Technical advisory event

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Gertjan Meutgeert, Kesnia Tolstrup, Reinhard Kaisinger, Wiljo Treurniet
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Magnus Energy's Technical Advisory event

Introduction

It is not that common that so many bright minds from TSOs, DSOs, market participants and operators, regulators and the European Commission gather to discuss some of the most pressing challenges of the energy transition: system adequacy and stability. On 16 January, Magnus Energy organised an event for these experts. We discussed the different dimensions of security of supply in terms of timeframes, geography, and stakeholder integration. In this report, we share the outcomes of these discussions*.

Key insights

The event participants shared their views on the main questions and pressing issues related to societal, technical, market-design-specific and organisation issues of the energy transition.

Keynotes

Three presenters offered their views on system adequacy and stability. The first presentation covered system adequacy, its assessment, and the role of capacity markets in the future electricity market design based on the German, Belgian and Dutch experience. The second presenter introduced the evolution of transmission and distribution system operators' relations, priorities, and coordination approaches with regard to congestion management. Finally, the third presentation established a link between congestion management and balancing processes of the TSO.

Discussion rounds

Based on the presentations, the subsequent discussion rounds were centred around capacity mechanisms, TSO-DSO coordination, and their main concerns, the (future) role of demand response, the need for additional (locational) incentives for flexibility providers and others.

Acknowledgements

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**Please note, that this report constitutes a summary of the opinions and issues raised during this event under Chatham house rules and not a uniform position of all the participants on the issues discussed.*

Introduction

On 16 January, Magnus Energy organised an event for from TSOs, DSOs, market participants and operators, regulators, and the European Commission to discuss some of the most pressing challenges of the energy transition: system adequacy and stability. We discussed the different dimensions of security of supply in terms of timeframes, geography, and stakeholder integration, using the model below.

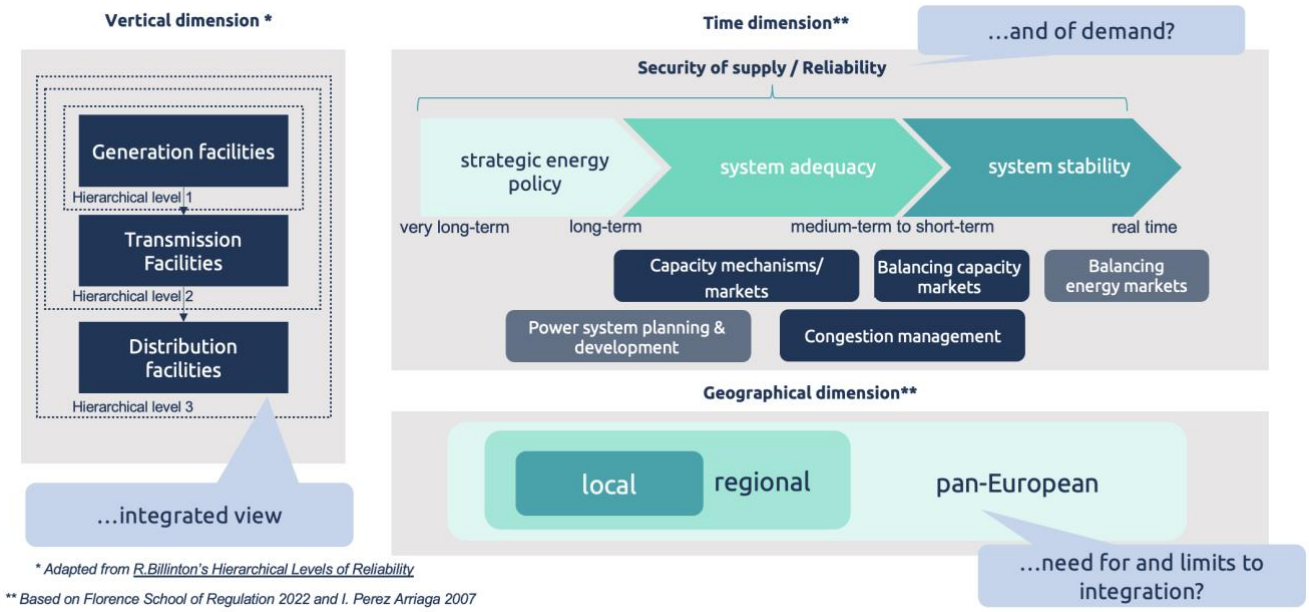


Figure 1. From adequacy to congestion management and balancing: Layers of future energy system challenges.

Also, we pondered on what cake baking and power system reliability have in common and engaged in lively discussions around capacity markets, congestion management at TSO and DSO levels and its intersection with system balancing. These exchanges did not just allow us to share views but also to obtain a deeper insight into the topics above and beyond from different stakeholder perspectives.

Key insights

Overall, the energy transition towards 2030 and beyond poses multiple challenges.

Societal/Political challenges

Affordability of the energy transition, shift in consumer behaviour and resistance towards the expansion of energy infrastructure (NIMBY), fragmentation of solutions and market interference due to political pressure

- Rebuilding trust in the energy sector among general population
- "Building enough [generation + storage + transmission + distribution], fast enough"
- Incentivising a behavioural shift among all kinds of final consumers towards reacting to the needs of the system, by increasing their exposure to price signals (high and low) and raising awareness
- Keeping energy affordable while transitioning to a cleaner and more sustainable system, while reversing on energy density for the first time in human history
- Securing sufficient investment in energy infrastructure, renewable energy sources (RES) and flexibility, which is challenging due to public opposition to such projects leading to a significantly higher risk for investors and system operators alike.

Technical market challenges

Complex technical transitions to be managed with high stakes in terms of investment risk, system security and the successful integration of renewable energy sources (RES)

- "Speeding up the energy transition while keeping the lights on – How long can we continue squeesing all the margins?"
- "Managing a massive amount of assets that you now can hardly control"
- Upcoming PICASSO and MARI go-lives for multiple Member States in 2024
- MW vs MWh: Designing incentives to ensure not just sufficient non-fossil capacity [MW] but also sufficient dispatchable generation [MWh]
- Keeping the market secure while satisfying consumer needs
- A proper design of bidding zones allowing a non-discriminatory approach between bidding - zone internal and cross-zonal trade while ensuring operational security
- Building a grid for a future-proof energy system

Market design challenges

Challenge to design the right incentives and to set the "right" price signals in the design of the energy market, especially when it comes to ensuring sufficient flexibility at any time and location.

- Giving adequate price signals to all types of generation, storage and demand in a technology-neutral way
- Evolution of the Target Market Model and the challenge of adapting it to face up to the reality of an increasingly renewable energy system: Can and should zonal market design be maintained in the future at all costs – is it fit for a decarbonized energy system? How to provide locational signals to generation and demand and provide non-discriminatory access to the grid?
- Increasing the degree of harmonisation necessary with regard to the ways of dealing with flexibility and aggregation

- Avoiding EU market distortion due to fragmented national instruments, in particular exacerbated by the energy crisis
- Ensuring more stable market rules for all – that can be preserved next time we experience price spikes – combined with clear measures to shield vulnerable consumers from price shocks
- Integration of offshore bidding zones, requiring a lot of international stakeholder coordination and underlining the importance of developing efficient solutions, including in cooperation with the UK. It is coupled with a technical system challenge of how to operate offshore grids only with the help of interconnectors and in the absence of load-frequency control and demand
- Implementing existing regulation into national laws while new regulation is continuously developed

Organisational challenges

Roles of different players, especially system operators, are evolving. Furthermore, the cooperation between different stakeholders, especially TSOs and DSOs is bound to become closer and more complex.

- Network operators' journey to *system* operators. DSOs need to understand what's necessary (expertise/organisation) based on their changing role. Handling increasing volumes of flexible assets in distribution grids remains the major DSO concern. The learning curve towards a market facilitator role, including utilization of digitalization, remains very steep.
- TSO-DSO cooperation in terms of governance, data exchanges and process coordination is still in its infancy in most Member States.

Time to address these challenges is running out. "2030 is tomorrow".

Keynotes

ADEQUACY: "Should capacity mechanisms be treated as an integral part of the EU electricity market design?" – Presenter's input

A well-functioning market design is efficient and reliable. It limits market power and ensures overall fairness while encouraging innovation. In an energy-only market design, price signals drive investment (or retirement) decisions, which ultimately affect indicators of reliability and scarcity. The cycle continues as these indications are later manifested in the evolving price signals.

Yet, interventions in the energy-only market are frequently made, which interfere with market price signals and create, among others, regulatory uncertainty affecting capital costs. These can range from technology-specific subsidies (i.e. net metering) to temporary interventions such as caps of inframarginal rents, as applied during the 2022 energy crisis.

Another mechanism that complements the energy-only market is CM (capacity mechanism), which is allowed to be introduced if a number of conditions stipulated in the Clean Energy Package (CEP) are met. For instance, according to the currently applicable EU regulation, CMs should be measures of last resort, temporary, technology-neutral, market-based and allow cross-border participation. The mood towards CMs has been gradually changing as in the Electricity Market Design Reform (EMD), CMs are deemed "**a structural element** of the electricity market design, although they remain subject to the approval by the EC for no longer than 10 years.

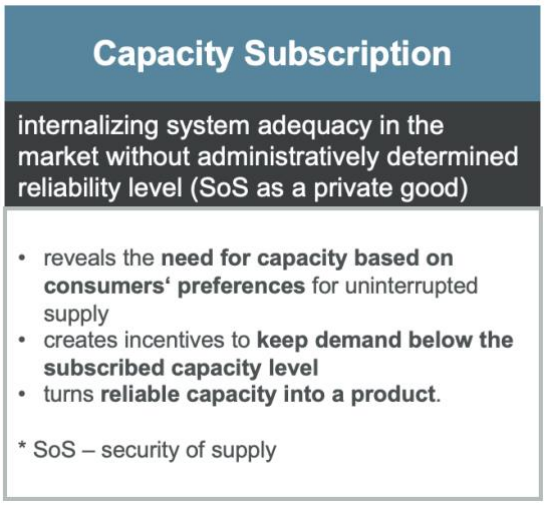
For certain countries, the availability of capacity in future scenarios is expected to be very low, which hints on the need for CMs or other market intervention to secure sufficient generation adequacy and flexibility. Therefore, there's a trend of an increasing number of CMs in the EU, which is in contrast the approach stipulated in the regulation until recently.

Main issues with CMs:

- The design parameters of a CM, such as the derating factors per technology, make the CM **by default technology biased**. In practice, this may lead to most of the CM capacity to be fulfilled by specific generation technologies, in particular CCGTs[1].
- The costs of CMs are included in the overall pot of network tariffs while current grid tariffs are based on grid capacity (ergo, peak load). Therefore, **the costs for CMS might not be distributed fairly** since the reserved capacity is of highest relevance in times of scarcity. This calls for a CM cost distribution that is at least to an extent distributes the larger chunk of the costs to the consumption in scarcity hours while distributing the rest among all – due to risk reduction for all consumers.

[1] One of the experts observed, however, that it was technically possible for demand side management to have a derating factor of 100% when there is no limitation to activation duration. In terms of participating technologies, it was further observed that storage turning into a relevant contributor (cf. latest results of Belgian Y-4 capacity auctions).

- The need for CM is getting increasingly complicated to model as **the situation is becoming less predictable and stable over time** (cf. in Germany, the projected need for additional capacity for 2050 ranges between 8GW and 56GW depending on the scenario and assumptions).
- Even with CMs**, it is unlikely that EOM + CM arrangement will complete the overall design**. For instance, nuclear energy is not expected to be involved in CMs in current design, so support schemes for new nuclear outside of a CM could be applied.
- A big challenge is to go from explicit remuneration of availability (for example by means of CMs) to implicit flexible demand response. **Capacity subscriptions** could be a way to facilitate implicit flexible demand response and turn reliable capacity into a product. This in essence would mean privatisation of reliability depending on the willingness to pay for it.



CONGESTION MANAGEMENT: "Wired Relations: Balancing TSO and DSO Interests in Congestion Management" – Presenter's input

The ENTSO-E's vision is to have a strong cooperation between transmission and distribution SOs in the System of Systems, which encompasses the whole energy sector. Variable resources coming online are almost exclusively connected to the distribution grid. When this happens, TSO-DSO cooperation on balancing the energy grid is no longer a nice-to-have but rather a prerequisite for a stable functioning of the power grid.

In this cooperation, markets can theoretically solve everything. However, they can do so only to the market time resolution – and down to the geographical resolution (bidding zone) represented in the market. Furthermore, markets only work efficiently when sufficient competition exists. The competition for local services in DSO grids is expected to stay limited in the foreseeable future. However, this may change over time with an exponential growth of distributed flexible technologies and efficient linkage between local and zonal markets.

Conflicts between DSO TSO or same priorities?
Thermal limits in DSO grids must initially have priority over TSO constraints due to less available flexibility and tools to keep the system within bounds. However, excessive security margins are to be avoided, to make sure that flexibility for the TSO grid is not unnecessarily "blocked". The flexible potential of the distribution grid should be transferred to the transmission grid to the largest extend possible.

At the same time, the adverse effects of DSO congestion management on system balance should not be exaggerated, as it could restrict the DSOs to perform their congestion management effectively.

According to the presenter, balancing and congestion management are not to be separated, as they are vastly intertwined. BRPs are to be involved to bridge the gap between balancing and congestion management efforts.

In terms of TSO-DSO coordination mechanisms, these range from a centralised flex market for system services (+DSO validation), local DSO and TSO flex markets with resource sharing to common TSO-DSO flex markets.

What could be the way forward?

- **Hierarchical balancing** based on a model of a local DSO market and a TSO market, is seen as a promising concept. Its gradual implementation is possible yet requires a high level of DSO digitalisation and real-time data availability.
- **Day-ahead and intraday markets are also implicit sources of flexibility.** Yet, if consumers are locked away behind fixed price contacts, there is no possibility to involve them. One option is to apply fixed consumer contracts with fixed minimum *volumes*, so that outside of the minimum volume, consumers are still subject to flexible prices.
- Focus on creating **incentives for DSOs** to share flexible resources with TSOs. It might not suffice to wait for commercial/market pressure.
- Effects of **DSO congestion management activations on system balance should not be exaggerated** as these are relatively small and uncorrelated and level out at system level. DSOs should not "balance", they are not BRPs.

Main take-aways

- Flexibility platforms impact unknown and therefore, impact on grid planning can be evaluated only after years of experience with operational platforms/products.
- Consumer behaviour change and reaction to price signals is very uncertain, diverging opinions. In many cases, consumers don't even have the capacity to react to prices (no smart meters, no smart appliances, minimal power consumption).
- Future role of DSOs with respect to balancing (and in relation to CM) to be defined.
- Expertise, organisation, and digitalisation on DSO level requires years to get to a level where flexibility can be effectively exploited.
- In the foreseeable future, DSOs' main concern is responding to the increasing volumes of volatile and/or flexible resources at the distribution level rather than their active use for DSO-specific purposes.
- The EU regulation for DSOs (e.g. NC DR) should reflect the experimentational phase that DSOs are currently in, giving them sufficient room and time to innovate and make mistakes.

INTERSECTION OF BALANCING & CONGESTION MANAGEMENT: PICASSO/MARI Implementation: How available transfer capacities influence the cross-border exchange in the balancing timeframe – Presenter's input.

Besides intrazonal congestion management involving either TSOs or DSOs, cross-zonal congestion is the other side of the coupled market reality.

Limited cross-zonal transmission capacity affects market outcomes in all timeframes, forward, day-ahead, intraday but also balancing timeframes. The European balancing energy market integration manifested itself in the go live of IGCC, PICASSO (aFRR), MARI (mFRR) and TERRE (RR) projects

between 2020 and 2022. Managing all the platforms on the same border is getting increasingly complex. Generally, balancing platforms receive the remaining capacities available after the allocation in the day-ahead and intraday timeframes: from RR to mFRR to aFRR and, finally, to imbalance netting.

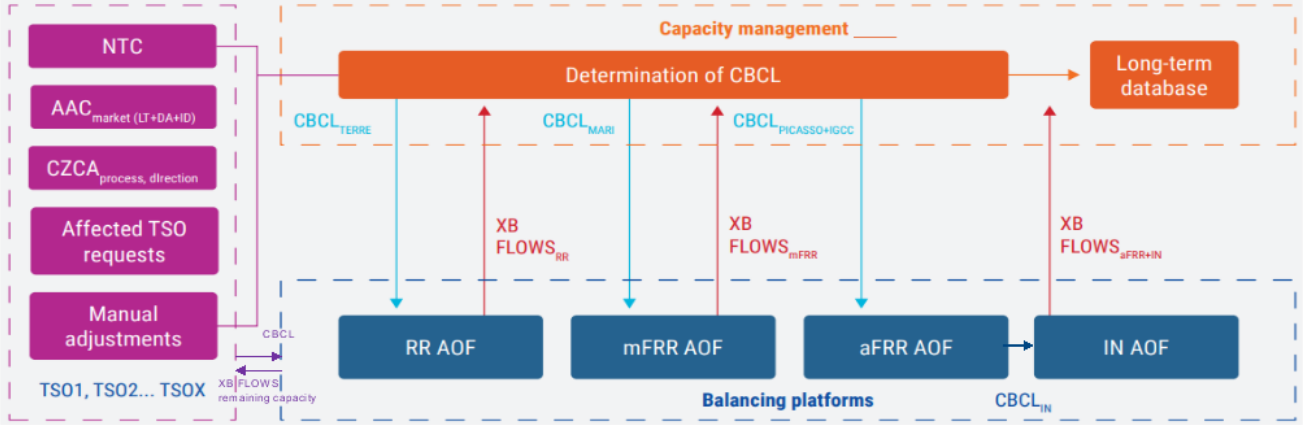


Figure 2. Overview of the process for capacity management in the balancing timeframe. Source: TransnetBW 2023.

German TSOs are conducting simulations by **using the bids from the balancing timeframe for short-term congestion management.** For this, the result of load flow calculation in PICASSO is implemented for monitoring, after which hourly PTDFs generated in DACF (day-ahead congestion forecast) are used. (If used in operation, the approach should rather use PTDFs from continuous intraday congestion forecast.) Using this method, it is possible to estimate the additional induced load flow by an X-Border exchange of aFRR on selected lines and corridors (set of lines). Possible further steps might be to even use the optimiser to set „target load flows" on certain lines/corridors (with significant consequences for the aFRR activation).

The simulations confirm the importance of not separating balancing from congestion management, as both are tightly intertwined. It is, however, observed that this type of congestion management directly impacts the imbalance settlement price of the complete region, which might not be the right incentive for an efficient balancing market. The simulations also showed that a parallel calculation of imbalance settlement price without actions for congestion management was possible.

Main take-aways from the simulations

- Possibility for a closer to real-time congestion management
- More cross-border exchange of FRR (energy and capacity)
- Thus, closer link needed between congestion management and balancing while the challenges for their coordination will become more important.
- Powerful optimisation systems are in place and in operation in the balancing platforms, which might be used in the future for congestion management purposes.

Discussion rounds

Capacity remuneration mechanisms

With regards to the cost structure and harmonised design of CM across Europe, there is scepticism about the feasibility of full harmonisation – mostly due to the region-specific, technical, political, and geographical, circumstances. Furthermore, it is argued that each country has the freedom in its design to boost innovative solutions and learn from surrounding regions. However, **"regionalisation" of CMs** seems to be a good middle ground before national fragmentation and full integration. It is, however, noted that EU Member States have so far made little effort to open their CMs to cross-border participation or coordinate their CM designs.

Even though the legislation requires to use a **probabilistic instead of a deterministic approach to defining adequacy**, the energy sector, politicians, and society may not yet be fully ready for it, in terms of accepting that in the future electricity may not be available at all times to all consumers.

The value of RES, demand response and battery storage for CM is debated. The possibility of significant CM revenue streams for these technologies, due to their potentially limiting derating factors, remains an open question. Options such as specific products within the CMs, low carbon tenders or flexibility support schemes could increase investment incentives for RES, demand response and battery storage. Care should, however, be taken with not locking in specific resources – a market or system need may be filled by different technologies, an expert observed.

Energy trading companies are concerned about the uncertainty of where the investment incentives will go. Some experts questioned whether CMs (and the rules conditioning their implementation and design) will still be relevant with additional technology-specific support schemes, such as 2-way CfDs, being introduced. It is thus important to clarify what the ultimate goal of CMs is – namely, to promote efficient investments to safeguard resource adequacy.

Day-ahead prices above €200/MWh, frequently occurring in the two past years, indicate among others an inflexible demand side. Electricity prices may play a limited role in household economy in many places, others may not have access to prices or not be in a position to act on prices. In addition, one of the experts noted, most consumers are partly or fully shielded from short-term price fluctuations through fixed-price supplier contracts or regulated tariffs. However, in extreme cases, which drew major attention, there was a 10% reduction of consumption observed, even though this flexibility was not in any case observable or modelled/forecasted. This "invisible" flexibility exists and is to be considered and exploited in the future. As one of ideas, access to information through (social) media can be used to induce consumer flexibility.
It is noted that affordability does not seem to be an optimisation parameter in the energy transition, but rather a limiting boundary condition to make this transition happen.

Demand response

It is argued that **more of explicit demand response (DR)** will be necessary in the future, as the reliability of the implicit response is currently limited in some countries. In addition, current regulated prices and network tariff structures do not account for or not aligned with RES peaks and thus hinder DR that is generally aligned with demand peaks.

Participants see an opportunity in industrial / larger consumers to run **semi-flexible contracts.** This would strike a balance between the risk for such consumers, and the acknowledgement of the fact that DR likely cannot guarantee 100% reliability. For this, it should be further identified where the potential is for semi-flexible contracts and how to use (temporary?) tools/incentives to get access to this flexibility.

The potential of dynamic prices for the demand side drew mixed reactions. Some participants argue that this impact is already significant in some countries, as consumers are proven to be willing to change behaviour with adequate financial incentives. Consumers have already shown a change in their behaviour based on dynamic pricing, for example in the Nordic countries. However, others see that existing financial incentives are not leading to significant changes in behaviour, such as switching energy suppliers or contracts. Furthermore, they argue that consumers are not used to changing their energy consumption behaviour based on limited financial incentives in the long-term. Knowledge and especially automated IT solutions need to be further developed and widely spread to be able to benefit from dynamic prices as a consumer. Further digitalisation will increase automatic response of consumers by ensuring similar comfort levels and optimising economic benefits.

TSO-DSO interface for congestion management and balancing

Some participants argue that the **market time resolution** should be improved to improve the market's role in providing congestion management and balancing services. Some TSOs successfully allow markets to run until 5 min before real time.

Some experts argued that BRPs could only be involved to bridge the gap between balancing and congestion management efforts if solutions are found to make balancing and congestion management systems compatible.

At the same time, care should be taken when considering the cost allocation for system services. If the cost of congestion management is not properly allocated, this could result in freeriding and cost being paid by those actually not causing it, e.g. by BRPs facing high imbalance prices due to the market outcome not being respected. In pilot projects, this can be accepted but when structurally implementing congestion management by DSOs, it cannot.

Using the balancing time frame bids for short term congestion management

In the Nordics, using the balancing timeframe bids for short-term congestion management is common today. According to some participants, attention should be paid to making sure that any cross-zonal capacity used by SOs for cross-zonal balancing/ congestion management would not have been more efficiently used by market participants themselves. There is a finite amount of capacity to be used across timeframes, and the one used by system operators cannot be used by the market.

DSO perspective on flexibility and system challenges

There is **no uniform DSO perspective in Europe.** The perspective of different DSOs across the EU is even more dispersed than the perspective of different TSOs. The main operational and organisational challenges of DSOs are omnipresent, but the local circumstances make all the difference for the solutions.

DSOs are impacted by flexibility markets, regardless of whether DSOs are themselves participating in the market. Instruments like metering devices are forcing DSOs to take a more active part in the complex system, which was until recently mostly operated by TSOs.

DSOs do not necessarily agree that everything should move closer to real-time and stress the **importance of grid planning and longer-term availability products** in this changing dynamic environment. However, there's no consensus between DSOs on the way to design such products most efficiently and effectively.

Experience with availability products and flexibility markets/mechanisms is needed before it can be rolled out on a large scale by DSOs. This slows down the impact of flexibility mechanism innovation on the grid planning of DSOs. Furthermore, the operational implementation for these innovations and required (real-time) data cause the implementation to take considerable time. The speedy wide role out of smart meters and the utilization of data obtained is thus crucial.

DSOs are in the process **of understanding the market mechanisms and flexibility, which is a significant learning process** that will take time. Furthermore, the digitalisation of distribution grid is lagging compared to the transmission grid. **DSOs need regulation to get certainty on how to prepare for the future.** Meanwhile, there should be sufficient possibility and room in the regulation to learn and experiment.

A similar learning curve is required for consumers – from not thinking about their electricity consumption to using their flexible potential. Aggregators might play an accelerating role in this, although this will only be the case for a limited set of assets.

It is stressed that balancing impact of congestion management of DSOs on TSO grid is relatively small and should not be exaggerated. The participants debate the balancing responsibility for DSOs that perform congestion management. There's no consensus on who should bear this responsibility. Prosumers are mentioned as the biggest cause of congestion at DSO level whereas other experts urged to look for ways to turn them into the largest source of flexibility. A solution could be to provide a financial incentive to prosumers to reduce capacity (non-firm contracts).

Locational price signals

There's an open question on how to apply **geographical filters on activation products.** Many agree that incorporating locational signals into the electricity market will be needed to ensure that flexibility is invested into and used where it is needed the most.

Some participants stress the huge opportunity in flex from renewables and vouch for active market-based redispatch from renewables at moments of low-demand and high-supply, especially for bigger renewable assets, such as offshore wind farms. Yet, it is also stressed that frequent curtailment of RES will lead to a more expensive energy system, and overall system costs will be high even though costs of curtailment at a certain instance might be low. It is on the other side argued that flexibility from RES will always be cheaper than demand response.

As a market party, it is hard to tell where potential congestion problems are and where it will be interesting to develop RES or DR and what will the economic value be in the future. Geographical visibility on the business case is a prerequisite for development of demand response by market

participants. The alignment between local price signals and zonal markets needs to be thoroughly researched to avoid welfare losses and ensure their benefits for the improved system operation without compromising market efficiency.

Finally, preserving an adequate system where demand can be covered by supply becomes more and more linked to flexibility as the latter is required to ensure demand coverage (or demand response) in a system with rapidly growing shares of non-dispatchable generation. Thus, **adequacy and flexibility should be considered jointly** to identify system needs and availability of flexible resources.

Contact

If you have any questions about the event, or about our technical advisory services, do reach out to our experts.

Gertjan Meutgeert
Partner
g.meutgeert@magnus.nl

Ksenia Tolstrup
Principal
k.tolstrup@magnus.nl

Reinhard Kaisinger
Principal
r.kaisinger@magnus.nl

Wiljo Treurniet
Consultant
w.treurniet@magnus.nl

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