National Infrastructure Commission Call for Evidence

Electricity Interconnection and Storage

Introduction

Energy Networks Association (ENA) represents the “wires and pipes” transmission and distribution network operators for gas and electricity in the UK and Ireland. Our members control and maintain the critical national infrastructure that delivers these vital services into customers’ homes and businesses.

Since privatisation the energy networks have managed to maintain a high level of security of supply at value to money for customers.

- Network costs are now 17% lower than they were when at the time of privatisation.
- The stability of the regulatory model has ensured consistent investment. Between 1990 and 2020, £80 billion will have been invested in the gas and electricity networks.
- This investment has delivered UK energy networks which are amongst the most reliable in the world. There has been a reduction in power cuts of 30% since 2002. The reliability of the transmission networks and gas distribution network is over 99.9%.

In order to maintain this strong record, the networks are adapting to meet the challenges of the UK’s low carbon transition in a secure and affordable way.

1. What changes may need to be made to the electricity market to ensure that supply and demand are balanced, whilst minimising cost to consumers, over the long-term?

The traditional role of the networks in the energy market has been relatively passive; taking energy in one direction, from generation to consumer with predictable levels of supply and demand.

The growth of intermittent renewables connecting to the electricity distribution network and the possible electrification of some sources of heat and transport will profoundly impact on the nature of electricity demand and supply with implications for electricity network infrastructure and the role of Distribution Network Operators (DNOs).

DNOs have connected 11.5 GW of generation to the networks since 2005. This includes almost 4GW in the last year[1]. The growth of Distributed Generation (DG) has outstripped expectations in recent years, with solar PV connected, already close to the levels previously expected by 2030[2]. The electricity distribution network has been able to connect this new generation with little need for reinforcement; therefore not impacting significantly on customer bills. In the same period, demand has fallen as a result of energy efficiency measures, meaning that the net change in generation on DNOs' networks is even greater.

As a result of the changing nature of supply and demand associated with the transition to a low carbon economy, energy networks will play a more active role in the market to maintain security of supply, deliver efficiency and keep the cost to consumers low.

DNOs are already meeting the challenges of increasing DG and changing demand patterns by deploying new smart technologies on the networks. The distribution network is moving away from the traditional, passive role and is being run in a more intelligent and active way so that the operation responds in real time to demand and supply. This trend will continue as smart network technology advances, with an increasing number of network areas managed in this way. These active networks will play a crucial role in reducing the need for investment in traditional network reinforcement, while maintaining network reliability in a low carbon energy system.

We are already seeing the development of new technologies on the networks, with advances in data monitoring, communications technology and automation enabling the network to operate in a more sophisticated and efficient way.

New technologies are enabling networks to look at market solutions to challenges associated with a low carbon energy system, for example by entering into commercial arrangements for demand side response, energy storage, reactive power and voltage support.

Whilst frameworks are in place to provide sufficient technical governance to meet the above challenges, changes to the energy market to facilitate active management of the network at distribution level will deliver benefits to customers in terms of security of supply, improved efficiency and costs:

* **Evolution from DNO to DSO**

[1] Taken from Ofgem and DNO slides presented at 2015 DG Fora

[2] As above

The move away from a centralised energy system to one with increased DG, bidirectional energy flows and more active networks at lower voltage levels will see DNOs transition to become Distribution System Operators (DSOs).

DSOs with more information about and control over their networks will be able to offer new services and seek market solutions to the challenges they face. Low carbon innovation projects are already delivering the technical learning required for network operators to offer such services, including demand side response, voltage control and embedded storage.

In order to facilitate the DNO-DSO transition the regulatory framework will need to evolve in the coming years to reflect the new technologies on the system and offer services which will deliver benefits to customers.

* <u>Distributed Generation and Balancing Costs</u>

At present, balancing costs are increasingly driven by intermittent generation, a large volume of which is connected to the distribution network. This type DG needs to sell its output whenever it is producing (i.e. when it is windy or sunny.) There are often power purchasing agreements in place with suppliers to provide a guaranteed price for electricity whenever DG can produce.

The cost to the system operator of balancing supply and demand on the electricity system is paid for by customers and market participants through Balancing Services Use of System charges (BSUoS). Increasingly, many of these costs are posed by intermittent DG.

As most DG does not pay BSUoS, it does not contribute to the cost associated with the impact of intermittent generation on balancing charges. Therefore, there is a lack of incentive for these generators to reduce the balancing costs they impose. Consequently, the parties driving balancing costs have no incentive to reduce those costs and are effectively cross-subsidised by larger generators which do pay BSUoS. If DG customers were more exposed to these costs, it would provide a stronger incentive on them to install storage (behind the meter) so that they only exported onto the network when the costs of doing so were lower. Without exposure to these costs, they have no incentive to do this.

* <u>Ongoing Work</u>

There is significant ongoing work across industry in GB addressing the challenges associated with developing a flexible market, for storage and other demand side response participants.

ENA's members have undertaken to efficiently facilitate rapid developments in storage and other demand side response mechanisms. There is significant innovation in the networks industry in both trialling and developing solutions that can ensure long term efficient costs to customers, while also facilitating other market participants. Additionally, maximising the benefits of smart meters to customers through working with suppliers and DECC is a key focus area for our members in enabling flexible solutions both in the medium and longer term.

Examples of these areas of collaboration include:

- ENA Transmission Distribution Interface Steering Group
- ENA Low Carbon Technology Group
- ENA Shared Services Working Group
- ENA Demand Side Response Working Group
- Smart Metering Steering Group

The networks also look to share this knowledge through the Smarter Networks Portal.[3]

In addition, the Ofgem/DECC Smart Grid Forum provides a platform for industry, government and other key stakeholders to engage on the significant challenges and opportunities posed by GB's move to a low-carbon energy system, particularly for electricity network operators.

National Grid's work in developing the Power Responsive program is another example of a platform for businesses, suppliers, policy makers and others to shape the growth of demand side response.

Outside GB, there is large volume of work ongoing at EU level on demand side response and ensuring electricity markets are working effectively. The European Commission led a Smart Grid Task force which, among other things, looked at the design of markets to encourage demand side response. ENA fed directly into this work and a final report was published in January 2015[4]. Many of the concepts within this report are being taken forward at European level. The ENA attends the so called TSO/DSO platform[5] meetings, where network operators and system operators are

[3] http://www.smarternetworks.org

[4] https://ec.europa.eu/energy/sites/ener/files/documents/EG3%20Final%20-%20January%202015.pdf

[5] http://www.geode-eu.org/uploads/GEODE%20Germany/Stellungnahme/2015/V%20-%20TSO%20DSO%20platform%20.pdf

coming together to agree high level models to improve how demand side response can be co-ordinated. They are producing a report for the European Commission later in 2016. This work is helpful in agreeing high level principles and potential roles and responsibilities which can then be applied at national level. ENA is using the work quoted below to help feed in a GB view to these debates.

2. What are the barriers to the deployment of energy storage capacity?

Storage on the electricity distribution network can play a role alongside other solutions in meeting the challenge of increased intermittency from renewable generation.

Through innovation funding mechanisms established by Ofgem in 2010 network companies are trialling new technologies and smart grid solutions, including the potential of battery storage to deliver benefits to customers. For example SSEPD's NINES project in Shetland has included the installation of a battery which will provide learning regarding the operation of MW scale batteries on a constrained distribution network. A 2MW battery has also been installed to help balance the grid and support renewable generation in Orkney, where total annual output from renewable sources exceeds annual demand from customers on SSEPD's network.

UK Power Networks is trialling how to integrate at 6MW battery into the distribution network. This is the largest of its kind in the UK and one of the largest in Europe. The project is trialling how energy storage could be used to provide benefits to consumers by deferring traditional network reinforcement and evaluating additional benefits that can be gained to maximise value. In order to achieve these additional benefits, the storage will be used for a range of other system-wide services, to benefit other electricity system participants, and test both the technical and commercial aspects of these applications.

Further details and learning from the trials of storage are available via the Energy Storage Operators Forum Good Practice Guide.

The findings from innovation projects are being transferred to business as usual, and DNOs are testing the market for the deployment of smarter solutions such as battery storage. For example, SSEPD's Constraint Managed Zone initiative is inviting interested parties to provide services such as energy storage, embedded generation and demand-side management/response to reduce the need for traditional reinforcement of the network. This process will not benefit from any innovation funding and is therefore a commercial test of the ability for new smart options to compete with conventional solutions.

The cost of storage on the network must be considered against the cost of conventional reinforcement of infrastructure to ensure value for money for customers over the long term. The cost of battery technology is falling, and is projected to further reduce in the coming years. However, large scale battery storage is not currently justifiable against the cost of traditional solutions. The projects and initiatives referred to above will therefore play an important role in both improving the technical understanding of storage and exploring commercial arrangements; facilitating an increased take up of the technology and a further reduction in costs.

Storage is seen as a potential solution to many of the congestion issues which companies are seeing on the networks. Consequently companies are keen to embrace storage technology and ensure that connection policies and commercial frameworks actively encourage storage to connect where it can provide most benefit for the network and save money for customers. As a result, companies are considering how they could adapt the current common charging methodologies to provide these incentives to storage parties. Network operators are also considering the types of contracts they offer, to see if they allow storage providers to ‘stack’ value across different vendors.

In order for battery storage to play a role in the balancing of the network in a low carbon future, there needs to be further clarity on which parties can own and operate storage and how it is treated from a regulatory perspective. This barrier to grid scale storage has already been identified by the Smart Grid Forum. There is ambiguity within the existing framework as to whether DNOs can own and operate storage assets where that involves buying and selling energy into the market. Clarity on this from Ofgem or DECC would be welcome along with guidance on the regulatory treatment of any income earned from the market.

In addition to battery storage there is also potential for energy storage within the UK’s gas network to play a role in balancing intermittency from wind generation. ‘Power to Gas’ technology takes excess wind generated electricity and converts it to hydrogen gas through electrolysis. Hydrogen can then be stored in the gas network and help meet demand for heating, cooking and transport. National Grid estimate that the gas network currently has up to 650 GWh of storage, and even if all the UK wind generation were to be stored in this way it would use only 5% of the grid.

3. What level of electricity interconnection is likely to be in the best interest of consumers?

Interconnectors will be important in enabling renewable energy by providing a solution to renewable intermittency. They also add diversity to our electricity mix and strengthen security of supply. For consumers the ability to link electricity supplies from the rest of Europe is good for competition in the market and will generally help to keep prices competitive. Doubling UK interconnector capacity to meet the European benchmark of 10% could save UK consumers up to £1billion a year.[6]

Existing and future interconnectors will also allow for the provision of services which are required for future system operability. Appropriate interconnectors can provide frequency response, black start, reactive power capability, and constraint management that may be at the most efficient cost to consumers.

4. What can the UK learn from international best practice in terms of dealing with changes in energy technology when planning to balance supply and demand?

The UK is establishing itself as a world leader in smart network technology, and the regulatory framework which has been put in place to encourage innovation is being considered in other countries. We consider that is leading the way in terms of identifying how to integrate new markets and technology in an energy system where generation, transportation and supply are treated as separate businesses.

In parts of the United States, such as California, there is a fast growing market for battery storage technology due to the explicit incentives which have been put in place for storage.

In Australia the role of manufacturers and equipment providers is helping stimulate smart grid development. The Government has mandated that electricity intensive products have an 'eco' mode which can be activated by DNOs when demand on the network is very high. This is something which could be of use in the UK if and when we see greater penetration of energy intensive technologies in households.

[6] National Grid, "Getting More Connected" (2014)