Local electricity markets: Lessons and implications for the DSO transition

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Contents

Towards the DSO transition

- The transition to DSOs requires to manage more active networks to accommodate more DER and more participation from demand customers.

- It requires to operate and manage the networks more efficiently with the consideration of alternative methods.

- The Electricity Directive EC 944/2019 (Art 32) encourages the procurement of flexibility services as an alternative method, using transparent, non-discriminatory and market-based procedures.

- It stresses the role of flexibility services in network development planning.

- Jurisdictions are already transposing the Electricity Directive into national regulations.

Current developments in local flexibility markets

- Selection of Use Cases (13 in total) from 7 jurisdictions (AU, FR, DE, GB, JP, NL, NO).
- Discussion of latest projects/initiatives (from 2017 onwards).

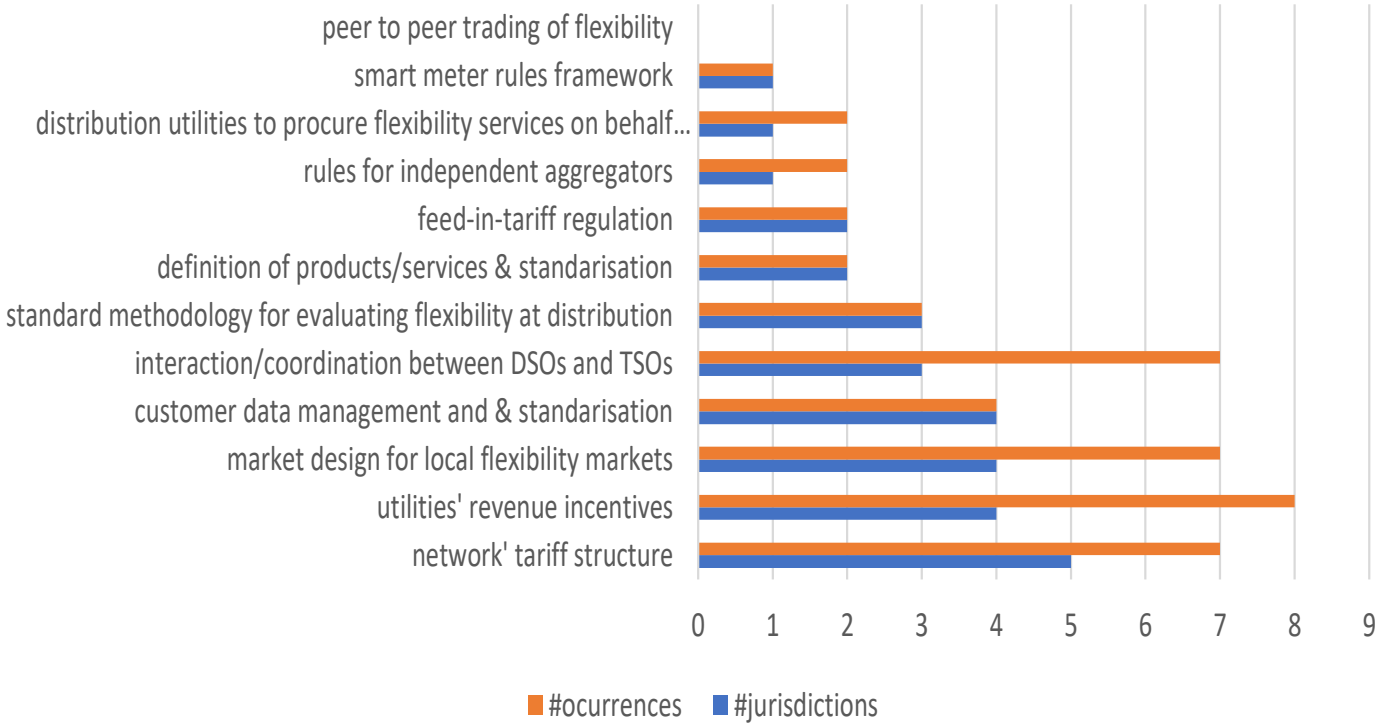
Summary of Use Cases (selected)

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)

The role of regulation

- Two questionnaires were designed (1) with general view, (2) Use Case specific
- Identification of key regulatory topics (12 in total)
- Responses from 18 stakeholders (7 jurisdictions)

Top 3 - Summary



Recent developments in connection charges and access rights

Ofgem minded to positions (The Access SCR)

Connection charges:

- Boundary for generators should be made shallower but not fully shallow.
- Generators to pay for reinforcement at the same voltage level at their connection and DNOs would pay for any reinforcement at voltage levels above the point of connection.
- Demand customers fully shallow.

Access rights:

- *level of firmness:* introduces better defined non-firm access choices based on the user experience of curtailment.
- *time-profiled access*: encourages users to move away from network peak times (already practiced by some DNOs).

Summary of minded to positions for choice of access rights

Ofgem minded to positions	Non-firm	Time-profiled
When to curtail?	no specific time (continuous)	only on peak network times (i.e. demand in winter, generation in summer)
What kind of user can participate?	all (except small users)	all (except small users)
What is the value of alternative access rights for users?	lower connections charges	lower connection charges or reduced distribution use of system charges
What would happen if the user is curtailed above the agreed threshold or outside peak times?	DNO procures the service	DNO procures flexibility from the user
Can a user choose different access rights?	Yes, users can choose the percentage allocated to non-firm and firm access rights	Yes, during peak periods a user may request: no access, reduced access or non-firm access

Source: Ofgem (2021a)

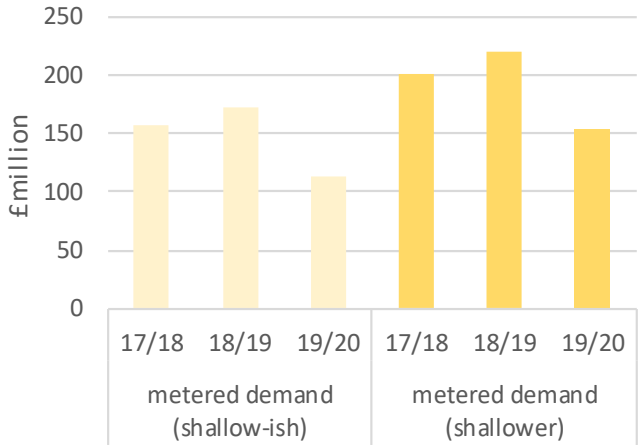
Recent developments in connection charges and access rights

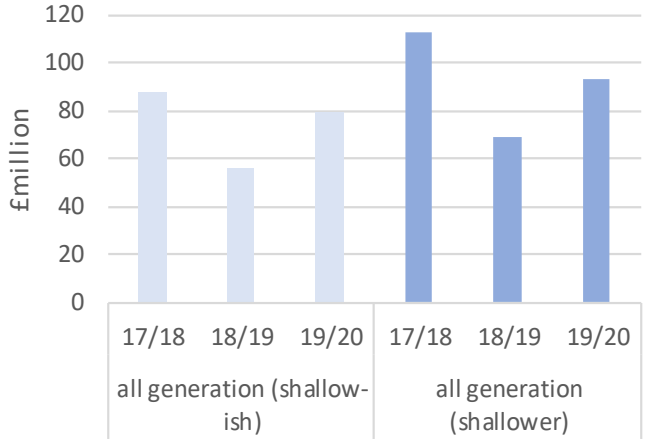
Ofgem minded to positions (Access Review) – Impact on flexibility markets

How is the estimation of ceiling prices (as an indication of DNO willingness to pay) affected by the new proposal with higher reinforcement costs to be funded by DNOs via DUoS charges?

- Initial increase in cost incurred by DNOs to reinforce the network.
- DNOs to be encouraged to invest in their networks and adapt them progressively.
- Strategic network investments and contracting for flexibility ahead of need contribute to having more robust networks that can accommodate better new connections with less export/import restrictions.

Apportionment rule – DUoS funded (shallow-ish versus shallower) for metered demand and generation across DNOs





Source: Ofgem (2021b). Unmetered demand connections are not included (< 5% of metered demand connection costs)

Recent developments in connection charges and access rights

Ofgem minded to positions (Access Review) – Impact on flexibility markets

What are the potential conflicts with different markets that may be envisaged?

- Non-firm connection customers are the most exposed to curtailment, which may deter their participation in other energy markets (i.e. balancing services).
- Better coordination and exchange of information between DNOs and NGESO may help to (1) increase DER participation in other markets with more possibilities to stack revenues and to (2) lower the cost of procurement due to more DER participation, increasing market liquidity.

Level of compatibility between alternative access choices and DSO markets

Level of compatibility between alternative access choices and DSO (and non-DSO) markets		Non DSO Markets							DSO Markets					
		Wholesale market	Capacity Market	CfD	Balancing Services				Current markets	Planned future markets		Potential future markets		
					Frequency response services	Reactive power services	Reserve services	System security services (B. Start)	Flex for reinforc.	Flex for planned outage	Flex for unplanned outages	Reactive power	Curtailment market	Ancillary services to ESO
Firmness	Non-firm - physical drivers	🟢	🟢	🟢	🟠	🟠	🟠	🟠	🟠	🟠	🟠	🟢	🟢	🟠
	Non-firm - consumer outcomes	🟢	🟢	🟢	🟠	🟠	🟠	🟠	🟢	🟢	🟢	🟢	🟢	🟠
	Firm	🟢	🟢	🟢	🟢	🟠	🟢	🟠	🟢	🟢	🟢	🟢	🟢	🟠
Time-profiled	Static time profiled	🟢	🟢	🟢	🟠	🟠	🟠	🟠	🟠	🟠	🟢	🟠	🟢	🟠
	Dynamic time-profiled	🟢	🟢	🟢	🟠	🟠	🟠	🟠	🟠	🟠	🟢	🟠	🟢	🟠

🟢 no compatibility concerns 🟠 compatibility concerns

Source: Chargingfutures SCR Access subgroup market participation table (adapted)

Recent developments in connection charges and access rights

Ofgem minded to positions (Access Review) – Impact on flexibility markets

How well informed are customers with non-firm access rights about the level of curtailment that might be exposed to?

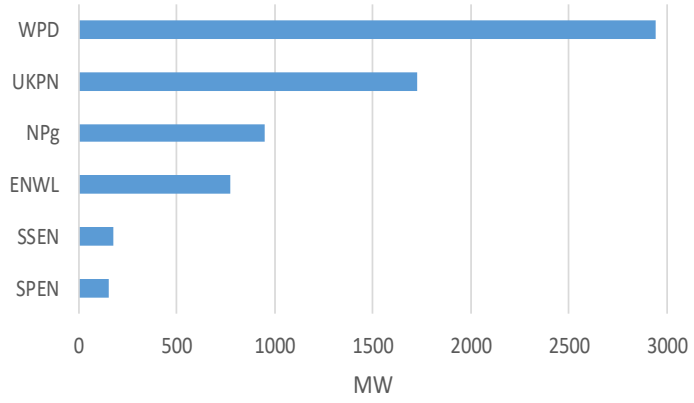
- More certainty about the likely level and variance of curtailment is needed.
- A reference value in the form of a curtailment cap can be useful as well for the DNOs as a trigger for network reinforcement.
- Ideally, we would imagine a standard curtailment methodology across DNOs.

Summary of curtailment assessment methods applied by DNOs

Curtailment assessment methods	Description	Key pros/cons	DNOs method
the DIY	relevant network data is provided by the DNO to customers to perform their own assessment	freedom to choose basis of curtailment assessment but required key skills to perform assessment	**SSEN** (& NPG, SPEN, WPD, UKPN with partial network data)
DNO Curtailment Assessment	an assessment report is prepared and provided (1-2 year predicted output, freq/duration of events, total MWh curtailment)	site specific report but with different approaches used by DNOs	**SPEN, NPG, UKPN, WPD,** SSEN (2021)
Curtailment index (CI)	focus on connections >200kW, IC as an indication of a cap on curtailment for each voltage level, with possibility to take action (i.e. network reinforcement)	provision of actual annual curtailment, commitment of intervention (6 year average curt.>CI) but subject to funding approval	**ENWL**

Source: ENA (2021a)

Volume of ANM connected and planned (MW) by Jan. 2021



Source (WSP-CI-CS, 2021)

Recent developments in connection charges and access rights

Ofgem minded to positions (Access Review) – Impact on flexibility markets

How to ensure fair play and be technology agnostic (e.g. between storage units and controllable loads) in the procurement of flexibility?

- Energy storage and controllable loads with the same opportunities to participate in flexibility markets.
- Controllable loads do not have the locational flexibility that generators and/or storage units may have (where to install and operate them) and their responsiveness may be different.
- Energy storage defined as “generation” in GB and many European countries.
- Some controllable loads can be more predictable than others.

Use Case: Power Potential

About Power Potential (PP) (with NGESO-UK Power Networks)

- Seeks to procure reactive power from DER located in the distribution network operated by UK Power Networks (NGESO as a buyer) using a market based approach.
- Considers the contribution DER could make in supplying reactive power support in combination with the current approach.
- Involves four GSPs (UK South) where transmission network capacity is limited by voltage.

Scenarios

- Three scenarios with a set of sensitivities

Summary of Scenarios (Power Potential)

Scenario	Mvars from New reactive power assets (TO)	Mvars from DER	Mvars for network optimisation	Elements that provide RP support and to take into account in each scenario	Cost figures considered in the CBA
S1	✓			Mvars from: T-connected generators, interconnectors, existing RP assets, new RP assets	new RP assets
S2	✓	✓		Mvars from: T-connected generators, interconnectors, existing RP assets, new RP assets, DER	new RP assets , bid prices (availability, utilisation)
S3	✓	✓	✓	Mvars from: T-connected generators, interconnectors, existing RP assets, DER, network optimisation	new RP assets , bid prices (availability, utilisation)

Note: RP assets include only STATCOMS.

Use Case: Power Potential

CBA methodology

- CBA focuses on the estimation of the Net Present Value (NPV) of the difference between the BAU (S1) and alternative scenarios (S2, S3), period 2020-2050.
- The methodology draws on the original CBA undertaken for the PP bid in 2016 (NIC).
- The final CBA undertaken takes into account actual bid prices from the live trial (Jan.-March 2021).

Main findings

- Contracting reactive power from DER using a market-based approach would result in savings of around £14.3mi in 2018 prices, equivalent to 8% of the BAU costs.
- When the contribution of network optimization is added, expected savings increased to £23mi representing 13% of BAU costs.
- Higher savings if bid prices from live trial are used (+£5mi).

Use Case: Merlin project

About Merlin (with SSEN)

- Development of a transactive energy management system that optimises economic network investment.
- Procurement of flexibility from DER in order to deal with network constraints.
- The conventional solution suggests the upgrade of two conductors.

Scenarios

Three scenarios with a set of sensitivities

Summary of Scenarios (Merlin)

Scenario	Business as Usual	Flexibility services from DER	Societal benefits/costs	Cost/benefit figures considered in the CBA
S0	yes			reinforcement costs, power losses, network performance costs of failure
S1	yes (with deferred investment)	yes		all the above plus bid costs (availability and utilisation payments & procurement costs)
S2	yes (with deferred investment)	yes	yes	all the above plus CO2e associated with losses, community credit generation

Use Case: Merlin project

CBA methodology

- Savings are given by the NPV difference of the BAU and other alternative options.
- BAU solutions refer to the upgrade of two conductors (11kV, 33kV).
- The alternative network intervention is given by deferring for one or more years the upgrade of the asset and contracting flexibility services during those years.
- CBA methodology is aligned with the CEM CBA (ENA) and RIIO ED Ofgem CBA tool.

Main findings

- Flexibility does not bring value at 11kV but at 33 kV (WC) due higher reinforcement costs).
- We are evaluating the deferral of replacement conductors given that the existing (older) ones are performing increasingly poorly.

Cumulative savings by 2050 per type of approach and line, central case

Conclusions

- Some jurisdictions are making more progress than others in the transition to the DSO.

- The deployment of local flexibility markets is still in early stage, with some exceptions.

- Flexibility should be valued very carefully, and should consider societal benefits/costs.

- Competitive procurement can be beneficial under certain circumstances but it is not always the most cost-effective option, especially when existing assets are deteriorating.

- Deeper DNO engagement with DER who could potentially provide flexibility is suggested (via well-designed surveys) in order to explore their preferences.

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Thank you!