

Capacity mechanisms for electricity

SUMMARY

Concerns about a lack of investment in electricity generation capacity to meet peak demand have prompted several EU Member States to introduce rewards for making capacity available, in the form of capacity mechanisms. Such mechanisms must conform to the EU guidelines on state aid for environmental protection and energy.

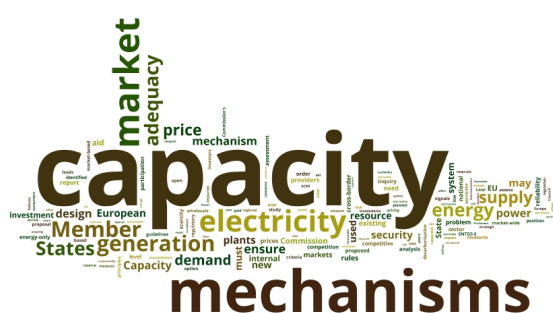
However, capacity mechanisms are considered problematic because they risk distorting the internal electricity market. Moreover, purely national mechanisms are not as cost-effective as mechanisms that allow for cross-border participation.

To tackle these issues, the European Commission carried out a sector inquiry, in which it analysed capacity mechanisms in the EU and offered conclusions about the design principles needed to ensure their effectiveness and compatibility with the internal electricity market. It found that many Member States did not adequately assess the need or cost-effectiveness before introducing capacity mechanisms.

Consequently, the Commission's 'clean energy for all Europeans' package, adopted in November 2016, includes a proposal for a recast of the Electricity Regulation, which updates the rules for European resource adequacy assessments and sets out design principles for national capacity mechanisms.

In several resolutions, the European Parliament has expressed support for market-based cross-border capacity mechanisms, pointing out, however, that they should only be used under certain conditions.

The Council of the EU stresses that ensuring the security of electricity supply is the responsibility of the Member States. Stakeholders have expressed various views about what the appropriate design of capacity mechanisms should be.



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Glossary

Capacity: the maximum amount of power (measured in watts) that a power plant can produce. Typical large power plants have capacities of around 1 gigawatt (1 billion watts).

Capacity mechanism: administrative measure to ensure the achievement of the desired level of security of supply by remunerating generators for the availability of resources.

Energy-only market: a type of market design where generators are remunerated for the electric energy they generate, but not for their generation capacity.

ENTSO-E: European Network of Transmission System Operators for electricity.

Merit order effect: the decrease of wholesale electricity prices due to an increased supply of renewable energies that have a low or zero marginal cost.

Missing money problem: electricity prices that are too low to incentivise the construction of new generation capacity.

Resource adequacy: the ability of the electricity system to offer sufficient generation and flexibility to ensure reliable electricity supply at all times.

Scarcity pricing: price formation depending only on actual supply and demand.

Strategic reserve: capacity that is kept outside of the electricity market and only used if the market participants do not offer enough generation to meet short-term demand.

Resource adequacy and the need for capacity mechanisms

Introduction

In recent years, electricity markets have undergone big changes, which have had impacts on the security of supply and investments in generation capacity. One such big change has been the increasing share of variable renewable energy sources – such as wind and solar – in the electricity mix, which leads to a growing need for backup generation capacity. Furthermore, this leads to shorter runtimes (load factors) for conventional power plants, some of which are only used in case of peaks in demand and may not be profitable because of limits as to how much electricity prices can rise in such cases.

As variable renewables have a low or zero marginal cost, their increasing share in the electricity mix also leads to lower wholesale electricity prices in a competitive market (merit order effect). The profitability of conventional power plants is therefore decreasing, as a result of both shorter runtimes and lower wholesale prices.

As a result of these trends, electric utilities lack incentives to invest in new generation capacity, a situation often referred to as the 'missing money problem'. They may also close existing power plants which are, at best, only used during short periods of peak demand.

Although the EU electricity sector is generally characterised by an over-supply of capacity, capacity shortages may occur in cases where high demand coincides with low generation from variable-capacity generators (for instance, due to a lack of wind or sunshine).

Generation capacity and flexibility

Generators are rated by their generation capacity, that is, the maximum power they can produce. **Firm-capacity** generators can be switched on or off on demand. **Variable-capacity** generators are only able to generate certain amounts at certain times as they depend on factors such as wind or sunshine.

Generators also differ with respect to the flexibility with which they can be operated. Some generation technologies, such as nuclear, are well-suited for producing a stable amount of electricity over longer periods, while others (such as gas turbines and hydroelectric power) can change production more rapidly to adapt to fluctuations in electricity demand and in production from variable sources. Flexibility can also be provided by adapting energy demand (through measures such as demand-side response or interruptibility schemes) and by using energy storage.

This situation leads to concerns that not enough dispatchable generation capacity may be available to ensure the security of electricity supply. Besides generation resources, energy storage and flexible demand resources (demand side response) can also contribute to resource adequacy – the ability of the electrical system to ensure the reliability of electricity supply.

Capacity mechanisms

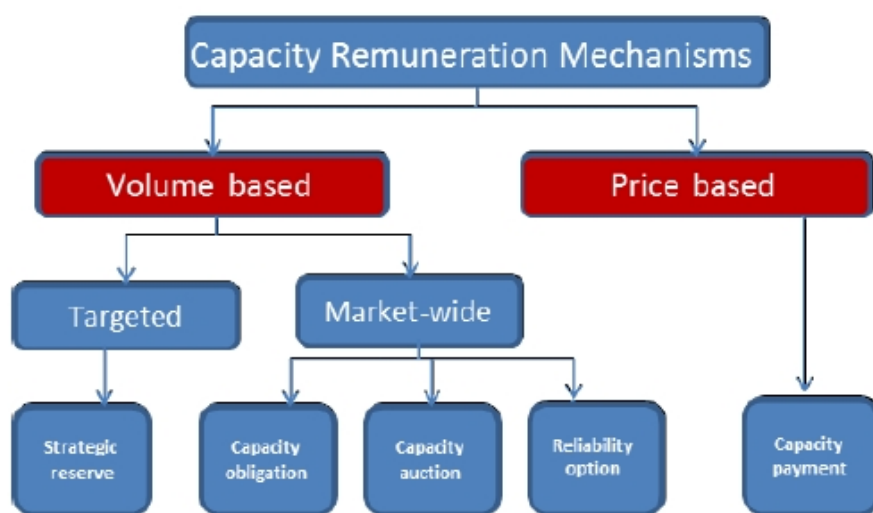
In the light of concerns about resource adequacy, some EU Member States have introduced capacity mechanisms – measures to reward the availability of electrical generation capacity in order to ensure that electricity supply can match demand in the medium and long term. Depending on the organisation of an electricity market, such capacity mechanisms may be needed to ensure that the provision of reserve generation capacity is economically viable.

There is a debate as to whether capacity mechanisms are necessary or whether an energy-only market with time-variant scarcity pricing (based only on supply and demand) can provide sufficient incentives for the provision of spare capacity. Another issue is the optimal geographic scope of capacity markets, considering that cooperation across borders may increase the cost-effectiveness as spare capacity is pooled. However, an EU-wide capacity mechanism is not feasible as long as only limited amounts of electricity can flow across borders, due to limited interconnection capacities.

Types of capacity mechanisms

The Agency for the Cooperation of Energy Regulators (ACER) has identified five types of capacity mechanisms (see Figure 1).

Figure 1 – Taxonomy of capacity mechanisms



Source: [Capacity remuneration mechanisms and the internal market for electricity](#), ACER, July 2013.

In volume-based mechanisms, policy-makers decide on the required volume of capacity and let the market set the price. In price-based mechanisms, policy-makers set the price and let investors decide how much they are willing to invest for a given price. Targeted mechanisms reward only specific plants or technologies, whereas market-wide mechanisms reward all capacity providers. There is an additional distinction between decentralised mechanisms, where contracts are awarded through bilateral arrangements (such as capacity obligations), and centralised mechanisms, where contracts are awarded centrally (for instance, through capacity auctions).

Main types of capacity mechanisms employed in the EU

Strategic reserve: A central agency (transmission system operator or government agency) decides upon the amount of capacity needed a few years in advance and contracts capacity – a strategic reserve – usually through a competitive tender. The contracted power plants cannot participate in the electricity market and are only activated in case of capacity shortfalls, according to pre-determined criteria. Strategic reserves are used in Belgium, Germany, Poland and Sweden.

Capacity auction: The total required capacity is decided upon a few years in advance and is centrally procured in an auction. Capacity providers bid to receive a capacity payment that reflects the cost of building new capacity. The new capacity participates in the energy-only market. Capacity auctions involve the risk that investors may not take investment decisions based on market price signals and that new capacity may undercut existing capacity. The [UK](#) uses [capacity auctions](#) to ensure security of supply.

Capacity obligation: An obligation for large consumers or electricity suppliers to contract an amount of capacity linked to their self-assessed future consumption or supply, plus a reserve margin. This is usually done by means of certificates that are issued by capacity providers. Suppliers or consumers are penalised financially if they have not contracted the required level of capacity. This type of capacity mechanism is used in [France](#).

Reliability options: A capacity provider enters into an option contract with a counterparty (a transmission system operator or a large consumer or supplier). The contract offers the counterparty the option to procure electricity at a predetermined strike price. The counterparty will exercise the option in situations of scarcity, when the price on the spot market exceeds the strike price of the option. A capacity market based on reliability options is [planned in Italy](#).

Capacity payments: Pre-determined fees are set by the regulator and paid to capacity providers. The plants receiving capacity payments continue to participate in the energy-only market. Targeted capacity payments are currently used in Italy, Poland, Portugal and Spain, while Ireland has a market-wide capacity payment.

Existing EU state aid guidelines

Capacity mechanisms have an impact on competition in the EU's internal market for electricity. They often involve state aid and are therefore subject to EU state aid rules. The guidelines on state aid for environmental protection and energy for the period 2014-2020 ([EEAG](#)) contain rules to assess capacity mechanisms. Member States must notify planned capacity mechanisms to the European Commission if the intended amount of aid is above €15 million per project. The Commission will assess proposed capacity mechanisms on the basis of six criteria:

1. The measure must pursue an objective of common interest, that is, the resolution of short- or long-term generation adequacy problem. Short-term measures will generally support existing back-up capacities, whereas longer-term measures will promote new investment. The mechanism must only remunerate the capacity and not the electricity actually generated. Analysis of generation adequacy must correspond with the ENTSO-E forecast for generation adequacy across Europe.
2. The necessity of the capacity mechanism must be demonstrated, including an identification of the underlying causes of the existing problems, in particular possible market failures and regulatory barriers. Alternatives to the capacity mechanism should be examined.
3. The capacity mechanism should be technology-neutral and should not discriminate between existing players and investors. The evolution of interconnections must also be taken into account.
4. The measure must be proportional.

5. The measure must have an incentive effect, that is, it should not cover costs that would normally be paid by the beneficiary, or standard commercial risks.
6. The mechanism should avoid undue negative effects on competition and trade. It should therefore not deter investment in interconnections or impede the functioning of market coupling. It should be open to all and not reinforce dominant positions. However, it should favour low-carbon technologies.

The Commission announced that it would be working with Member States to ensure existing and planned capacity mechanisms are brought in line with state aid rules.

The Commission's sector inquiry

To assess the impact of capacity mechanisms on competition and trade in the internal energy market, the Commission launched a sector inquiry in 2015 and published its [final report](#) on 30 November 2016, as part of its clean energy package. It is the first and only inquiry focused on an entire industry sector.

The report, which is based on the analysis of 35 previous, existing or planned capacity mechanisms in 11 Member States, finds that Member States have often introduced capacity mechanisms without having made an adequate assessment of the need for them, and that 'cost benefit assessments and evaluation of capacity mechanisms are the exception rather than the rule'. In many Member States, market and regulatory failures stifle the price signals that would be necessary to ensure appropriate levels of security of supply. Therefore, the report emphasises that capacity mechanisms must be accompanied by appropriate market reforms.

Furthermore, the report finds that many of the capacity mechanisms introduced by Member States were not designed to address a clearly identified problem related to security of supply. Member States often did not assess the situation regarding the security of supply thoroughly enough, and did not always base capacity mechanisms on an economically justifiable target for security of supply.

The report recommends ways to improve the design of capacity mechanisms:

- The capacity mechanism must match the identified adequacy issue. Long-term adequacy issues are best addressed through a market-wide mechanism, while temporary ones require transitional measures, such as strategic reserves.
- For generation adequacy issues that are limited to a geographical area, improving grid connections and adapting the geographical boundaries of the bidding zones is likely to provide an appropriate solution.
- Payments for reduction of electricity consumption at times of scarcity may be appropriate to encourage flexible demand, but should not turn into subsidies for energy-intensive consumers.
- A competitive process should be used to determine the price paid for capacity.

Capacity mechanisms should be open to capacity providers in neighbouring Member States in order to incentivise investment in domestic and foreign capacity and in interconnection, as well as to reduce system costs.

Academic analysis and expert opinion

A [study](#) for the European Parliament's Committee on Industry, Research and Energy (ITRE) identifies market and regulatory failures as the reason why market prices currently do not cover the fixed cost of conventional generation capacity. These failures include inelastic electricity demand, electricity price caps and the impact of (subsidised) variable

renewable electricity sources on price and load factors. This leads to a lack of investment in new capacity and premature closure of existing power plants. The analysis of case studies conducted in the context of the study, examining the new French and British capacity mechanisms, shows that uncoordinated national capacity mechanisms can distort the market and competition as well as hinder the completion of the internal energy market. National support for existing uneconomic power plants can have an impact on price formation and disturb the transition to a low-carbon economy. Capacity mechanisms that are not market-based can result in inefficient capacity investments, and mechanisms that are not market-wide can lead to distortion of competition. Without cross-border participation, the effects on the market and on investments will be suboptimal and there will be a shift of generation capacity towards the country with a capacity mechanism. The study concludes that capacity mechanisms should only be considered if price signals from an energy-only market do not lead to timely investments in needed generation capacity. As an EU-wide scheme is not currently a feasible option, preference should be given to capacity mechanisms harmonised at the regional level.

A 2016 [report](#) by the International Energy Agency (IEA) concludes that capacity mechanisms can have an important role in ensuring resource adequacy in liberalised markets. According to the report, a properly designed capacity market should have three key elements: a pre-determined level of demand based on the assessment of resource adequacy needs, a mechanism for price discovery, and a well-defined capacity product that is as far technologically neutral as possible. Well-designed capacity markets can help to resolve the 'missing money' problem without distorting wholesale energy markets. The IEA considers that properly designed wholesale markets are a prerequisite for functioning capacity markets. It recognises the benefits of regional collaboration to ensure that capacity can be delivered across borders, enabling the participation of external capacity without requiring that capacity mechanisms be completely harmonised.

Another 2016 report, published by the Overseas Development Institute and focused on [capacity mechanisms and decarbonisation](#), suggests that current and planned capacity mechanisms in the EU and the USA risk locking in dependence on fossil fuel power plants and thus undermining decarbonisation objectives, and that their introduction is based more on political motivations than on a rigorous analysis of their need. The report recommends that governments take a system-wide approach that supports decarbonisation. This would include making a thorough analysis of reliability challenges, using market design to improve system reliability and recognising the role of demand response, storage and interconnection in providing economically competitive, low-carbon flexibility.

A Catholic University of Leuven (KUL) 2013 [factsheet on capacity mechanisms](#) provides a brief economic analysis of the different types of capacity mechanisms. A recent [simulation of investment decisions](#) in electricity markets concludes that both capacity mechanisms and scarcity pricing are equally effective if investors are prepared to take risks, but capacity mechanisms are more effective when investors are risk-averse.

A study on competition policy and the internal energy market is being carried out for Parliament's Economic and Monetary Affairs Committee (ECON). In its [preliminary results](#), presented in March 2017, the authors recommend a non-discriminatory and competitive market design for capacity mechanisms, to ensure that they are open to providers in all Member States and the price paid for capacity is determined in a competitive process. They advocate clear rules for the deployment of strategic reserves, which should not be used to keep prices low or to reinforce the position of incumbents.

The Commission's proposed design criteria

In November 2016, the Commission adopted a [legislative proposal](#) for a recast of the Electricity Regulation, as part of its clean energy package. The proposed regulation sets out a new design for the EU energy market, aimed at making the electricity market fit for more flexibility, decarbonisation and innovation, by providing for undistorted market signals (scarcity pricing). In the chapter on resource adequacy, the proposed regulation introduces new rules for capacity mechanisms. In case of resource adequacy concerns, Member States would have to publish a timeline for eliminating the regulatory distortions that caused the concerns, and to consider developing interconnections, energy storage, demand-side measures and energy efficiency.

The proposal sets out design principles for national capacity mechanisms, which may only be applied if the European resource adequacy assessment has identified a concern, if regulatory distortions have been addressed, and if the Member State has a reliability standard indicating its desired level of security of supply. Capacity mechanisms other than strategic reserves should be open for participation to capacity providers from other Member States, provided there is a network connection. Neighbouring Member States would have to consult with each other before introducing a capacity mechanism. Power plants constructed after the entry into force of the proposed regulation may only participate in capacity mechanisms if they emit less than 550 grams of CO₂ per kilowatt-hour. For pre-existing power plants, the emissions limit would be applied five years later. Existing capacity mechanisms would have to be adapted to the new rules.

The proposal also defines principles and a procedure for developing a European resource adequacy assessment that would be used by Member States to determine the need for capacity mechanisms and to set reliability standards. Furthermore, it specifies the roles of the new regional operational centres, the national transmission system operators, ENTSO-E and the national regulators via ACER, in defining technical parameters and operational rules for the participation of capacities located in another Member State.

European Parliament position

The [resolution of 15 December 2015](#) on 'Towards a European Energy Union' expresses the view that 'national capacity mechanisms should only be used as a last resort, once all other options have been considered'. This is backed by the [resolution of 13 September 2016](#) on moving towards a new energy market design, which states that 'market-based cross-border capacity mechanisms should only be allowed under certain conditions'.

Council position

In its [conclusions](#) of 9 December 2014 concerning the completion of the internal energy market, the Council of the EU notes that ensuring generation and system adequacy is a challenge to be addressed by Member States. It calls on Member States to take synergies of cross-border regional cooperation into account when implementing capacity mechanisms, to respect the state aid guidelines on energy and the environment, and to avoid any disincentives for investment in interconnection while minimising market distortion. The Council asks the Commission to study the development of a European generation and system adequacy assessment (with involvement from ENTSO-E, ACER and the Member States' authorities), while recognising the right of Member States to determine their energy mix and their responsibility for ensuring security of supply.

Stakeholder views

A 2015 [ENTSO-E policy paper](#) suggests ways to design cross-border capacity mechanisms and highlights the role of transmission system operators in their design and operation.

[Business Europe](#) is generally in favour of an energy-only market and asks the Commission and Member States to ensure that existing capacity mechanisms can work together with the internal energy market. In its view, the sole purpose of capacity mechanisms should be to ensure security of supply. Business Europe proposes a number of criteria to ensure that capacity mechanisms are market-based and cost-effective.

[Climate Action Network](#) (CAN) Europe warns that the widespread introduction of capacity mechanisms would distort price and investment signals, increase costs, and favour fossil and nuclear power generation over renewables, energy efficiency and demand response, thus undermining EU climate policies. CAN proposes several changes to the Commission proposal, in order to advance the decarbonisation of electricity generation.

Main references

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