CONSULTA PÚBLICA PREVIA RELATIVA A LA IMPLEMENTACIÓN DE MECANISMOS DE CAPACIDAD EN EL SISTEMA ELÉCTRICO ESPAÑOL

MITECO Capacity Market Consultation

Response prepared by **Aurora Energy Research**

Contacts: ana.barillas@auroraer.com, pablo.borondo@auroraer.com

1. From the perspective of all the market participants involved, are capacity mechanisms necessary to guarantee the existence and availability of generating capacity, demand response and storage necessary to guarantee security of supply, while meeting decarbonisation targets? If so, for what reasons might the mechanisms provided for in Article 20 of the Internal Electricity Market Regulation be insufficient to guarantee resource adequacy?

The need to ensure resource adequacy in Spain

Since 2018, the Spanish electricity market has seen an increase of over 5.3 GW of solar PV and 3.4 GW of wind installed capacity, a change over two years of 114% and 15%, respectively. By 2030, the PNIEC calls for 39 GW of installed solar PV capacity and 50 GW of wind, an increase of almost 53 GW (145%) from current levels. While less aggressive, Aurora's projections[1] expect 31 GW of installed solar PV capacity and 41 GW of wind, an increase of over 35 GW (97%) from current levels.

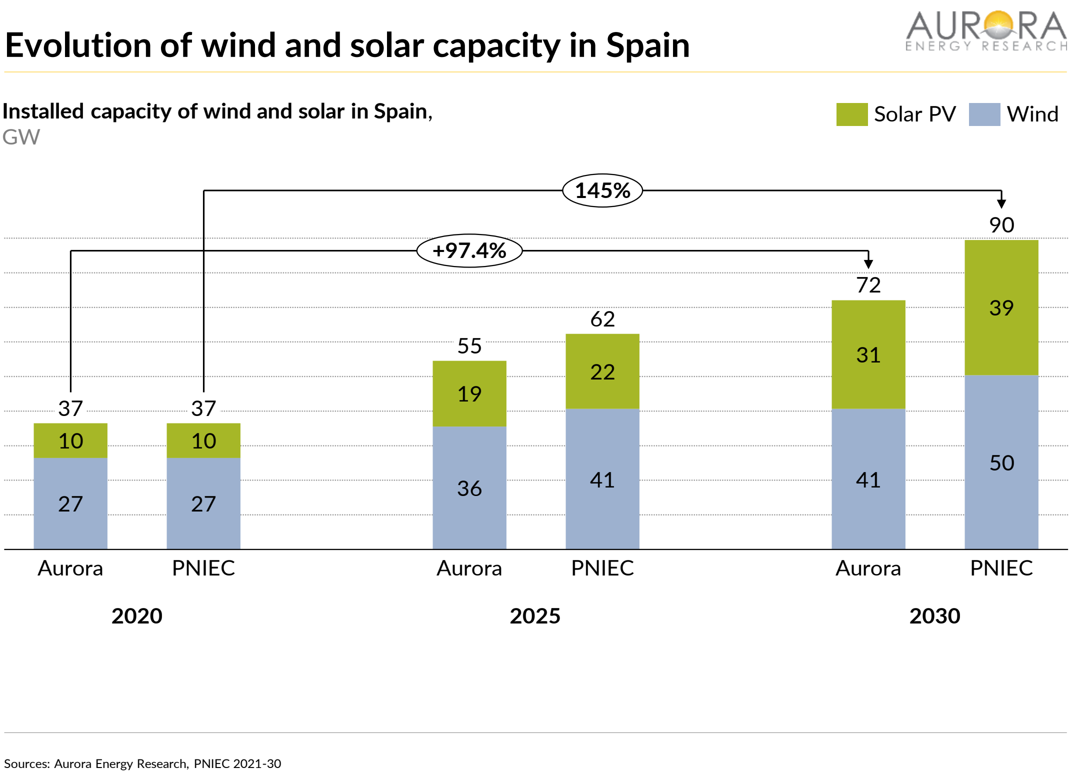

Figure 1: Wind and solar buildout projections through 2030

[1] Aurora's projections have been extrapolated to represent all national territory using the ratio of demand at bus-bars.

As the generation mix becomes more intermittent and traditional thermal generation is pushed out of the system by the existence of lower-cost generation, concerns about the reliability of the electricity system grow. These concerns can materialise in different ways across the interrelated parts of an electricity market: resource adequacy (e.g. availability of firm capacity to meet expected peak demand), system operability (e.g. managing system frequency) or locational grid constraints are all growing concerns under renewable-heavy systems.

The impact of renewable generation growth on the reliability of the Spanish power system is further exacerbated by other market characteristics and expected changes:

1. **The planned exit of coal and nuclear generation:** there are over 15 GWs of capacity that have been planned for retirement between the start of 2020 and the end of 2035. This includes both coal plants closing for economic reasons and a phased exit of nuclear as agreed between nuclear operators and the Government.
2. **The limited interconnection capacity of the peninsula with the rest of Europe:** the firm value of interconnectors towards security of supply targets needs to be assessed based on the probability of coincident stress events between neighbouring countries. However, simplistically, the less interconnected a country is, the more it is likely to require domestic generation to meet its resource adequacy targets.

   The Iberian Peninsula is fairly isolated from the rest of Europe. Spain is interconnected to Portugal, Morocco and France, but the current capacity of interconnectors represents 14% of total peak demand in Spain. This compares to interconnectors representing 34% of peak demand in Germany.
3. **The role of hydro generation on the Spanish power system:** The Spanish power system benefits from over 17 GW of hydro generation (excluding pumped storage). Out of this total, 2 GW are run-of-river and 15 GW are hydro reservoir.

   The availability of hydro varies based on rainfall. Over the last 10 years, hydro generation has made up between 8.3% and 16.8% of total generation[2] in Spain. The year-on-year variability of hydro requires planning for firm capacity that can help fill in the gap during low hydro years. This assessment should consider, however, the fact that even in low hydro years hydro reservoirs and pumped storage are able to shift generation to periods of high demand, contributing positively to security of supply.

[2] Includes all hydro sources in the Peninsular territory (REE, 2020)

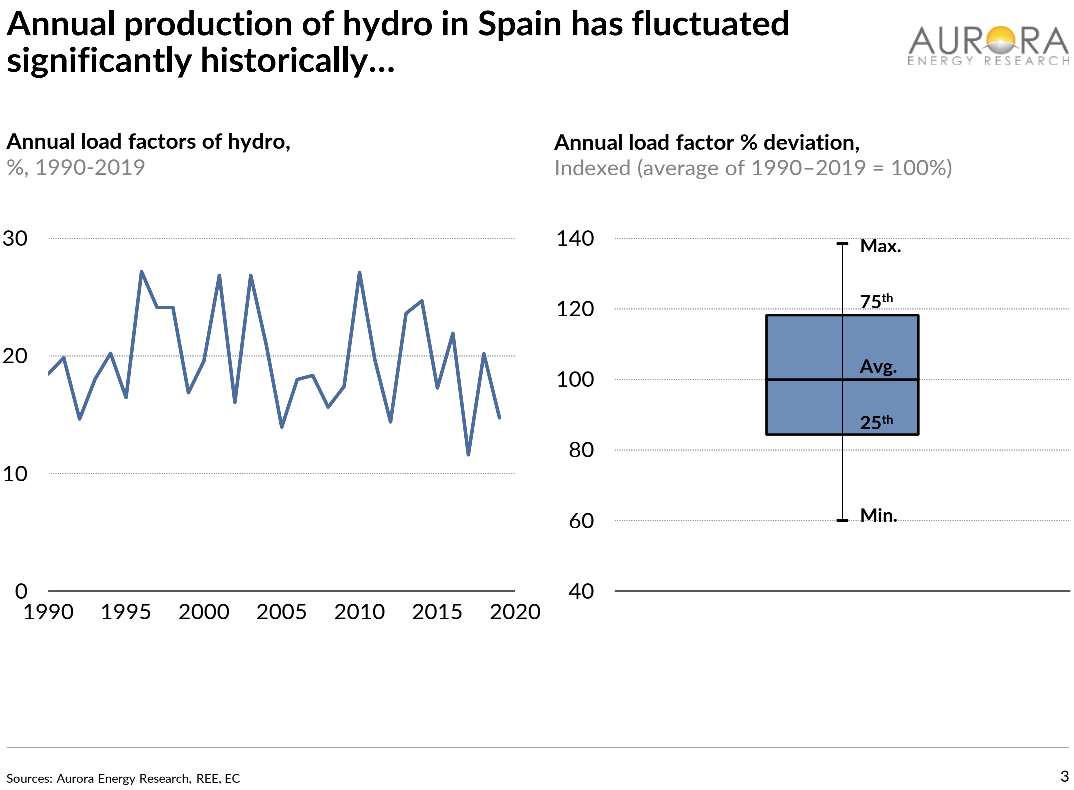

Figure 2: Variability of hydro generation in Spain

Resource adequacy requirements

Under the current market conditions, the large majority of CCGTs in Spain are unprofitable. This problem is only likely to get worse as more renewables enter the system. Increasing levels of renewable generation lead to lower CCGT running hours which in turn decrease the profitability of these assets.

Based on Aurora's analysis, between 2020 and 2024 CCGTs would require between €15/kW-year and €20/kW-year to cover their fixed operating costs. Without this, the economically rational thing to do is to exit the system.

In order to assess the resource adequacy problem that Spain would face without some form of CRM, we have estimated the amount of new capacity that would be required under both the PNIEC's projections and our own if only 50% of the existing CCGT fleet remained operational by 2025.

As shown in Figure 3, taking into account Spain's current security of supply standard of a 10% reserve margin and the changes in capacity outlined above, by 2025, the Spanish system would require just over 3GW of installed capacity under the PNIEC's assumptions, and over 11GW under Aurora's Central Scenario.[3]

[3] The difference is mostly driven by a more aggressive view of solar thermal and battery storage development under the PNIEC.

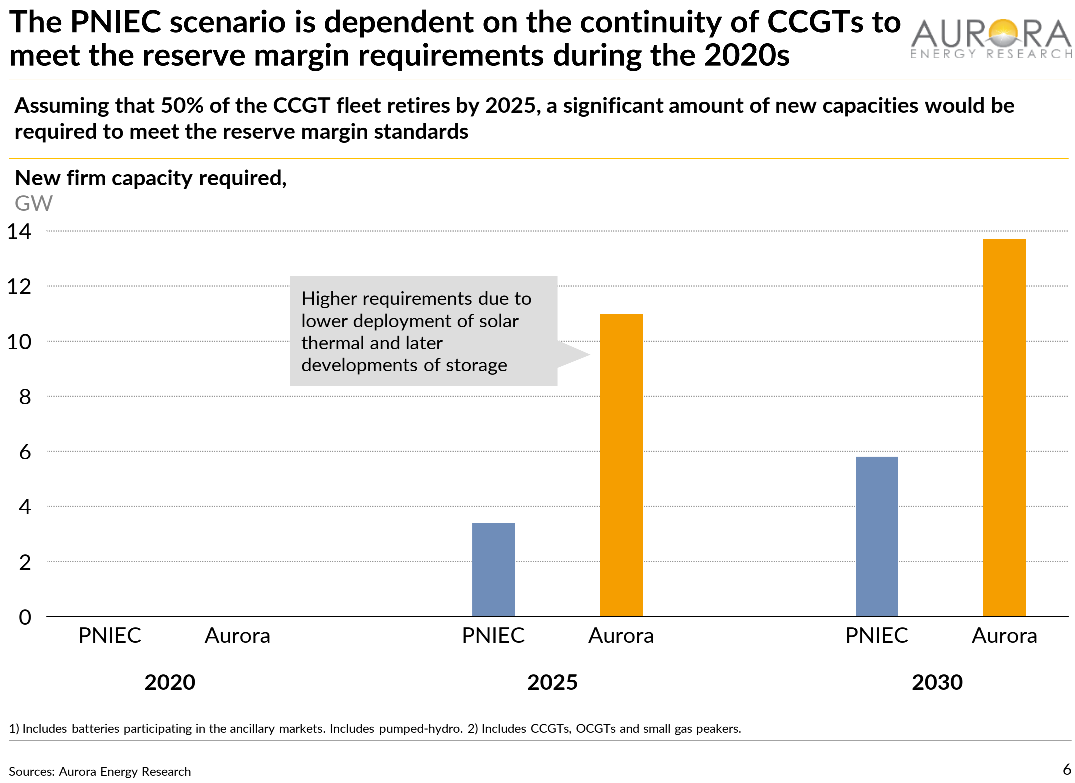

Figure 3: Required new firm capacity with CCGT retirements

Based on Aurora's Central case, meeting a 10% reserve margin by the late 2020's would require two things:

1. Incentivising existing CCGTs to stay in the market by providing support to cover their fixed costs of operation;[4]
2. Incentivising enough new build to meet the security of supply standard.[5]

This is illustrated in Figure 4 below.

[4] Assuming that only 20% of the CCGT fleet is economically viable by 2030 without any form of support.

[5] This assumes that interconnectors are not counted towards the security of supply target. Accounting for some of this capacity would defer the need for new build but would still require ensuring that existing CCGTs remain operational.

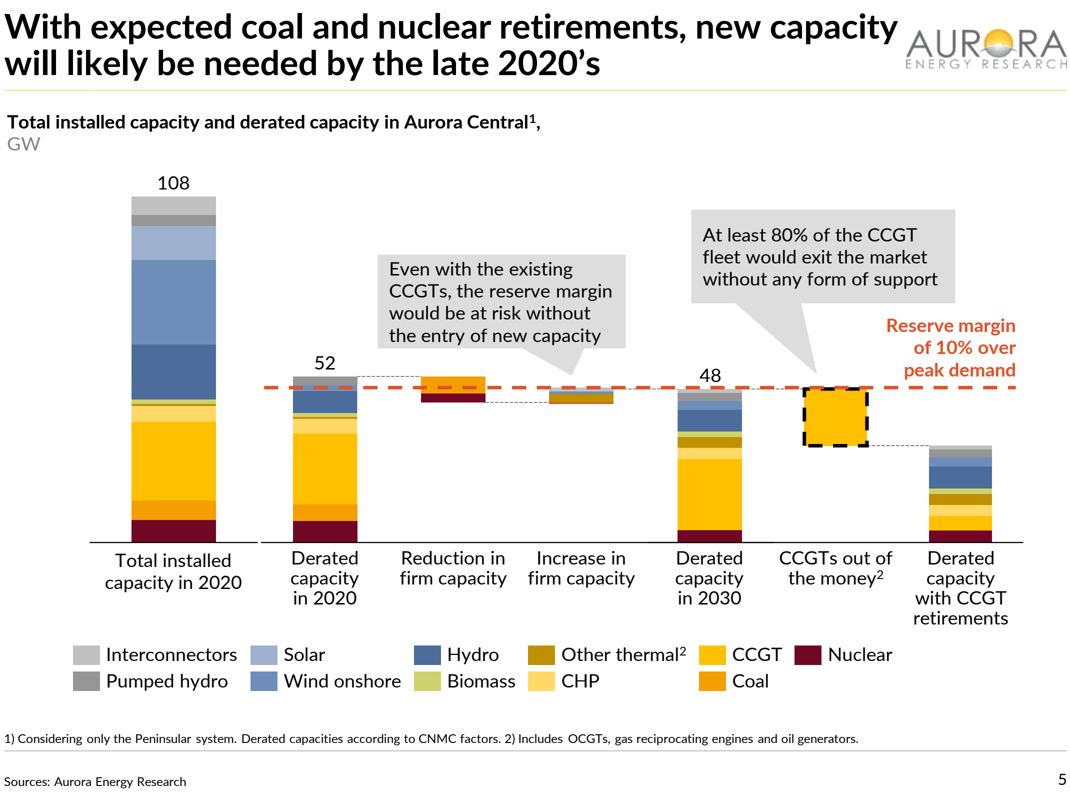

Figure 4: Evolution of derated capacity in Spain

Under the assumptions in the PNIEC less new capacity would be needed, and it would be needed later. However, it is important to highlight that two key assumptions would have to be made for that to be the case without a CRM to support such expansion in the first place:

1. That existing capacity remains operational even when incurring losses;
2. That new solar thermal and battery storage capacity (which is included in the PNIEC) ahead of 2030 is profitable on the basis of energy market and ancillary services. Aurora's analysis suggests that is unlikely.

<u>Why may market mechanisms be insufficient to guarantee resource adequacy?</u>

Market mechanisms may be insufficient to incentivise the delivery of resource adequacy. Two market failures are prominent when establishing the need for a capacity remuneration mechanism:

1. The reliability of the power system is a public good. Even assuming that a "socially optimal" level of reliability could be accurately assessed and quantified (with all of the limitations of such an approach), capacity providers are unlikely to provide the socially-optimal level of reliability without some form of intervention. This is because most customers cannot choose their desired level of reliability (as, for the most part, the system operator cannot selectively disconnect electricity customers).
2. Energy markets can suffer from "missing money" problems. Even when a socially optimal level of reliability has been established and valued (typically in the form of a Value of Loss Load ("VOLL")), electricity prices might not rise high enough or often enough to incentivise the market to provide the required capacity. This is due to two main reasons:

a. Price caps;

b. Even if price caps were lifted, market participants might be hesitant to bid up to such prices for fear of perceptions of abuse of market power.

The missing money problem is particularly acute in a market like Spain, for a number of reasons:

- Day-ahead prices are currently capped at €180/MWh;
- Even though these price caps are likely to be removed soon in line with ACER's harmonised price clearing limits for the day-ahead market of (-€500/+€3,000), there is no history of price spikes and consumers might be less willing to tolerate them. Further, as mentioned above, market participants might be hesitant to bid up to such prices for fear of perceptions of abuse of market power.
- The rapid increase of renewable generation will result in thermal capacity increasingly operating as back-up, relying on a few hours of scarcity-driven prices to recover their fixed costs.

Addressing the market distortions that result from price caps and fears of abuse of market power should precede (or at least be planned in conjunction with) the introduction of any form of CRM.

However, even with market mechanisms able to appropriately reflect short-term scarcity, experience in other markets suggests that even if both consumers and politicians were tolerant of price spikes, the unpredictability of such price behaviour makes the financing of assets difficult. One of the key objectives of CRMs is, therefore, to provide the longer-term price visibility required by market investors.

2. If required, what type of scheme is considered more appropriate, taking into account the guiding principles established in EU regulations (strategic reserves, competitive capacity mechanisms, tenders for new capacity, others…)? Why? Does the model you propose resemble any of those existing or planned in other European countries?

CRMs have been deployed widely in markets across Europe and the US, with different approaches to a number of key parameters including the forward-looking horizon for the product, differences between the contract length awarded to new and existing plant, the shape of the demand curve, etc. A summary of key characteristics across the GB, Ireland, France and PJM CRMs is presented at Figure 5.

Capacity mechanisms exist in various markets to ensure security of supply – each with their own characteristics

	GB	Ireland	France	PJM
How it works	Capacity contract auction – capacity providers enter into capacity contracts with a central delivery body through an auction.	Reliability option auction – capacity providers enter into option contracts with suppliers through an auction. They receive option fees, levied on suppliers. When spot price exceeds the strike price, they pay suppliers the difference between the spot price and the strike price.	Capacity Obligation –capacity providers sell capacity certificates to consumers, who forecast their consumption and purchase sufficient number of certificates. New-build can lock-in long-term price through a CfD contract; if the obligation price in a given year is below the strike price, they receive a top-up.	Reliability pricing model – similar to GB but includes locational pricing for capacity which would vary according to limitations on transmission system
Centralised	Yes	Yes	No	Yes
Forward looking horizon	4 & 1	4 & 1	4 & 1[3]	3
First delivery year[1]	2018/19	2022/2023	2021 (transitional arrangement)	2007/08
New build price lock in period (years)	15	10	7	1
Net CONE[2] (£/kW/year)	50	82	-	75
Energy price cap	£6,000/MWh	€3,000/MWh	€3,000/MWh	$3,700USD/MWh
Sloped demand curve	Yes	Yes	-	Yes
Restrictions on carbon intensity of plants?	550gCO2/kWh	550gCO2/kWh	200gO2/kWh	No

1) For new build assets. 2) Cost of New Entry. 3) 4-year ahead for the CfD auction. Multiple decentralised auctions and OTC trading for the Capacity Obligation, typically a year ahead of delivery.

Sources: Aurora Energy Research, PJM, RTE

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Figure 5: CRM comparison across Europe and PJM

The most appropriate market design for a CRM in Spain will depend on a careful assessment of system requirements now and in the future. Understanding how these needs are likely to evolve and manifest themselves over time is necessary to define a CRM design that follows EU guidelines but is also robust against rapidly evolving markets, technologies, consumer behaviour, and demand.

Based on our analysis of the Iberian power market, we do not believe that a CRM in the form of strategic reserves would be appropriate for Spain. Based on EU regulation, resources that form part of a Strategic Reserve are effectively excluded from participating in energy and balancing markets. Given that the firm capacity available in the Spanish market is largely flexible and able to effectively compete in both energy and ancillary services markets (when required), ringfencing some of this capacity to create a strategic reserve is unlikely to result in an optimal market solution, reducing competition in energy and ancillary services markets and resulting in the overall loss of system flexibility.

While there will be many details to define in the process of designing a robust and transparent CRM for the Spanish market, experience does suggest that there are some principles of a well-designed system that should be considered. Market-wide, competitive, technology-neutral mechanisms with a single clearing price, for example, most closely resemble the outcomes of a perfectly efficient energy market.

3. In relation to the storage sector and demand response, what barriers are there to their access to electricity markets? To what extent is the implementation of capacity mechanisms needed to achieve the storage objectives of the PNIEC, while maintaining full compatibility with Regulation (EU) 2019/943?

Limitations to the penetration of storage and demand response

Across Europe, demand response and storage has faced several barriers to entry:

- Minimum capacity requirements to participate in wholesale markets;
- Difficulty of participating in balancing markets through aggregators;
- Lack of clarity regarding the regulatory treatment of batteries for grid access and electricity consumption for charging purposes;
- Complexity and lack of transparency in the requirements and procurement practices for ancillary services markets;
- Changing regulations on derating factors and pre-qualification requirements to participate in CRMs;

Addressing these barriers to entry is critical to ensure the full participation of storage and demand-side response across wholesale, ancillary and capacity markets.

Need for a capacity mechanism to achieve the storage objectives of the PNIEC

Under the current market design, a substantial penetration of storage capacity is likely to rely on market arbitrage opportunities. This, in turn, will depend on the willingness of investors to take on the market risk inherent in building a business case solely on the evolution of price spreads in wholesale markets. In Aurora's Central Case, we do not see the viable entry for standalone storage capacity before 2030 without any form of support. This compares to the 2.5 GW storage target set by the PNIEC.

The following barriers to entry are apparent:

- The provision of primary regulation in Spain is a mandatory, non-paid service, so no market exists for a service that batteries are well-placed to provide;
- Commodity price uncertainties limit the bankability of daily energy market spreads and the value of ancillary services that battery or other storage projects can provide;
- There are no other forms of stable, predictable revenues for batteries or other forms of storage.

A CRM would support an earlier development of batteries and storage solutions in the system, if the product is defined in a way compatible with the operational characteristics of batteries. In the GB market, for example, only 10% of the capacity of short-duration batteries is counted as firm capacity for purposes of the Capacity Market contract. This is in line with the expected contribution of short-duration batteries towards the defined CRM product (which requires capacity availability over a prolonged period of time), but has made revenues from the capacity market a fairly insignificant component of the business case for most new battery development. Longer duration batteries or other storage technologies (like pumped storage), however, benefit from higher capacity payments.

Whether storage technologies benefit significantly from a CRM, therefore, will depend on how the CRM product is defined. For example, a product that values the availability of dispatchable generation over prolonged periods of time (to meet demand during long periods of low wind generation, for example) might be more beneficial to CCGTs and long-duration storage than to short-duration storage. This would be the right outcome if the intent of the CRM is to provide for resource adequacy. However, attention should also be paid to the design of energy and ancillary services markets. Without careful consideration to the necessary reforms that might be required for these markets to deliver other needed products and services, the market might not deliver the optimal level (and location) of short-duration storage and fast response required in a high-renewables system.

4. In the design of these mechanisms, how do you consider that the principles of technology neutrality and of avoiding excess compensation enshrined in community regulations should be combined with the decarbonisation objectives and the particular needs of the Spanish electricity system? How should different time horizons be taken into account to combine predictability and investment certainty with optimising costs for consumers?

Technology Neutrality

As stated above, a market-wide, technology-neutral mechanism with a single clearing price, most closely resembles the outcomes of a perfectly efficient energy market. As long as the technical parameters required to participate in the market are clear and consistent with the agreed definition of the product procured under a CRM, all current and future technologies should be able to participate in the market.

This definition of participating entities could further be extended to include a portfolio of assets that together can ensure compliance with the requirements under the contract. This could be the case for hybrid projects (e.g. combined solar, wind, and battery projects).

Proportionality of Compensation

Further consideration needs to be given to the interaction of any market design with the wholesale market, balancing mechanism, ancillary services and other forms of support for capacity or generation. This is important to limit undesired distortions on other markets, but also to ensure that the support granted by the CRM (or other policy instrument) is proportional and doesn't result in windfall profits.

In GB, renewables in receipt of any form of subsidies are not eligible to participate in the capacity market. France, on the other hand, allows for the participation of subsidised renewables in the CM but nets off the benefit when settling the capacity market payments. Essentially, there is an accounting method to ensure that the contribution of renewables towards the security of supply standard is properly accounted for.

While the design of capacity markets across GB, France, Ireland and Italy might provide some useful points of reference, any proposed design would have to consider the nuanced interactions between markets in Spain, as well as any proposed reforms (like changes to the proposed renewable scheme, existing price caps or the harmonisation of balancing markets across Europe). CRMs are designed to complement energy and ancillary services revenues, so changes in these markets will affect capacity clearing prices.

Revenue predictability

When it comes to the length of the contract awarded under a CRM, it is important to consider the market failures the mechanism is trying to address. Providing the type of revenue stability required to enable debt financing for new plants is likely to be a critical objective in any mechanism aimed at solving a long-term resource adequacy problem.

Experience across Europe and the US suggests that incentivising new capacity onto the system might require longer-term contracts. The length required for such contracts, however, can vary depending on the merchant risk aversion of capital markets in a given country or region, and the capital expenditures require to bring new capacity online. For example, while GB capacity contracts for new capacity are 15 years, new capacity in Ireland can only benefit from 10-year contracts. In the US markets, new capacity contracts range from 1-year contracts in PJM to 7-year contracts in ISO-NE.

Longer-duration contracts for new capacity need to be evaluated against the discriminatory nature of such an approach, the transfer of risk to consumers, and the consistent applicability of such rules to new capacity across different technologies. For example, under the original design of the GB market, new demand response capacity was not eligible for 15-year contracts, while supply-side capacity was. This was a constant source of challenge to the GB mechanism, and the Government has recently announced that demand response will now be able to prequalify to bid for all the agreement lengths in the capacity market, provided they can demonstrate planned capital expenditure over the set thresholds.

Consistency with decarbonisation objectives

A capacity market that remunerates new, highly polluting power plants will make the decarbonisation of the power sector increasingly difficult. Therefore, defining a CRM that is able to meet both short-term and long-term objectives will be critical in providing the market with a clear, consistent policy framework for future investments.

Take the example of the GB market: from the perspective of delivering cost-effective capacity, it has succeeded. It has secured 10.5 GW of new capacity at average prices of £14.5/kW-year against an assessment for the Net Cost of New Entry ("CONE") of £50/kW-year. However, looking forward, the Capacity Mechanism may be at odds with the UK's Net Zero target. Close to 40% of new capacity delivered under the mechanism (or at least aided by it) are reciprocating engines with relatively high CO_2 emission intensities.

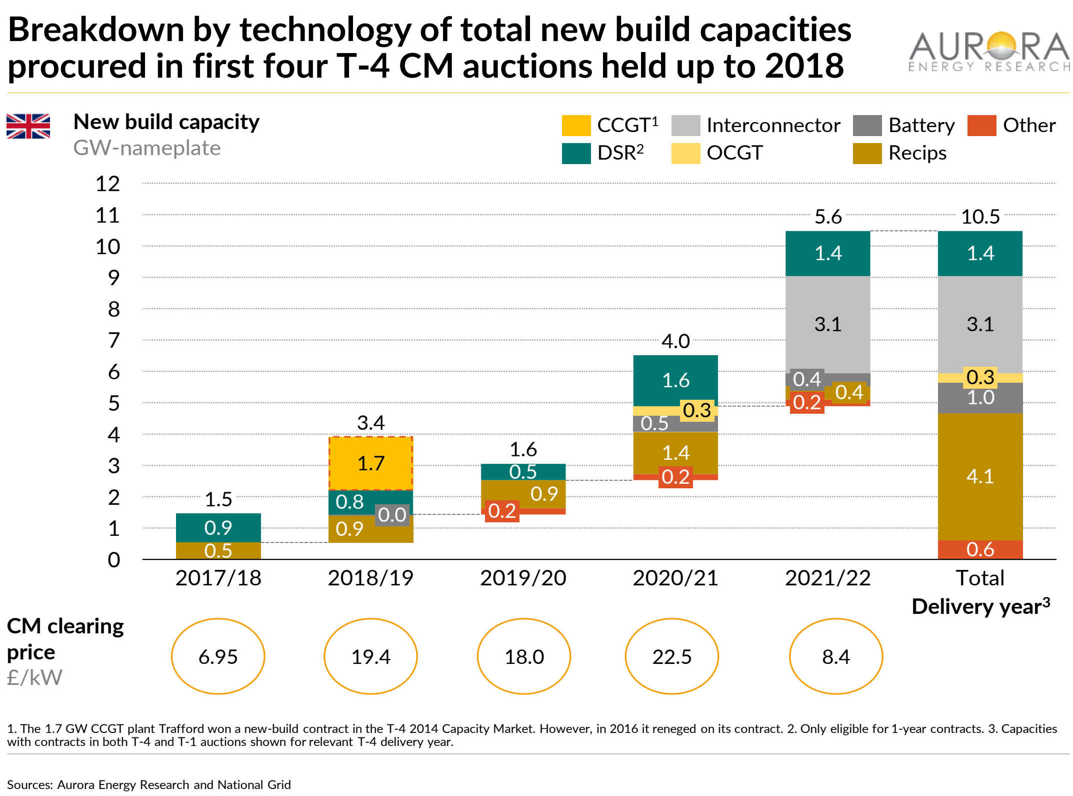

Figure 6: Total new build procured by the Capacity Market in GB

To ensure that a CRM is able to meet resource adequacy concerns and do so in a way that doesn't further increase power emissions, a few options can be considered:

- Ensure that there is a robust carbon price outside the CRM, which in combination with a well-defined CRM leads to the desired outcome;
- Establish emission limits outside the CRM. For example, emission performance standards for new capacity or running hour limits on peaking plant;
- Monitor plant's performance against the EU limit of 550gCO_2/kWh, or considering a tightening of these requirements;
- Combine capacity auctions with set carbon budgets in a two-stage auction. Under this design, the first stage focuses on an auction for the CRM product without any technology constraints. The second stage then adds carbon emission constraints consistent with carbon budgets and renewable targets. A second, constrained auction may then be required.[6]

The trade-offs between different options need to be carefully assessed and considered by policymakers.

5. If new capacity mechanisms are developed in our country, how could they be designed to allow cross-border participation of facilities from other Member States, in accordance with the provisions of Article 26 of Regulation (EU) 2019 / 943?

The participation of cross-border capacity providers is required by Regulation 2019/943. Specifically, Article 26 establishes that "[c]apacity mechanisms […] shall be open to direct cross-border participation of capacity providers in another Member State […]". Defining the pre-qualification procedures, performance incentives and non-delivery penalties, however, needs careful consideration.

As cross-border participation in CRMs should not alter physical interconnector flows, and delivery under the CRM product should coincide with price signals in the wholesale and balancing markets, which ensure that electricity flows to the area with highest prices (subject to physical capacity constraints).

Given the degree of market coupling between Spain and Portugal, coordination on a cross-border CRM should be easier to manage, with more visibility on contract delivery. A higher degree of coordination on the CRM procedures (pre-qualification, auctions, delivery requirements, penalties, etc.) would be required with France. This is further complicated by the existence of a different CRM in France, with different rules applicable to the participation of interconnected capacity.[7]

In defining the participation requirements for cross-border capacity, it will be important to define:

1. The de-rating approach to the interconnector capacity;
2. The pre-qualification requirements for capacity, including the party responsible for verifying compliance with such requirements;
3. The technical requirements to comply with the CRM contract and the compatibility with these requirements with cross-border energy and ancillary services markets;
4. Verification of completion milestones;
5. Non-delivery penalties and enforcement.

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[6] This proposal has been made by Dieter Helm, Professor of Economic Policy at the University of Oxford and Fellow in Economics at New College, Oxford. http://www.dieterhelm.co.uk/energy/energy/reforming-the-fits-and-capacity-mechanisms-the-2-stage-capacity-auction/

[7] In the case of capacity mechanisms in operation on 4 July 2019, Member States may allow interconnectors to participate directly in the same competitive process as foreign capacity

As cross-border capacity should be allowed to participate in more than one CRM, capacity providers should carefully assess:

1. The contract obligations under each CRM and the compatibility of delivering in both markets;
2. The risk of coincidently being required to deliver the product of a CRM contract in two markets at the same time;
3. The penalties associated with non-delivery in each of the markets.

Understanding how capacity providers would evaluate their ability to deliver under cross-border contracts will also help policymakers define a mechanism that can enable cross-border participation, while carefully assessing the incremental value of interconnected capacity to security of supply. This is particularly important in integrated markets where the probability of coincident stress events is high.

As with other questions posed in this consultation, all these issues require careful consideration at different stages of the CRM design process.

6. What actions are considered necessary, if any, to ensure the continuity and availability of sufficient firm generation in order to be able to count on its contribution in the scenarios provided for in the PNIEC?

As mentioned above, Aurora's analysis suggests that ensuring a 10% reserve margin in the Spanish power system will require some form of CRM as soon as possible in order to incentivise existing CCGTs to remain operational. Otherwise, there is a risk that a large number of plants exits the market, posing a near-term resource adequacy problem.

Under the simplistic assumption that such a CRM would compensate required capacity for the gap between its fixed costs and revenues received from other markets (i.e. the "missing money"), payments of around €15/kW-year to €20/kW-year would be required between 2020 and 2024.

Required payments would increase to between €35/kW-year and €45/kW-year between 2025 and 2029 as new capacity is required to meet the target security of supply standard.[8] Under the PNIEC, no new build would be required if CCGTs are kept online, but this is subject to an aggressive view of solar thermal deployment and storage capacities which according to Aurora's analysis will need significant support, in some cases beyond the capacity payments outlined above (and shown in Figure 7).

[8] Based on Aurora's Central Case scenario. This assumes a 10% reserve margin target, the current derating factors applied to different technologies by CNMC's methodology, and no assumed contribution from interconnectors.

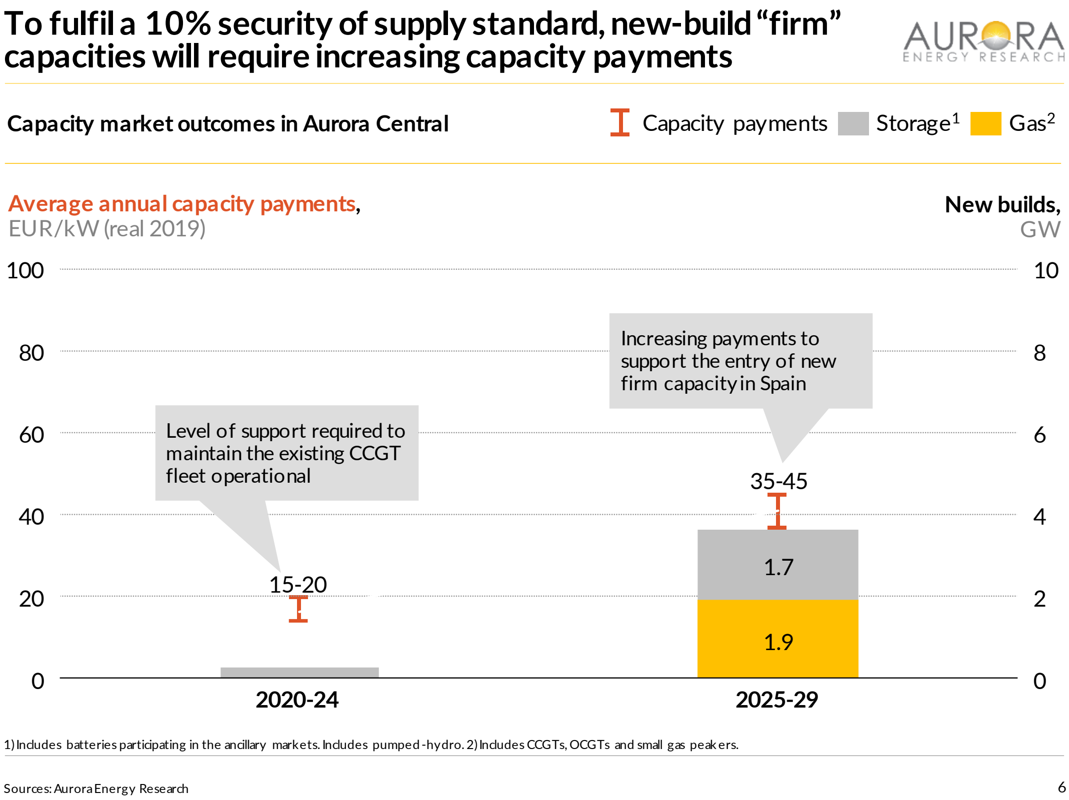

Figure 7: Required capacity payments to fulfil security of supply standard

The missing money metric indicates the profitability of assets in the market. With the majority of the CCGT fleet in Spain largely unprofitable in energy and ancillary services markets (and likely to remain so for the foreseeable future), lack of action might result in the accelerated exit of capacity from the market, further exacerbating the resource adequacy problem that is likely to materialise late in the 2020's.

While it is perfectly possible that a well-designed CRM still results in the closure of a portion of the existing CCGT fleet, it is also likely that the market reveals that meeting short-term resource adequacy concerns is done most effectively through existing CCGTs. Policymakers should consider the risks and potential cost to consumers of an accelerated CCGT exit.

7. Is any type of additional regulation on generation facilities required if they are not necessary for a period of time, but can be re-incorporated when their contribution is required?

When assessing whether to remain operational, mothball, or permanently close a power station, operators will have to weigh expectations of costs and revenues over the next several years. If a CRM design is able to clearly establish expectations for future revenues, then the mechanism itself is well suited for bringing back mothballed plants if prices are sufficiently high. This is particularly true if sufficient notice is given through mechanisms that secure capacity several years ahead of delivery. This implies that there isn't a need to pay plants for mothballing, unless there is a worry of plants decommissioning altogether.

If a decision to pay assets to be mothballed were to be made, then sufficient tests/milestones should be put in place such that plants are ready to return to operation within a pre-defined timeframe. This is consistent with the design of other mechanisms where contract holders need to meet routine tests as part of their contract requirements.

In summary, a firm, reliable timeline for the implementation of a CRM and a clear definition of the product that will be procured should provide market participants with enough visibility to make economically efficient decisions. Plant operators might decide to mothball assets, for example, if there is a clear route for recovering de-mothballing and operating costs once the delivery of the product is required.

8. What other measures, other than capacity mechanisms, can make it possible to achieve the environmental and energy objectives (flexibility, other specific solutions on the demand and storage side…)?

A CRM that simply targets the delivery of capacity to meet peak demand is a common but blunt mechanism. Meeting the challenges of a high renewable system will require properly functioning energy and ancillary services markets able to incentivise the delivery of flexible, fast-response generation in the right locations.

A well-designed CRM functioning alongside transparent and efficient energy and ancillary services markets can, in fact, incentivise flexibility, demand-side response and storage while keeping a level-playing field for all existing and new technologies. Mechanisms that are targeted to specific technologies are always prone to short-sightedness, asymmetry of information, and often result in sub-optimal solutions. Therefore, policymakers should focus on clearly defining the system requirements and allowing the market to uncover the most cost-effective way of meeting the needs of the power system.