TSO-DSO coordination

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Energy transition strongly impacts balancing services[1]

Development	Challenge	Solution
• Strong growth in share of intermittent generation in energy mix.	Intermittent character increases inaccuracy in generation forecasts, which could **increase imbalance volumes** in (near) real-time.	This impact largely needs to (and can) be solved by market parties in the intra-day time window, e.g. by using these same renewable generators.
• Phasing out of fossil power plants, the "traditional" suppliers of balancing power.	**Need for other technologies** to deliver balancing services, that traditionally did not participate (or were not even around),	Plenty of new technologies will enter the energy system that are well capable of providing balancing services (next to renewables: batteries, EV chargers including V2G, E-boilers, electrolysers).
• Balancing services will increasingly be provided by distributed assets, • Distribution grids are operated closer to their thermal limits	Availability of balancing assets may be depending on **local grid situation**.	TSO-DSO coordination?

According to Electricity Market Regulation, article 57.2:
*"DSOs and TSOs shall **cooperate** with each other in order to achieve **coordinated access** to distributed resources that may support particular needs of both the DSOs and the TSOs"*

[1]In this presentation, the term *balancing service* refers to the ancillary services FCR, aFRR, mFRR

What if we don’t coordinate (like today)? Example 1

(not) Connecting a battery to a distribution grid

- Batteries optimised against wholesale markets, in general, show a grid-friendly behaviour.
- To ensure grid-friendly behaviour, the DSO can apply congestion management against very low costs.
- However, the main earning model of batteries (today) is based on participation in FCR and aFRR
- The DSO needs to facilitate this, even during (grid) peak hours
- The DSO could apply congestion management, yet restricting the battery exceeds the price cap in the Dutch grid code substantially
- As a consequence, the battery is not connected before the grid reinforcement is completed.
- Today 30GW of batteries cannot be connected to the grid, because they wish to participate in a 1,4 GW market.

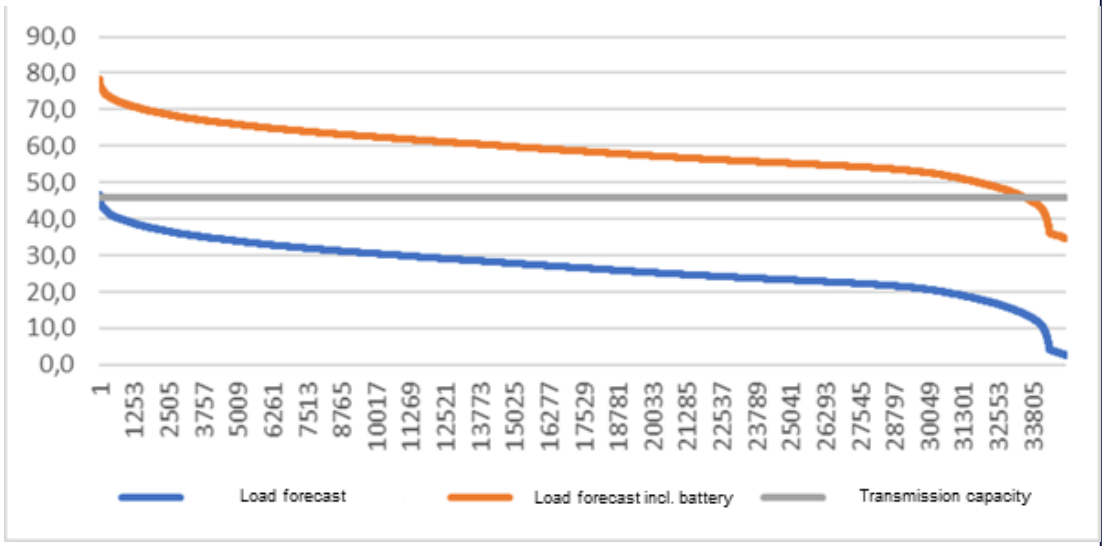


Figure 1: Load duration curve (forecast) of HV/MV transformer prior to grid reinforcement (blue) – incl. additional 24MW battery (orange).

The current challenge of connecting batteries to the grid are a direct consequence of the conflict between balancing services and DSO congestion management – yet there is no coordination in place.

What if we don’t coordinate (like today)? Example 2

How balancing and DSO congestion management can interfere

- STOR (Short-Term Operating Reserve) is an mFRR product operated by the ESO in GB
- Active Network Management is a mechanism where renewables can be connected to congested (distribution) grids through non-firm connection agreements.
- When an asset operated by a STOR provider is located in an area where the DSO operates ANM connections, things may go wrong.
- When the STOR asset (e.g. a CHP) is dispatched, it may trigger the ANM system curtailing a renewable generator, counter acting the balancing activation.
- The ESO needs to pay the STOR provider (that has delivered the service), yet the system balance has not been restored.

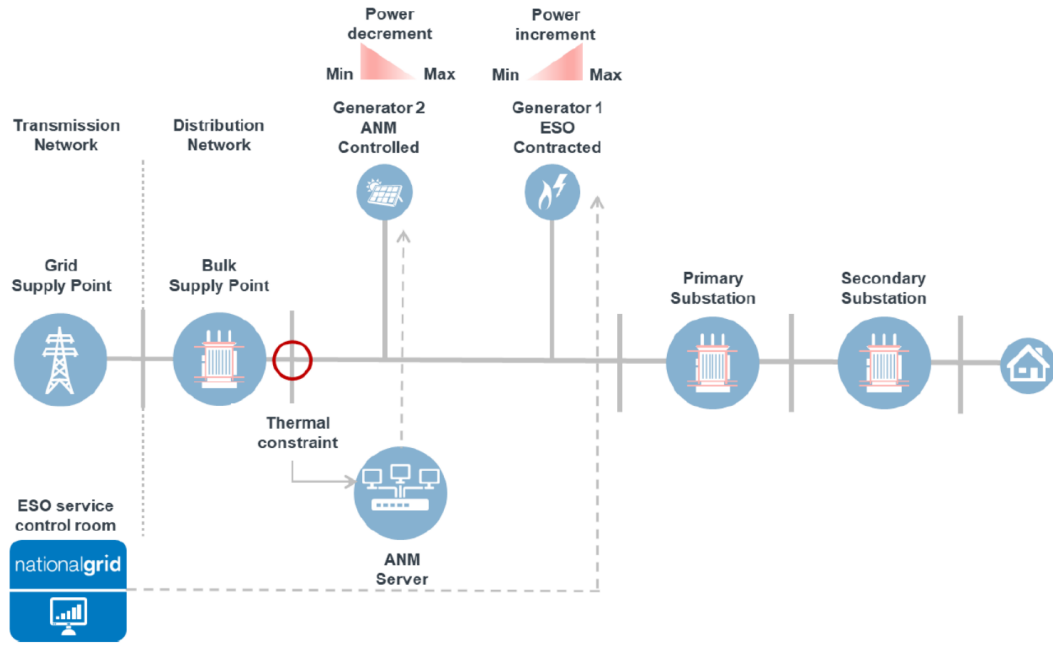


Figure 2: Load duration curve (forecast) of HV/MV transformer prior to grid reinforcement (blue) – incl. additional 24MW battery (orange).

This conflict was one of the main triggers for the ENA to further develop the ESO-DSO coordination, an activity that already started in 2018.

ENA's *future worlds* – how to coordinate distributed flexibility

- **World A: DSO Coordinates – DSO acts as the neutral market facilitator for all DER and provides services on a locational basis to the TSO ("DSO centric")**

- **World B: Coordinated DSO-ESO Procurement and Dispatch – DSO and ESO work together to efficiently manage networks**

- World C: Price-Driven Flexibility – based on world B, with improved access arrangements and forward-looking signals for Customers

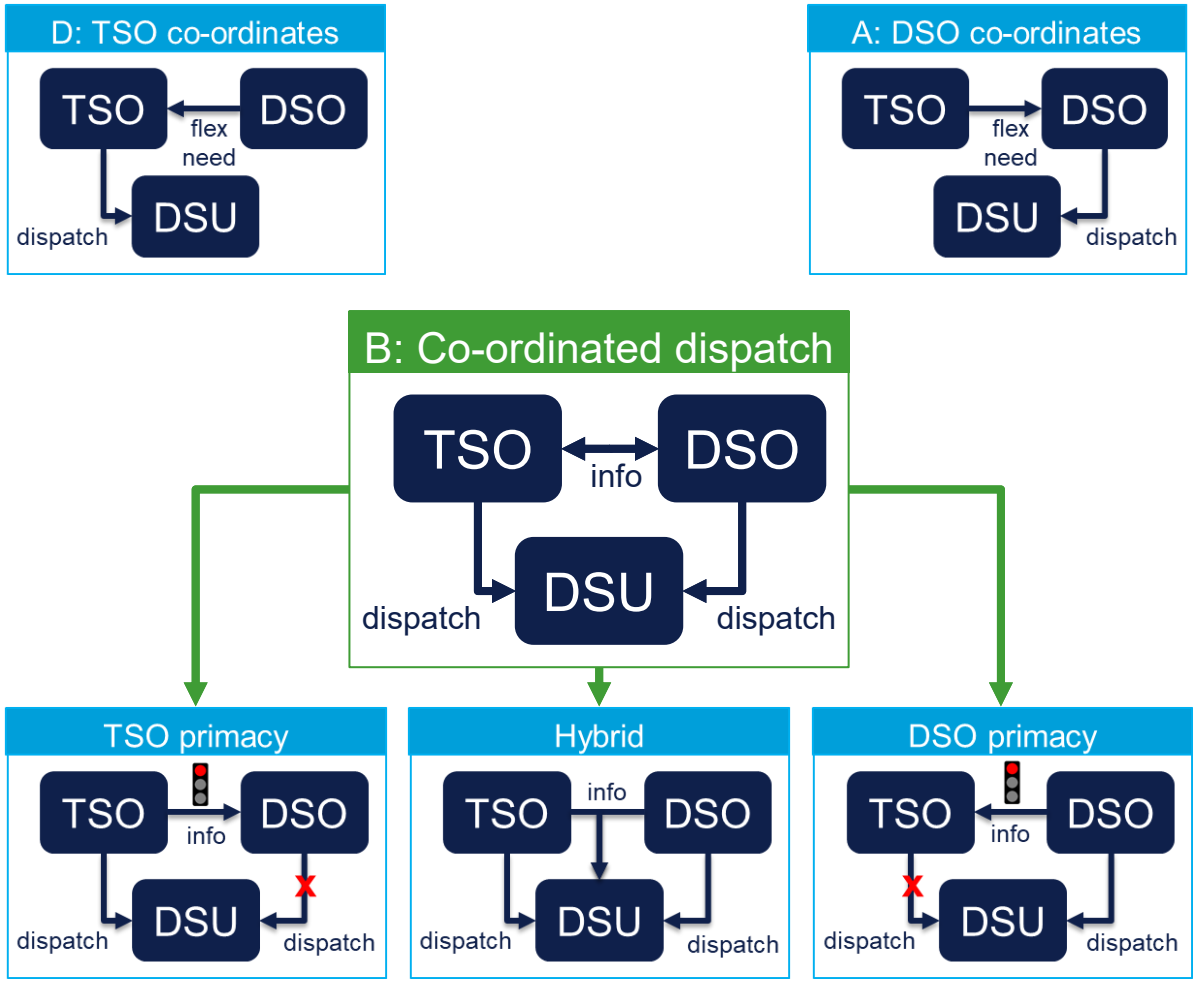
- **World D: TSO Coordinate(s) – TSO takes a central role in the procurement and dispatch of flexibility services with DSO's informing the TSO of their requirements ("TSO centric")**

- World E: Flexibility Coordinator(s) –a national third-party acts as the neutral market for DER providing efficient services to the TSO and/or DSO as required

After further analysis, World B seemed the best (short-term) compromise. It minimises structural changes, yet it
• is likely to lead to higher longer term costs compared to other Future Worlds
• introduces greater complexity in system operation and dispersion of accountabilities across different actors

Sources: Open Networks Future Worlds, Energy Networks Association, 31 July 2018. *ESO* replaced by *TSO*.
Future World Impact Assessment, Baringa, 22 February 2019

Choosing a model does not resolve potential conflicts



Comments

- In **"World B", both TSO and DSO procure and dispatch flexibility**, and co-ordinate their activities in order to avoid / resolve conflicts
- **World B does not describe how this co-ordination occurs**, more specifically who takes *primacy*. To avoid the demand-side unit (DSU) receiving conflicting signals, information exchange is needed between TSO & DSO
- This could still lead to e.g. a "TSO primacy" model, yet this choice can be depending on the situation / conflict.
- Since service providers are involved (both for TSO and DSO) and market parties in general (also controlling flexible assets), coordination needs to involve market parties.
- Value stacking also implies receiving different signals from different actors (yet not leading to a conflict).

Case study – ENA primacy – Methodology, rules and outcome

DNO primacy[1]	ESO primacy	Joint primacy
RULE 1 • **STOR providers excluded (by the ESO)** from provision of the service if this coincides with **forecast ANM curtailment** activity in a given geographical area	**RULE 2** **DNO holds headroom** value in ANM Systems **to allow STOR to be provided**	**RULE 6** **The ESO would pay** the DNO (and therefore ANM customers or Flex providers) **to hold headroom on their ANM systems**
RULE 3 • Similar to the principles in rule 1, however, in this case**, information would be provided to the market for STOR providers to exclude themselves** from participation		**RULE 7** **The STOR provider would pay** the DNO (and therefore ANM customers or Flex providers) **to hold headroom on the ANM systems**
RULE 4 • **ESO over-procures** to help counteract any non-delivery as a result of ANM pullback.		

Main outcomes:

- Each rule can be optimized by introducing (more) information exchange within the operational timeframe, yet this increases the complexity
- Contrary to expectations, rule 2 proved the most economic (least cost) to end-users across all scenarios
- This triggered a second iteration of the analysis, based on modifications in the STOR product (shorter availability windows). This time rule 3 proved the most economic.

Source: Development and impact quantification of primacy rules, DNV, October 2022

Main take-aways

- Urgent need to start designing the coordination between balancing services and DSO congestion management
- Not limited to TSO-DSO coordination, this is about market coordination
- Distribution of roles and responsibilities between TSO and DSO should be based on the optimal solution for the customer.
- Not limited to information exchange in the operational domain, this could go as far as product alignment (baseline design) and product re-design (both balancing and congestion management)
- Timing is everything
- Do not forget to accommodate value stacking!

Market coordination

The future of balancing markets

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