Impact Assessment of Capacity Mechanisms

REPORT FOR THE FEDERAL MINISTRY FOR ECONOMIC AFFAIRS AND ENERGY (BMWI)

EXECUTIVE SUMMARY (ENGLISH VERSION)

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Executive Summary

Background

In Germany as well as in large parts of Europe there is currently an intensive discussion on the introduction of capacity mechanisms in order to ensure security of supply in the electricity sector.

Electricity market design in Germany and most of its neighbouring countries has so far been based on the principle of an "energy-only market" (EOM). In an EOM, investments for electricity production are primarily financed through energy-based prices (in €/MWh), which incorporate an implicit payment for available capacity. In this context, various market stakeholders have questioned whether a market design based on the EOM principle generates sufficient incentives to ensure mid- and long-term security of electricity supply. Some stakeholders have suggested the introduction of a CRM. Through a policy intervention, a CRM would induce explicit capacity payments (e.g. in €/MW per year) that would incentivise additional capacity and thus security of supply. Some of Germany´s neighbouring countries, for instance Belgium, France or Great Britain, are currently introducing CRMs.

Therefore the Federal Government is exploring the following questions:

- *Parallel study (Frontier/Formaet):* **Ability of EOM to provide security of supply** – Is the current electricty market design, based on the EOM principle, sufficiently reliable to guarantee mid- and long-term security of supply in the electricity sector – even in a market which is increasingly dependent on intermittent renewable energy? Which approaches exist within the EOM design to overcome possible obstacles to security of supply?

- *This study (Frontier/Consentec):* **Impact assessment of capacity reliability mechanisms** – How do CRMs perform in terms of their impact on factors such as security of supply, overall economic costs and wealth distribution?

To analyse these questions, the Federal Ministry of Economics and Energy (Bundesministerium für Wirtschaft und Energie – BMWi) has commissioned two studies. This final report summarises the results of the study conducted by Frontier Economics Ltd. ("Frontier") and Consentec GmbH ("Consentec") on the impact assessment of different capacity mechanisms.[1]

[1] In parallel, Frontier has conducted a joined study with Formaet Services ("Formaet") on the ability of the EOM to ensure security of supply (Frontier/Formaet (2014): Funktionsfhähigkeit des EOM bezüglich Gewährleistung von Versorgungssicherheit). Please refer to the respective final report.

Efficiency of EOM basically given

In the parallel study (Frontier/Formaet (2014)), we conclude that an electricity market design based on EOM principles can basically secure electricity supply according to consumer preferences at lowest possible cost.[2] In particular, in an EOM the provision of power and flexibility is implicitly reimbursed via electricity prices. This is basically also valid on the background of increasing shares of intermittent renewable energies and capacity mechanisms in neighbouring countries.

In real EOM, mid- and long-term constellations could come up in which the respective mechanisms of EOM cannot fully function. Reasons could be:

- Market imperfections (e.g. external effects with partial supply interruptions, market dominance, uncertainties in imperfect markets); or
- Regulatory intervention in the electricity market (e.g. implicit or explicit price limits, erratic changes of the market framework through political or administrative ad-hoc decisions).

To address these potential imperfections, we recommend some adjustments and clarifications to the current market framework, among others in the following areas:

- Avoidance of implicit and explicit price caps for the electricity wholesale market price and therefore explicit acceptance of scarcity prices ("Peak Load Pricing");
- Reduction of barriers for the integration of demand flexibility and unconventional generation capacities that are currently not participating in the market (e.g. emergency generators);
- Commercial rules for the case of production-caused, involuntary load reduction for minimisation or prevention of (hypothetical) external effects;
- Improved incentives for the management of balancing zones through further development of rules for balancing energy;
- Long-term, stable political framework (e.g. regarding promotion of renewable energy, CHP promotion, EU ETS) to minimise political risks; and

2 Both studies refer exclusively to security of supply meaning sufficiently available electricity production to cover (non flexible) electricity consumption. Possible supply restrictions through distortions or shortages on transport or distribution level are not part of these studies.

- International coordination of the definition of security of supply and cross-border processes for the case of shortages.

We think that these measures can create a sufficiently defined market environment in order to ensure profitability also for rarely used capacities and therefore to guarantee security of supply within an EOM (EOM 2.0). However, the level of security of supply achievable and therefore the need for action to introduce capacity mechanisms depend on how far these measures will be put into practice.

Capacity mechanisms analysed

The capacity mechanisms analysed are based on proposals which have been launched in the public recently in Germany:

- **Reserve (Strategic Reserve) –** The Reserve concept analysed (termed "Fachdialog Strategische Reserve") was developed by several universities, industrial associations and consultancies on behalf of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit) in 2013.[3] In this system, a central entity (e.g. TSOs, regulators etc.) tenders additional capacity which is only dispatched in scarcity periods and – apart from this – does not participate in the whoselsale market.

- **Decentralised capacity mechanisms with capacity obligations (DKM)** – This model of capacity obligations (reliability certificates, "VSN-Modell") was developed by BDEW (Bundesverband der Energie- und Wasserwirtschaft – Federal Association of Energy and Water Business) and VKU (Verband Kommunaler Unternehmen – Association of Communal Companies) in 2013.[4] In this system, market participants (e.g. retailers) are obliged to hold available a specific amount of capacity for their customers in scarcity periods. This capacity can be procured from other market parzicpants and traded by capacity certficaties.

- **Centralised capacity mechanism with tendering and reliability contracts (ZKM)** – The concept of capacity tendering and "reliability contracts" was developed and recommended by the Institute of Energy

3 See BMU et al. (2013)

4 See BDEW (2013) as well as BET/Enervis (2013). In some parts we refer additionally to different effects of model variations like for example the currently planned model in France. Here, the complete demand is fixed according to capacity certificates, but the purchase still happens centrally through distribution. In many regards, the French model is therefore a hybrid of a central comprehensive capacity mechanism and a decentralised comprehensive capacity mechanism like the model proposed by BDEW/VKU.

Economics at the University of Cologne (EWI, Energiewirtschaftlichen Institut der Universität zu Köln) in 2012.[5] In this system, a central entity (e.g. TSOs, regulators etc.) procures the whole capacity deemed to be required under short and long term contracts. The capacity is tendered in long and short term puclic auctions. Further more, operators of contracted capacity have to sign reliability contracts in which they agree to deliver energy at a predefined maximum price in scarcity periods.

- **(Central) focussed capacity mechanism (FKM)** – Here we refer to the concept of a focused capacity market developed by Öko-Institut/LBD/Raue in 2013. In this system, a central entity (e.g. TSOs, regulators etc.) procures only parts of the capacity deemed to be required in public tendering. The capacity which can participate in the tendering is either new capacity or which as assessed to be threaten by closure (separate auctions). Also in this system, operators of contracted capacity have to sign reliability contracts in which they agree to deliver energy at a predefined maximum price in scarcity periods.

Furthermore, we compare the impact of the capacity mechanisms to a further developed energy-only-market (EOM 2.0). The analysis in the parallel study of Frontier/Formaet (2014) shows that an electricity market design based on EOM principles can ensure a safe electricity supply at lowest possible cost according to consumer preferences.[6] However, adjustments to the current market framework are recommended in the parallel study.[7]

Approach

The impact assessment is based on in-depth qualitative and quantitative analyses (market simulations). We assess the mechanisms alongside the following criteria:

- **Effectiveness** – How effectively do the mechanisms ensure sufficient generation capacity? Here we distinguish between:
  - The ability to achieve a security of supply level defined by consumer preferences (according to optimal social welfare); and

5 See EWI (2012).

6 Both studies refer exclusively to security of supply meaning sufficiently available electricity production to cover (non flexible) electricity consumption. Possible supply restrictions through distortions or shortages on transport or distribution level are not part of these studies.

7 For details, refer to Frontier/Formaet (2014).

  - The ability to achieve a security of supply level or a level of generation capacity defined by political decisions/preferences (which may or may not correspond to consumer preferences and optimal social welfare)[8];

- **Efficiency** – At which cost can security of supply be achieved and which cost risks exist?

- **Regulatory assessment** – Which roles and tasks a fulfilled by government institutions, which are fulfilled by the market, what are the regulatory and administrative risks?

- **International integration** – To which extent can contributions to security of supply from foreign countries be be integrated in the mechanisms? Can foreign market participants take part in the mechanisms?

- **Impact on competition** – What impacts do the capacity mechanisms have on competition in the electricity market and in the mechanisms themselves?

- **Reversibility/Flexibility** – Is a regime reversible in case of changing circumstances? How robust/flexible are regimes in case of design failiures or unexpected developments?

Furthermore, we assess distributional effects on consumers and electricity producers inland and abroad. However, distributional effects are not an economic criterium by itself but are important in the public and therefore in the political debate going forward.

Results

In the following we summarise our impact assessment of the capacity mechanisms analysed alongside the evaluation criteria described above. For each criterion, we provide a table with summarising the assessment and a brief explanation of the conclusions.

8 Meeting preferences of politicians is not an economic criterium by itself. Therefore the respective assessment is shown in in the following in shaded colour.

Effectiveness - regarding preferences of consumers

EOM (today)	• Allows for relatively high level of security of supply close to welfare-maximum • However, there is some risk of insufficient capacity, e.g. through political risks, lacking definition of rules in case of brownouts or market entry barriers for demand flexibility	+/-
EOM 2.0	• Further developed EOM is suited to reach a level of security of supply corresponding to consumer preferences • Slight risk of distortion remains; e.g. for the determination of a brownout price the value lost load (VoLL) can only be estimated	+
Reserve	• Reserve can increase the effectiveness of the balancing energy system as settlement of imbalances remains possible in any case also in scarcity events • However, in a functioning EOM, reserve leads to a capacity level which slightly exceeds consumer preferences (overcapacity)	+/-
Decentralised capacity mechanism	• Basically analogue to EOM 2.0 • Risk of non-adequate capacity (especially overcapacity) through parameterisation risks, e.g. penalties or gate closure times (to be defined administratively)	+
Central capacity mechanism	• Low probability for a level of security of supply reflecting all costs and benefits (consumer preferences) through ▫ Expected overcapacity due to administrative determination of capacity requirements ▫ Probably incomplete integration of foreign capacities	−
Focussed capacity mechanism	• Low probability for a level of security of supply reflecting all costs and benefits (consumer preferences) through ▫ Expected overcapacity due to administrative determination of capacity requirements ▫ Risk of undercapacity and overcapacity through market separation (mainly new vs. existing, threatened by closure vs. not threatened by closure) ▫ Probably incomplete integration of foreign capacity	−

The effectiveness of capacity mechanisms depends strongly on the actual design and parameterisation of the mechanisms and on then definition of effectiveness:

A security of supply level according to consumer pereferences can most probably be achieved by an EOM (EOM 2.0) or the capacity obligation mechamism proposed by BDEW/VKU model. A reserve (strategic reserve) can be expected to lead to moderate overcapacities. The central capacity tendering mechanism with reliability contracts (EWI model) and the focused capacity mechanism (Öko-Institut/LBD/Raue) bear the risks of considerable overcapacities. The latter is due to the fact that regulatory authority/administrations can be expected to aim at rather high capacity levels due to the high risk aversion.

Effectiveness – regarding the ability to achieve politically defined generation capacity levels[9]

EOM (today)	• Current EOM reaches **only coincidentally** a politically determined level in capacity or security of supply	−
EOM 2.0	• EOM aims for a social welfare optimal level of capacity and security of supply in the market (only supported by price management) • Political management of capacity level is not aim of an EOM; political determined level of security of supply can only be reached coincidentally (e.g. autarky)	+/-
Reserve	• Reserve enables provision of additional capacity outside the EOM; increases administrative control of total installed capacities compared to an EOM 2.0 • However, uncertainty of capacity outside the reserve,	+
Decentralised capacity mechanism	• Administrative control of total capacity and level of security of supply in the range of the EOM 2.0 • However, additional administrative leeway (e.g. penalties, definition of scarcity events, gate closure times), - effect on total capacity unclear due to complexity	+/-
Central capacity mechanism	• Political control of total capacities the highest through definition of tendering volumes • However, risks remain that capacity contracted with long lead-time is not built, as well as uncertainty over link between capacity and level of security of supply	+
Focussed capacity mechanism	• Political control of total capacity relatively high through definition of tendering volumes • However, uncertainty of capacity outside of the mechanism remains (e.g. do plants not threatened by closure really stay?)	+

If the target is to achieve a certain politically-defined level of generation capacity (e.g. national self-sufficiency in capacity), the central capacity tendering mechanism with reliability contracts (EWI model) and the focused capacity mechanism (Öko-Institut/LBD/Raue) seem to be most suitable. However, uncertainties remain. For example, capacities contracted in the capacity mechanisms may not be realised. Moreover it is not clear what level of security of supply a certain generation capacity in the system will provide, for example due to the uncertainties in estimating the contributions of foreign countries to security of supply.

[9] As political accuracy is not an economically assessable criteria itself, the respective assessment is shown in this study with shaded colour.

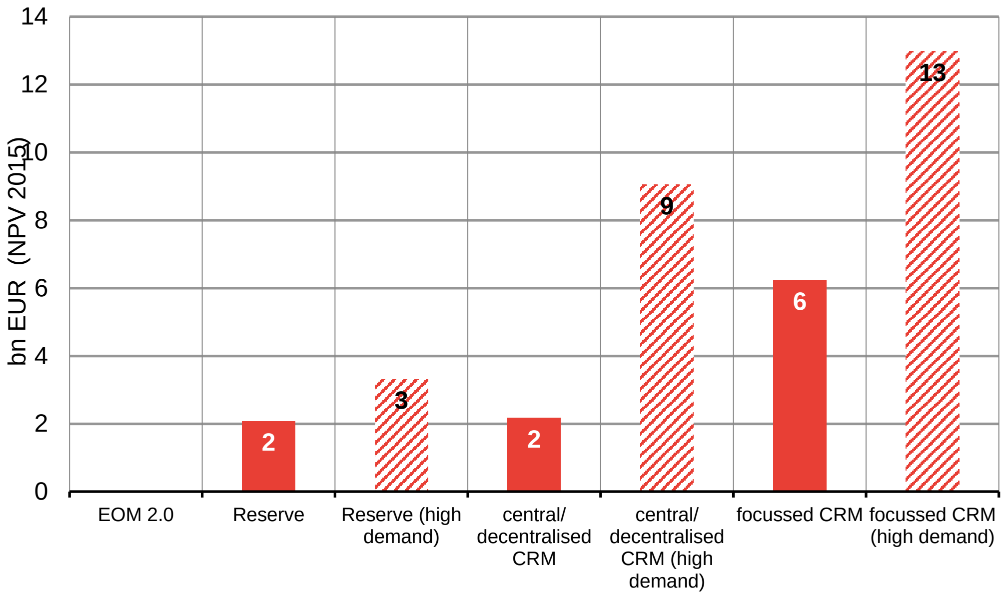
Efficiency

EOM (today)	• EOM basically leads to efficient market outcomes (see EOM 2.0) • Without reforms, EOM contains efficiency risks, e.g. through political risks, lacking definition of rules in case of brownout or costs resulting from market entry barriers for demand flexibility	+/-
EOM 2.0	• Leads basically to efficient market outcomes as market participants decide on investments and plant dispatch using information close to the market and facing own financial risks • Competition between technologies (e.g. integration of DSM) and integration of foreign countries in the single market allow for efficiency	+ +
Reserve	• Basically analogue to EOM, with additional costs for reserve • Efficiency risk mainly in the size of the reserve • Potential efficiency risk if the market environment changes unexpectedly and plants for which dispatch costs decrease have to stay in the reserve	+
Decentralised capacity mechanism	• Efficiency risk mainly in ▫ Possible overcapacity through parameterisation risks (e.g. penalties, gate closure times, definition of requirements for capacity availability, participation of foreign capacity) ▫ Costs through checking availability of plants (test alarm)	+/-
Central capacity mechanism	• Efficiency loss/risk mainly through ▫ Expected overcapacity due to administrative determination of capacity requirements ▫ Inefficient plant mix due to split of tendering in new and existing plants as well as DSM in an eraly stage ▫ Challenging integration of foreign capacity and of demand flexibility	−
Focussed capacity mechanism	• In addition to costs in central capacity mechanism, efficiency loss/risk mainly through ▫ Administrative decision on quantity, time and technology of new plants (e.g. potential construction of inefficient technologies) ▫ Possible inadequate definition of "existing plants threatened by closure"	− −

A further developed EOM (EOM 2.0) provides the lowest economic cost of all reviewed market systems. In comparison, the reviewed capacity mechanisms show additional economic costs.

Capacity mechanisms designed relatively close to the economic ideal face limited additional costs (**Figure 1**, red bars). However, there are significant regulatory risks due to misparameterisation due to the high complexity of the mechanisms. It can be expected that these failures will increase the costs of the mechanisms significantly in practice. This holds especially for the central capacity tendering mechanism with reliability contracts (EWI model) and the focused capacity mechanism (Öko-Institut/LBD/Raue). If for example higher capacity targets are assumed in the mechanisms, system costs increase considerably according to **Figure 1** (hatched bars). Furthermore, the cost risks are the highest in comprehensive capacity mechanisms - targeting the total of the capacity in the market - since the impact of a regulatory failure concerning the dimensioning of capacity demand is the highest (compared to selective capacity mechanisms).

Figure 1. System costs of capacity mechanisms in comparison to the EOM 2.0[10]



Source: Frontier (central and decentralised CRM simulated analagously)

10 Shown are the net present values of system costs in the model period from 2015-2039 as difference in comparison ti the EOM 2.0. In case of a higher requirement, the reserve was increased from 3 (5) to 4 (8) GW in 2015 (2035), in comprehensive and focused capacity markets to 88 (79) GW instead of 74 (60) GW in 2015 (2035).

Regulatory intervention and risks

EOM (today)	• Lowest level of state intervention • Information advantages and incentive compatibility of market systems used most effectively and efficiently	++
EOM 2.0		++
Reserve	• Lowest invasive into market mechanisms of the four analysed capacity mechanisms → Changes compared to today´s system relatively small	+
Decentralised capacity mechanism	• Conceptually, relative low intervention into existing markets • In practice, however, at least medium intensity of intervention (and respective regulatory risk) due to e.g. parameterisation of penalties, trigger for scarcity events and gate closure times	+/-
Central capacity mechanism	• High level of state intervention → considerable changes compared to today´s system (among other things through obligatory contracts for security of supply) • Central authority need to decide on parameters beyond the determination of total capacity procurement, e.g. also for split of purchase in new, existing and DSM plants, auction design, etc.	–
Focussed capacity mechanism	• Highest level of state intervention → considerable changes compared to today´s system (among other things also through obligatory contracts for security of supply) • Central authority need to decide on parameters beyond the determination of total capacity procurement, e.g. also decision on quantity, timing and technology for procurement of new plant, definition of cost effectiveness of existing plants, etc.	– –

The level of intervention into the market should be as high as needed, but as low as possible. The EOM is already characterised by complex regulations but requires the lowest level of intervention.Beyond the EOM, of the analysed capacity mechanisms the Strategic Reserve incorporates the lowest level of state intervention.

Capacity obligations (BDEW/VKU), the central capacity tendering mechanism (EWI) and the focused capacity mechanisms (Öko-Institut/LBD/Raue) increase the level of discretion in decision-making for politicians. Therefore they imply an increased level of state intervention. Therefore, especially centrally administrated capacity mechanisms should be assessed critically regarding regulatory leeway. This is especially true for the focused capacity mechanism.

International integration

EOM (today)	• Integration of foreign capacity happens comprehensively and efficiently via the single electricity market	++
EOM 2.0		++
Reserve	• Integration of foreign capacity happens comprehensively and efficiently via the single electricity market - reserve addresses only a relatively small market segment • Implicit integration of foreign capacity into the mechanism: Foreign capacity can be taken into account when the amount of reserve to be procured is defined • Explicit integration of foreign capacity : Possible for existing plants, but not/hardly practicable	+
Decentralised capacity mechanism	• Implicit integration of foreign capacity into the mechanism: Foreign capacity can be taken into account when the amount of reserve to be procured is defined • Explicit integration of foreign generation capacities: in principle possible – however access to x-border transmission capacity would have to be secured by Physical Transmission Rights in today´s market framework increasing costs	+/-
Central capacity mechanism	• Implicit integration of foreign capacity into the mechanism: Foreign capacity can be taken into account when the amount of reserve to be procured is defined • Explicit integration: For cross border integration physical transmission rights required, today; today's setting for FTR's not suitable for central capacity mechanism due to lead-time of procurement and contract duration	–
Focussed capacity mechanism	• Implicit integration of foreign capacity into the mechanism: Foreign capacity can be taken into account when the amount of reserve to be procured is defined; however, pre-qualification criteria not applicable cross-border • Explicit integration: In theory possible for existing plants, but implementation not realistic in practice	– –

The EOM is based on an integrated European market and therefore allows a full, effective and efficient international integration of foreign market participants.

The Reserve addresses only a small market segment and therefore essential parts of the market stay fully internationally integrated via the EOM. However, the procurement of Reserves across borders is difficult to organise in practice since cross-border transmission capacities would have to be reserved for calling the generation reserve.

Among the other capacity mechanisms, the decentralised capacity mechanism based on capacity obligations (BDEW/VKU) performs slightly better than the other mechanisms regarding international integration. This is due to the fact that foreign generation capacities can explicitly be integrated into the mechanism at a security level similar to inland production, even though the access to cross-border transmission capacity would have to be secured by Physical Transmission Rights in today´s market framework (which implies higher costs). Due to longer contract and lead times of capacity procurement in the other capacity mechanisms, an explicit integration of foreign capacity in the mechanisms is not possible in practice. Therefore, foreign capacities can only be integrated in an implicit way by deducting expected capacity contributions from abroad from the targeted capacity levels inland. However, this approach may be linked to a lower level of security of supply compared to an explicit integration of capacities into the mechanisms.

Furthermore, the focused central capacity mechanism (Öko Institut/LBD/RAue) foresees specific prequalification criteria for parrticipation in the mechanism (e.g. technological requirements). However, these criteria would be difficult to implement cross-border, especially if foreign capacity is taken into account in an implicit way rather than explicit way in the mechanism.

Impact on competition

EOM (today)	• Competition in EOM in principle working (e.g. market shares below thresholds for dominance, market is contestable) • However, potential market entry barriers e.g. for demand flexibility e.g. due to specifics in the structure of grid charges	+/-
EOM 2.0	• Competition working due to contestability of markets and diverse market structure • In scarcity events, scarcity rents allowed to refinance investment costs of capacity „at the margin"	+
Reserve	• Competition in energy market: Mostly unaffected by reserve • Competition for capacity payment: can be a challenge e.g. if prequalification criteria are defined in a strict way or markets but competition can be expected to sufficient at least if reserve is procured on a national level	+/-
decentralised capacity mechanism	• Competition in energy market: possibly intensified through additional capacity • Competition for capacity payment: Basically possible as no requirement for prequalification → but possible disadvantage for small supplier portfolios	+/-
Central capacity mechanism	• Competition in energy market: possibly intensified through additional capacity • Competition in capacity market for new plants: Dependent on auction design • Competition in capacity market for existing plants: potentially challenging - incentive for market players with a dominant position (if there are) to strategically shut-down capacity to increase payments for the remaining portfolio	+/-
Focussed capacity mechanism	• Competition in energy market: possibly intensified through additional capacity • Competition in capacity market for new plants: Possibly dependent on auction design • Competition in capacity market for existing plants: Challenging as in mid-term tendered capacity volumes may be similar to potential supply (i.e. no competition possible)	+/-

In the current EOM, competition can be assessed as effective and working. The market structure in power generation has become less concentratedin recent years, and the market can be deemed as contestable in a dynamic perspective. Furthermore, market entry barriers can be reduced further for potential newcomers (e.g. through enhanced market access for demand flexibility and emergency generators),

Regarding capacity mechanisms, potential effects on competition on the energy market on the one hand side and the capacity market (created by the mechanism) on the other hand side have to be taken into account. Competition in the energy market may be increased by additional capacities incentivised by the mechanisms. However, the positive effect is limited if the market structure is already relatively diverse which is the case for the German market, today. Furthermore, in the mechanisms which foresee reliability contracts (EWI model, Öko Institut/LBD/Raue), additional instruments exist to limit potential market power in the energy market. However, these reliability contracts can be expected to change the market dynamics fundamentally (for example regarding the forward market and traded reserve products) and increase the level of state intervention into the market.

Regarding competition on the capacity side, the mechanisms bear the risk of market power, especially in the case of capacity auctions with certain pre-qualification criteria or long lead times. Instruments such as mandatory offers by certain types of technologies are meant to relieve competitive concerns but at the same time increase the level of state intervention into the market further which can lead to inefficiencies.

In decentralised capacity mechanisms with capacity obligations (BDEW/VKU), there is the additional risk that market particpants with large portfolios are better off and market barriers for small and new market stakeholders arise since portfolio effects have an impact of the risk position of the stakeholders. The design of the mechanism should therefore aim at minimising these effects as far as possible (e.g. regarding the definition of gate closure for trading certificates, trading rules, pooling options, etc.).

Reversibility/Flexibility

Reserve	• Reserve can be adapted to a changing environment under short notice • Phasing-out of reserve possible on short notice (dependent on contract duration) • High calling price of reserve as prerequisite for low influence of changes to the system (e.g. capacity demand) on investment decisions outside reserve	+
Decentralised capacity mechanism	• Changes to the system (e.g. height of penalty) possible on short notice because of short-term character of the mechanism • However, capacity effect of mechanism is based on long-term expectations of revenues from sale of capacity certificate → therefore: limited flexibility/reversibility	+/-
Central capacity mechanism	• Short-term changes to the mechanism only with long-term effect due to long lead-times of contracts (new-builts) • However, auctions/tendering can be phases out; existing contracts stay valid	+/-
Focussed capacity mechanism		+/-

The reserve can relatively flexibly be adapted to a changing market environment.

The central capacity tendering mechanism with reliability contracts (EWI model) and the focused capacity mechanism (Öko-Institut/LBD/Raue) incorporate capacity contracts with long durations. Therefore, modifications in the mechanism take effect (e.g. on the costs of consumers) only with long lead-times. On the other hand, these mechanisms can comparatively easily run out e.g. by ceasing to tender new capacities and to conclude new capacity contracts.

In the decentralised mechanism with capacity obligations (BDEW/VKU), markert particpants can relatively flexible adapt to changing market conditions due to the comparatively short-term lead-times and the specific role of decentralised decisions (e.g. regarding the amount of capacity procured).

However, a future reversibility of the mechanism is challenging as modifications of the mechanism have an effect on the returns of all investments made on the basis of these mechanisms being in place in the long-term.

Distributional effects (consumer perspective) [11]

<table>
<tr><td>Reserve</td><td>• Burden on consumers slightly higher than in reformed EOM; profits/benefits of inland producers in sum slightly higher.
▫ Capacity payment only to a fraction of plants (e.g. 3-5 GW)
▫ Electricity prices mainly unaffected</td><td>+/-</td></tr>
<tr><td>Decentralised capacity mechanism</td><td rowspan="2">• Additional burden on inland consumers and additional benefits for inland producers through capacity payments, however, partly considerably compensated through lower energy prices
• Extent of additional burdens and benefits depend on
▫ Amount of capacity procured → Risk of considerable additional consumer burdens due to the risk of high capacity requirements
▫ Interaction with foreign countries (especially energy price effect is dependent on reaction of foreign governments and market particpants)</td><td>−</td></tr>
<tr><td>Central capacity mechanism</td><td>−</td></tr>
<tr><td>Focussed capacity mechanism</td><td>• Focussed capacity mechanisms goes along with opposing effects for consumers:
▫ Focus on plants threatened by closure leads to temporary reliefs of consumers
▫ Inefficiencies of mechanisms lead to additional costs also for consumers
• In sum a temporary relief for consumers seems possible, however, at the expense of existing generators who's capacity is not remunerated by the mechanism – negative effect on the credibility of the market framework and investors can increase costs of the mechanism</td><td>+</td></tr>
</table>

Capacity mechanisms face in general a trade-off between the burden on consumers on the one hand side and the profits for plant operators on the other hand side:

- **Additional capacity payments** – Capacity mechanisms provide explicit capacity payments for (at least some) plant operators. However, the mechanisms differ on how and which capacities receive those payments.

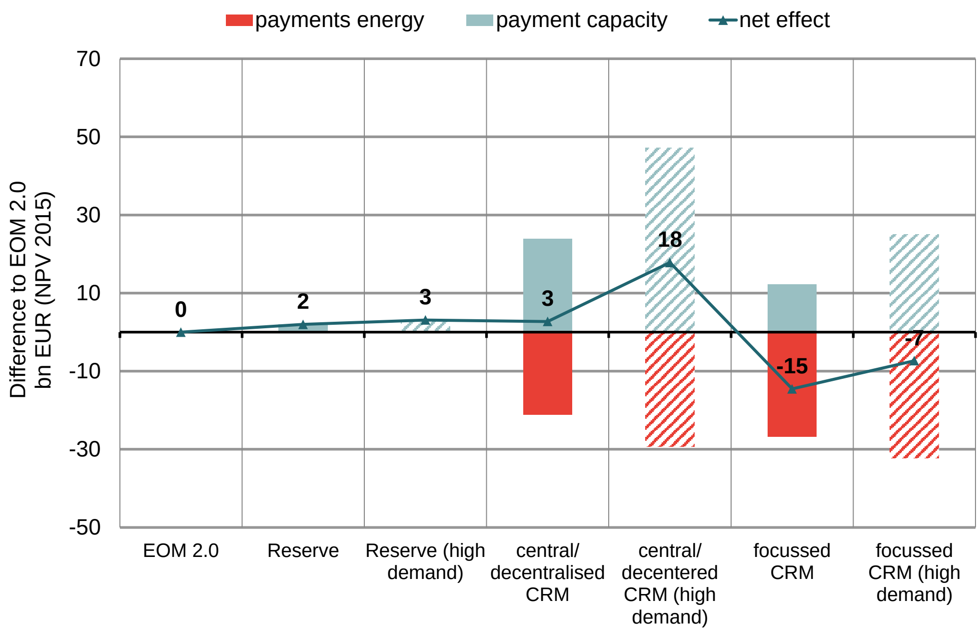
- **Reduced wholesale electricity prices** – In return, average wholesale electricity prices can be lower with capacity mechanisms (compared to a pure EOM) due to the additional capacity on the market incentivised by the capacity payments.

The extent of the two opposing effects and the net effect depend substantially on the design and the exact parametrisation of the mechansisms e.g. regarding the amount of capacity procured as well as on further factors such as the impact on international imports and exports.[12]

11 Distributional effects are not an economic criterium. The assessment (here from the perspective of consumers) is therefore shown with shaded colour.

12 In practice, capacity in neighbouring electricity markets is likely to decrease in reaction to additional capacity within a capacity mechanism in Germany. This could be managed centrally within a capacity mechanism abroad (e.g. in France), if the possibility of electricity import from Germany is explicitly considered in the capacity mechanisms, or within the EOM abroad, where plant operators could react with closures or reduced investments to lower electricity prices due to additional capacities in

Figure 2. Burden of inland consumers in relation to EOM 2.0[13]



Source: Frontier

The two comprehensive capacity mechanisms (EWI, Oko-institut/LBD/Raue) can be expected to create the highest financial burden on inland consumers as capacity payments are made to all contracted capacity. This effect (and therefore the burden on consumers as well as the additional benefits for producers) can, however, considerably be reduced through the lower wholesale electricity prices resulting from the additional capacity.

A reserve implies a considerably lower burden on consumers as well as lower additional benefits for producers. Benefits for producers are limited to those capacities which are part of the reserve.

The focused capacity mechanism (Öko-Institut/LBD/Raue) goes along with opposing effects. The FCM can at least temporarily lead to a lower burden on consumers, however, on the expense of existing capacities not benefitting from

Germany. The stronger the reaction abroad, the lower will be the effect on electricity prices, and therefore the higher the burden for consumers in Germany. In our model we assume a constant capacity abroad. Therefore, the results regarding the consumer burden are to be understood as conservative. In case of a simulation of foreign adjustments, the burden for Germnan customers would be higher.

13 Payments of inland consumers for capacity and energy (related to non-renewable quantities) as net present value from 2015 to 2039 in difference to the EOM 2.0.

the mechanism. This undermines the legitimate expectations of investors and therefore the credibiltity of the market framework.

Conclusions and recommendations

A further developed EOM (EOM 2.0)[14] can create a sufficiently defined market framework to ensure an adequate value of even rarely used capacity and flexibility and therefore ensure security of supply. However, the attainable degree of security of supply and therefore the need to introduce a capacity mechanism depend on how accurately the EOM framework is defined.

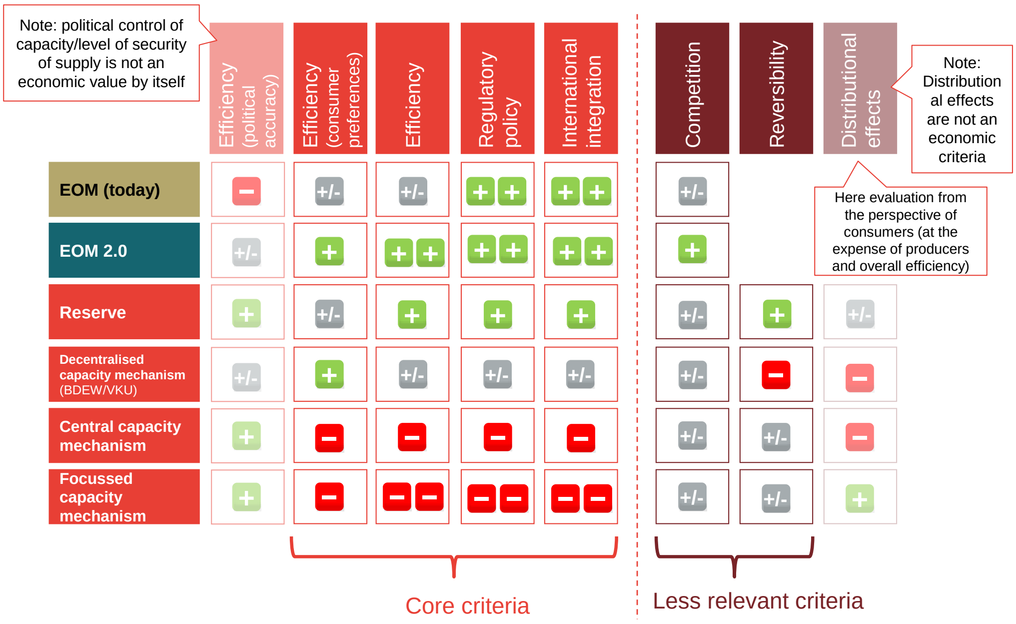
Given this background, capacity mechanisms may be implemented if

- EOM reforms are not put into practice and therefore significant (mainly political) risks remain;
- Potential remaining external effects shall be addressed; or
- A politically determined level of security of supply (e.g. national self-sufficiency) is deemed to be desirable.

Figure 3 summarizes the detailed assessment of the reviewed market systems according to the evaultaion criteria.

14 As described in Frontier/Formaet (2014).

Figure 3. Summary - Assessment of capacity mechanisms[15]



In summary, the available options can be assessed as follows (**Figure 4**):

- A **reserve** is an option to support a further developed EOM if remaining market failure risks are assessed to be significant or an additional "safety net" is politically desired.

- The **decentralised capacity market with capacity obligations** (defined as in BDEW/VKU) is compared to the mechanisms with comprehensive capacity tendering/auctioning linked to the least regulatory market intervention. With a design close to the market, costs are moderate, but additional benefits are probably also limited in comparison to an EOM 2.0. Risks of a decentralised capacity market are mainly associated with an inadequate design of the mechanism (with effects on costs, competition, etc.) and with slipping into an increasingly high level of state intervention ("slippery slope").

- A **central capacity market with capacity tendering/auctining** (EWI) can not be recommended from a cost and benefit perspective. This option should only be considered if long term risks are assessed to be prohibitive

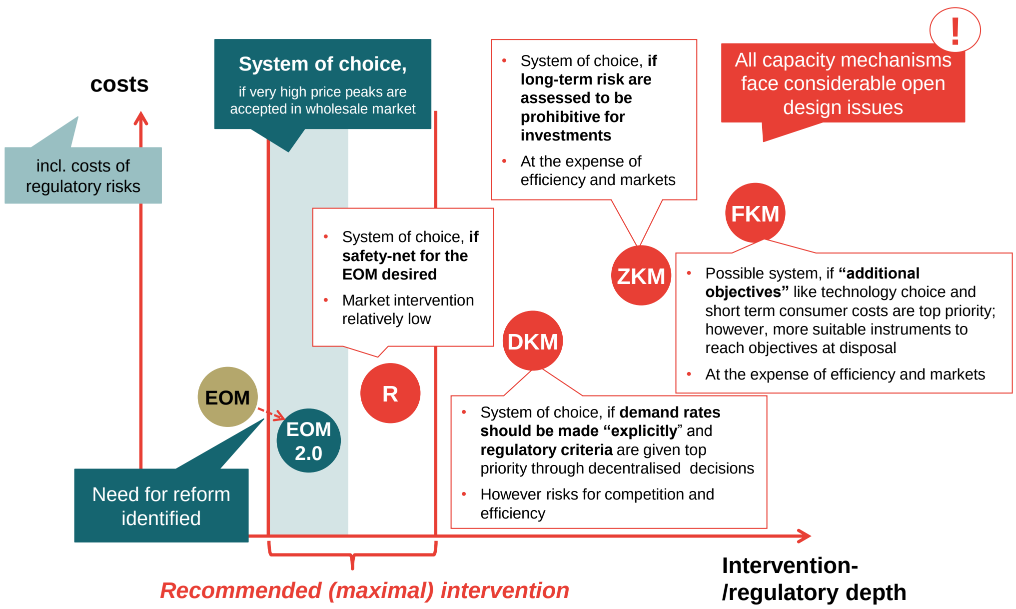
15 There is no assessment of the criteria "reversibility" for EOM (today) and EOM 2.0, as no explicit additional mechanism is established that could be reversible. There is no assessment for "distribution for EOM (today) and EOM 2.0, as EOM 2.0 is a reference.

for new investments or market dominance in the EOM became considerable – in a further developed EOM, we assess these challenges to be manageable or of minor importance.

- A **focused capacity market** can not be recommended from an energy-economic and regulatory perspective.

Capcity mechanisms face a substantial risk of false paramtresiation and substantial regulatory risk leading to misincentives for market participants. Additional costs for consumer can be substantial. Therefore, we recommend that regulatory intervention into existing market mechanisms is minimised. Costs for ensuring security of supply are minimised and dynamic market processes, which also contribute to the transformation of the energy system towards renewables and low carbon, can be kept effective.

Figure 4. Illustration - Costs vs. intervention/regulatory depth of the mechanisms



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