DistributionSystemOperator

Flexibility Service Selection Use Cases

March 2024

DSO | nationalgrid electricity distribution

1. Introduction

The energy system is undergoing a huge transition because of the changes to electricity generation and use, including the growth of distributed generation and the increasing popularity of electric vehicles and heat pumps. These changes and the associated increases in demand have required us to develop new processes and systems, such as adopting flexible solutions to manage different power flows on the network. To continue to operate a smarter, more efficient energy system, we are carrying out the functions of a Distribution System Operator. Our DSO Charter outlines our vision and strategic commitments.

As these functions develop, we are committed to providing clear information about how we operate flexibility services.

This document aims to highlight how we currently make decisions around flexibility service selection and dispatch, including the principles we follow. We then detail a number of use-cases we are now seeing in our decision making. As operational volumes grow, we are learning by doing and sharing these use cases to increase transparency, and highlight some areas of focus going forwards.

We hope this provides visibility of some of the challenges we are facing, and stimulate open discussion on how best to address them.

2. How we select and dispatch flexibility services.

2.1 Service Selection Principles

In March 2020 the ENA Open Networks Project published a set of dispatch decision criteria guiding principles, which guide how DSOs decide which services to dispatch.

PRINCIPLE	DESCRIPTION	NATIONAL GRID ELECTRICITY DISTRIBUTION IMPLEMENTATION
Security	The needs of the system will be met using flexibility in such a way that security of supply is maintained.	This principle can be subdivided into two key criteria that need to be met, Technical Integrity and Customer Security. • Technical Integrity considers Network Integrity, the ability of a network to operate within technical limits and System Frequency Integrity, the ability of the System to operate within acceptable frequency limits[1]. • Customer Security is the ability of a network to meet customer demand and generation. There are minimum standards for these National Grid Electricity Distribution must meet but opportunities to go beyond these standards are also considered where these are economic.
Cost	Flexibility will be operated to meet system need at the minimum level of cost.	The use of Flexibility Services should be cost effective and expenditure proportional to the benefits it brings to the network.

[1] Although System Frequency is not managed by National Grid Electricity Distribution, it can be affected by the operation of National Grid Electricity Distribution's network and customers.

Operability	DSOs will seek to dispatch services that offer compatible levels of operability.	Operability is a measure of how well an offer of a Flexibility Service meets actual or potential System needs. National Grid Electricity Distribution will seek to develop an objective and transparent method for assessing the operability of offers of Flexibility Services.
Competition	DSOs will provide transparency of their dispatch decisions and activities.	Flexibility should be procured using simple, fair and transparent rules and processes. Services should be developed such that service providers can participate easily in different markets.
Fairness	DSOs will operate a fair dispatch methodology and provide equal opportunities to participate.	Flexibility Services shall be assessed and selected impartially purely on their technical and commercial merits. Where multiple technically sufficient Flexibility Services are available at a comparable cost, we will share the dispatch of services across these providers.

We set out our underlying service selection principles in our Guidance for Distribution Flexibility Services Providers and Distribution Flexibility Services Procurement Statement. These guide both our current service selection process and the more detailed service selection rules we will be developing. These principles incorporate the Open Networks principles and provide further information about how these are implemented in practice. These are common across our selection of services to make available, as well as utilise.

To ensure security of supply is delivered for the most cost-effective outcome, we will consider these items in the following order:

PRIORITY	NAME	MEANING	IMPLEMENTED OPEN NETWORKS PRINCIPLE
1	Technical Integrity	The National Grid Electricity Distribution requirements of Network Integrity, System Frequency Integrity (SD2/ TP1B) shall be met. Where these are dependent on Flexibly Services, these services must meet these requirements.	Security
2	Customer Security	National Grid Electricity Distribution requirements for demand and generator security (SD2) shall be met. Where these are dependent on Flexibility Services, these services must meet these requirements. Opportunities for enhancements to demand and generator security may be used where economic.	Security
3	Value	Flexibility should be procured and operated to carry out the roles of a DSO, in a cost effective manner.	Operability & Cost
4	Market Resilience	Where multiple technically sufficient Flexibility Services are available at a comparable cost, we will share the dispatch of services across these providers.	Competition & Fairness

As our operational experience in dispatching flexibility increases, we are seeing how these principles apply in practice, and what further rules we must implement to ensure these are applied consistently and that we have effective and transparent decision making.

2.2 Timelines

We operate over two distinct timeframes for service selection.

Our Shorter-Term products operate within a week-ahead timescales. FSPs offer availability, capacity and availability/utilisation prices to us. These are matched against requirements and are manually cleared according to our dispatch principles set out above. The timings are highlighted in the figure below.

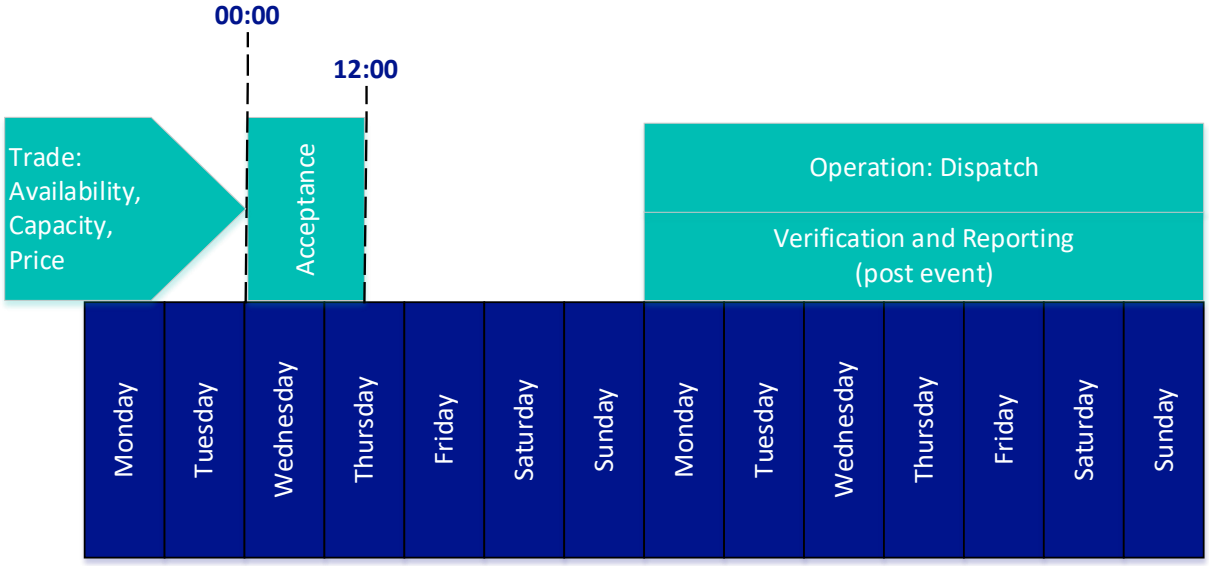

Figure 1: Weekly Operational process

Availability Declarations: By 00:00 on Wednesday, FSPs provide us with their trade responses for the following operational week (Monday to Sunday). This includes providing details such as the available capacity they can provide, the price and key operational parameters such as maximum and minimum run times.

Acceptance: By Thursday morning, before 12:00, we assess the available volume declared and accept availability to meet the volumes required for us to manage the relevant constraint.

As Restore has no availability payment, all availability declarations are accepted automatically.

Long Term products trade in much the same way, however they will happen over a longer timeframe. The timings for next year are highlighted in the figure below. This is moving to a yearly cycle rather than 6 monthly as is currently the case.

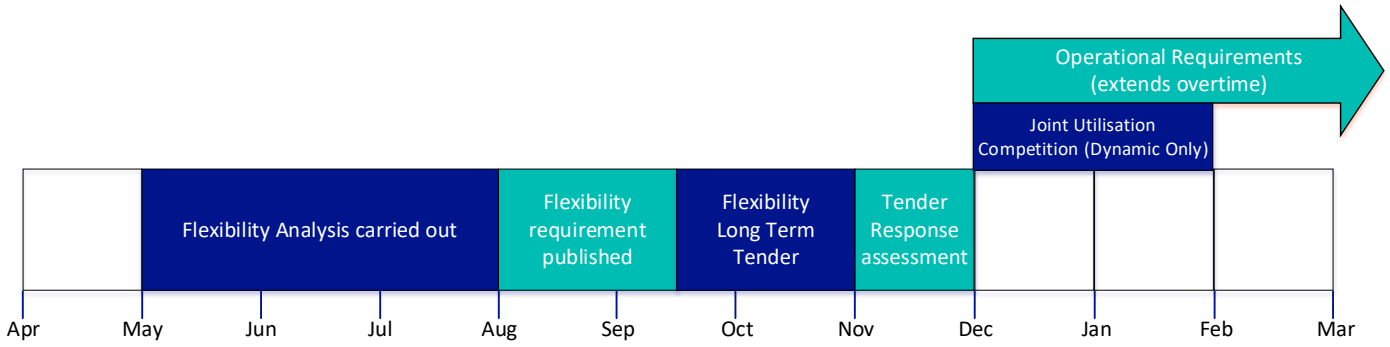

Figure 2: Long Term Operational process

Availability Declarations: Following publishing results in August, FSPs will be able to submit their availability declarations in September/November. This includes providing details such as the available capacity they can provide, the price and key operational parameters such as maximum and minimum run times.

Acceptance: We will accept or reject trades by the end of December.

Once trades have been cleared, our dispatch processes then focusses around the Flexible Power Portal (https://flexiblepowerportal.co.uk) and its associated API. This is a simple API used to send start/stop messages and receive metering data (see our Guidance document for more details).

Operation
When we instruct FSPs to deliver flexibility depends on the service being used. These will always be within periods of accepted availability.

2.3 Price Clearing

We use a Pay as Clear (PaC) mechanic where we have competitive pricing. This means that all providers are paid at the rate of the marginal offer, rather than the price they bid. This is designed to encourage bids at the marginal cost, rather than gravitating towards the expected clearing price of the zone. This mechanic is being used in most new flexibility service across Europe.

The decision between PaC and Fixed pricing will be determined in the trade. Our default parameters are:

PRODUCT	PRICING MECHANIC
Sustain	Pay As Clear
Secure	Pay As Clear
Dynamic	Pay As Clear
Restore	Fixed Price

Our initial implementation of Pay as Clear is based on manual processes looking to best align with the service principles. The clearing price are set by the most expensive provider selected. Some interesting use cases for this are highlighted in section 3.
Restore Services are used in response to rare, high impact, network events. The nature of these events often restricts the Flexibility Services that could be use due to locational requirements. In order to ensure timely usage of these services they will remain fixed price. This is communicated in the Trade Opportunity. We also have some legacy contracts which remain on our fixed price approach.

2.3 Trade results and Dispatch Data

We publish extensive data on our trade results and dispatch data.

Trade results including the volumes and prices of accepted and rejected bids are published on our Connected Data Portal and the Flexible Power website.

We currently publish full dispatch data as part of our yearly Distribution Flexibility Services Procurement Report. We aim to publish more regularly in the next year.

3. Use Cases

As we gain operational experience with flexibility services a number of considerations and challenges have emerged.
These are described below with brief examples.

Defining our time profiled need

Due to the profiled, time-varying nature of network loading, there are a number of considerations when we set out our need, generally looking to trade-off between accuracy and simplicity. We can define our needs in a detailed granular manner, allowing us to request less overall flexibility, translating to higher pricing, but this adds complexity in the data structures needed to both define and then clear against our need. Alternatively, we can define simpler requirements, but with lower pricing.
We currently take different approaches to our LV and HV zones, with the former defined in simple 4-hour delivery periods over the entire season. For our higher voltage zones, we provide much more detailed definitions of requirements.

The example below highlights the different requirements in a zone, and a potential simplification.

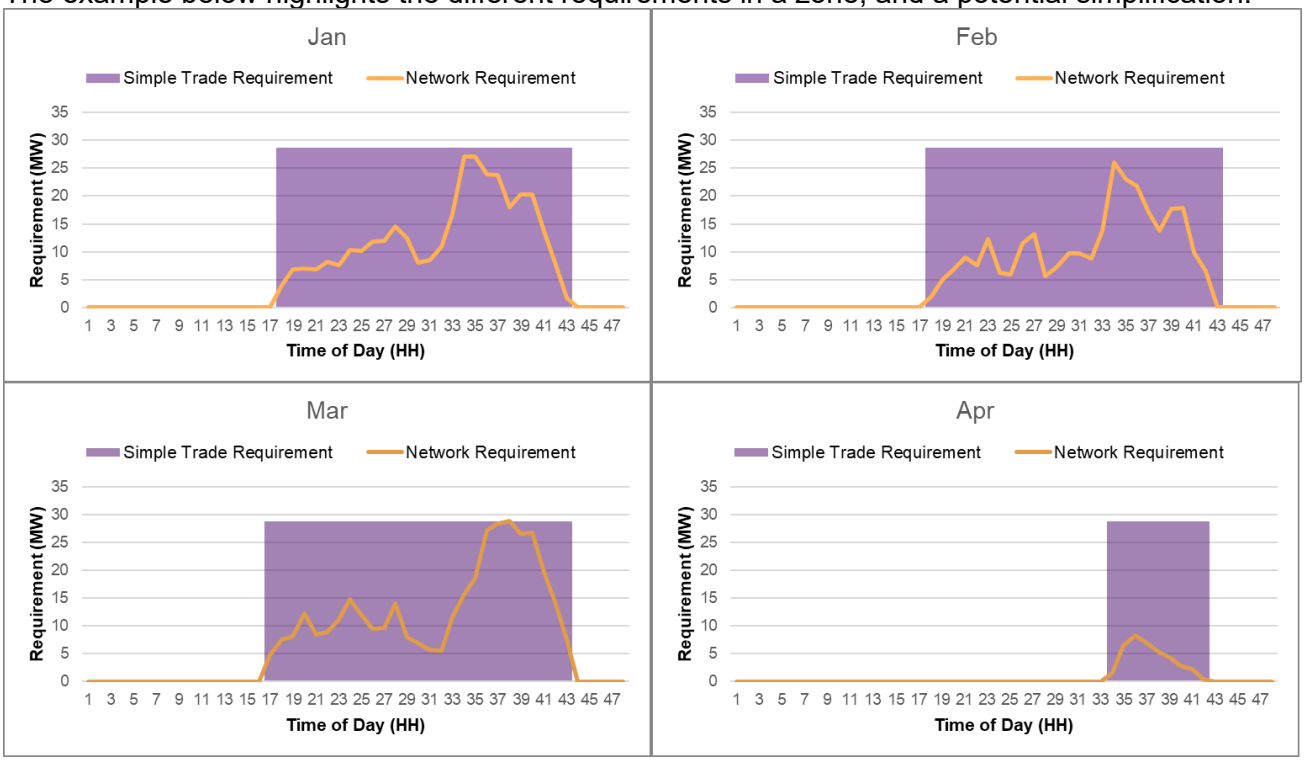

Figure 3: Example of requirements and options for simplified trades

We will continue to review how we define our needs to find the optimal balance between efficiency and simplicity.

Maximum and Minimum Capacity Requirements

Our trade structure allows us to define maximum and minimum requirements for each delivery period within a trade. This allows to communicate the range associated with our need.

As our Long-Term trades on our higher voltage zones, are still relatively new, and we have been transitioning from all availability decision making at the week ahead stage, we set minimum requirements to 0 to allow us to better understand volumes available in Long Term markets. This however presents a wide

range within clearing, especially as we would like to clear as close to the Maximum as possible. We may even want to over procure where we can to reduce risk to support our principles of Technical Integrity and Customer Security. As such we expect to set minimum requirements in these trades going forwards. This should make our requirements clearer and narrow the number of acceptable clearing permutations.

Maximum offer sizes

To better match the offered volumes to our needs, within our longer-term trades we now cap the maximum capacity an FSP can offer to the maximum need. This avoids us receiving offers that far exceed our need, and allow for easier comparisons across offers.

Where we have profiled requirements, capping at the maximum need, can still leave challenges in matching requirements to offers away from peak. More granularity could be added to our limits on maximum offers; however, this adds more complexity.
In most circumstances having more, smaller offers, gives us far more flexibility than fewer larger ones.

The example below shows a simplified requirement. If a single provider sizes up to the maximum offer allowed (2MW) then in hour 1 we have to either over or under procure. Accepting a higher unit price, lower volume asset may present better value.

	HOUR 1	HOUR 2
Requirement (MW)	2	1
Maximum offer allowed (MW)	2	2

FSP	CAPACITY	UTILISATION PRICE
FSP A	2 MW	£ 500/MWh
FSP B	1 MW	£ 550/MWh
FSP C	1 MW	£ 600/MWh

Over procurement, large marginal bids and skipping

We have seen a number of zones where we large offers, often at the maximum offer capacity at the top of the price stack.
This presents challenges where there is moderate volume below them on the stack. This gives us 2 options, under or over procurement.

To date we have worked up the price stack and accepted over-procurement where it is of minimal financial cost. Where the increments would have created significant over procurement, and over spend we have under procured.

Future options could involve ordering the price stack on total cost, and allowing skipping of assets for best fit. However, we must consider the impact this might have on competition and the support of new entrants to the market.

As seen in the example below, with a requirement of 3MW, working up the price stack with no over procurement would select FSP A & B. Over procurement would accept all and skipping would accept only FSP C.

FSP	CAPACITY	UTILISATION PRICE
FSP A	1 MW	£ 500/MWh
FSP B	1 MW	£ 600/MWh
FSP C	3 MW	£1000/MWh

Partial volume acceptance

Asset volumes are currently offered to us in fixed capacities. We cannot partially accept volumes. Doing so would add greater ability to match offers to our needs, however it does add significant complexity, particularly in defining the capabilities of an asset and the associated costs. We understand that various capacities may have different prices. Representing this is a robust manner is non-trivial

In the example below. If we allowed partial volume acceptances, then for a requirement of 3MW we could simply select 1 MW from each FSP.

FSP	MINIMUM CAPACITY	MAXIMUM CAPACITY	UTILISATION PRICE
FSP A	0.5 MW	1MW	£ 500/MWh
FSP B	0.5 MW	1MW	£ 600/MWh
FSP C	1 MW	3 MW	£1000/MWh

To support this, we would need to build out the capability for FSPs to define their capabilities robustly, as well as the ability for us to consider all the additional variables in a scalable and transparent manner. This may involve partial volume acceptances in offers, or multiple interlinked offers with differing capacities

Considering redundancy

In traditional network design, we build redundancy into our solutions, to ensure we maintain a security of supply.

How we factor that into flexibility procurement can be complex. We already consider over-procurement into our requirements. However, this may not build in redundancy automatically. For example, procuring 50% more volume from a single generator does not mitigate the risk of it faulting.

Options for mitigation may include adjusting maximum bid sizes relative to the requirement. By reducing the size of offers we can reduce the impact of losing the largest asset.
We will need to consider how we build in redundancy, whilst keeping processes clear and transparent. We also need to decide at what level (asset, meterable unit, organisation…) redundancy is required.

Selecting all bids

Our general principle for Pay as Clear markets has been to set the price at that of the most expensive offer selected. An interesting edge case has emerged when selecting all bids. Where all bids are accepted, and core needs are not fully met, it is clear that the market is not competitive and therefore the price should remain at the ceiling price. However, where needs are met, but only by accepting all offers, this is less clear. Should this be considered competitive (all needs are met), or not (there are no remaining options unmet). Where this has occurred in our long-term trades we have opted for the latter, as we believe the former would drive FSPs to alter their bids away from their marginal costs.

In the example below if the requirement is 2MW, then if we do not consider it competitive it would clear at £1000/MWh rather than £600/MWh

FSP	CAPACITY	UTILISATION PRICE
FSP A	1 MW	£ 500/MWh
FSP B	1 MW	£ 600/MWh
Ceiling price		**£1000/MWh**

Price clearing across a trade

To date we have defined our long-term trades in 6-month time periods over summer and winter respectively with pricing clearing in a uniform manner across the whole trade.

A longer trade period might allow us to better communicate the value to the DNO. Whereas a shorter time period could allow us to clear at a lower price.

For example, as shown below the DSO puts out 2 trade requirements for winter and then summer. The summer requirement lower, and hits minimum volumes, when the winter does not. This leaves the DSO with a period of risk over the winter, that might make deferral of investment unviable. This would undermine the value of the summer trade.

FSP	WINTER TRADE	SUMMER TRADE
MINIMUM REQUIREMENT	2 MW	1MW
COMBINED RESPONSE	1 MW	1MW

Conversely if a trade has many requirements, then the levels of competition in some months could deliver a lower price than clearing across the whole trade. In the example below, clearing both months together would provide a price of £ 600/MWh, whereas month 1 alone would clear at £ 500/MWh.

	PRICE	CAPACITY IN MONTH 1	CAPACITY IN MONTH 2
MINIMUM REQUIREMENT	£1000/MWh (Ceiling price)	1MW	2MW
FSP A	£ 500/MWh	1MW	1MW
FSP B	£ 600/MWh	1MW	1MW
FSP C	£1000/MWh	1MW	1MW

Options could be to define longer trade periods with independent price clearing within it (say by month), or to create the concept of interlinking trades. However these add complexity.

Maximum and Minimum run times

To allow FSPs to manage their assets efficiently and effectively, we allow FSPs to define maximum and minimum run times.

Whilst important for managing assets, and customer expectations, they provide additional complexity when utilising assets. With different run times, the total costs of FSPs with the same capacity and price will be different, and would impact on the decision making.

For example, as shown below, for a 1-hour requirement FSP B has a lower total cost than FSP A despite a higher unit price. In general shorter minimum run times make an offer more flexible.

FSP	CAPACITY	UTILISATION PRICE	MINIMUM RUN TIME	TOTAL COST
FSP A	1 MW	£ 500/MWh	2 hours	£ 1000
FSP B	**1 MW**	**£ 600/MWh**	**1 hour**	**£ 600**

Availability and Utilisation Ratios

We currently operate a fixed ratio between availability and utilisation prices. This was implemented to simplify bidding for FSPs and clearing for the DSO. We see strong value in being able to allow FSPs to set this ratio themselves to best reflect the costs of their specific assets and business models. However this adds complexity, especially on the comparison of bids, their clearing and their utilisation.

Rather than a simple, single stack for selection, and uniform pricing for dispatch, we would need to translate the various offers into an “effective cost” stack to clear. This would need a view of the zonal availability to utilisation ratio. Once selected we would then need to translate prices back out to the separate components via the FSP provided ratios. When dispatching site we would also need to consider different utilisation prices.

We will review the systems needed to support varying ratios, so these can be implemented effectively.

Nested requirements

There are a number of areas on the network where requirements could “nest”. There might be a limitation on multiple voltage levels that an FSP could help manage.

However this introduces complexity in managing assets, especially where there are maximum and minimum run times. These would need to be tracked across trades. As such we have not allowed assets to operate in nested constraints so far. However we will work to put in places the processes needed to support nesting to allow us offer out more market value. There are open questions on whose role it is to manage which requirements and how to manage asset movements.

Coordination with ANM and curtailment

To date we have had limited coordination between flexibility services and ANM schemes. These have tended to operate in different geographic areas, different directions and different times. As both methods of managing network loading build out, we will need to build better coordination in our processes to ensure actions do not conflict

4. Next Steps

As highlighted in section 3, we are seeing a growing number of considerations on how we define our needs and then select and dispatch our services. There are a growing number of use-cases to consider, all of which interact, building additional complexity.

Alongside this complexity we acknowledge the need to build scalable solutions, to ensure we can operate efficiently and consistently as volume grow

As such we are developing an operational decision-making road map in the first half of 24/25. This will set out the how we intend to build out decision making capability, covering flexibility services, but also curtailment decisions.

We acknowledge that capability will need to be built out iteratively, building on the latest learning. We must also ensure that solutions are proportional to the need, and there is a clear cost benefit to improved tooling and processes.

We look forward to collaborating with our stakeholders as we develop this roadmap and then execute it.

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