Local flexibility markets: Which Design and Governance to Support an Efficient Interface with National and European Markets?

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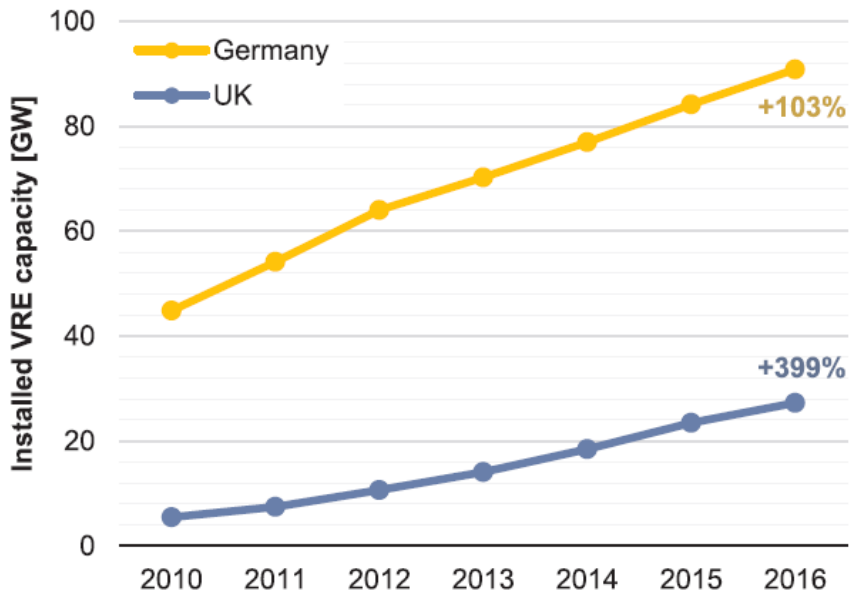
Energy decentralisation is increasing rapidly, changing fundamentally the nature and role of distribution networks

Decentralisation increasing with RES capacity

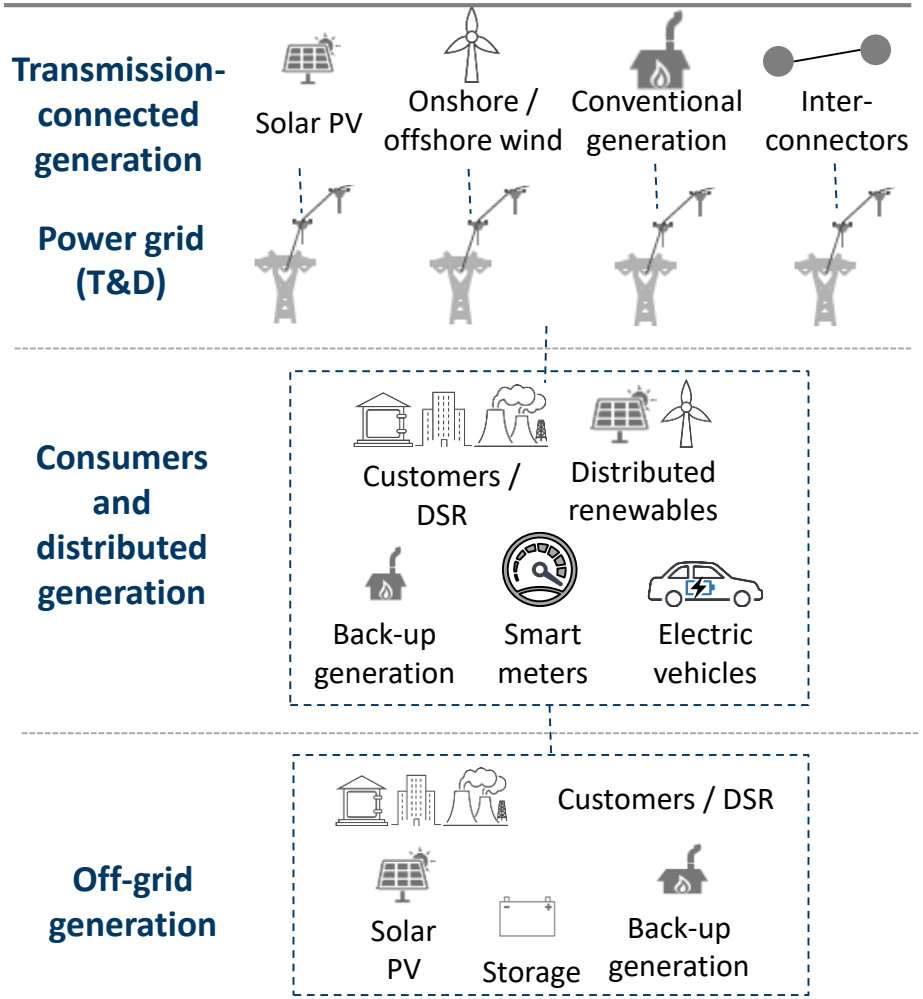


Source: Short-term integration costs of variable renewable energy: Wind curtailment and balancing in Britain and Germany (2018) Michael Joos, Iain Staffell

Key drivers of uncertainty.:

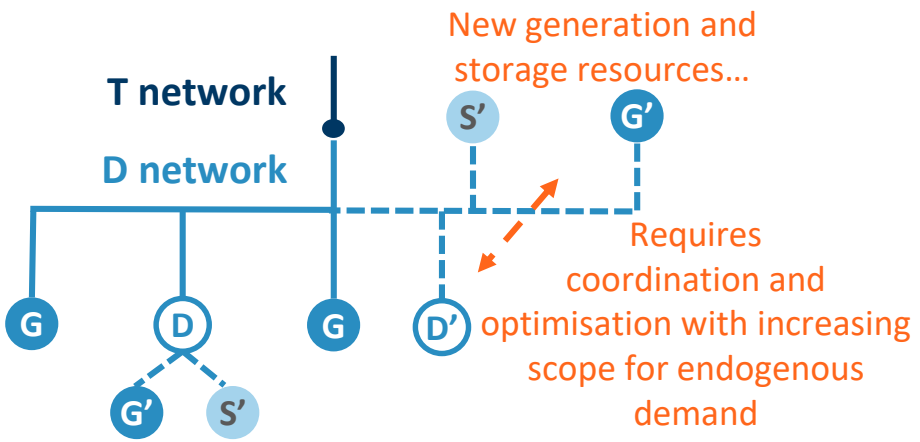
- Electrification of heat / heat policy
- Electrification of transport
- Emerging technologies (battery storage, DSR etc)

As well as greater volumes, type of decentralisation increasingly diverse

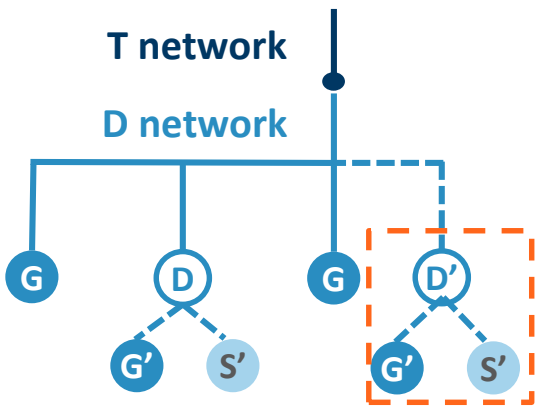


Greater decentralisation offers potential for system benefits – but could be costly unless managed properly

Distribution network no longer passive one way flow system



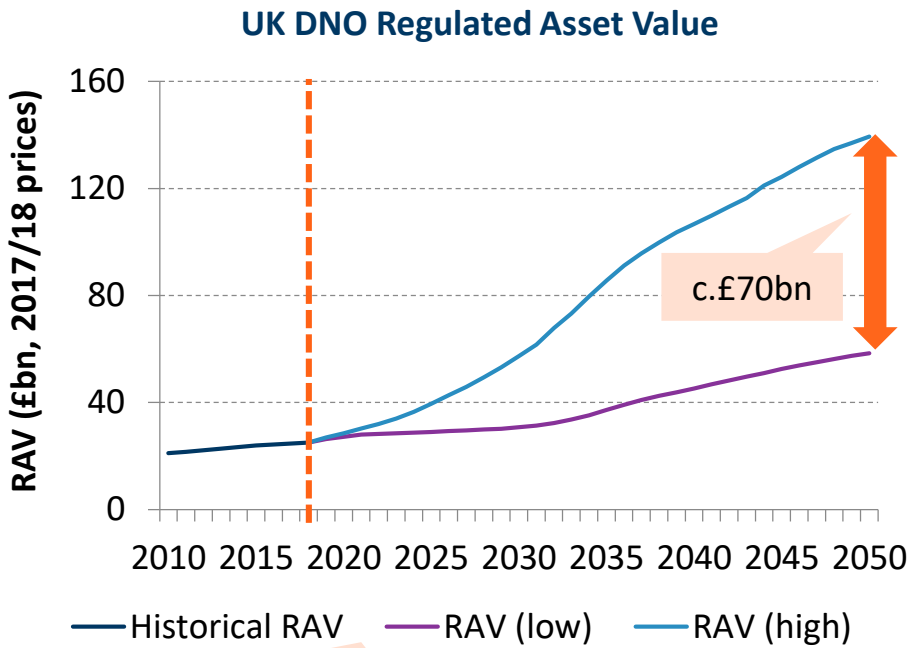
So long as it is well located, generation and storage can offset need for distribution network…



Certain configurations of generation storage might be beneficial to overall network costs… but some not

G *Generation* D *Demand* S *Storage / Electric vehicles* *New connections*

…but badly located and managed could necessitate a huge expansion in network costs



In one scenario, the CCC estimates that there are potentially £8bn/year of savings through better use of existing assets (i.e. through the value of flexibility)

**illustrative RAV growth based on the same % increase in decentralised capacity in slide 2*

=> Improved market design offers opportunity of running a system without need for excessive additional network capacity

Policy makers and regulators have 30 years experience in trying to achieve investment and operational efficiency at transmission level

…and have used a range of market and policy tools at the transmission level…

Wholesale market	Incentivise operational efficiency (and investment)
Network use of system / connection charging	Incentivise efficient siting decisions
Regulation of networks	Encouraging efficient investments in expansion
Regulation of system operation	Incentivise better congestion management, procurement of reserves and balancing
Capacity market	Incentivise investments through longer-term price signals
Market coupling	Enables efficient trading across interconnectors

…variants of which could be deployed at distribution level.

However managing transmission is relatively easy…

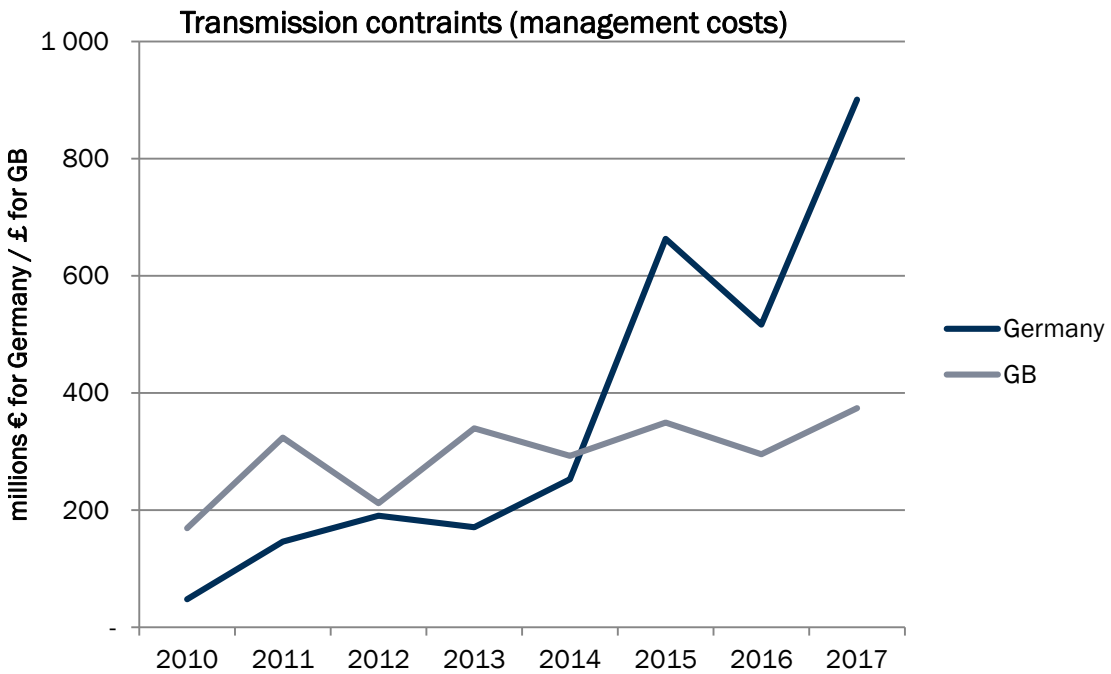
- Hundreds of assets to manage
- Few discrete investments annually
- Network expansion regulated carefully
- Meshed network
- Congestion resolved through operational measures
- Losses relatively low

…distribution promises to be much more difficult

- Thousands / millions of assets to manage
- Many small investments continually annually
- Difficult to regulate network expansion (due to scale)
- Meshed and radial networks
- Very limited experience of congestion management
- Line losses, voltage limits and reverse flow issues more prominent on the distribution level

However, some countries have not achieved optimal investment or operational efficiency at the Transmission level…

Growth of renewables has been a factor in the increase in congestion costs in GB and Germany



Source: FTI-CL Energy , based on Bundesnetzagentur monitoring reports and National Grid system balancing reports

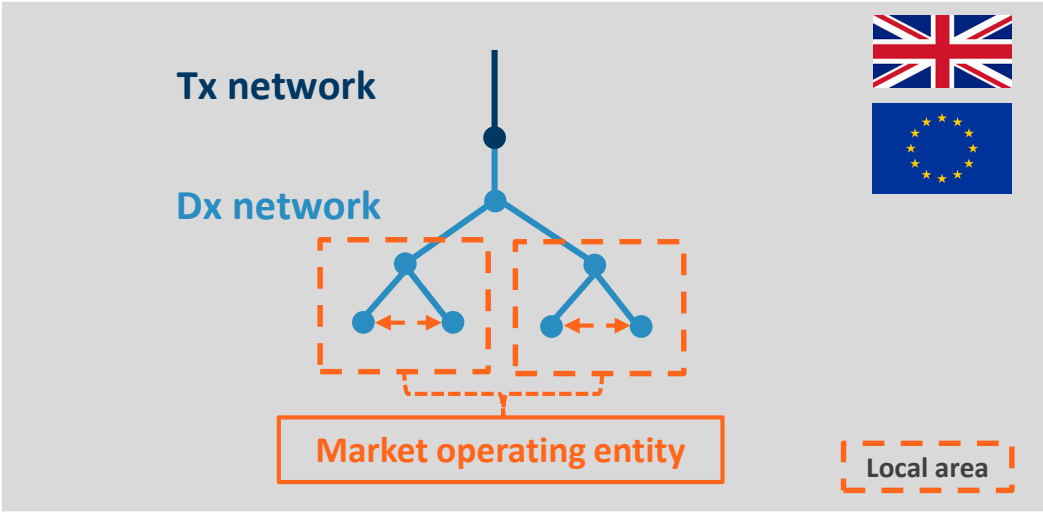
For instance in the UK and Germany congestion costs have increased, which suggests that policy makers need to be wary about extrapolating current market approach to distribution network issues

However, in some other countries such as France congestion is much more limited and/or the type fo flexibility needed is different suggesting that a differentiated approach may be needed

Economic theory suggests two broad options to deal with congestion: the old debate about 'zonal versus nodal pricing'

Zonal pricing

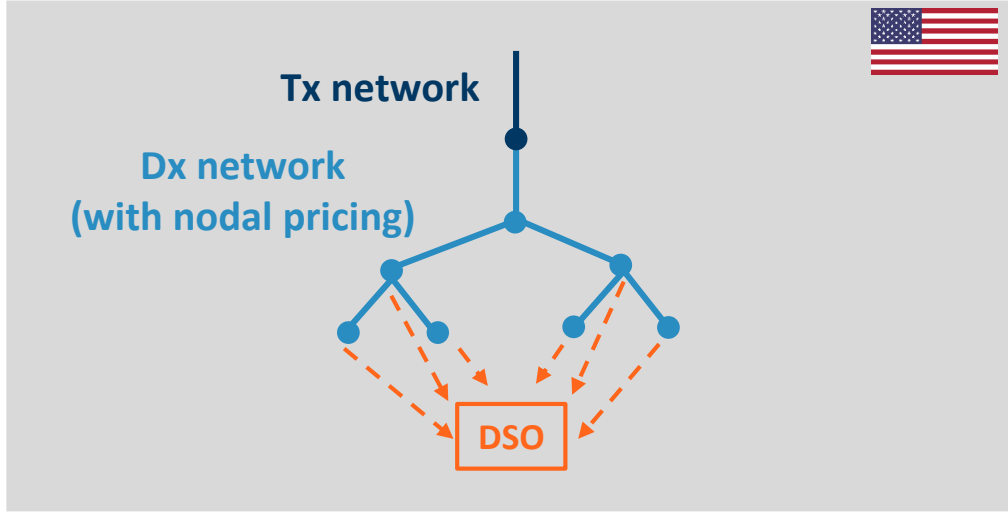
Transposition of the EU Target Model on the distribution level



- Akin to EU target model, the distribution network could be broken down into zones reflecting constraint boundaries
- Resources can trade with each other within zone on a bilateral basis (or through aggregator)
- Price per zone
- Trading between zones via centralised market (cf market coupling)
- Network operator can also contract for services to manage network issues (as per NG now)
- Could have locational network charges within zone…
- …could complement with a locational capacity mechanism
- Congestion within zone either compensated or curtailed

Nodal pricing

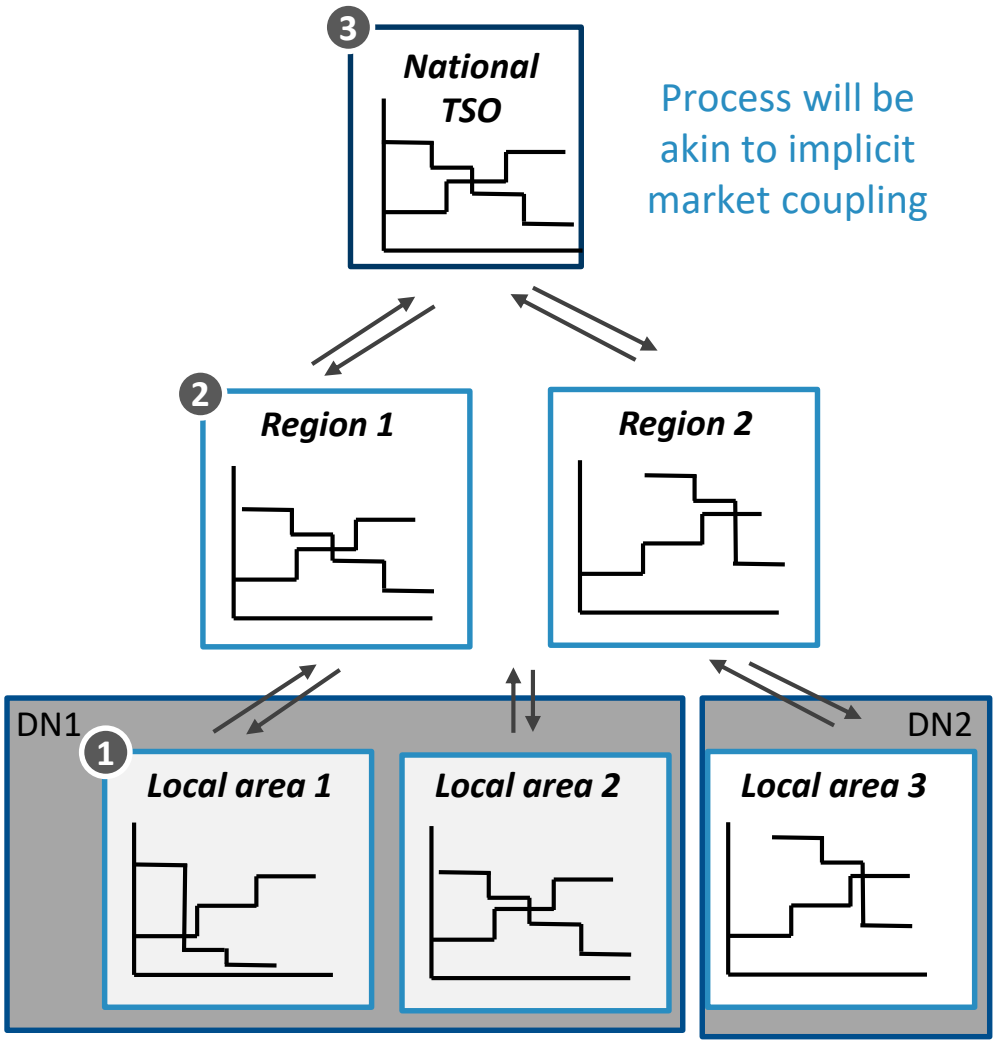
Extension of the US-style nodal pricing on the distribution level



- Akin to US model, the DSO co-optimises reserve and energy, albeit for local area only
- Participant bids / costs either submitted or assumed (standing bids)
- Nodal prices could provide price signals at granular level (at cost of computational complexity)
- Ex ante scheduling time needs to take account of trade off between forecast uncertainty and computational time…
- …and need slick "intra day" updating processes
- No "physical" trading between peers other than via the distribution system operator…
- …but financial peer-to-peer trading might be possible.
- Postage stamp network charge to recover residual d costs

In practice, local flexibility markets are a promising way forward round the practical issues that affect nodal pricing but raise issues about interface with national markets

Example of a potential model of "co-optimised" local flexibility markets with national markets



Example of the mechanics of the coupling of local flexibility markets and national markets

1. Participants / aggregators submit day-ahead / intraday offers (which could be standing or assumed)
2. DSO and/or local market operators optimises local schedules both within, and across each local area
   - DSOs submit (network constraint) compliant increment and decrement bids to the TSO
3. TSO optimises these schedules at day-ahead / intraday (and may direct each DSO and/or local market operator on adjustments needed)…
   - …in concert with transmission connected units (e.g offshore wind, interconnectors etc)
4. Will need to update frequently as real time approaches given RES and Demand uncertainty

Emerging technology offers potential for consumers to engage in local trading nearly effortlessly – aka "democratisation"

Users simply set preferences through devices - no need for "super-engaged" consumer

- Set expected time at home / away at home
- Set preferred time to charge / use EV
- Battery storage to optimise time-of-use
- Device informs (or locks-in) expected costs of the different options
- Or in-built machine-learning algorithm to optimise preferences

Instead, supported by suppliers, aggregators or other third parties, the "Internet of Things" will engage on consumers behalf

Millions of separate payment flows will be facilitated through a decentralised platform

- ✓ Potential role for blockchain technology as a distributed, secure "ledger" - holds millions of transaction records (in each time period) securely
- ✓ Records actions privately and independently of a centralised operator
- ✓ Platform could then be used to make or aggregate any forecasts of unscheduled demand / resources
- ✗ Blockchain technology still in nascent stages (e.g. potentially requires lots of energy to process)
- ? Unclear to what degree consumers will (or should) be exposed to price fluctuations/imbalances (but perhaps choose)

In practice, different platforms to monetize local flexibility emerge across Europe, including:

- A joint venture between Agder Energi & Nord pool.
- Established at the beginning of 2018 and active in two pilots : One is Norway with DSO Agder Energi Nett and an other one in the TSO area of 50Hertz with the DSO Mitnetz Strom.

- Piclo Flex is a Peer-to-peer Energy matching platform gathering 6 DSO's in UK.
- Launched in June 2018, the first calls for tenders were launched in March 2019 for 2019/2020 & 2020/2021. On the 15/05/2019 the second tender launched contracted 18.2 MW of power from 6 companies in 8 different locations for a total value of £ 450,000.

- Coordinated platform within the SINTEG project, coordinated by EPEX, EWE, EWE NETZ, Avacon NETZ and TenneT, focusing on the northern area of Germany.
- Project launched in 2018 with two years of demonstration phase in 2019 & 2020 with the first transaction made on February 6th on the platform.

- Dutch platform launched by 1 TSO & 4 DSO.
- This is not a market platform but rather a link with offers posted on the ETPA intraday platform.

Key issues in the design of local flexibility platforms include:

- **The existing flexibility platform experiments differ in the way they manage the different steps of flexibility procurement:**
  - **Prequalification** : Who decides / prequalifies among the assets which want to participate in this market?
  - **Reservation** : Will there be a capacity reservation and who will take care of it ?
  - **Activation** : Once the offers have been selected, which actor will send the signal to activate the energy block chosen and in what will b the form of this signal?
  - **Measurement, control of the realized and penalties**: Once the order has been placed, who will take care of the effective control that the service has been performed according to the defined characteristics, and will define the penalties in case of failure?
  - **Treatment of the perimeter of equilibrium** : Offer activation may cause an imbalance within the perimeter of balance responsible party: will there be compensation, who will do it and in which form (physical, financial …)?

- **And how do the existing platforms fit with the current institutional and market organization?**
  - **Organization of TSO / DSO's coordination** : How will TSOs & DSOs communicate to avoid unappropriated activation which could cause additional constraints, and how do prioritize activation if both are interested by the same assets ?
  - **Creation of a market apart or extension of the current functioning of the market** : Should a separate order book be created besides the current national market or should the current market be adapted with some evolutions, e.g; by tagging orders based on their location ?

Comparison of the different flexibility platforms reveals different approaches…

	GOPACS	enera	UK Power Networks	NODES
Reservation and capacity payment	NO. More into context of ad hoc activation	NO. More into context of ad hoc activation.	YES. They plan contract with availability window.	No. They are more into context of ad hoc activation.
New market Creation	NO. They will use ETPA market platform and only match different bids which could solve congestion at demand of SO.	YES. Bids and supply are post in a separate order book.	YES. They will launch separate call for tenders.	Yes. They create a new market to solve local congestion first with a separate order book, but they will coordinate it to allow resources which are involve in their market to participate as well on other market (intra-day, reserves)
Temporality of bid activation	Thanks to the platform. Before TSO operational window	Thanks to the platform. Before TSO operational window	Direct order from DSO. Before or during TSO operational window.	Direct order from DSO. Before operational window.
Balance management of balance responsible party	Balancing is doing automatically because, the activation is made thanks to the intraday market as a classic exchange.	No management. Actors has to make their own balancing in intra-day market.	No management.	Re-balancing thanks to intraday-Market or to it's own portfolio
Coordination TSO/DSO	Coordination is made on the platform.	Only DSO so far but TSO should integrate the platform soon. Manual coordination is made.	Not a strong coordination. DSO has to notify TSO when he activates a resource for congestion management.	Currently only DSO are actives in the platform. But, because flexibility offers inactivated come into TSO market, they will have a direct regard on DSO's activation.

Conclusions: More experimentation and research is needed to derive recommendations for market design

- Greater decentralisation offers potential for system benefits – but could be costly unless managed properly…
- Some form of local price signals is needed to coordinate the operational and/or investment decisions across networks and generation - demand response - storage at the local level
- The theoretical debate about nodal pricing is an old debate and raises significant practical issues… but local platforms for flexibility could be a promising way forward…
- …provided the interface with the existing national markets and processes run by DSOs and TSOs is defined carefully, and takes into account local specificities such that it is unlikely that there will be a silver bullet approach.
- Different approaches are emerging raising a number of questions for further research, including:
  - Which parameters play a role in revealing the local value of flexibility?
  - Which kind of products have value and could be exchanged at the local level ?
  - How to define the best market-mechanism which fit better with local specifics needs ?
  - Can the existing national markets / balancing mechanisms be adapted to provide a locational signal or are new markets needed?
  - Which evolution on market structure, product definition and operator's role do that implies ?
  - How to coordinate emerging local markets with the existing national / European markets?
  - What are the governance /institutional implications, for instance regarding the TSO/DSO interface?

Thank you for your attention

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