Changing practices of power system resilience – enhancing GB electricity network resilience through demand side measures

Summary

The relationship between consumers and electricity network operators is changing, as operators move beyond primarily supply side measures to maintain network resilience and seek to incorporate end users through measures including demand side management. Using data from a series of focus groups, which explore social responses to approaches to manage the resilience of the electricity network, we consider how these changes impact on the ability of consumers to engage in everyday practices and the implications for energy system governance. This work suggests that whilst the resilience of the network can be managed through demand side measures, these can challenge the ability of households or businesses to maintain their everyday functions highlighting how, when considering resilience, different actors, such as consumers, network operators and regulators, have differing views of what is a desired end-point.

Extended abstract

Approaches and practices to increase the resilience of electricity networks are moving from primarily supply side measures to incorporate end users through measures including demand side management, potentially changing the relationship between consumers and electricity network operators is changing. This paper explores social responses to alternative strategies for managing the electricity network, which include both supply and demand side approaches. Using data from a series of focus groups, we consider how these changes impact on the ability of consumers to engage in everyday practices and the implications for energy system governance.

The power network can be conceptualised as a socio-technical system consisting of linked elements such as infrastructure, technologies, organisations, policies and end users (Geels 2002). Resilience in the context of the power network has traditionally been framed around engineering- based notions of resilience where the focus has been on maintaining the robustness of a centralized supply system (Pantelli and Mancarella, 2014). The power network is managed around the supply of electricity to meet demand at a given time. This engineering framing of resilience consists of four elements (The Cabinet Office 2011):

- Resistance – emphasising the strength of components
- Reliability – stressing the importance of the design of the network
- Redundancy – through the provision of back-up plant
- Response and recovery – achieved through a fast and effective strategy for taking action when the resilience of the network is threatened and when an incident has occurred

Currently, electricity in the UK is supplied by relatively predictable generation, meeting similarly predictable demand. Decarbonisation of electricity supply will lead to the deployment of new generators, including renewable technologies, and increasing proportions of intermittent generation

will have consequences for the management of the networks. Furthermore, new demands will be placed on the network as a consequence of climate change mitigation measures such as the electrification of heat and transport. There is also the potential for the effects of climate change to impact both on the physical infrastructure and the profile and level of demand for electricity. For example, if temperatures increase there may be new demands for electricity such as air conditioning, whilst at the same time there is a reduction in the performance of network components. Under these conditions it is harder to meet demand (Electricity Networks Association 2011) and the resilience of the network is challenged.

Going forward, therefore, we are likely to see greater participation of consumers through the integration of smart technologies to enable more flexible electricity consumption and the reduction of demand to protect the network. When thinking about the resilience of electricity networks, managing demand for electricity from an end user perspective places users into a more central role in maintaining that resilience. An example of new responsibilities for end users in the UK is illustrated by the 'new balancing services' tools (Ofgem 2014) brought in by the UK Electricity Regulator (Ofgem), the UK Government and National Grid to improve security of supply. These regulations allow National Grid to request that commercial and industrial users, who have tendered for a contract, reduce their electricity consumption in the event that demand for electricity is higher than can be supplied. Should further actions be required, there is the possibility for controlled disconnections of DNOs from the transmission network, which could ultimately impact at the level of end users through the implementation of rota load disconnections.

The electricity network is thus evolving and transitioning to a more flexible network, where resilience is no longer solely the domain of hard technology and infrastructure. Resonating with changes in other sectors such as water, maintaining the function of a system requires it to evolve in the face of pressures upon it (Chappells and Medd 2012). End users will become more involved in the operation of the network, firstly through more flexible management of their electricity consumption, and secondly through the increased use of demand side management for the provision of system balancing services in the event of unexpected events.

In this paper we present data from 6 focus groups convened to explore social responses of measures to manage the resilience of the electricity network; the focus groups were framed around three sets of conditions which may place pressure on the future electricity networks. In the first incident, there are power cuts as the result of damage sustained during high winds and storms. The second incident focuses around a heatwave, and the need to reduce electricity demand in order to manage a peak. The third incident explores how consumers would react to a period of winter cold weather, when electricity demand may need to be reduced as a consequence of low levels of supply. We unpack the new ways in which end users are involved in measures to maintain resilience in the face of day to day operation and in response to extreme events and consider the impact of these measures in terms of energy system governance and the resilience of consumers.

In considering resilience as an end or an outcome, literature on resilience assumes that there is a consensus on the desired state, or that a desired state exists (Brown, 2012). Analysis of our results highlight that different actors – consumers, network operators and regulators for example, have different perspectives on a desired state. Thus whilst the resilience of the network is enabled through demand side measures, these challenge the ability of households or businesses to maintain

their everyday functions. This highlights the importance of cyclical and adaptive capacity, and the need to develop the collective capacity of stakeholders to manage under these circumstances.

References

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