Energy UK

The voice of the energy industry

Defining Flexibility - 2018

"We define flexibility as 'modifying generation and/or consumption patterns in reaction to an external signal (such as a change in price) to provide a service within the energy system'." - Ofgem

The Purpose of Flexibility - A Changing Energy System

The term flexibility refers to the ability to react to the fluctuating needs of the power system, maintaining security of supply. Under requirements detailed in the Climate Change Act, the UK must reduce carbon emissions by at least 80% of 1990 emissions by 2050, and the UK energy market is rapidly transitioning to support this target. From a system primarily built upon large, centrally dispatched, flexible fossil fuel generation, the UK is manoeuvring to deliver increasing volumes of less flexible low carbon power. National Grid, as the System Operator (SO), recognises that "needs are increasing, most notably at the extremes"[i] while conventional sources of flexibility are becoming less available due to continuing decarbonisation efforts.

Distributed Energy Resources (DER) and Demand Side Response (DSR) capabilities are growing steadily, expanding upon existing capabilities from pumped hydro and peaking plants to create a broader range of flexible energy assets. Flexibility is enabled in part by increasing digitalisation, helping to maintain balance on the system efficiently. Changing customer behaviours and infrastructure upgrades, including the roll out of Smart Meters, mean that demand is increasingly able to make valuable contributions towards maintaining security of supply.

Competitive markets that integrate the diverse range of flexible technologies operating today and in future will deliver a number of benefits for consumers, market participants and networks, including:

- Maintaining security of supply and improving electricity system resilience;
- Improving power market efficiency;
- Reducing redundancy across network and generation assets, keeping costs as efficient as possible;
- Deferring and / or avoiding the need for additional network reinforcement / investment;
- Facilitating reductions in the carbon footprint of the whole system, including power, heat, transport, and industry;
- Providing opportunities for innovation in products and services.

Defining Flexibility

Flexibility relies on the ability of energy system agents to understand and respond to market signals, and adapt their demand for, or supply of, energy in such a way that they can realise direct or indirect benefits. The result of this is an energy system that helps to meet carbon targets whilst delivering energy security for consumers at the lowest cost via efficient competitive markets. A study presented to government estimates the benefits of a smart energy system to be **£17-40bn to 2050**[ii], and analysis from Imperial College London for the CCC estimates **£2.9bn per annum** in gross benefits of flexibility by 2030[iii].

There are a range of classifications for flexibility, including *centralised flexibility* (operated from the top down), *decentralised flexibility* (including DER and DSR capabilities), *explicit flexibility* (activated for a specific task with a specific reward) and *implicit* or *price-based flexibility* (offered proactively based on variable price signals). These cover broad areas, and within and across them lie a number of functional definitions of flexibility. Whilst the following is not an exhaustive list, the following are some of the functional definitions of flexibility, which can be used in a holistic, whole-systems approach:

Time-based flexibility: the ability of agents in the system to shift *the time* of their demand for or supply of energy:

- Seasonal flexibility, weekly flexibility and intraday flexibility.

Locational flexibility: the ability of agents in the system to provide changes in demand for or supply of energy in a specific location.

- Instructing assets in a particular location to generate or absorb reactive power to manage local voltage levels.
- Changing the demand or supply of specific users within an aggregated group of clients, and effectively changing the geographic distribution of the demand or supply of this group.

- Actively monitored mobile generators and transport assets including electric vehicles.

Interruptible flexibility: the ability of agents in the system to interrupt the demand or supply of energy without shifting the demand in time.

- The ability (and willingness) of a customer to temporarily accept a lower or higher indoor temperature in return for a financial compensation.
- A generator able to stop or start supplying energy based on external signals.
- Redirecting energy flow to or from energy storage, reflective of the needs of the grid.

Type flexibility: the ability of agents connected to the grid to change the energy source for their load.

- Customers with capability to switch between electricity and gas to deliver their heating requirements.

***System flexibility*:** the ability of agents to provide system support services on demand

- Providing inertia to the grid to limit sudden uncontrolled changes in frequency.
- Providing reactive power services when requested by the SO.

Markets for Flexibility

For flexibility to be delivered, there is a need for robust, technology neutral, competitive markets that reflect the value of flexibility and fit appropriately into the wider electricity market framework. This includes having clear routes to market, consistent procurement periods and consistent requirements across existing and future electricity markets. The Balancing Mechanism (BM) already procures and appropriately values flexibility, as the SO dispatches power minute by minute within each half hour period between gate closure and delivery. However, there is an existing barrier to participation by potential flexibility providers connected to the distribution networks at sites registered to Licensed Supplier BM Units, in that not all flexibility providers can 1) access the market and 2) be dispatched effectively by the SO. At present, aggregated assets cannot easily access the Balancing Mechanism; the new 'Secondary BMU' definition, as introduced by BSC proposal P344, Project TERRE, should enable independent aggregators to access the Balancing Mechanism, and is a welcome change.

Both BMU and non-BM balancing units can offer flexibility via contracted services in the form of National Grid's ancillary services. Contracted services like these are provided post-gate-closure to manage system or energy balancing issues. Participants range considerably, from large thermal plant through to DSR. The main barrier for participation has been differentiation across number, type and remuneration of contracts, and a lack of transparency around procurement processes. National Grid is pushing through a number of reforms in 2018/2019, as part of the System Needs and Product Strategy, that will streamline procurement of Reserve and Response services, create greater transparency, and facilitate revenue stacking.

Smart Systems and Flexible Networks

Network flexibility refers to management systems and operations being dynamic enough to react to different supply and demand patterns on distribution and transmission networks. Improvements in how we use networks should reduce redundancy and innovative solutions can further reduce network costs. For example, integrating smart systems can enable the deployment of flexibility and greater utilisation of existing assets, reducing the required amount of physical network reinforcement.

Distribution networks are currently moving towards a more flexible future, developing a framework for Distribution System Operators (DSOs) to enable active network management and open up the potential for local flexibility markets to integrate into national markets. This would enable flexibility to address local constraints not necessarily visible to the SO. There are a number of questions about how DER providers will access power markets and integrate distribution network flexibility requirements into their business models, and further concerns over how responsibilities and priorities across SO and DSOs will be apportioned. Local markets should be integrated with existing markets, consolidating the range of available services in a simple way to encourage the inclusion of new energy system participants. Special care needs to be made to avoid duplication of services at the local level that could have been shared at the national level.

[i] https://www.nationalgrid.com/sites/default/files/documents/8589940795-System%20Needs%20and%20Product%20Strategy%20-%20Final.pdf
[ii] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568982/An_analysis_of_electricity_flexibility_for_Great_Britain.pdf
[iii] https://www.theccc.org.uk/wp-content/uploads/2015/10/CCC_Externalities_report_Imperial_Final_21Oct20151.pdf