

EFR tender results

Market briefing

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KPMG Energy Advisory

Summary

The results of National Grid's (NG's) first Enhanced Frequency Response (EFR) tender has brought forward investment in 8 battery storage facilities in the UK. The year-long auction process secured 201 MW of capacity at prices between £7 and £11.97/MW/hr, at a total cost of £65.95 million over the four years.

We note that:

- The auction was highly competitive and tender clearing prices were significantly lower than anticipated given technology costs, as illustrated by the weighted average bid price of £20.20/MW/hr;
- Service 2¹, which allows NG to control frequency deviations pre-fault and is more valued by it, attracted an overwhelming response from the bidders;
- The c.1.2 GW of unsuccessful capacity clearly indicates the market's appetite and readiness for investment in fast response technologies; and
- Changes in market dynamics resulting from changes in the generation mix, and its impact on the costs of system balancing, will increase the future requirement for fast response to control grid frequency variations

The need for rapid response

In addition to continuously matching demand and supply, NG has a licence obligation to maintain system frequency within +/- 1% of the target value of 50Hz.

Inbuilt system inertia has reduced as conventional thermal generation comes off line while increasing amounts of intermittent renewables are connected. The resultant increase in frequency volatility has increased the requirement for faster response times by NG.

Thus far, NG's fastest tool has been Firm Frequency Response (FFR), with response times for Primary and Secondary FFR of 10 seconds and 30 seconds respectively. The deployment of EFR, with a sub-second response time, will provide NG with greater control over frequency deviations, resulting in potential cost savings of £200 million.

Tender Results – The highlights

A lower than expected clearing price

Despite a weighted average bid price of £20.20/MW/hr, the auction cleared at a lower price than anticipated - by both the market and the auction participants. Roughly 87% of the capacity was bid at a price higher than the most expensive contract awarded (£11.97/MW/hr).

Exhibit 1 – successful tenders

Company	Capacity (MW)	Tender price £/MW per EFR hr
EDF ER	49	7
Vattenfall	22	7.45
Low Carbon	10	7.94
Low Carbon	40	9.38
E.ON UK	10	11.09
Element Power	25	11.49
RES	35	11.93
Belectric	10	11.97

Note: (1) Under the EFR tenders participants were invited to submit bids under either 'Service 1' or 'Service 2'. Service 1 has a deadband of +/- 0.05 Hz compared to Service 2 with a deadband of +/- 0.015 Hz deadband. Whilst the wider deadband Service 1 facilities are cheaper to run, they are less useful to National Grid since they are allow a greater frequency variation around NG's nominal 50 Hz frequency and thus are unable to control pre-fault frequency deviations.

The successful participants

To explain the low auction prices, there has been much speculation of strategic bidding in the auction to gain first mover advantage as being the driver. While this may be true for some bidders, for utilities, low bids might partially be explained by their access to lower-cost capital and ability to take merchant risk exposure post EFR contract.

Independent developers see storage as the market of the future and may have used aggressive future revenue assumptions while accepting lower returns to win in a competitive and crowded landscape.

Future Revenue Expectation

Regardless of strategic objectives, bidding behaviour will have considered future revenue assumptions post the EFR contract.

The market for flexible capacity (Demand Side Response (DSR), small scale flexible generation and storage) is subject to regulatory and market uncertainty.

While some of the market mechanisms are supportive of storage and rapid response technologies, others are highly uncertain explaining the range of bid prices (Exhibit 2):

- **Pricing arbitrage in the imbalance market** – Cash-out reform is set to allow imbalance prices to reach £6000/MWh in times of system stress. A flexible capacity provider's ability to capitalise on increased volatility and price spikes in the imbalance market is a crucial future revenue stream.
- **Capacity Market (CM)** – The December 2016 CM auction is predicted by some to clear at over £35/kW (possibly sufficient to secure investment in new CCGT's). While EFR service providers are allowed to participate in and secure long term contracts, EFR is not recognised as a 'relevant balancing service' in the CM (2016) rules, leaving the EFR providers with the risk of penalties in a stress event. A view on whether EFR is a permissible balancing service in the future will have a significant impact on the economics of EFR projects.
- **Embedded benefits** – In the wake of Ofgem's letter, potential removal of triads (up to £70/kW by 2020) and other embedded benefits have created uncertainty over revenue assumptions for small scale flexible capacity. Revenue assumptions from Embedded Benefits post the EFR contract are crucial in advising the EFR tender price.

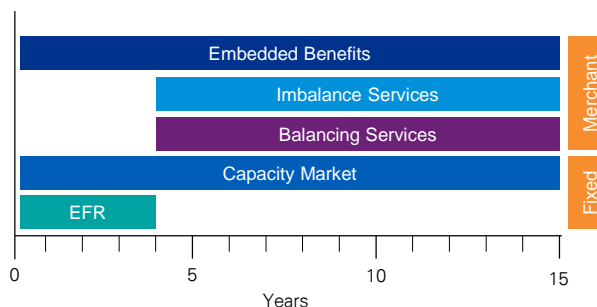
Success of storage

Although a technology neutral auction, storage technologies were the clear winner securing all 201 MW of capacity. Of the 64 sites that pre-qualified for tender, 61 were storage technologies, two Demand Side Response (DSR) and only one thermal generator.

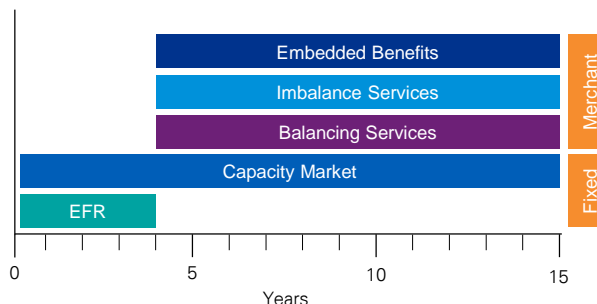
Since all sites had sub-second response times, the success is largely down to cost effectiveness; the

Exhibit 2 – revenue build up

Scenario 1 – revenue build up incl. triad periods



Scenario 2 – revenue build up excl. triad periods



weighted average tender prices for thermal generation and demand reduction were £35.20 and £28.56/MWh/hr against the weighted average tender price of £17.39/MWh/hr for storage technologies.

Overwhelming supply of Service 2

Despite a lower cost option and NG's expectation that Service 1 would prove more popular, 165 tenders were submitted under Service 2 compared to just 55 under Service 1 (Exhibit 3).

As a more useful service for controlling frequency pre-fault, the overwhelming number of narrow dead band Service 2 submissions is a clear signal that developers are willing to absorb greater costs in order to satisfy NG's preferences.

Unsuccessful capacity

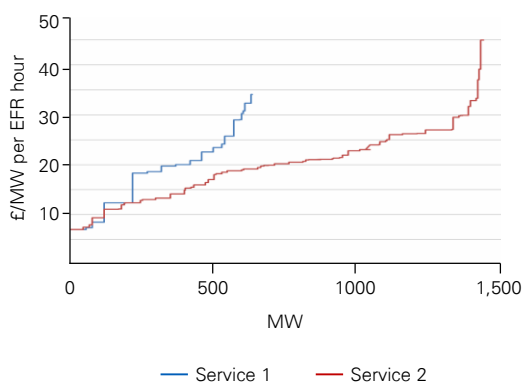
With a limit of securing 200 MW of EFR capacity, National Grid's auction has left almost 1.2 GW of construction ready sub-second technology disappointed. However, the results indicate a solid pipeline for future growth of battery storage in the UK market compared to international competitors.

Future for rapid response and storage

Despite falling costs and significant technological advancements, 1.2 GW of unsuccessful EFR construction ready storage capacity is currently left without any support. National Grid has indicated the intention to continue with similar EFR tenders, however if sector momentum is to be maintained, developers will require a clear route to market and clarity of any future EFR support.

Exhibit 3 – tender supply curve

Supply curve – most beneficial option per site



Source: National Grid

Much of the clarity depends on future policy direction. The newly formed Department for Business, Energy and Industrial Strategy (BEIS) and Ofgem are still to publish their 'call for evidence' on 'flexibility in the UK energy market' which would pave the way for future deployment of flexible capacity.

It is worth noting that whilst waiting for clarity on policy support for storage, the market has begun to utilise existing market mechanisms to commercialise the storage proposition. As demonstrated by the North Star project in County Durham, when storage facilities are combined with alternative technologies such as solar PV, commercial viability becomes feasible for self-consumption solutions without policy support.

Thus, whilst securing a longer term EFR contract will certainly help project economics and access to funding, falling technology costs and new commercial structures will also help the continued roll-out of battery storage technologies.



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