UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

Local flexibility markets: lessons from international evidence

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Introduction and background

- Local flexibility markets are markets for constraint management within the lower voltage distribution network.
- They usually involve bids to increase or reduce MWs (real power) or MVars (reactive power) to manage current or voltage fluctuations on the network.
- Demand for local flexibility is rising as local demand grows or as more generation connected to distribution network. In the UK capacity for distributed generation export may be limited.
- Distribution system operators (DSOs) have been experimenting with procurement of flexibility from loads or from generators behind a constraint.
- We look at the results from two sets of studies: one for the **Centre on Regulation in Europe (CERRE)** in Brussels and one from **Project Merlin**, an innovation project in the UK.

About CERRE study

With thanks to my colleagues Karim Anaya and Monica Giulietti, and CERRE and sponsors for funding this study

Full report and webinar published at CERRE website:
[Optimal regulation for European DSOs to 2025 and beyond – CERRE]

The report aims to:

- **Suggest how regulation of the distribution system operator (DSO) can be improved** in the period to 2025 and beyond

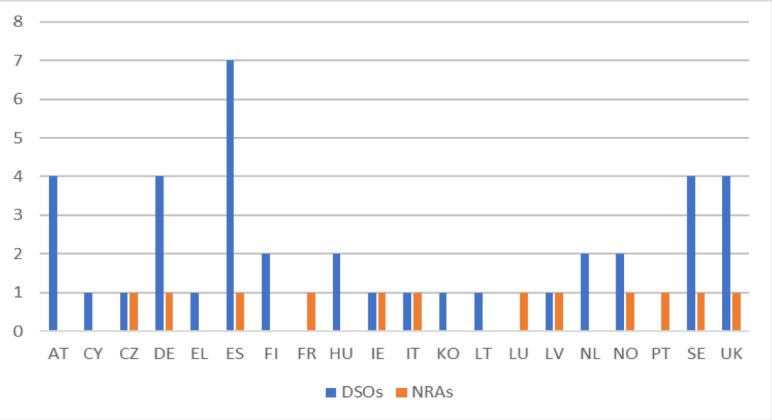
- Investigate directions in which current regulation might be developed leading to an **improvement in social welfare**

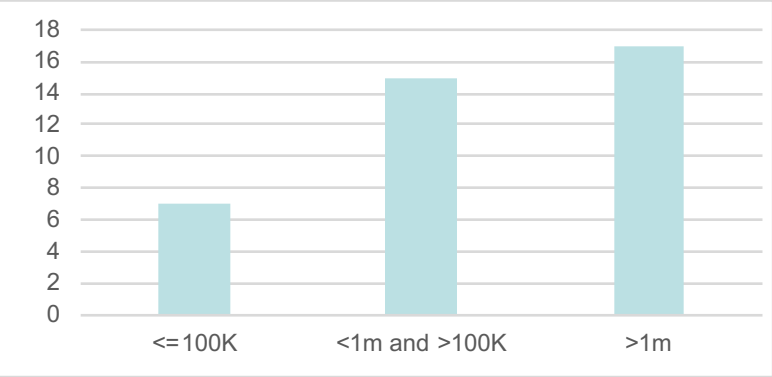
Methodology:

- **2 parallel surveys** to national regulatory agencies (NRAs) and DSOs

Survey participants and respondents

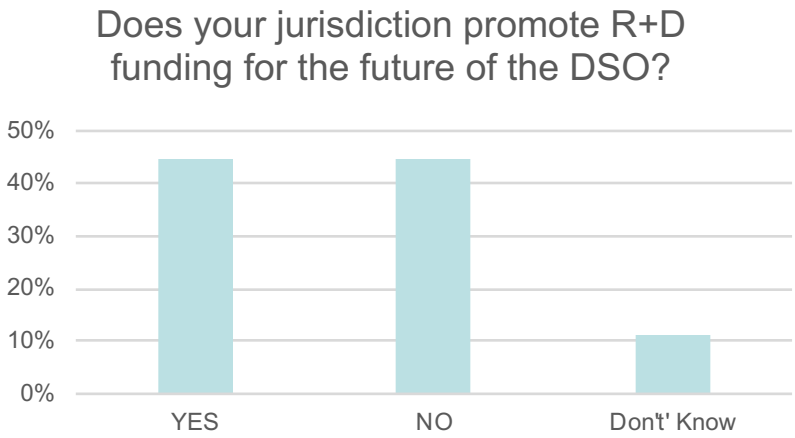
- 51 responses, 20 countries.
- Respondents from 12 NRAs and 37 DSOs.
- 9 countries with responses from both NRA and DSOs.
- 39 responses from DSOs, 17 countries represented.
- 125m customers served by the DSOs, 225m protected by NRAs
- 40% of DSOs with 1 million or more customers.
- Participation of 2 energy network associations.

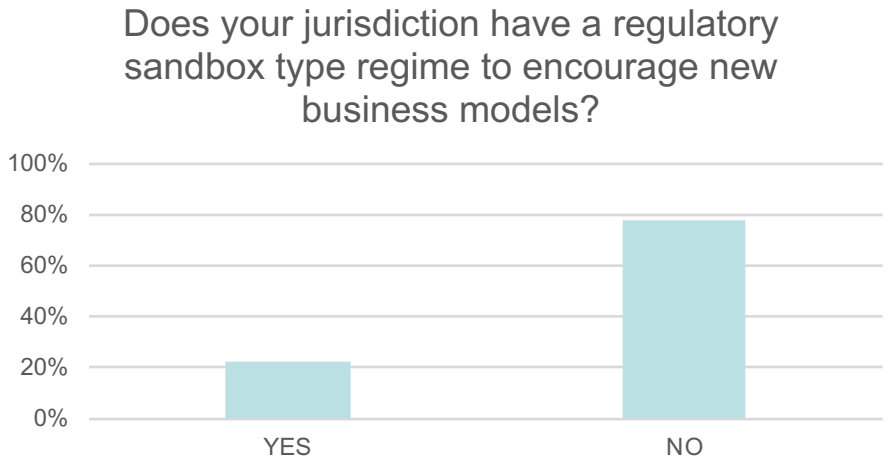


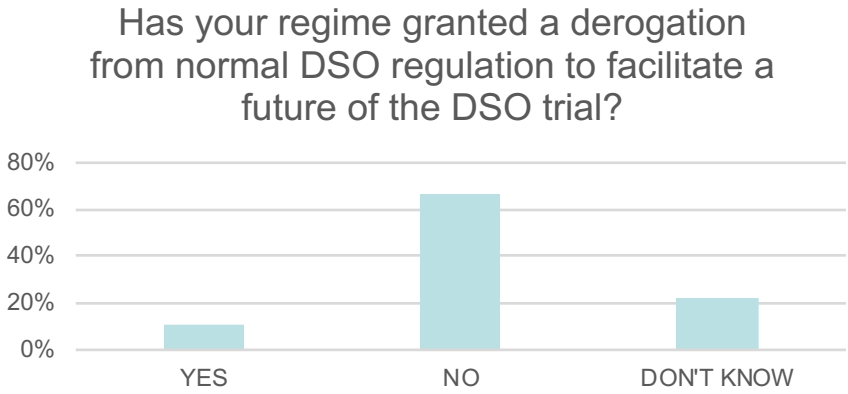


DO NRAs PROMOTE THE MORE ACTIVE DSO?

NRAs could do more to support the transition to an active DSO…







WHAT IS THE SIZE OF ANNUAL COMPETITIVE PROCUREMENT BY DSOs?

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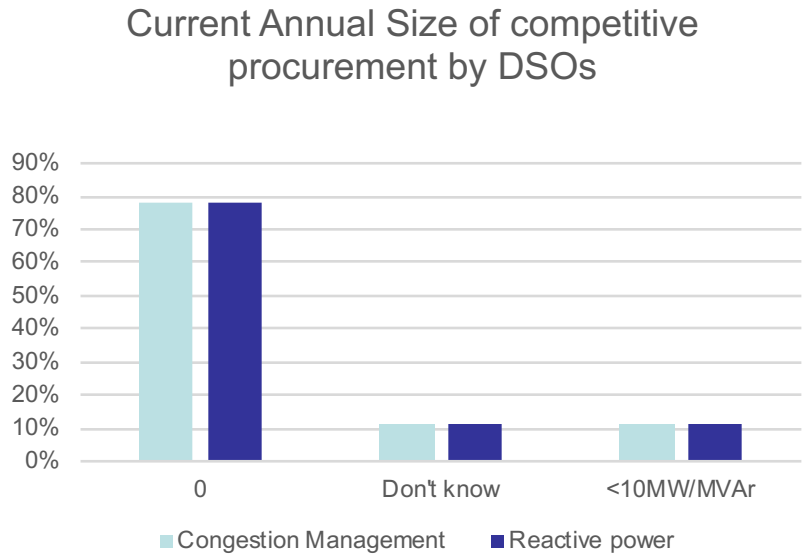
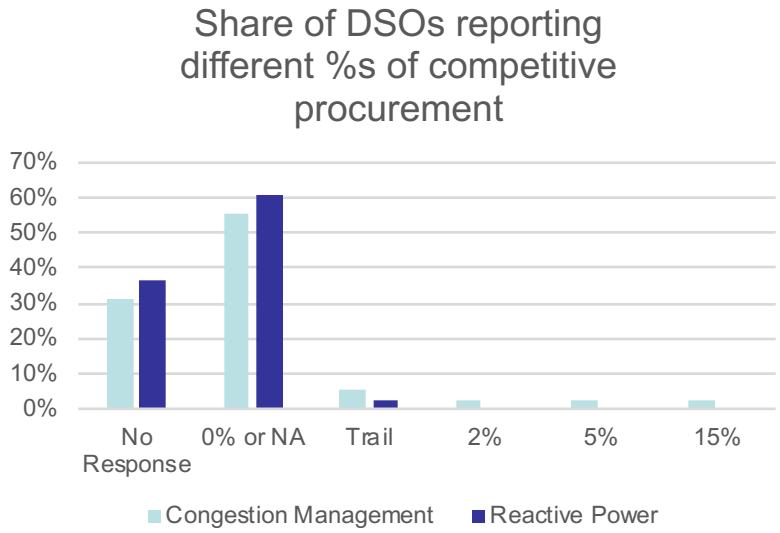
Current competitive procurement by DSOs of congestion management and reactive power is small.





WHAT DSOs WANT THEIR REGULATORS TO DO?

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- This produced a range of responses, which brought out a number of issues.
- First, DSOs questioned whether there were the incentives in and around the revenue allowances for monopoly DSOs and the extent to which these encouraged non-capex solutions.
- Second, there was the issue of the incentives to innovate and the general regulatory support for innovative solutions.
- Third, there were issues raised around stakeholder engagement.
- Fourth, points were made about whether current regulatory arrangements were sufficiently flexible.

WHAT ARE DSOs DOING THEMSELVES TO FACILITATE THE MORE ACTIVE DSO?

- This produced a range of responses, which brought out a number of issues.
- First, there was attention to staff training.
- Second, there were improvements to network planning.
- Third, there was investment in network capacity and the energy transition itself.
- Fourth, there was an emphasis on R+D and new experiments.

WHAT DO NRAs AND DSOs KNOW ABOUT PROJECTS?

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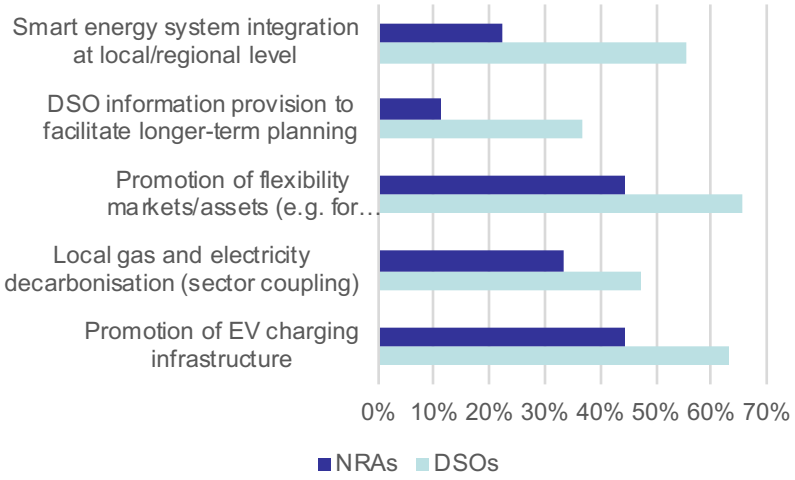
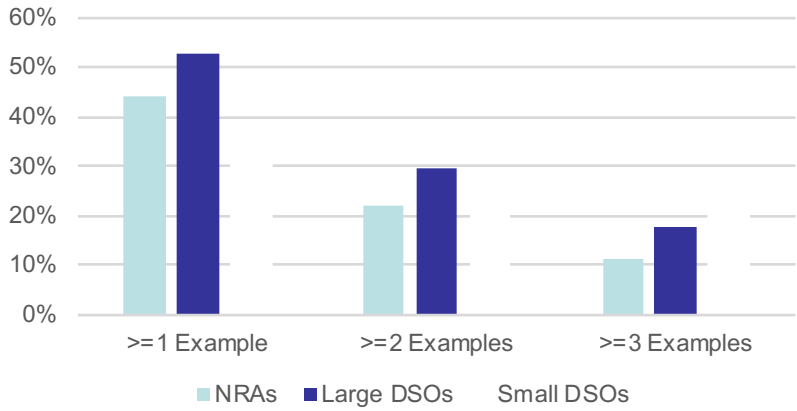
Patchy awareness of experimental projects in both NRAs and DSOs about the future of the DSO…

Percentage of respondents naming example projects in their jurisdiction

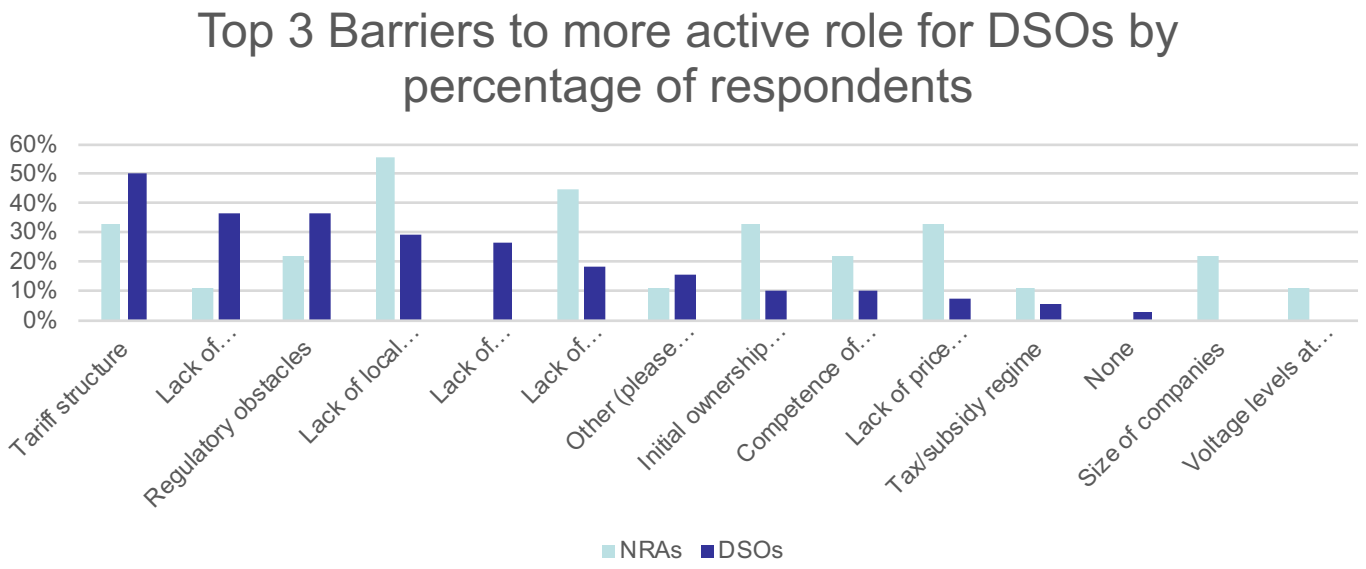


Percentage of DSOs and NRAs citing extra-jurisdictional examples



BARRIERS TO EMERGENCE OF MORE ACTIVE DSO?

DSOs concerned about regulation, NRAs concerned about competition…



About Project MERLIN

With thanks to Karim Anaya and all our colleagues from Project MERLIN

With thanks to distribution utilities/ESOs (Ausgrid, Avacon, Enedis, Liander, NGESO, Stedin, Tennet,Tepco, UK Power Networks, Western Power Distribution), ENA UK, FfE, NYSDPS, Silicon Grid, energy experts.

MERLIN = Modelling the Economic Reactions Linking Individual Networks:
Is a BEIS funded innovation project, under the Power Forward Challenge: Canada-UK Joint Challenge on Smart Energy Systems.

Project reports published at SSEN website. https://project-merlin.co.uk

This presentation draws on our first, second and third reports:

- The first of which compares 13 use cases of DNO/DSO to procure flexibility
- The second makes recommendations of what can be learnt from the cases
- The third identifies key regulatory aspects for the development of local flexibility markets in 7 jurisdictions
- The fourth (forthcoming) measures the value of procuring flexibility (CBA) under key scenarios

Procurement projects we examine

- Selection of Use Cases (13 in total) from 7 jurisdictions.
- Discussion of latest projects/initiatives (from 2017 onwards).

Country	project/initiative name	project leader(s)	type	start date	status	use of an independent platform (e.g. marketplace, others)
Australia	Battery Virtual Power Plant (VPP)	Ausgrid (DSO)	demonstrator	Jun-18	ongoing (Phase 1 completed)	no
France	Nice Smart Valley	Enedis (DSO)	demonstrator	Jan-17	end Dec. 2019	no
Germany	Avacon	Avacon (DSO)	demonstrator	Jan-17	end Dec. 2019	no
	The Altdorfer Flexmarkt (ALF)	FfE e.V.	demonstrator (proof of concept)	2017	ongoing (end in 2020)	yes
GB	Power Potential	NGESO (TSO)	demonstrator	2017	ongoing (end in March 2021)	no
	Flexible Power	WPD (DNO)	BAU	Mar-19	ongoing	no (but it can be also via Piclo Flex, CLEM)
	Flexibility Services	UKPN (DNO)	BAU	Mar-19	ongoing	yes (only via Piclo Flex)
	Piclo Flex	Piclo	BAU	Mar-19	ongoing	yes (involves several DNOs)
	Cornwall Local Energy Market	Centrica	trial	May-19	ongoing (Phases 1 and 2 completed)	yes
Japan	V2G Demonstrator Project Using EVs as Virtual Power Plant Resource	Tepco (integrated utility: DSO/TSO)	demonstrator (proof of concept)	Jun-18	ongoing (end in 2020)	no
The Netherlands	Dynamo	Liander (DSO)	BAU	Q4 2017	ongoing	no
	GOPACS	TenneT (TSO) and 6 DSOs	BAU	Jan-19	ongoing (potential extension to first DSOs: Liander, Stedin)	yes, national platform (involves several DSOs)
Norway	Nodes	Nodes	BAU	2018	ongoing (different European countries)	yes

Current developments in local flexibility markets

Questions raised per each Use Case:

- *What are the recent developments in smart architectures and solutions for the procurement of flexibility services?*
- *What are the different proposals for market design for the procurement of flexibility services?*
- *Why are new business models required to capture the value of flexibility?*
- *How do network operators value flexibility?*
- *What are the most and least common trends in the acquisition of flexibility services and what is still missing?*
- *Can regulatory changes help to unlock the value of flexibility for a more efficient grid management and service provision?*

Current developments in local flexibility markets

Summary of Use Cases (selected)

Country	Use Case	product/service to be traded/tested	flexibility providers	aggregators	price rule	use of maximum prices, ranges (market-based only)	remuneration scheme
GB	Power Potential (NGESO)	reactive and active power	PV systems, wind turbines, CHP, biogas plants, etc	optional	pay-as-bid (wave 2)	no	utilisation (active and reactive power) and availability (reactive power)
	Flexible Power (WPD)	flexibility services (several)	PV systems, wind turbines, CHP, biogas plants, storage systems, flexible loads	optional	pay-as-bid (with regulated prices)	yes	availability (secure, dynamic), utilisation (secure, dynamic, restore); with maximum prices (£300/MWh secure, dynamic; £600/MWh restore)
	Flexibility Services (UKPN)	flexibility services (several)	PV systems, wind turbines, CHP, biogas plants, storage systems, flexible loads	optional	HV: pay-as-bid, LV: regulated price	yes (range per site)	availability (secure), utilisation (secure, dynamic), service fee (sustain: £47.58/kW/year). Range (with lower and upper values) regarding total price for HV (secure)
	Piclo Flex	flexibility services (several)	PV systems, wind turbines, CHP, biogas plants, storage systems, flexible loads	optional	pay-as-bid	yes (based on each DNO's requirements)	utilisation and/or availability depending on the service
	Cornwall Local Energy Market	flexibility services (several)	diesel generators, gas turbine, flow battery, domestic battery clusters, ice manufacturer	optional, phase 1 (Kiwi Power)	phase 1: pay-as-bid (with regulated prices), phase 2: pay-as-clear	yes (Phase 1)	phase 1: utilisation, phase 2: utilisation, availability (reservation). Regulated price up to £300/MWh (combined) in phase 1
The Netherlands	Dynamo	constraint management (congestion)	Lidl (with cold store and battery at the distribution centre), Van del Valk (heat pump)	required (Scholt Energy)	regulated price (aggregator)	not applicable	availability and utilisation. High ratio availability/utilisation (0.9)
	GOPACS	constraint management (congestion) , TSO-DSO coordination	PV systems, wind turbines, CHP, biogas plants, storage systems, etc	optional	pay-as-bid (trading parties), TSO/DSO pay a spread (difference between buy and sell order)	no	dispatch (utilisation)

Current developments in local flexibility markets

Main findings and recommendations based on Use Cases

smart architectures and solutions	*market design for flexibility services*	*the value of flexibility*
different bespoke and third-party platforms in use	different designs with a variety of services to be procured	different ways to value flexibility, from regulated prices to market-based ones
easy for participants to understand and access extensive stakeholder engagement	clear rules need to be adopted, ideally aligned with the current ones and ensure consistency, standardisation and stakeholder buy-in	need of a standard cost-benefit methodology with the incorporation of social values to be published and with indication of WTP

new business models	*most and less common trends*	*the role of regulation*
different channels to procure flexibility aggregators are playing an important role	most: to solve congestion, multiproduct, PAB less: pay-as-clear, reactive power, etc	can help via different ways, a supportive regulatory environment is crucial
distribution utilities must identify the sources of value and to market test them	to experiment a reverse clock auction with a customer revenue benefit target	Unlocking the value of flexibility depends on allowing the benefits to society to be monetised via the regulatory regime

The role of regulation in supporting DSO flexibility procurement

Questions raised:

• To what extent the current regulatory frameworks from different jurisdictions support the development of the future distribution utility with a focus on the use of flexibility?

• What is missing and the status of current or future proposals to deal with this?

Methodology:

• Questionnaires were designed and sent to key parties

• Identification of key regulatory topics (12 in total)

• The questionnaires aim to capture for each regulatory topic what has been already changed (past), what is currently under consideration (present) and what should be changed (in future)

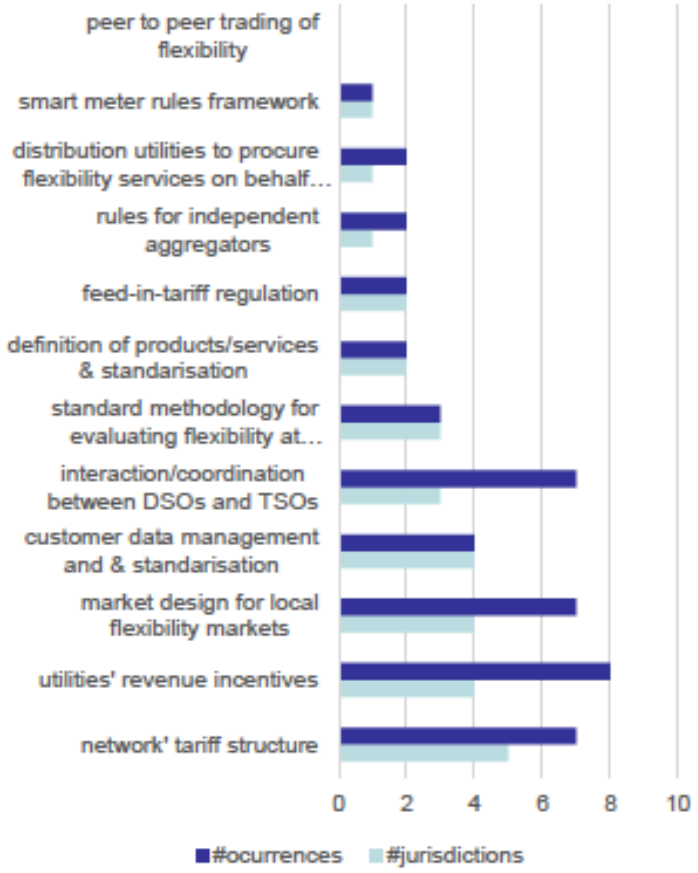
• If at least one of the participants confirmed any existing change, or changes being Considered/changes that should be considered we mark the country response as a “Yes

Summary of respondents to questionnaires:

Summary of responses	AU	FR	DE	GB	JP	NL	NO	total
Regulator	1		1	1		1	1	5
Distribution utilities	1	1	1	3	1			7
Energy Associations	1			1				2
Platforms/marketplaces				2			1	3
Experts					1			1
number of responses	3	1	2	7	2	1	2	**18**

Expert views on the role of regulation in supporting DSO flexibility procurement

Top 3 regulatory aspects



Top 3 country level summary

utilities' revenue incentives	AU	FR	DE	GB	JP	NL	NO
already changed?	yes			yes	yes		
change being considered or should be considered?	yes	yes	yes	yes		yes	
top 3	yes		yes	yes	yes		

network tariff structure	AU	FR	DE	GB	JP	NL	NO
already changed?	yes	yes					
change being considered or should be considered?	yes	yes	yes	yes		yes	yes
top 3	yes	yes		yes		yes	yes

market design for local flexibility markets	AU	FR	DE	GB	JP	NL	NO
already changed?						yes	
change being considered or should be considered?	yes		yes	yes	yes	yes	
top 3	yes		yes	yes	yes		

Observations on regulation and local flexibility markets

Key Takeaways

- Even where flexibility markets are highly developed and incentives (i.e. DSO revenue model and tariff structure) exist to undertake least cost procurement, it remains unclear as to whether they are cost effective at a sustainable scale.

- More dynamic network tariffs have been or are being considered in several jurisdictions, but all jurisdictions remain cautious as to the practicality of their implementation.

- While there are moves across multiple jurisdictions to specify and standardise flexibility products it remains unclear as to whether this is the optimal way to handle customer willingness to pay which is not a function of the flexibility product but of the assets' characteristics.

- Market design of flexibility markets is a work in progress, and we remain in an experimentation phase.

- There is little interest across our jurisdictions in P2P trading as an issue in current debates about flexibility markets. The focus, outside GB, remains on procurement by the distribution utility to meet its own needs.

Observations on regulation and local flexibility markets

Key Takeaways

- The facilitation of increased co-ordination between TSOs and DSOs is actively being pursued across most of the jurisdictions where unbundling is in place, with some signs of active conflict between the TSOs and DSOs in some areas which needs to be addressed.

- Allowing DSOs to procure flexibility on behalf of the TSO is not seen as a big issue outside of GB. This reflects the fact that currently DSOs and TSOs are procuring very different types of flexibility and trying to avoid direct competition or even direct contractual relationships. It is not clear how sustainable this avoidance of conflict (and its resolution) is in the longer run.

- Most of our jurisdictions are working on a common cost benefit methodology to evaluate flexibility solutions. There is clearly a need for this and for it to be consistent with standard social cost benefit methodologies being used by central and local government.

References

- ACM (2019), Verkenning naar de mogelijkheden van flexibilisering van nettarieven, Authority for Consumers & Markets, May 2019.
- AEMC (2020), *Consultation Paper. Distributed Energy Resources Integration – Updating Regulatory Arrangements*. Australian Energy Market Commission, July 2020.
- Anaya, K.L.; Pollitt, M.G. (2021a) How to Procure Flexibility Services within the Electricity Distribution System: Lessons from an International Review of Innovation Projects. *Energies*, 14, 4475. https://doi.org/10.3390/en14154475
- Anaya, K.L.; Pollitt, M.G. (2021b) The Role of Regulators in Promoting the Procurement of Flexibility Services within the Electricity Distribution System: A Survey of Seven Leading Countries. *Energies*, 14, 4073. https://doi.org/10.3390/en14144073
- Anaya, K. and Pollitt, M.G. (2020a), *A review of international experience in the use of smart electricity platforms for the procurement of flexibility services (Part 1), April 2020.*
- Anaya, K. and Pollitt, M.G. (2020b), *A review of international experience in the use of smart electricity platforms for the procurement of flexibility services (Part 2 – Main Findings), May 2020.*
- Anaya, K. and Pollitt, M.G. (2020c), *Regulation and policies for local flexibility markets: Current and future developments in seven leading countries, August 2020.*
- BNetzA (2017), Flexibility in the electricity system. Status quo, obstacles and approaches for a better use of flexibility. Discussion Paper. Bundesnetzagentur, April 2019.
- ENA (2020), *Open Networks Project Phase 4 2020 Project Initiation Document*. Energy Networks Association, January 2020.
- EN Australia (2020), *Open Networks Project. Position Paper*. Energy Networks Australia, 2020.
- Ofgem (2020), *RIIO-ED2 Methodology Consultation: Overview*. Office of Gas and Electricity Markets, July 2020.
- Pollitt, M., Giulietti, M. and Anaya, K. (2021), *Optimal regulation for European DSOs to 2025 and beyond*, Brussels: CERRE.