2023 PORTUGAL RENEWABLE ENERGY SUMMIT

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APREN Associação de Energias Renováveis

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An overview of flexibility markets in Great Britain (GB) – lessons learnt

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APREN Associação de Energias Renováveis

Energy UK: Who do we speak for?

- Energy trade association
- Over 100 members

Membership:

- delivers 80% of UK's power generation
- over 95% of energy supply (28 million UK homes and many businesses)
- includes service providers across energy, transport, heat and technology.

Full members

Amp X	Equinor	Mercia Power Response	Sembcorp Utilities UK
Arenko	ESB	MGT Teeside	Sense
BES Utilities	Foster Turner Hydro	Microsoft	Shell Energy
BP	Foxglove Energy	National Grid	Smart DCC
British Solar Renewables	Garbhaig Hydro Power	National Grid ESO	Smartest Energy
Brockwell Energy	GE Gas Power	Natural Power	So Energy
Centrica	Good Energy	Nodes	SSE
Conrad Energy	Green Frog Power	Octopus Energy	Stark
CRF Hydropower	Hero Future Energies	Orsted	Statera Energy
Drax Group	Highview Power	OVO	TESLA
E	InterGen	Passiv UK	Total Energies Gas & Power
Ecotricity	JBM Solar	Picio	Uniper
EDF	Jersey Electricity	Pod Point	Utilita Energy
Engie	Kensa Group	Rebel Energy	Utility Warehouse
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Envision Group	Low Carbon	Rock Power Connections	Vattenfall Heat UK
E.ON	Manx Utilities	RWE Generation	Vitol / VPI Immingham

Associate members

AFRY Management Consulting	DNV	Gentrack	Newsom Consulting
Arup	EDF Trading	Green Switch Capital	Newton Europe
Austrade	ElectroRoute	Google Cloud	Nord Pool Spot AS
Axpo UK Ltd	Elexon	Herbert Smith Freehills LLP	NuScale Power / Madano
British Hydropower Association	Enel X UK (formerly Enernoc)	Honda R&D Europe (U.K.)	Ombudsman Services
Buglass Energy Advisory	Enertechnos	Intercontinental Exchange / Ice Futures Europe	Open Grid Systems
Calvin Asset Management	EPEX Spot (APX Power UK)	ION Ventures	Osaka Gas
Catalyst Commodities	Ernst & Young	Japan Electric Power Information Center	PLMR
CGI	ESCP Europe	LCP Delta	Publicis Sapient
Chubu Electric Power Company	ESG Global	Marchwood Power	PWC
Correla	ESP Utilities Group / ES Pipelines	Moorhouse Consulting	Siemens Energy
Cornwall Energy	Fichtner Consulting Engineers	Mott MacDonald Power	TESLA Europe
Deloitte	Forsa Energy	Navitas Surveyors / Ruddle Merz	Tokyo Electric Power
			Wood Mackenzie

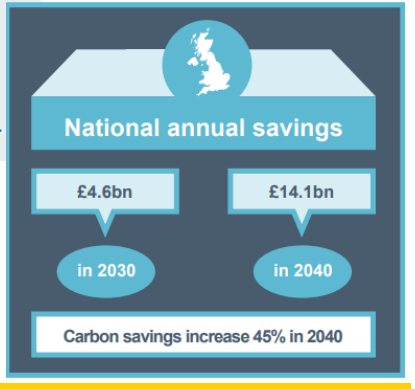
1. Why flex? What problems can it solve?

What is flexibility?

Flexibility is the ability of electrical generators and consumers to alter their output or consumption on demand. It can be provided by assets ranging from large front of meter generation to residential appliances.

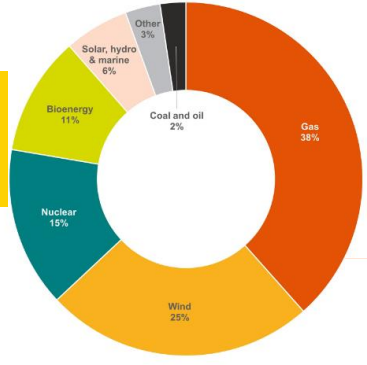
What is Demand Side Flexibility?

DSF is the deviation to the planned consumption, generation and use of storage, in response to price signals or instruction, from residential, commercial or industrial customer sites, individually as well as through aggregation.

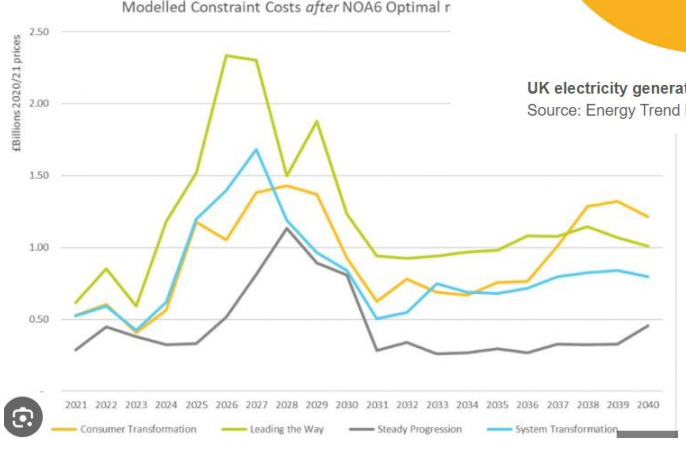


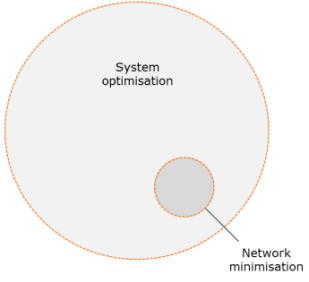
The Power of Flex – Cornwall Insight

Generation mix 2022
- 31% wind and solar.
- 34% gas



UK electricity generation, 2022
Source: Energy Trend March 2023 (DESNZ, 202





Venn diagram of system optimisation and network minimisation

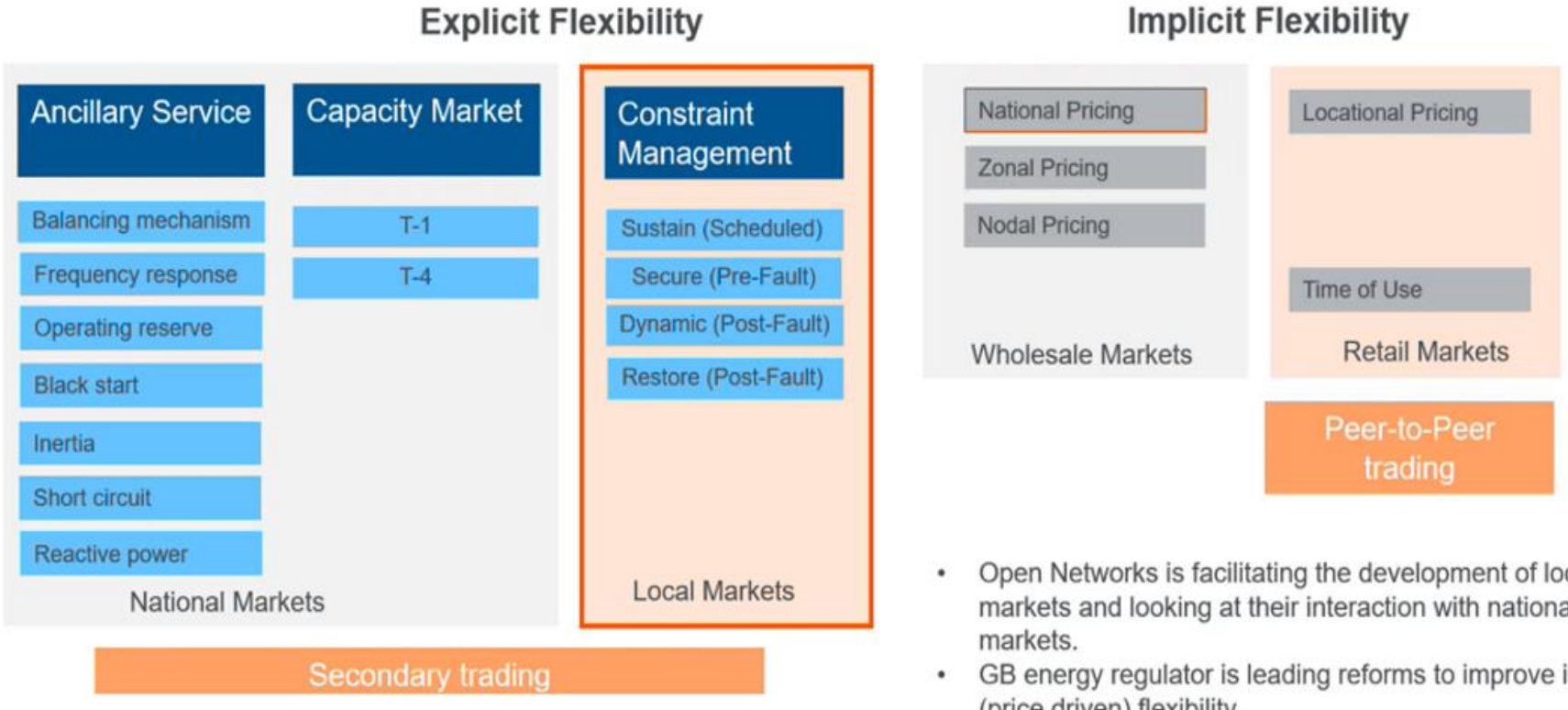
Network Minimisation - flexibility markets to defer or mitigate network reinforcement, or to manage post fault network restoration.
These markets are innately **transient in time and geography**

System Optimisation – flexibility provides services simultaneously trading across multiple markets at both Distribution and Transmission, facilitating effective integration of intermittent renewable generation and smart low carbon tech.

By focusing on network minimisation, **uses of distribution may be inhibited**. DER flexibility has the potential to provide numerous services.

2. How is Great Britain (GB) doing?

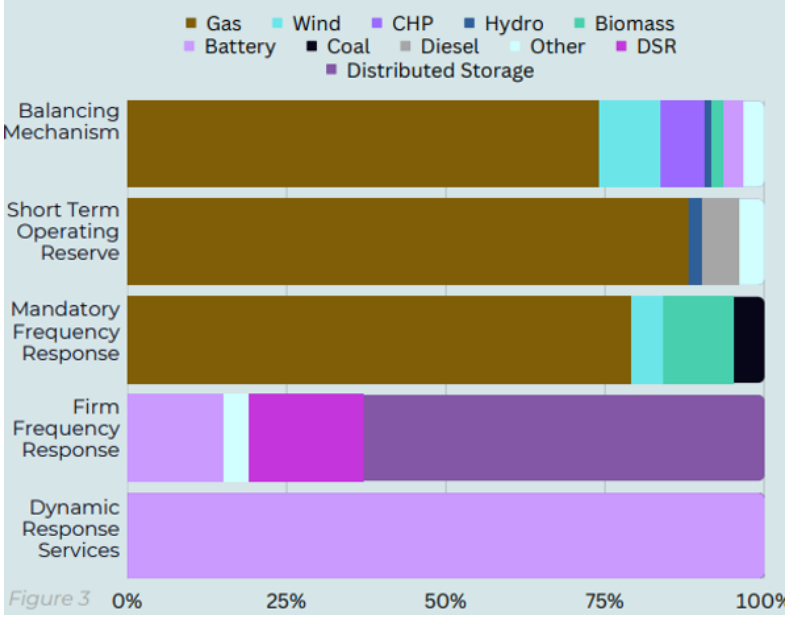
Flex starting to emerge across all markets .. But mixed picture



- Open Networks is facilitating the development of local markets and looking at their interaction with national markets.
- GB energy regulator is leading reforms to improve implicit (price driven) flexibility.

2. How is Great Britain (GB) doing?

- Batteries (**lilac on the chart**) now dominate some ancillary markets
  (e.g. Dynamic response)
- DSO markets are opening up
- But … gas (**brown on the chart**) still accounts for majority of most markets and for the highest value markets
- Work to unpick the barriers is underway – but slow



Graphic from the Association of Decentralised Energy
[Finding the Balance for a Net Zero Future (theade.co.uk)]

Case study – Capacity Market

2022/23 T-1 Auction (source Ofgem CM report 2023)

- 45% - Gas - 2.6GW (95% existing)
- 24% - Nuclear - 1.4GW.
- 11% Battery Storage - 621MW (red bar)
- 7% Coal - 412MW
- 7% DSR - 404MW (green/ purple bar)
- 2% waste - 114MW

2022/23 T-4 Auction

- 68% of Gas - 29.0GW (93% existing)
- 16% Interconnector capacity - 6.9GW
- 4% Pumped storage - 1.8GW (top blue bar)
- 3% Battery Storage - 1.3GW (green bar)
- 2% Nuclear - 1.0GW
- 2% DSR - 925MW (dark blue bar)
- 2% Hydro - 814MW

❖ Batteries: 10% of T-4 capacity, but only 3% of derated
❖ Increase from 2022 due to policy & regulatory changes:
✓ Classification as electricity generation
✓ Removal of double charging of electricity storage (generation and demand)
✓ Changes to planning law so storage projects +50MW can bypass Nationally Significant Infrastructure Project process.

Capacity Market

Consultation on proposals to improve security of supply and align with net zero (Phase 2) and call for evidence on Ten-year Review

Closing date: 8 December 2023

Figure 30: 2022/23 T-1 Auction Results for Cleared De-rated Capacity by Primary Fuel Type and CMU Category

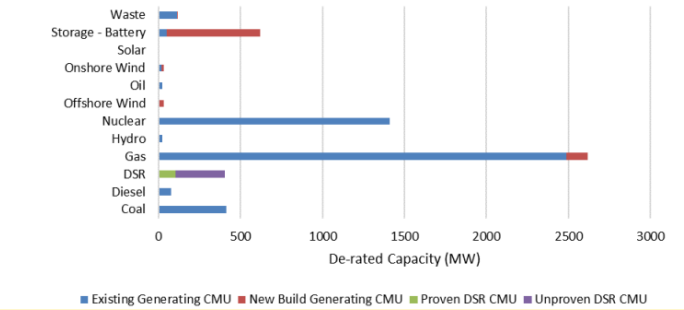
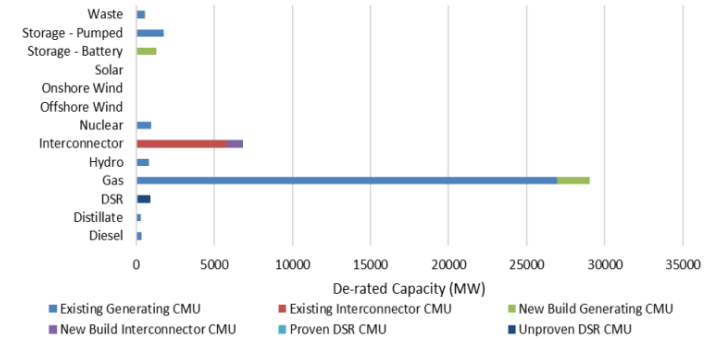


Figure 23: 2022/23 T-4 Auction Results for Cleared De-rated Capacity by Primary Fuel Type and CMU Category



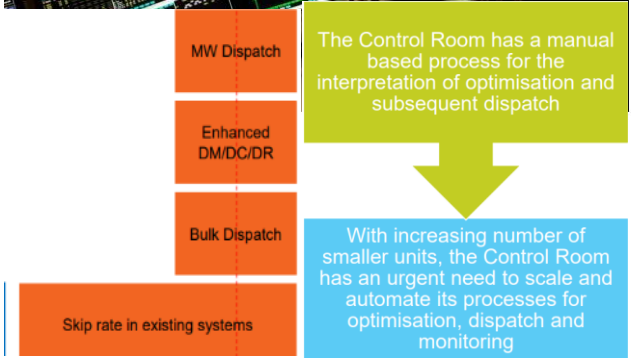
Case study – System balancing

- Main balancing tool (Balancing Mechanism BM), is still dominated by gas plant (~70%) despite 4GW batteries (skip rate issue) (ESO Markets Roadmap 2023)

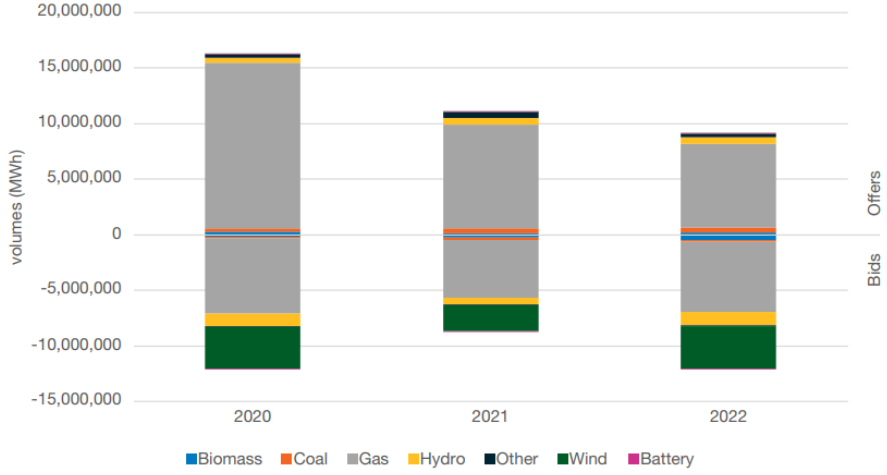
i) Control room processes and IT can't manage small-scale assets in aggregated portfolios

ii) The part manual processes can't manage high volumes of instructions

- **ESO's Open Balancing Platform**, with the capability to dispatch multiple providers (first release December 2023)
- **Metering standards -** ESO requires 1% accuracy for small assets. Unnecessary barrier?
- **ESO trial** (Sept 2023 to April 2024) - relaxed metering standards (2.5%) to help EVs play role in system balancing.



BM Figure 3: BM Bid and Offer Volumes by Technology (2020-2022)



2. How are GB DSO markets doing?

High-level view of Europe

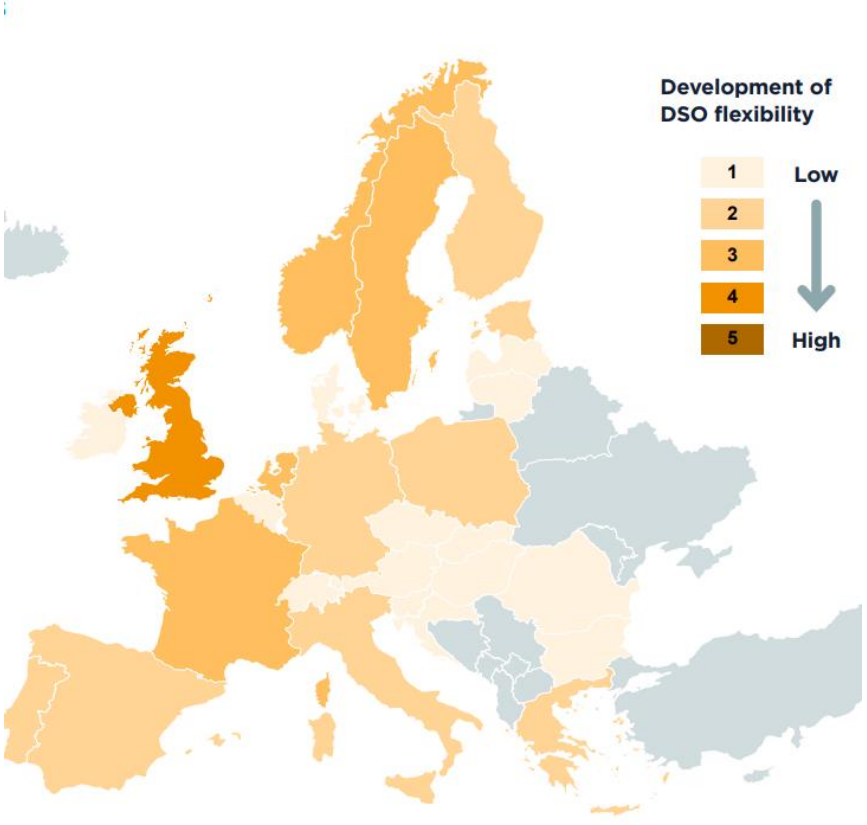
- Great Britain, the Netherlands and France have commercial markets
- E-Redes delivered Portugal's first-ever flexibility market trades (76MW sought, 36MW traded)
- Norway and Sweden - advanced trial offerings with relatively high traded volumes.
- No commercial and trial activity - grey

GB market

❖ All 6 DSOs have procured flexibility through market tenders and are trialling additional services (including Reactive Power).

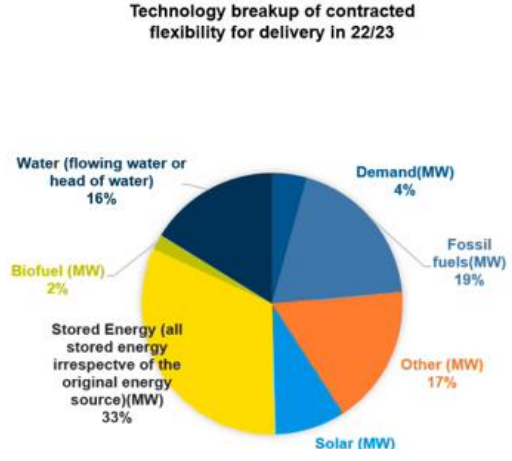
❖ Contracted volumes are increasing annually (from 116MW in 2018 to 2.4GW in 2023)

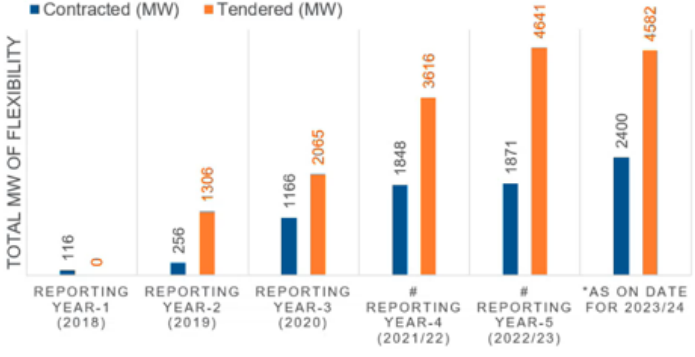
❖ *But, large shortfall between tendered and contracted volumes (supply not meeting demand - friction)*



LCP Delta/ smartEn's 2022 Market Monitor for Demand Side Flexibility

The evolution of DSO flexibility markets

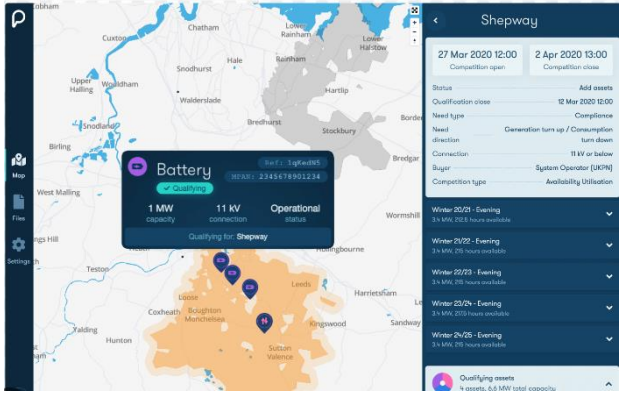


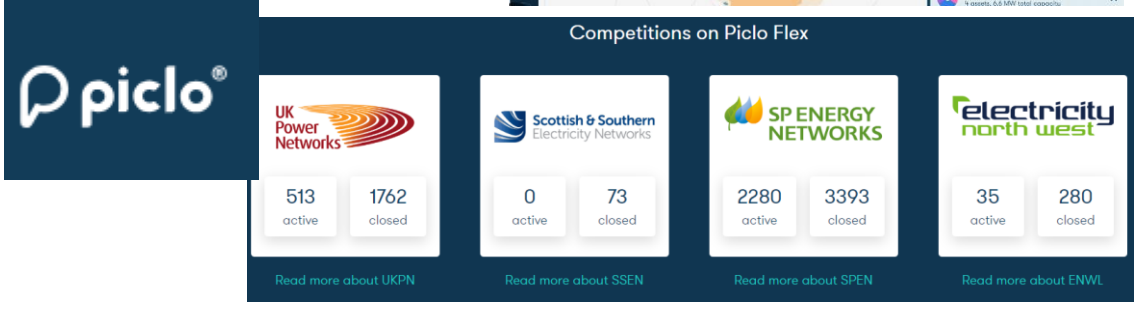


Products	Overview
Open Networks	The Open Networks programme brings together the nine electricity grid operators in the UK and Ireland working to standardise customer experiences and making connecting to the grid as easy as possible. This focuses on ensuring open and transparent, accessible and efficient markets that are coordinated between DSOs and the ESO.

- Technology mix - improving Early market was diesel generators. Now fossil fuels = 1/5
- Tackling friction by improving standardisation

i) **ENA Open Networks**
ii) **Independent marketplaces** – Piclo Flex





Case study - UK Power Networks (DSO)

UKPN aims to save £410 million in 5-years by using flexibility to deliver network capacity at lower cost than building new infrastructure

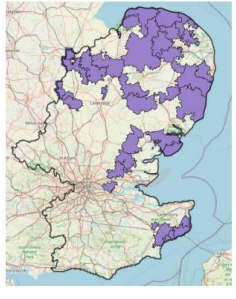
New innovation for 2023/24

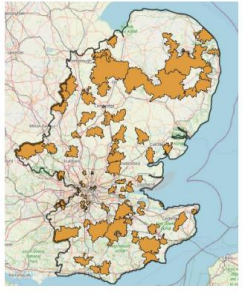
- 2023 - Demand Turn Up auction (1000MW for 426MW – competitive)
- 2024 launch of day-ahead flexibility market

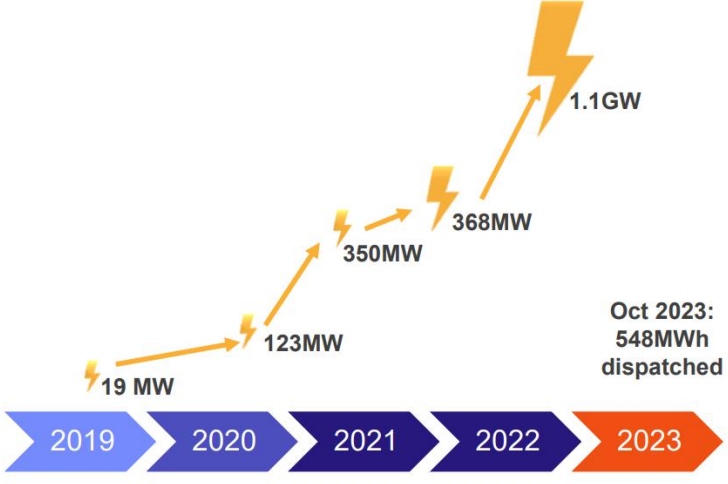
8.4M homes and businesses
9.7GW distributed generation
14GW peak demand
189,822km of network
More than 120,000 substations

Most recent tender: Budget of £33m

Demand Turn Up (Low & High Voltage)	Demand Reduction (Low & High Voltage)	Demand Reduction (Low Voltage only)
600MW need	250MW need	7MW need

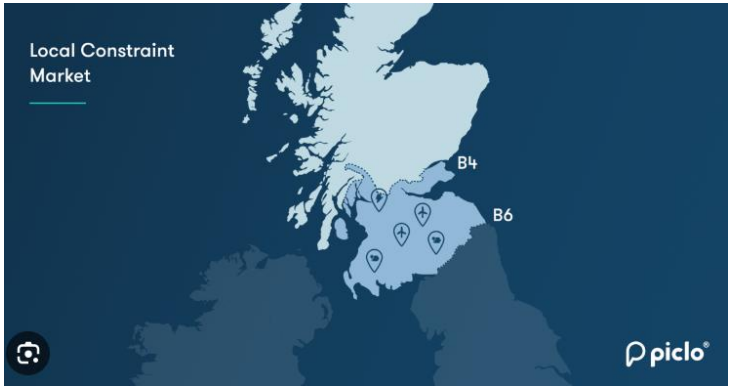






Case study - Local Constraint Market

- New ESO trial by the ESO - April 2023 – April 2025
- Demand Turn-Up product, the ESO will pay consumers in Scotland to increase consumption to tackle transmission constraints - instead of paying to curtail the wind power
- End-to-end service run by 3rd party platform provider (Piclo Flex)
- Twice-daily auctions; a primary auction day-ahead, and a top-up auction same-day. Sits before the Balancing Mechanism (BM), which takes place close to real-time (aim to cut costs in the BM)
- Small volumes so far with bids averaging ~£0.20/kWh
- Alternative to power market reform? (LMP)

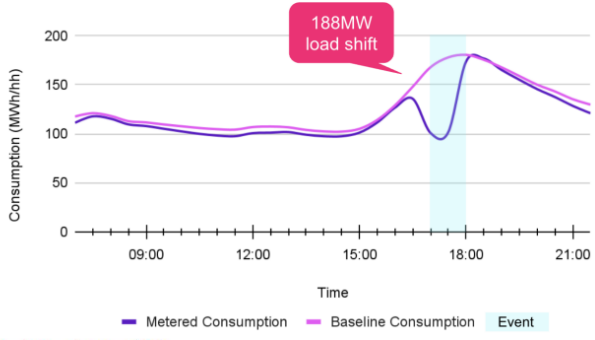


Constraint Management Intertrip Services (CMIS)²:	• Pre-fault • Day ahead and intraday • 30 minute service duration • Pay as bid • Utilisation payment (£/MW/h)
Trades:	
Local Constraint Markets (LCM):	We are developing the LCM, helping to ease constraints at, and above the Scottish/English boundary (B6 and B4) to facilitate the provision on thermal constraint services from DER units. This will provide the ESO with a competitive alternative to the Balancing Mechanism. We expect this service to complete trials in Q2 and for this marketplace to be fully launched in Q3 of 2023.
Balancing Mechanism (BM):	
MW Dispatch Service:	
Network Build:	

Case study – Demand Flexibility Service (DFS)

- Gas crisis - winter 2022/3, the ESO developed a package of winter contingency options (coal contracts, and DFS)
- The award-winning service was a nationwide trial of a demand reduction service, enabling domestic consumers, industrial and commercial users to be incentivised for shifting demand to avoid the peak

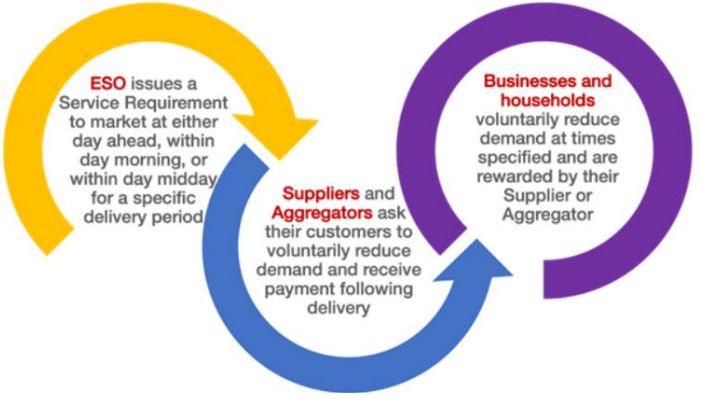
Figure 1: Octopus Saving Sessions aggregated consumption profile, 23 January 2023, 17:00-18:00



What are the key criteria for Demand Flexibility Service?

Half-hourly smart metering	A minimum response time of 30 minutes
A minimum unit size of 1MW, maximum of 100MW with an ability to aggregate on a national basis	Ability to respond to signals issued at day-ahead via email
Settlement calculated by the supplier using historical baselining of household usage	12 tests between 1st November and 31st March with a Guaranteed Acceptance Price (GAP) of £3000/MWh

low does it work?



- 1.6 million households and businesses supported the service by shifting demand, saving over 3,300 MWh of electricity – enough to power ~ 10 million homes .
- End-of-year report

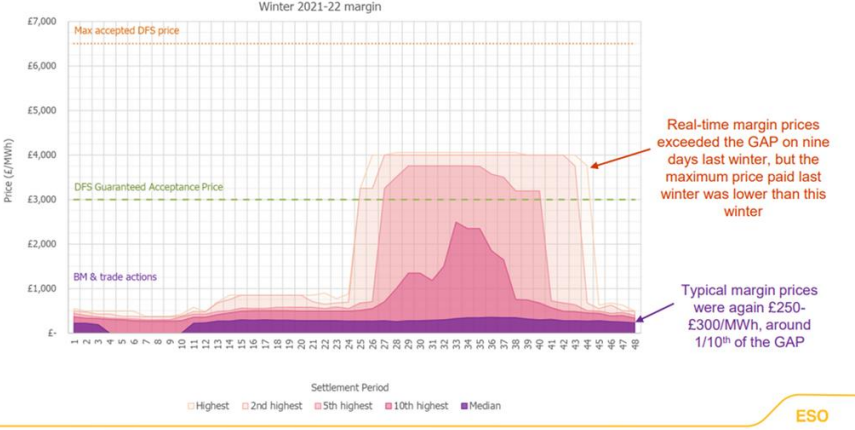
Case study – DFS

- 2023/4 – the ESO expects to run 12 test events between November 2023 and March 2024.
- First 6 tests at £3,000/MWh. Fully competitive auction for tests 6-12 if volumes reach 1.25GW
- Is DFS expensive? Compared to BAU balancing **- Yes**
  Compared to 2022/3 coal contracts **- No**

Guaranteed Acceptance Price (GAP)
£3,000/MWh
for at least 6 test events

20 onboarding and regular test events	2 live events	>2.2 GWh delivered
Over 1.6 million reach	c.350 MW contracted capacity	31 DFS approved providers
£3,000 average price per MWh for test events	£11.1m paid for delivery	£4,559 average price per MWh for live events

DFS prices compared to other prices



Building foundations for scaling the future market

1. **Governance**:
   - Future System Operator
   - Regional Energy Strategy Planner,
   - Market Facilitator
   - TSO-ESO coordination
2. **Digital infrastructure and common marketplaces**
3. **Enablers**

Unlocking the full potential of residential flexibility

We are only scratching the surface and more needs to be done to realise the full potential of residential flexibility

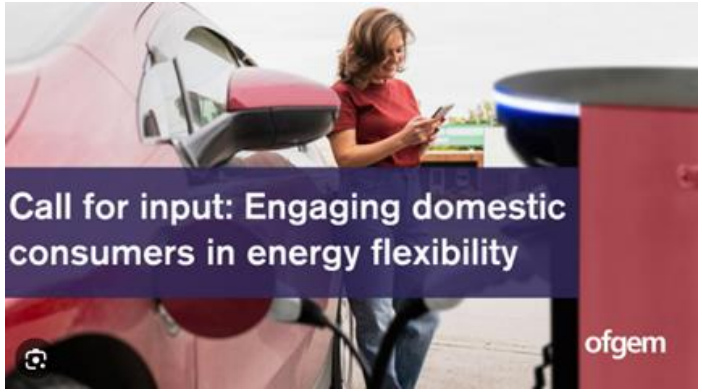
Data and visibility | Clear future market vision | Focused stakeholder engagement | Market access rationalisation | Standardisation

ofgem
Making a positive difference

[The Future of Distributed Flexibility | Ofgem]

	Market failure 1: lack of **information transparency**	**Market failure 2:** lack of **coordinated market access and operations**	**Market failure 3:** lack of **trust**	**Market failure 4:** contextual **market-specific issues**
Part A: FDI	**Flexibility Digital Infrastructure**			
	1. Information Transparency • market rules and product data • asset capability and performance data • current and historic market data	**2. Coordinated Market Access & Operations** • streamline registration / procurement / qualification processes • improve coordination for multi-market stacking / primacy	**3. Trusted Governance** • uphold standard processes and security • participatory change management processes • transparency in decision making	
Part B: Enablers (direct)	Data standards	Standardised market products Standardised contracts & pre-qual Stacking and primacy rules		**Enablers (indirect)** Operational metering Baselining methodologies Minimum 1MW limits Minimum liability amounts

To emphasise the importance and urgency of **enablers delivery** we published an **Open Letter** to the **ENA Open Networks Project**



Key lessons – what worked?

What worked?

1. Regulatory structure that incentivises flex (and OpEx over CapEx spend)

- GB's price control framework (RIIO (Revenue = Incentives + Innovation + Outputs) rewards networks for 'Flexibility First' to defer investment

2. Standardisation and simplicity - 'one market'

- Common set of products (with same definition!), procurement rules/ process
- Difference = friction = cost = illiquid markets
- Challenging! (6+ years of Open Networks)

3. **Third party platforms providers can speed progress**

- Support 'one market' – common asset register etc. (Piclo Flex – for 4/6 DSOs)
- End-to-end services including dispatch can support innovation (whilst network operators incrementally change legacy systems (Local Constraint Market)

What next?

4. **Strategic direction** - unlocking value requires markets to work together ('revenue stacking') - TSO/ DSO coordination won't *evolve*, needs *direction* (GB's Future System Operator)

5. **Governance** - new roles, enforcement, monitoring (GB – FSO, Regional Energy System Planners, Market Facilitator).

Thank you APREN!

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