slovakia); (ii) multi-year annual payments that could take the form of contracts-for-difference (e.g. Greece) or a different form (e.g. the 'floor and share' approach in Ireland); and (iii) a combination of the above elements (e.g. the support schemes of Greece and Hungary combine investment grants with contracts for difference). The support schemes are broadly designed to select beneficiaries and determine remuneration through a competitive process across eligible participants.

51 For example, the electricity market design reform has placed an obligation on ACER to approve or amend the applicable methodology for the national and pan-European flexibility needs assessments, to be developed by ENTSO-E and EU DSO Entity, as well as issuing a report to analyse and provide recommendations on issues of cross-border relevance stemming from the national flexibility needs reports. The latter should also provide recommendations on removing barriers to the entry of non-fossil flexibility resources.

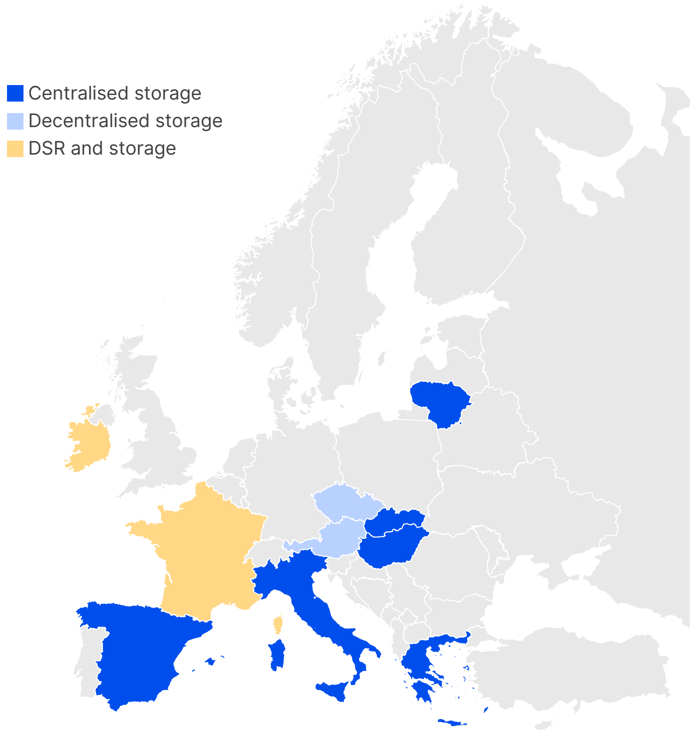
52 ACER collected information from national regulatory authorities on a voluntary basis. The support schemes presented do not include any system operator ancillary services aiming at non-fossil resources, such as the so-called SRAD service (Servicio de Respuesta Activa de la Demanda or active demand side response service) in Spain. For more information, see, for example, ACER's 2023 market monitoring report.

53 Table 4 provides information and resources per support scheme, where such information was readily available.

54 The Irish support scheme is currently under development and the information provided in this report reflects current considerations and intentions.

77 The above section provides a first, high-level overview of support schemes for non-fossil flexible resources in ACER's security of supply monitoring report. Considering the growing application of flexibility support schemes and the enhanced focus on flexibility, ACER intends to expand its monitoring activities related to this topic in future editions.

Figure 12: Status of support schemes for non-fossil flexible resources



Source: Created by ACER based on NRA data.

4. Capacity mechanism design elements

78 The Electricity Regulation sets forth certain design principles that capacity mechanisms must follow, including transparency, competitiveness and openness to various technologies[55]. The European Commission's State Aid Guidelines elaborate on these principles further[56].

79 In the previous edition of the monitoring report, two design elements were discussed: penalties and cross-border participation. This chapter continues the discussion by examining the alignment of capacity mechanisms with decarbonisation and affordability goals. It reviews the current practices across mechanisms in the EU and draws lessons for improving their effectiveness and compatibility with the energy transition.

4.1. Alignment with decarbonisation goals

80 The energy transition will require an orderly phase-out of fossil fuel power plants to ensure the security of supply until fossil-free alternatives are available. Capacity mechanisms can play a key role in this respect but may lead to locking in fossil fuel power plants.

4.1.1. Capacities committed for years

81 Pledges to decarbonise the electricity sector come from various political levels. Most recent declarations, including that of the central European countries[57] and the G7 ministers[58], commit to attaining carbon-free power systems by 2035.

82 Even with the shift towards decarbonised energy, conventional generation remains a notable part of the power system. Similarly, fossil fuel generation seized the lion's share of long-term contracts under capacity mechanisms, with 85 % until 2035 and close to 76 % until 2040. As presented in Figure 13, most of the carbon-intensive beneficiaries are gas-fired and, in Poland, also coal-fired plants. These long-term contracts will prevent the earlier exit of these power plants (if cleaner alternatives become available).

83 Awarding high-carbon resources long-term contracts could also significantly discourage new market entries (e.g. demand side response and storage). Participation of those resources could be further restricted when the strong position of incumbent conventional plants is combined with additional hurdles. ACER's Market Monitoring Report on barriers to demand response emphasises that some distributed energy resources can be specifically excluded from participation in capacity mechanisms due to requirements in the product design.

84 These risks are less prominent for strategic reserves, where capacities are procured for the short term and, once committed, cannot participate in the energy market. Importantly, such resources operate for a very limited time, if at all, as they are called on only when market supply cannot meet consumers' needs. In fact, contracting high-carbon capacities under a strategic reserve scheme could, in certain situations, be an expedient option to control how much existing thermal capacity leaves the market[59]. This is especially true in power systems that are experiencing a rapid growth in intermittent generation and limited (or delayed) expansion of firm capacity.

55 Article 22 of the Electricity Regulation. For more details, see Box 6 in ACER's 2021 security of EU electricity supply monitoring report.

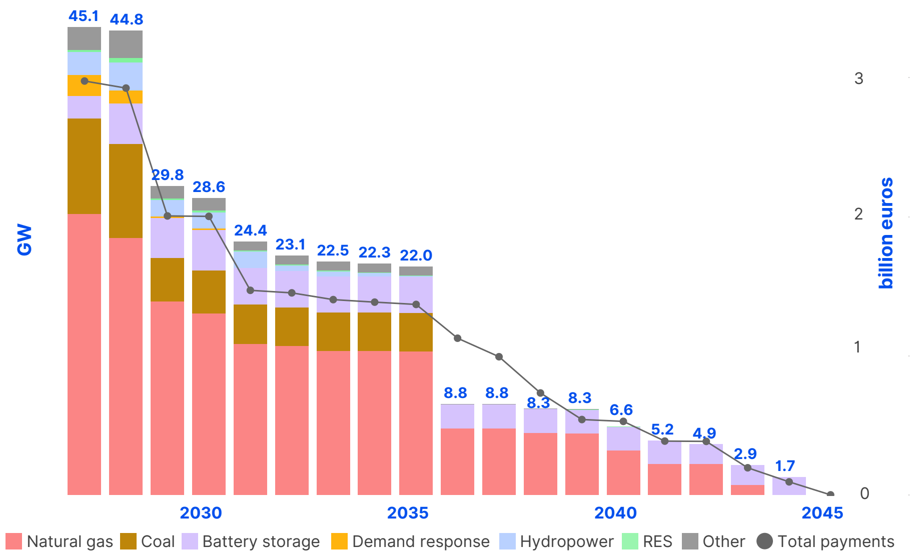
56 Guidelines on State Aid for climate, environmental protection and energy 2022.

57 Statement by Ministers of the Pentalateral Energy Forum, 18 December 2023.

58 Climate, Energy and Environment Ministers' Meeting Communiqué, 29-30 April 2024. The G7 refers to the group of leading industrialised nations: Canada, France, Germany, Italy, Japan, United Kingdom, United States.

59 See the Commission's Report of the Sector Inquiry on Capacity Mechanisms.

Figure 13: Total payments and capacities awarded long-term contracts under market-wide capacity mechanisms by technology



Source: Calculated by ACER based on NRA data.

4.1.2. Curbing emissions and promoting non-fossil resources

85 Certain actions to align capacity mechanisms with the decarbonisation policy are already required in the EU legal framework. In 2019, the Electricity Regulation introduced carbon dioxide emission limits for new capacity mechanism participants[60].

86 A performance standard of emitting less than 550 g carbon dioxide per unit of generation (1 kWh) effectively excludes fossil-based generators, except for more efficient gas power plants. As for existing units, starting from July 2025, they will need to either meet the same performance standard as new units or limit the annual operation to stay below the 12-month emission cap[61].

60 Article 22(4) of the Electricity Regulation.

61 This limit equals 350 kg of carbon dioxide emitted on average during one calendar year and 1 kWe of installed capacity. To harmonise the application of emission limits, ACER issued an opinion on common methodological principles, see ACER Opinion 22/2019.

87 More recently, the latest Electricity Market Reform introduced a conditional derogation for old generators. If granted, the derogation would allow resources exceeding the emission limits to participate in capacity auctions and sign new contracts until the end of 2028[62]. Notably, the derogation can be approved only when low-carbon resources cannot resolve the adequacy concern at hand after maximising their participation.

88 It is worth noting that the Electricity Market Reform also introduced another rule, not directly linked to emission caps. In the context of the new framework for the development of flexibility, Member States already applying capacity mechanisms should consider adapting them to promote non-fossil flexible resources. They can encourage market entries of such resources, such as demand response and energy storage, through capacity contracts or dedicated flexibility support schemes[63].

4.1.3. National practices

89 Most capacity mechanisms in the EU feature carbon dioxide limits as outlined in the Electricity Regulation. The latest measure to introduce such limits is the German strategic reserve, effective for the delivery period that started in October 2024. The Swedish strategic reserve, dating back to 2003 and active until 2025, does not have any carbon dioxide limits in place.

90 The Commission's State Aid Guidelines encourage Member States to introduce additional criteria or features promoting participation of greener technologies, or reducing participation of polluting technologies, in the capacity mechanisms[64].

91 A few existing mechanisms include requirements that go beyond the Electricity Regulation's minimum requirements. For illustration purposes, they could be categorised into two main groups: benchmark- and guideline-based approaches. The practices in the first group rely on measurable criteria, while the second group is founded on broader principles.

62 See Article 64(2b) to (2d) of the Electricity Regulation.

63 Article 19g(1) of the Electricity Regulation.

64 State Aid Guidelines, recital 345.

92 Benchmark-based approaches are present in Poland and Finland. The Finnish rules require accounting for the resource's emissions when assessing the tender offers. Those emitting less receive a higher score. However, the weight of the emission criterion is set at a low level of 5 %, limiting its possible impact on the tender results. In addition, providers meeting stricter emission limits in Poland (450 g of carbon dioxide per 1 kWh) may have their long-term contracts extended by 2 years. This can be a significant incentive for providers with 5-year-long contracts, while the resources contracted for 15 years could see the 2-year extension as somewhat less prominent compared with their long contract duration.

93 Belgium and France belong in the second group, using the guideline-based approaches. Significantly, France takes action to encourage a roll-out of demand response and batteries using both guideline- and benchmark-based approaches. On the one hand, there are specific tenders for demand response providers and non-fossil storage, with short-term contracts[65]. On the other hand, new capacities can be contracted for up to seven years if they meet a stricter emission limit of 200 g of carbon dioxide per unit of generation. Both approaches adopted in France represent good practices in aligning the capacity mechanism with decarbonisation targets. In France, no high-carbon generators are awarded long-term contracts. In Belgium, capacity providers entitled to long-term contracts should commit to achieving climate neutrality by 2050 and develop a concrete roadmap. However, for now, the feasibility of those commitments has not been validated. The recently amended Belgian capacity mechanism also promotes participation of non-fossil resources. Belgium is set to run specific auctions for short-term contracts (two years before the delivery year) dedicated to non-fossil storage and demand response providers. Moreover, the amendment has introduced preferential contracts for both resource types from 2025 onwards[66].

65 This tender, dedicated to only demand response providers in the past, will, from 2025, also be open to non-fossil storage, according to the European Commission's Decision of 21 December 2023.

66 Preferential conditions refer to the exemption from payback obligation, that is, the obligation to pay back energy revenues when electricity market prices are above a pre-established level. Amendments received a green light in the European Commission's Decision of 17 September 2024.

4.1.4. Discussion and future considerations

94 Currently, fossil-based incumbents hold the majority of long-term capacity contracts in Europe. This may potentially deter new entries, such as demand side response or storage. There are limited national measures additionally promoting low-carbon participation in capacity mechanisms, but the new Belgian and French tenders targeting clean technologies stand out as examples of good practice.

95 Regarding the potential challenge of decarbonising while controlling the market exit of thermal dispatchable supply, strategic reserves appear to be more suitable than other capacity mechanisms, given the way in which the resources operate under them.

4.2. Cost recovery

4.2.1. Cost recovery can form demand response and reduce total costs

96 A capacity mechanism remunerates resources for their availability to address resource adequacy risks. The costs of such remuneration are recovered through a capacity mechanism fee ('CM fee'), which is typically passed on to the consumers of electricity. As capacity secured through the mechanism should be available in times of expected system stress, the cost of the mechanism, in principle, should be recovered from the demand that causes the stress, per the European Commission's State Aid Guidelines[67].

97 Well-designed cost recovery charges could incentivise reducing consumption during stress hours, thus reducing the adequacy risks that the capacity mechanism aims to mitigate. By doing so, they lower the capacity mechanism costs and subsequently the final costs to all consumers.

67 State Aid Guidelines, recital 367.

98 The potential benefits of a well-designed cost recovery method go beyond ensuring adequate capacity. Consumers who are offered incentives may become accustomed to adjusting their demand for energy based on price signals. Thus, they naturally form an implicit demand response potential in the country, which is crucial for meeting the future flexibility challenge cost-effectively[68].

4.2.2. Elements of cost recovery method

99 The rules governing cost recovery aim to reflect how market participants contribute to the need for the capacity mechanism. In doing so, different designs can either support or hinder the main twofold objective of the cost recovery: (i) minimising the size and cost of a mechanism by incentivising consumers to adjust their energy use (*providing signals*), and (ii) recouping the cost of the mechanism (*recovery*).

Box 2: Designing the cost recovery

The design of cost recovery lays down the approach for calculating the CM fee, specifying temporal considerations, the consumers participating in the recovery and exempted from it, and other applicable rules. Some prominent design features include:

- assessment period, that is, the duration over which electricity consumption is considered for the CM fee, including applicable days and specific hours of the day, which together form the temporal features;
- consumer segmentation, that is, grouping consumers based on the different applicable rates or charge calculation methods;
- special peak rates, which refer to rates differing from a general fare and applied for consumption during peak hours.

100 The aim of this chapter is to discuss the cost recovery rules applying in national capacity mechanisms. These rules reflect the way in which consumers are charged. In the case of France, the decision on how to pass on the capacity mechanism costs to consumers lies with the suppliers. Therefore, this analysis considers only the common regulated tariffs, which currently apply to approximately two thirds of household consumers and one third of mostly small non-household users. The next three sections analyse the aforementioned design features in more detail.

Table 2: Definition of temporal features in the cost recovery designs

	Assessment period	Applicable seasons	Applicable days	Targeted hours
Finland	3 months	❄	**Mo Tu We Th Fr** Sa Su	Total: 14 hours 07:00-21:00
Sweden	4 months	❄	**Mo Tu We Th Fr** Sa Su	Total: 16 hours 06:00-22:00
France • Tempo tariff	22 days	❄	**Mo Tu We Th Fr** Sa Su	Total: 16 hours 06:00-22:00
• Peak/off-peak tariff	12 months	❄ ☀	**Mo Tu We Th Fr Sa Su**	Total: 16 hours various time windows
• Baseload tariff	12 months	❄ ☀	**Mo Tu We Th Fr Sa Su**	Total: 24 hours
Germany	12 months	❄ ☀	**Mo Tu We Th Fr Sa Su**	Total: 24 hours
Ireland	12 months	❄ ☀	**Mo Tu We Th Fr Sa Su**	Total: 16 hours 07:00-23:00
Italy off-peak	12 months	❄ ☀	**Mo Tu We Th Fr Sa Su**	Total: 12 hours 09:00-21:00
Poland	12 months	❄ ☀	**Mo Tu We Th Fr** Sa Su	Total: 15 hours 07:00-22:00

Source: Created by ACER based on NRA data.

68 Lower peak demand can lead to additional cost savings, including reduced need for infrastructure investment.

4.2.2.1. Temporal features

101 The choice of time span during which consumption is considered for setting the CM fee has an important effect on the recovery effectiveness. It can either leave consumers unable or unwilling to respond or encourage them to moderate adequacy needs (and costs). The latter is particularly true where the signal is strengthened by time-varied charges that relate to system tightness.

102 Cost recovery methods should target periods of system stress – the same periods when capacity providers are supposed to provide a service under a capacity mechanism. This way, for instance, increased needs as a result of weather-sensitive demand can influence the selection of applicable seasons. In addition, daily demand patterns can help identify the specific hours of the day during which consumption contributes to the need for a capacity mechanism[69].

103 A high-level comparison between the temporal features of existing cost recovery methods shows that most Member States, although diverging in details, tend to apply two distinct strategies (refer to Table 2). The current methods often use consumption over extensive periods as the basis for setting the CM fee. In some cases, the assessment period covers all year, while France, Finland and Sweden set the focus on the winter months. The majority target all hours of the relevant months from early morning to late evening (from 14 hours per day in Finland to 16 hours per day in Ireland and Sweden).

Assessment periods

104 Comparing applicable seasons with historical consumption data across different months, as presented in Figure 14, gives insights for analysing the choices of specific assessment period. The differing shades of blue of the bars in the figure represent the intensity of consumption in each month relative to the others. Darker shades indicate higher consumption compared with other months. The data are based on average consumption between 2019 and 2023.

105 As France, Finland and Sweden target different winter months, Figure 14 highlights the applicable period. The seasonal peak falling in winter is most evident for these three Member States, with France's demand level in January reaching 38 % higher than the annual average. In France and Sweden, selected months align with the delivery periods of their capacity mechanisms. In Finland, while the delivery period spans the entire year, the consumption pattern it shares with France and Sweden indicates that the most critical months for resource adequacy are those covered by the cost recovery rules.

106 Ireland and Poland also experience higher relative demand during the winter, although not to the same extent as France or the Nordic countries. At its peak, the load exceeds the average by 14 % in Poland and close to 15 % in Ireland. Their yearly peaks are gentler, partly because both countries rely on fossil fuels for spatial heating, which renders their electricity demand less weather sensitive. Other potential factors in Ireland are the high contribution of data centres with a flat demand profile and a milder climate throughout the year compared with continental Europe. Italy also faces less pronounced peaks. Consumption levels peak in summer and remain high in winter and early autumn. This demand pattern could, to some extent, explain the reasons for covering all months in the assessment period.

107 Where the assessment period closely follows the demand pattern, consumers can more easily pick up the CM fee signal. This could improve their response at times of system stress and minimise the capacity mechanism costs. For this reason, prolonged assessment periods mute the signal for demand side response.

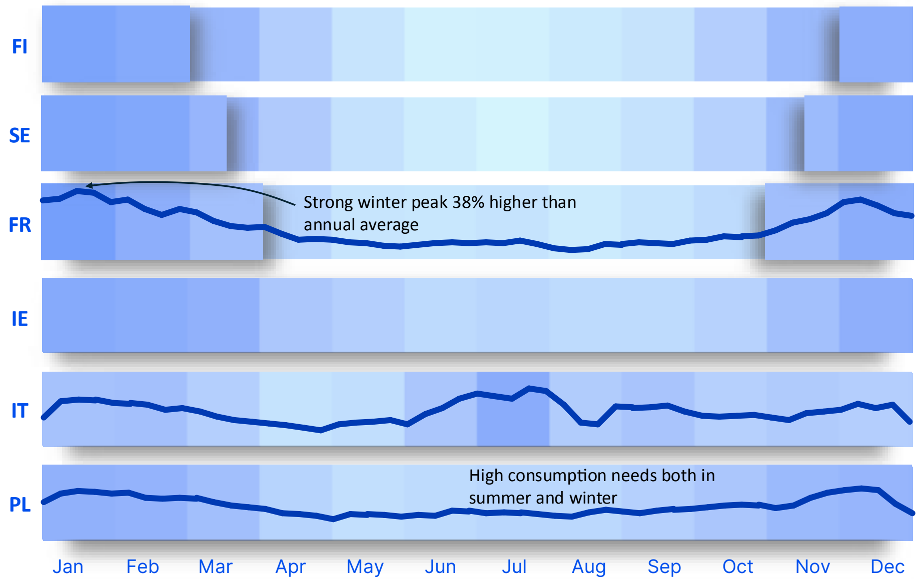
69 The time window considered for the CM fee calculation should be big enough to ensure that it is representative of consumption patterns.

Peak period: duration and rates

108 One of the features that could make the cost recovery signal sharper and clearer for consumers is the duration of a peak period, based on which the CM fee would be defined. It plays a major role in indicating the times of system stress and ultimately helps to assess how consumers contribute to the need for a capacity mechanism.

109 Currently, most cost recovery methods differentiate between daytime and night-time. They charge a fee for energy consumed over 12 hours per day or more. Applying prolonged peak durations may result in less of an incentive for consumers to adjust their energy use unless consumers can switch a large share of their consumption to night-time.

Figure 14: Yearly demand patterns in the Member States applying capacity mechanisms



Source: Created by ACER based on ENTSO-E Transparency Platform data.

Note: The figure represents the pattern of average total demand for the period 2019–2023. The shading of the bars represents the ratio between the monthly and the yearly demand – the darker the shade, the higher the ratio. The curves illustrate the demand pattern in more detail, representing the average weekly demand throughout the year.

110 The French and Italian designs improve the alignment of the peak definition with the system stress – by reducing either the duration or the number of peaks considered. In France, the tempo tariff specifically targets 22 days a year when the system is under the most strain (so-called 'red days')[70]. A 'red day' rate exceeds EUR 200 per MWh and applies to consumption over 16 hours (totalling 352 hours annually).

111 The Italian capacity mechanism rules prescribe a short-peak charge, which is 37 times higher than the off-peak charge[71]. It applies to consumption during the 500 hours in a year with the lowest surplus of supply over demand. The design may reconcile the need for a clearer signal to reduce consumption with the need to reduce uncertainty about recovering the costs[72].

112 Importantly, consumers in Italy are informed in advance about peak hours for the upcoming year. The transparency and relative simplicity of the charging method are critical to enabling the behavioural changes and ensuring that consumers know how to reduce their CM fee.

113 The French baseload tariff and the German CM fee are flat, meaning that they do not differentiate between peak and off-peak periods. A flat fee does not reflect how consumers actually contribute to the need for a capacity mechanism, which should be the purpose of a cost recovery method[73]. This flat-fee approach thus may increase the need and costs of the related capacity mechanisms. It also does not enable consumers to benefit from adapting their consumption patterns.

70 In France, there is also another tariff with a lengthy peak period duration (16 hours a day). In this tariff, a peak rate amounts to EUR 16.6 per MWh for households and EUR 12.2 per MWh for non-household consumers in 2023.

71 In this tariff, a small charge (EUR 1.81 per MWh in 2023) applies to all energy consumed over the year aside from a 'red days' rate.

72 Furthermore, the Italian cost recovery method also features an adjustment mechanism. After each billing cycle, the anticipated costs of the capacity mechanism and projected consumption levels are assessed ex post against the actual data. Any disparities lead to necessary adjustments every quarter in the following year.

73 State Aid Guidelines, recital 367.

114 To strengthen the link between energy use during periods of high demand and the associated costs, cost recovery design should use more specific definitions of peaks. With the right signals, consumers could adjust their energy consumption by shifting it from peak hours to off-peak hours, which might be more challenging to do over the entire day.

4.2.2.2. Consumer segmentation

115 Cost recovery designs, like many other methods laying down financial obligations, may categorise consumers into different groups. Various rates or rules may apply to specific consumer segments. In the majority of capacity mechanisms, the same rules apply across all consumer classes when determining the CM fee. Only the French and Polish capacity mechanisms differentiate based on consumer categories.

116 The CM fee for French consumers varies depending on whether they are household or non-household users. Non-household users paying a flat fee face a charge that is 41 % higher than that of households on a flat fee. However, when they select a time-differentiated tariff (targeting peaks), they pay 26 % less for consumption during peaks than household consumers. This relative difference between the two consumers groups (non-household users facing higher flat fee compared to households on the one hand and lower peak rate compared to households on the other) could indicate that the French cost recovery method incentivises non-household consumers to select a time-differentiated tariff, instead of a flat fee.

117 In Poland, the need for segmentation stems from the lack of smart meters. Until consumers are equipped with appropriate meters, expected by 2028, consumers are temporarily divided into two main groups:

- households and small businesses (approximately 29 % of Poland's yearly consumption) pay a lump sum;
- the remainder pays a volumetric fee[74].

74 The applicable rate depends on the shape of demand curve during working days, that is the flatter is the curve the lower the rate.

4.2.3. Communicating the rules

118 Cost recovery must focus on the type of consumer who contributes to the need for a capacity mechanism so that the need for a measure can be linked to its cost. This means that a recovery method can impact the need for a mechanism only when final consumers are aware of the fee they pay and how to minimise it. This understanding, along with the incentives motivating any change in behaviour, are crucial.

119 Energy bills in Italy and Poland show the amount of CM fee. In France and Ireland, mostly industrial consumers are provided with a clear indication of the amount charged and an explanation of how to reduce it; however, this clear information is often not available to Irish, French, Finnish and Swedish household consumers[75]. Nevertheless, as noted in the ACER Market Monitoring Report on energy retail and consumer protection, most household consumers in France and Ireland do not take up variable price contracts so they have limited ability to respond[76].

120 The above overview suggests the need to enhance transparency in how the CM fee is levied. Providing consumers with clear information about the specific amounts they are being charged is essential to convey the charge's signal. In addition, this information should be supplemented with simple, actionable recommendations for reducing the charge. Once consumers have the necessary information and understanding, they can make informed decisions to minimise their charges (and overall system costs).

75 Commonly, in Finland, the consumer bills show an aggregated cost category, such as 'grid service fee'. In Ireland, suppliers must provide general hints and tips on how to reduce or shift an overall energy consumption and, ultimately, cost to customers in the Smart Billing system.

76 In Ireland, most household consumers (99 %) have fixed prices all hours of the day but can vary with 30 days' notice from the supplier and, additionally, they have flexible elements such as time of use tariffs. From 2025, dynamic contracts will be introduced in Ireland (*Dynamic Electricity Price Tariffs: Decision paper*), which will help to reduce the system-wide peak demand by helping to shift demand away from peak hours.

4.2.4. Other approaches

121 Belgium uses an entirely different approach to recover the costs of its market-wide capacity mechanisms.

122 Initially, in Belgium, part of the network tariffs was used to recover the costs. Later, the underlying rules changed, leading to the capacity mechanism being entirely financed through the state budget. By distributing the financing costs across all taxpayers, this approach breaks the link between the need for capacity and its costs, which is the purpose of the cost recovery method. Consumers have no incentive to reduce demand during times of system stress, which could lead to non-optimal dimensioning of the capacity mechanism.

4.2.5. Discussion and future considerations

123 A successful cost recovery method can lower the overall cost of a capacity mechanism by linking the need for a measure and the cost of it. To reflect the cost, recovery methods must resonate with the system stress. Once achieved, this reflectivity can have positive spillover effects in empowering consumers to reduce their electricity consumption, thus lowering their electricity bill and ultimately decreasing overall system costs.

124 Closer examination of current practices shows that the Italian design aims to reflect the link between demand during periods of system stress and the CM fee paid by consumers. The operator of Italy's capacity mechanism provides advance notice of the specific hours when system stress is expected. It would be beneficial for other designs to take this good practice into consideration. Table 3 presents high-level recommendations based on the analysis in this section.

Table 3: Recommendations for the design of cost recovery methods

Aspect	Recommendation	Description
Assessment period	**Differentiate between system stress periods**	The closer the assessment period aligns with system stress periods, the more likely consumers will pick up the incentive signal.
Peak duration	**Allow for differentiation within the same day**	The incentive scheme should feature differentiated rates throughout the day to encourage consumers to shift their energy consumption.
Communication	**Send a clear price signal and recommend how to adapt**	The energy bill should clearly show the cost of the capacity mechanism. Consumers should also receive concrete, actionable advice on how to adjust their behaviour.

125 The review of existing approaches to cost recovery design also raises other important questions that merit further debate, especially those related to the temporal features. One of them concerns finding a balance between sending a signal to reduce consumption during stress periods and ensuring cost recovery. Short assessment periods can strongly encourage reducing consumption and, hence, allow consumers to profit from their flexibility to avoid charges altogether or partly. This brings benefits to all consumers by lowering the total capacity needs and thereby the overall costs for ensuring adequacy. In such cases, a predefined charge sends an intended signal. At the same time, extremely short assessment periods can:

- create a risk of unusually high charges for those who keep consuming during peaks;
- fall short of recovering the costs of the capacity mechanism, with particular risks associated with assessment periods as short as a couple of hours per year.

126 The risks associated with unusually high charges, particularly for households, or non-recovery of costs can be mitigated by, for instance, extending the assessment period and implementing a single rate for the entire duration, as is done in some Member States. However, it is important to assess such solutions carefully.

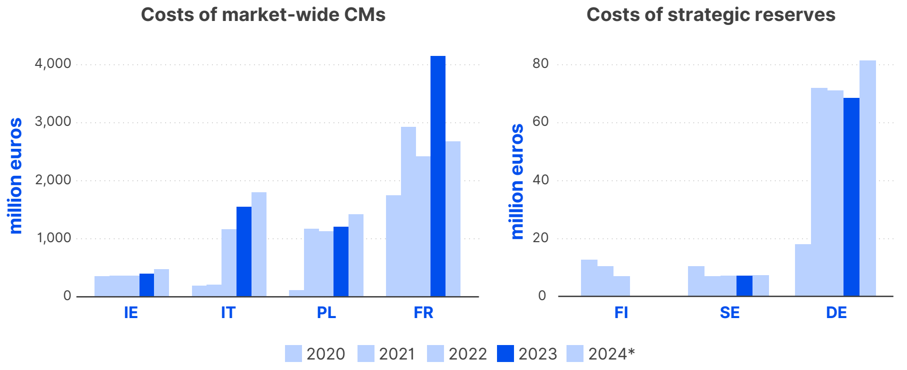
127 The first challenge is in determining when to send a clear signal to consumers and when a differentiation is necessary. In principle, retail contracts offer consumers hedging options that buffer them from unexpectedly high bills. Depending on the contract, consumers will either receive the signal that the CM fee aims to send or will be shielded from it. Therefore, designing a cost recovery method that also shields all consumers from high peak rates could be unnecessary. Such double cushioning eliminates any signal and may limit the incentive for consumers to respond by reducing demand. In some instances, however, a more nuanced approach might be appropriate, particularly for vulnerable consumers. The second potential issue relates to widening the assessment window or applying a single charge. These features could distort the signal to reduce consumption at times of system stress.

128 Lastly, once the cost recovery method has incentivised changes in consumer behaviour, these changes should be considered in defining the need for a capacity mechanism for subsequent delivery periods and lead to contracting less capacity[77]. In fact, increasing consumer involvement in determining the need for a capacity mechanism could help in assessing their contribution to the mechanism, namely their consumption during periods of scarcity.

77 Capacity mechanism designs need to take appropriate care to ensure that consumers offering or providing demand response are not remunerated twice for the same service.

Annex 1: Additional figures and table

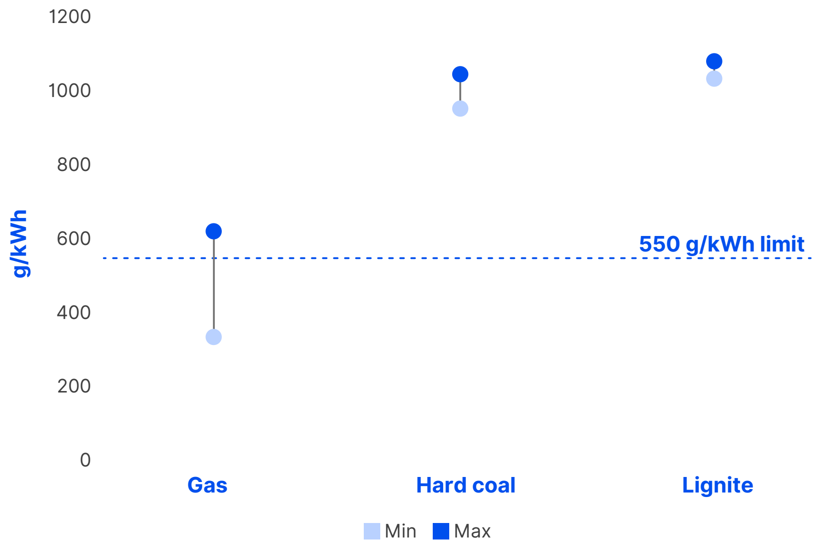
Figure 15: Incurred and projected costs to finance capacity mechanisms and per Member State for market-wide capacity mechanisms (left) and strategic reserves (right) – 2020–2024 (million euros)



Source: ACER calculation based on NRA data.

Note: Costs for 2024 reflect the expected costs. The overall costs for France are an approximation considering that all capacity certificates are valued at the market reference price. A significant share (which varies year-on-year) of the capacity certificates is implicitly valued through the Accès Régulé à l'Electricité Nucléaire Historique (ARENH) mechanism, a scheme that enables suppliers to purchase electricity from nuclear generators at a regulated price. Therefore, the actual costs for France are dependent on the reference used to value the capacity certificates related to the ARENH mechanism.

Figure 16: Ranges of the carbon dioxide emission of gas, hard coal and lignite-fired power plants per generated volume



Source: Created by ACER based on Ember, European Electricity Review 2024.

Table 4: Support schemes for non-fossil flexible resources across Europe (non-exhaustive list)

Member State	Objective(s)	Target technology	Resource
Ireland	Congestion management – distribution network	Technology neutral procurement with a primary focus on low and zero carbon technologies	CRU decision on DSO demand flexibility product procurement
Greece	RES integration Flexibility Ancillary and balancing services	Mainly centralised battery storage	State-aid (SA.64736) decision
Spain	RES integration Reliability	Innovative electricity storage	State-aid (SA.103068) decision
France	Resource adequacy Flexibility	Demand side response Storage	State-aid (SA.107352) decision
Italy	RES integration Flexibility Reliability	Centralised hydro pumped and battery storage	State-aid (SA.104106) decision
Lithuania	Secure system operations under emergency	Centralised battery storage	State-aid (SA.63178) decision
Hungary	RES integration Flexibility Ancillary services	Centralised battery storage	State-aid (SA.102428) decision
Slovakia	RES integration	Electricity storage	State-aid (SA.106554) decision

Note: CRU, Commission for Regulation of Utilities; DSO, distribution system operator: RES, renewable energy sources.

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Acronyms and country codes

Acronym	Meaning
ACER	European Agency for the Cooperation of Energy Regulators
CONE	Cost of new entry
DSO	Distribution System Operator
ENTSO-E	European network of transmission system operators for electricity
ERAA	European resource adequacy assessment
EU	European Union
EVA	Economic viability assessment
GW	Gigawatt
LOLE	Loss of load expected
MEC	Maximum entry capacity
MW	Megawatt
MWh	Megawatt hour
NRAA	National resource adequacy assessment
RES	Renewable energy sources
RCC	Regional coordination centre
TSO	Transmission System Operator
VOLL	Value of lost load
WTA	Willingness to accept
WTP	Willingness to pay

Country codes	
BE	Belgium
CZ	Czechia
DE	Germany
ES	Spain
FI	Finland
FR	France
GR	Greece
LU	Luxembourg
IE	Ireland
IT	Italy
NL	Netherlands
PL	Poland
SE	Sweden
SI	Slovenia
SEM	Single Electricity Market of the island of Ireland