MAKING SENSE OF MARKET TRENDS
– an ELEXON perspective

Active management of distributed generation

The UK Government has committed to reduce greenhouse gas emissions by at least 80% by 2050, which will require a transformation of our energy system. As part of this transformation, the amount of electricity generated from renewable sources will increase, with Government expecting around 30% of electricity generation to be from renewable sources by 2020. A significant proportion of this will be connected to the lower voltage networks which distribute electricity to consumers, which will in turn change the traditional role of these distribution networks. ELEXON considers how the commercial arrangements needed to support these changes could develop.

Distribution Network Operators (DNOs) are actively planning for the effects of increasingly larger volumes of distributed (and often intermittent) generation on their networks. As well as using the traditional approach of reinforcing the network to enable it to manage maximum power flows (that are typically seen only on a small number of occasions each year), one of the innovative ways in which DNOs are doing this is by using smart grid approaches to manage the bi-directional power flows created thus reducing the need for expensive additional network capacity.

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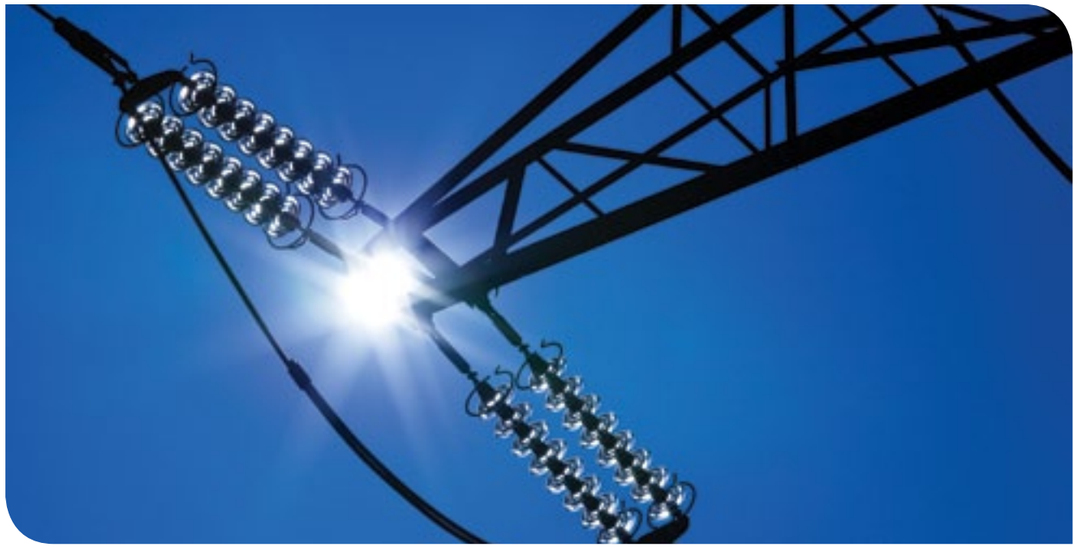


Smart grid approaches include the use of the following:

1. Demand response – where electricity consumers adjust their usage to help manage a constraint on the network, for example a large industrial customer could adapt their shift pattern slightly to manage a peak time network constraint.
2. Storage – where electrical energy is converted to another form of energy and stored, before being changed back to electricity when required. Storage sites can import electricity where there is a temporary excess of generation in a region (exporting it again when the constraint is no longer active), or export electricity where there is a temporary shortage.
3. Active management of distributed generation (DG) – the use of communications equipment and centralised control systems to limit generation for short periods, when output exceeds the operating limits of the network. This is also known as Active Network Management (ANM).

In this paper we focus on the third of these, in particular the active management of renewable generations in zones of distribution networks where the ability to export excess power is constrained.

Active management of DG

While the active management of DG remains in its infancy, all six of the major GB DNO businesses are currently trialling and testing these systems to a greater or lesser extent. The primary aim of these schemes is to reduce the cost and increase the speed of connecting new generation.

These schemes are focused in specific geographical areas, with a small number of generators involved in each scheme. The schemes range from 10–20 MW (in Orkney) to over 100MW planned in East Lothian and in Lincolnshire. The current projects are expected to deliver 160–360 MW of ANM controlled generation. Some schemes also include a degree of demand response and storage in their trials.

Examples of current schemes

Orkney Registered Power Zone

Since 2009, SSE has been working with Smarter Grid Solutions and the outcomes of University of Strathclyde research to develop the network on the Orkney Isles into the UK's first 'smart grid'.

The aim of the project is to address the issue of capacity constraints on the electricity distribution network which were limiting the potential for renewable generation developers to harvest the significant renewable energy resource on the Orkney Isles.

An ANM approach was devised to make better use of the existing network by instructing generators to control their output, in real time, to match the available network capacity. Around 24MW of new generation capacity has been connected under this approach, alongside a small volume of storage.

The approach to curtailment is Last In First Off (LIFO), which is currently the most commonly used approach for actively controlled generation on distribution networks. Under LIFO, when there is a constraint on the network the last generator to connect has its generation reduced (curtailed) first and then earlier generators in reverse order of their connection dates.

While the generator takes on the risk that they may be curtailed at certain times thus reducing revenues, they also benefit through a lower cost and faster connection (as reinforcement work is not needed or is materially reduced).

Flexible Plug and Play (FPP)

Since 2012, UK Power Networks has been working with a broad range of partners to increase the speed of connections for generators in a small area in Cambridgeshire.

This is being done by focusing on thermal constraints and using technical solutions to increase the capacity on the network, using an ANM control system and trialling new contract approaches for connections.

Around 25 MW of generation connection agreements have been signed under the FPP project. This project will use the pro-rata approach to curtailment. Under this approach, a generation threshold is set (in MW) for a particular area and generators up to that threshold are offered the same connection agreement, with the requirement to curtail generation spread equally across connected generators in the scheme, rather than treating the first generator to connect preferentially (as is the case under LIFO).

How will the active management of DG increase in future?

The amount of DG controlled under local balancing schemes administered by DNOs is likely to continue to increase steadily and expand from current trial areas due to the increasing volumes of distributed and intermittent generation. The rate of growth is expected to be relatively modest initially, constrained by the roll out of schemes by DNOs in the recently agreed April 2015–March 2023 price controls, but accelerate thereafter as local balancing and actively managed DG become integral to DNOs' business plans under future price controls.

How does active management of DG link to Balancing and Settlement?

Active management of DG currently operates outside the Balancing and Settlement arrangements, which operate at a national level. Unlike transmission connected generators, distributed generators operating under ANM schemes (LIFO or pro-rata) currently receive no compensation for curtailment. The generator must accept the risk of curtailment when connecting to a constrained part of the network, while benefiting from a lower cost non-firm connection. At the same time, the Transmission System Operator (TSO) is essentially blind to the balancing actions being taken by DNOs, and suppliers with offtake agreements with distributed generators are exposed to resulting imbalances caused by DNO actions.

While the volumes of local balancing actions are small, such inaccuracies in the Settlement processes have little overall impact. However, as the volume of DG increases, having accurate economic signals of the cost and value of local balancing actions becomes increasingly important for the efficient operation of the system. As such, Settlement will need to become more sophisticated.

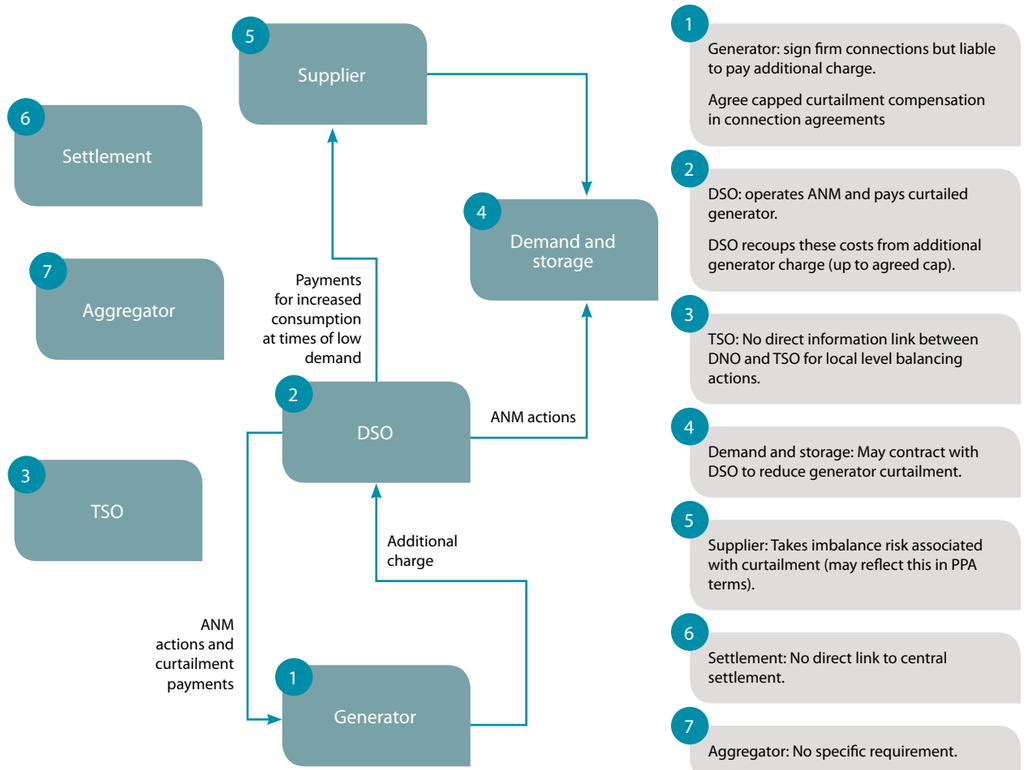
How should the commercial arrangements for active management of DG develop?

A key question is what degree of change to current market arrangements is appropriate to support the expansion of actively managed DG, and by when. New schemes could include payments for curtailment, which would have the advantage of allowing more efficient balancing decisions to be made, since certain generators may be willing to come off the system for a lower price than others.

A price-based approach would also effectively signal to DNOs the economic trade-off between curtailment and network reinforcement. It should also allow more renewable generation to be connected to distribution networks more quickly, by providing greater investor certainty.

An example of price-based curtailment is shown in Figure 1.

FIGURE 1: PRICE-BASED CURTAILMENT

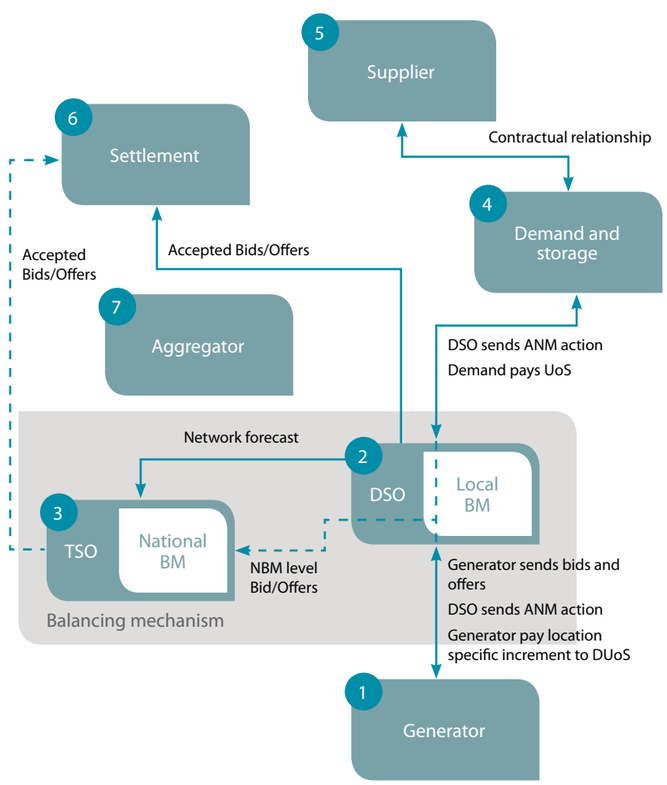


In the longer term, an appropriate model may involve local balancing arrangements being integrated into national balancing arrangements, with DSOs and the TSO able to access balancing actions offered into satellite local balancing mechanisms.

This approach could provide the appropriate incentives on DNOs to trade off more fully the costs of operational solutions with capital investment, while promoting efficiency in balancing the system overall through maximising information flows between DNOs and the TSO, and ensuring consistency of balancing signals through integrated Settlement arrangements.

An example of how this model could work is shown in Figure 2.

FIGURE 2: INTEGRATED LOCAL BALANCING



Concluding thoughts

The evolution from passive to active distribution networks could have significant implications for the way in which the GB electricity system as a whole operates, and the Balancing and Settlement of this system.

The changes present challenges for both network operators and the users of their networks. However, the additional information and control systems created through new smart technologies present opportunities
for more efficient network operation and expansion, facilitated by the correct regulatory and commercial incentives, and underpinned by more sophisticated Settlement arrangements.

ELEXON is keen to work with current and prospective BSC Parties to evolve the market, in particular through the support of trials involving new commercial arrangements of active management of DG.

Further details on the potential impact of actively managed DG on Balancing and Settlement can be found in the report *Actively Managed Distributed Generation and the BSC*, prepared by Baringa Partners and Smarter Grid Solutions for ELEXON. This report can be obtained from ELEXON through the contact below.

We are keen to get your views on this and other topics related to smarter systems. Please contact ELEXON at market.operations@elexon.co.uk.

This report is one in a series developed by ELEXON, in accordance with our agreed business plan, to understand and fully participate in developments in our market place.

ELEXON is vital to the smooth operation of the wholesale electricity market. We compare how much electricity generators and suppliers said they would produce or consume with actual volumes. We work out a price for the difference and transfer funds accordingly. This involves taking 1.25 million meter readings every day and handling £1.5 billion of our customers' funds each year.

The rules are set out in the Balancing and Settlement Code (BSC). We administer the Code and provide and procure the services needed to implement it. Our expertise and impartiality give our customers the confidence that the BSC operates efficiently and accurately.