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Central vs. hybrid capacity markets: What's in it for flexibility?

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"Central vs. hybrid capacity markets: What's in it for flexibility?" A follow up to our policy report on a technology-neutral flexibility strategy for the German power market.

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EPICO KlimaInnovation (Energy and Climate Policy and Innovation Council e.V.)
Friedrichstraße 79 — 10117 Berlin, Germany
#SustainableHub, Rue du Commerce 72 — 1040 Brussels, Belgium

Aurora Energy Research GmbH
Kottbusser Damm 25-26, 10967 — Berlin, Germany

AUTHORS

Dr. Bernd Weber (Founder and CEO, *EPICO KlimaInnovation*)
Joachim Schmitz-Brieber (Senior Policy Specialist - Industry and Energy, *EPICO KlimaInnovation*)
Nicolas Leicht (Project Leader, *Aurora Energy Research*)
Angelika von Dulong (Associate, *Aurora Energy Research*)
Manuel Baumhof (Graduate Analyst, *Aurora Energy Research*)

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Introduction

Germany has taken up the challenge of restructuring its energy system due to increasing power demand and the ongoing transition away from coal. To guarantee security of supply at all times, **more flexible capacity is needed, which shall be ensured by a market-based, technology-neutral capacity mechanism starting in 2028**. The capacity mechanism is only one of several instruments, albeit a very important one in the context of a technology-neutral flexibility strategy for the German power market.[1] **Among the different flexibility options, particular attention should be paid to ensure that demand-side flexibility and other emerging technologies are able to effectively participate in the capacity mechanisms, too.** This feeds back to design choices: There is a concern that capacity mechanisms with a central design might unduly favor large power plants as a source of flexibility, effectively crowding out more innovative, emerging technologies, a point also raised by the Ministry for Economic Affairs and Climate Action (BMWK)[2]. There are also other problems regarding the integration of demand-side flexibility into central capacity mechanisms, as we outline below.

While several options are being evaluated, a hybrid capacity market is emerging as the preferred choice by the BMWK, which forms the base of this analysis.[3] The hybrid capacity market is supposed to foster the integration of innovative flexibility technologies via its decentralized elements. However, its design is untested and more complex than a central capacity market. Thus, the follow-up question arises whether a central design can leverage similar benefits for innovative flexibility options at lower cost and implementation risk.

In the following, we present our assessment of both a hybrid capacity market and central capacity market. The key question we address is under which conditions and at which costs each of these market designs can incentivize the integration of innovative flexible technologies.

Pitfalls of a central capacity market for flexibility and innovation

In a central capacity market (CCM), a central authority holds yearly auctions to procure system-wide required capacity, usually 4 years (T-4) and 1 year (T-1) in advance. This market design reduces investor risk through long-term contracts, creates planning certainty, and tries to allow for a technology-neutral bidding process for all capacities. The concept has already been introduced in a variety of countries and, given these precedents, is expected to receive EU state aid clearance relatively quickly. **However, experience from capacity mechanisms in Europe and the US has revealed that a central implementation is not without obstacles.**

First, challenges exist when accounting for flexible demand technologies: Double counting can occur, when they are reflected both as flexibility on the demand side and a potential participant in the auction process. For example, the contribution of electric vehicles (EVs) to peak residual demand needs to be included in the simulation to calculate the required capacity. Potentially, even more EV charging capacity could afterwards participate in the capacity auction as demand side response. In contrast to a large asset, an individual EV could thus be accounted for twice, with

[1] See epico.org/.../accelerating-a-technology-neutral-flexibility-strategy-for-the-german-market

[2] See page 71 of bmwk.de/.../20240801-strommarktdesign-der-zukunft.html

[3] See bmwk.de/.../ag3-inputpapier-kombinierter-kapazitaetsmarkt-kkm.html

practically no possibility to be detected. This problem becomes more pronounced in the future as more flexible demand enters the system. In January 2024, around 1.4 million EVs were in use[4], corresponding to over 8 GW of charging power[5], while by 2030, the German government targets a significant increase to 15 million[6] EVs, accounting for around 90 GW of charging power.

Second, due to regulatory changes in the recent European electricity market design reform, assets that receive capacity payments are obliged to pay back "excess" wholesale market profits, e.g., using **reliability options as a "claw-back" mechanism**. The policy mandates that profits between a reference price, for instance, the wholesale electricity price, and a defined strike price are surrendered. This measure does not threaten the business case of power plants with variable costs below the strike price. Flexible technologies, however, can have high and uncertain opportunity costs, for instance, if they react to fluctuating market conditions, like price spikes, which are in and of themselves challenging to predict. **These opportunity costs, potentially above the strike price, could disadvantage flexible technologies compared to power plants with a more predictable operation.**

Third, **a CCM may not adopt innovation quickly**, since it requires a thorough evaluation and classification of all prequalified technologies by a central body. This creates bureaucratic hurdles in a centralised process, which could be avoided in a decentral capacity market design, if the latter offers the option of self-fulfilment, i.e., flexibilising demand, utilising decentral storage, or trusting a novel technology. The latter may be de-rated more strongly by a central regulator in a CCM.

Hybrid hype – are hybrid capacity markets outperforming a central approach?

The hybrid capacity market (HCM) proposed by the BMWK tries to address these challenges and ensure long-term investment security while fostering innovation and adaptability. The HCM includes a central component for assets with a long refinancing horizon, similar to the CCM, and a decentral component, which allows balancing responsible parties (BRPs) to manage the coverage of their own capacity demand and supply by purchasing certificates from plants procured in the CCM as well as from other market participants, likely mostly existing power plants. The decentral component is practically substituting the T-1 auction of the CCM. By handing the responsibility of capacity procurement over to BRPs, this approach incentivises them to fully leverage their own potential for flexibility. The two components are interconnected insofar that certificates of assets being financed under the central component can be traded in the decentral one.

In theory, a HCM seems like the ideal market design to address pitfalls of a CCM and to foster innovation and adaptability. When looking more closely into its implementation, however, **several potential obstacles become evident**.

- The HCM introduces notable **administrative burdens and complexity**. Additionally to the implementation of the central component, it requires the development and integration of a novel decentral system including various entities, such as hundreds of BRPs, requiring new functions and structures, as well as coordinated knowledge

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[4] See umweltbundesamt.de/.../verkehrsinfrastruktur-fahrzeugbestand

[5] Assuming a vehicle charging power of around 6 kW.

[6] See bundesregierung.de/.../nachhaltige-mobilitaet-2044132

building. This process could put the implementation of the full HCM by 2028 at risk.

- Since such a model does not yet exist, **it is unclear if it generally aligns with EU legislation**, which could prolong the process significantly if it deviates from existing market designs, e.g., how cross-border participation in self-fulfillment is guaranteed, as this element is not included in the certification system.

- Since it has not been applied in real-life scenarios, **unforeseen interactions between the two markets can occur**. One such interaction would be oscillating prices[7] for the certificates traded in the decentral component of the HCM, which intensifies with more flexible demand in the market. Even though this can also occur between the T-4 and T-1 auctions of a CCM, it can be more pronounced in a HCM, where different approaches to peak load management are applied by the central authority and the different decentral actors. While this is planned as a key feature to reflect the remaining scarcity, it might not yield sufficient investor certainty for assets outside the central component.

- As the BRPs are given new responsibilities, this **can introduce an overstraining burden, especially for smaller entities**. Additionally, decision-making can be quite subjective and while the HCM is intended to foster innovation, it may not achieve the desired level if BRPs are innovation-averse or lack the capacity to drive innovation.

Overcoming these obstacles may mean incurring considerable costs. It is therefore necessary to clarify if a CCM can deliver the same level of integration for flexible and innovative technologies as a HCM, but with markedly lower costs and reduced implementation risk.

Is a CCM able to deliver the same advantages as the HCM?

With these potential obstacles of a HCM in mind, it may be worthwhile assessing the supposed downsides of a CCM for flexible technologies and their solutions in greater detail.

First, regarding double-counting, we consider flexible technologies individually and observe that:

- An increasing number of smart **EVs** enters the system due to economic incentives, i.e., even without capacity market payments in place. As these EVs already react to price signals and show system-compatible consumption behavior, they contribute little to peak residual demand and receive low de-rating factors[8]. This reduces the problem of double-counting.

- **Electrolysers** are generally large assets, allowing to avoid double counting due to a limited amount

[7] Oscillation between extremely high and low certificate prices may occur. If the required capacity is overestimated in the central component of the HCM, an excess amount of certificates is available for BRPs, decreasing the price in the decentral component. If capacities are then reduced in the subsequent auction, certificate prices could spike due to scarcity. This ocillation could be triggered when the actual capacity requirements deviate from long-term central estimations.

[8] De-rating factors are a function of an asset's contribution to solving a system stress event. High (low) de-rating factors are applied to assets that can contribute more (less) to these stress events.

of units compared to EVs or heat pumps. Similar to EVs, they show system-compatible consumption behavior since their production profile must correlate with the generation profile of renewables in order to produce low-cost hydrogen that is considered "green" by EU legislation[9]. They would thus receive low de-rating factors, even if their storage facilities provide them with a certain degree of demand flexibility. Consequently, as with EVs, the risk of double-counting seems low.

- Since **heat pumps** for space heating only have limited opportunities to flexibly adjust their demand profile, low de-rating factors apply. Thus, the risk of double-counting is reduced.

- For **industrial demand**, flexible and rather inflexible processes must be differentiated: Flexible industrial processes can react to price signals by shifting their load between hours of high and low prices. Inflexible processes, in contrast, require a steady production profile. If inflexible processes receive lower de-rating factors, like heat pumps, double-counting again is negligible. Flexible industrial processes that react to price signals in a system-compatible manner should receive low de-rating factors, similar to smart EVs and electrolysers. As these industrial plants usually have individual metering installed, this increases forecasting accuracy alleviating the problem of double-counting in the first place. Differentiating de-rating factors within industrial DSR could be done in line with Belgium's approach of "Service Level Agreement" (see below).

Regardless of the technology in question, the problem of double-counting may be less pronounced going forward: As flexibility is entering the market gradually, the problem of inaccurate forecasts in the near future is limited. Hundreds of GW of flexible demand do not need to be forecasted tomorrow, but in a decade. At the same time, substantial learnings about the behavior of different technologies and market players can be expected, increasing the accuracy of forecasting and prediction of system dynamics. Additionally, optimisation in data and information processing in combination with ongoing digitalisation leads to more precise and improved decision-making and can mitigate the impact of double counting. This would also minimise the knowedge gap between BRPs and the central authority.

Second, regarding reliability options, **Belgium has opted for allowing load flexibilities to replace the strike price with a declared market price** (i.e., the short run marginal costs), which they would define themselves. **This measure was introduced to facilitate technologies with higher short run marginal costs (e.g., DSR) to participate in the auctions, thereby ensuring technology-openness.**[10] A potential issue with this solution is that in lieu of choosing their own trigger prices, load flexibilities are subject to test calls, where the central authority assesses their availability prior to delivery. Since they are remunerated for these test calls at the self-defined trigger price, they have an incentive to choose a high trigger price. This problem, however, exists both in a CCM and in the central and decentral components of the HCM.

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[9] See eur-lex.europa.eu/.../oj

[10] See ec.europa.eu/.../288236_2313671_226_2.pdf

Third, openness to innovation with low bureaucratic hurdles could also be achieved within a CCM: For instance, Belgium's CM includes "Service Level Agreements" for non-standard / innovative assets like DSR. Service level agreements include relatively fine-grained increments of de-rating factors – depending on the availability and duration of the corresponding technology. In particular, operators of DSR or storage technologies can classify themselves based on their availability and duration instead of being assigned a fixed (and in case of doubt too low) de-rating factor by the regulator. Here, penalties prevent an overly optimistic self-assessment. This increases their chances of a successful participation in the central CM auctions and indeed DSR and aggregated capacities have successfully won capacities in Belgium's auctions: DSR won 287 MW (de-rated) and 49 MW (de-rated) in the 2021 and 2023 Y-4 CRM auction, respectively, and aggregated technologies accounted for 50 MW (de-rated) and 22 MW (de-rated) in the 2021 and 2023 Y-4 CRM auction, respectively.

To sum up, several "fixes" exist to allow innovative, emerging flexibility technologies such as DSR to participate in a CCM. Nevertheless, some problems remain: The problem of a central prequalification persists, even though in a mitigated manner, in a CCM and the central component of the HCM, while avoided in the decentral component by the self-fulfillment. A related challenge for these technologies can be the minimum bidding size. Again, this problem is solely avoided in the self-fulfillment part of the HCM and might thus not be essential for the choice between a CCM and a HCM. Finally, it should also be noted that some of the above "fixes" have their own drawbacks or ancillary costs further down the road. For example, handling Service Level Agreements will require regulators to invest in developing technical knowledge, e.g. in order to devise appropriate penalties so as to avoid abuse.

Towards a no regrets approach? – A central approach can either achieve the goal or be the basis for a hybrid design

The above analysis highlights that one can go about **integrating innovative flexibility technologies into capacity mechanisms in different ways. None of them are perfect**, insofar as each of them come with particular costs. **Our proposal is therefore to opt for a gradual approach**.

To recall: The currently discussed **HCM evokes severe challenges,** including an untested interplay of two market segments and a potentially high administrative burden by involving hundreds of BRPs. **As we outlined above, the well-tested concept of a CCM can prevent these obstacles, while – at least in principle – allowing for the integration of flexible and innovative technologies**. This requires adopting **best practices from capacity markets in other European markets**: First, non-standard assets like DSR should be allowed to self-define their de-rating factors via **Service Level Agreements** to encourage their participation in auctions. Second, technologies with higher short run marginal costs **should be allowed to replace the strike price with a self-defined market price for reliability options.** These adjustments would support the integration of flexibility and innovation into a CCM without embarking on the potentially rocky road of implementing a HCM. Furthermore, we can expect significant learning effects regarding the behavior and forecast of flexibilities in the grid, which can be complemented by a brisk digitalisation, allowing for optimised data and information processing.

Another building block following this logic, is to introduce **a cautiously-sized CCM in the initial phase so as to keep the risk of overprocurement in check**. This approach could reduce administrative costs, while allowing to react via T-1 auctions similar to the decentralized element in the HCM. This would preserve a volatile spot market reflecting scarcity and thus incentivize flexible technologies. Innovation would result from the spot market rather than the self-fulfillment in the HCM.

It should be noted that **this approach would require the government to be transparent about the size of the CCM being kept comparatively low** – at least in the initial T-4 auction. While this is possible, it could invite public criticism of "underplanning", and thus is not entirely without risk. On the other hand, this could be communicated as trusting in market processes to develop the necessary flexibility.

In case that neither the CCM nor price signals alone are fully delivering the desired outcome, the introduction of the additional decentral component should be considered and compared with alternative solutions in the future. For this purpose, it should be **closely monitored what share of capacities in the CCM auctions are contracted by innovative, flexible technologies and how this share develops over several auction iterations**. According to the new European electricity market design (EMD), **EU national regulators are already obliged to begin reporting on flexibility needs and potential targets for national markets as of 2026.** This will be supported by common methodology developed by the EU's Agency for the Cooperation of Energy Regulators (ACER). This reporting could feed into the abovementioned monitoring and help decide whether or the CCM and price signals "deliver" with regard to incentivizing innovative flexibility.

If the CCM does not sufficiently pick up on these technologies, the decentral market can be a valuable addition to achieve the full potential of flexibility, allowing for further openness to innovation, and enabling use of local knowledge. For this, the obstacles of the HCM need to be overcome. The administrative burden should be mitigated, e.g. by providing BRPs with sufficient capacity to adequately meet their new responsibilities, granting sufficient financing and technical resources. Also, comprehensive trainings and continuous support should be provided to all parties, allowing for an effective introduction. Further, best practies from existing certificate schemes, such as the EU emission trading system, can be leveraged. To mitigate the risk of price oscillation, for instance, the introduction of floor prices and price caps in the certificate system may be considered, hereby reducing investor risk.

In conclusion, an optimised CCM can be implemented as a first step, with various "fixes" along the lines sketched above to integrate innovative flexibility approaches. This would be a no-regret option, that can be implemented in a comparably quick and less costly manner. It means embarking on a system whose final contours will only emerge over time (see above). While avoiding the risks of an untested HCM, it leaves the option to transform it to a full HCM, if needed. This allows for a quicker realisation of a capacity market in Germany and has the potential to already satisfy the needs of the future energy system without the potential obstacles of the decentral component. It also allows for a thorough preparation and possible tests with BRPs, while giving room to discuss alternative solutions. **If the CCM is not performing as desired, the decentral component can introduced at a later stage as a possible solution, provided that the obstacles of the HCM are addressed.**

AUTHORS

DR. BERND WEBER

Founder and CEO

EPICO KlimaInnovation

NICOLAS LEICHT

Project Leader

Aurora Energy Research

JOACHIM SCHMITZ-BRIEBER

Senior Policy Specialist - Industry and Energy

EPICO KlimaInnovation

ANGELIKA VON DULING

Associate

Aurora Energy Research

MANUEL BAUMHOF

Graduate Analyst

Aurora Energy Research

ABOUT US

EPICO KlimaInnovation is an independent think tank that advances constructive, market-based, and innovation-driven climate and energy policies through clear concepts and viable, balanced solutions. We create a network that brings together key stakeholders in climate and energy policy to establish and implement a socially broad-based agenda. We provide a platform for actors from politics, business, science, and civil society to engage, consult, contribute, and advance solution-oriented approaches.

CONTACT

EU Office

Energy and Climate Policy and Innovation Council e.V.
#SustainableHub, Rue du Commerce 72
— 1040 Brussels, Belgium

Barbara Vanotti
EU Communications Specialist
barbara.vanotti@epico.org

Berlin Office

Energy and Climate Policy and Innovation Council e.V.
Friedrichstraße 79, 10117 — Berlin, Germany

Agata Gurgenidze
Germany Communications Specialist
agata.gurgenidze@epico.org

@EPICO_online

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