Response to the Energy and Climate Change Committee's inquiry on electricity demand-side measures

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This submission is made by the DEMAND Centre, and specifically by Dr Jacopo Torriti and Mitchell Curtis from the University of Reading. The DEMAND (Dynamics of Energy, Mobility and Demand) Centre is one of six End Use Energy Demand Research Centres funded primarily by the Research Councils UK Energy Programme. DEMAND, which runs from 2013-2018, is co-directed by Professor Elizabeth Shove and Professor Gordon Walker at Lancaster University and involves collaborating academics and researchers from 9 universities across the UK (see WWW.DEMAND.AC.UK for more details). The University of Reading is one of the collaborating Universities and this submission draws on research undertaken both within and prior to the setting up of the Centre (see more details in Annex 1). For any follow up please contact Jacopo Torriti j.torriti@reading.ac.uk or g.p.walker@lancaster.ac.uk

Three of the specific questions posed in the call for evidence are responded to below.

- ***How will National Grid's new Demand Side Balancing Reserve (DSBR) enable demand-side response (DSR) to play a positive role in avoiding capacity shortfalls in the coming years? What improvements to the scheme are required?***

The National Grid's new Demand Side Balancing Reserve (DSBR) expands the opportunities for demand-side response (DSR). Several Government and academic sources point to the need for a greater level of DSR in order to avoid capacity shortfalls in the coming years. Perhaps the most significant question that the scheme does not address is what type of DSR is desirable for the UK and which companies can deliver these. Load turndown, for instance, is arguably more challenging to stimulate than distributed stand-by generation because it is associated with commercial and industrial activities which are complicated to shift in time. The types of energy-intensive activities and practices which groups of companies carry out throughout the day is partly an object of study in the DEMAND Centre and informs us about flexibility and DSR potential of sectors of the economy. Published research we have conducted recently shows that two improvements are required to enhance DSR in the UK:

1) *Increasing the overall amount of load reduction from demand side measures*

The share of DSR under the Non-Balancing Mechanism Short Term Operating Reserve operated by National Grid is only 5% of the so-called "demand side". Much of it is actually distributed generation rather than load reduction. When looking at aggregated contributions, the majority of the demand side reserve in UK non-aggregated markets still consists of distributed generation. Only 3% is associated with reduced demand. The rest comes from small stand-by and back-up generators, including CHP and hydro, which are not representative of load reductions from DSR. DSBR may help improve this area as it does not need require sophisticated hardware - it only requires users to manually activate reduction methods (e.g. turn off chillers) and relies on standard Half Hourly meters to measure results.

2) *Increasing opportunities for participation of business with response times of more than 10 minutes*

The majority of contracted loads under the Short Term Operating Reserve in 2012 and 2013 consisted of response times of less than 10 minutes. Such a response time does not represent any problem for small generator units, but is poses a challenge for demand resources. For instance, nationally only around 30% of STOR participants via an energy demand aggregator in the UK consist of diesel generators (http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=30376).

DSBR brings the following positive aspects to DSR:

1. Increased participant response time. Currently STOR DSR participants need to respond within 20 minutes whereas DSBR has a 2 hour response time. This helps increase the number of eligible participants by allowing enough time to manually activate DSR measures.
2. It only requires having half hourly metering with no other specialised hardware to participate.
3. It will expose more participants to DSR and therefore increase awareness of this service that could lead to greater participation in future DSR programmes.

DSBR could be improved by:

1. Increasing usage beyond just the current winter period (Nov-Feb).
2. Not treating DSR as a last resort option which is rarely used by energy managers. If a service is only rarely used it will cause the participates to either withdraw from future programmes due to lack of financial returns and/or cause them to believe that DSR is only a limited usage service. Both outcomes resulting in discouraging participates from joining future DSR programmes.

- ***What problems (if any) are there with the proposed Capacity Mechanism (CM) Transitional Arrangements (TA) in relation to DSR? To what extent does participation in the TA limit the future potential of DSR in the CM?***

Traditionally, CMs have been seen as incentive mechanisms to induce supply to invest in sufficient generation to satisfy a reliability standard at least cost. Less attention has been paid to possible DSR within CM. Under the propose CM customers may commit to providing pre-specified load reductions when system contingencies arise. CMs could be designed as venues for DSR (and storage) in addition to operating reserves and ancillary services. Published work that we have conducted on recent plans to implement CM in other European electricity markets shows that the type of physical or financial trading of capacity obligations, dispatch arrangements, load-following obligations, charging arrangements for recovering the costs of payments for capacity obligations, the type of penalties and the responsibility for the costs of the capacity payments are all decisive in shaping the role of DSR under CM. With this in mind, whilst CM might offer another venue for DSR participation, there is a sense of political urgency in the TA which might indeed limit the future potential of DSR.

- ***How can the Government ensure that new technology which facilitates DSR is deployed in a timely manner, now and in future, to reduce peak demand for electricity?***

Technology plays a vital role in facilitating the level of automation of DSR only if combined with knowledge of the scale and time of energy-related activities. In order to understand the type of participation that can occur DSR programmes, it is useful to distinguish between activities:

1) Activities which require high levels of supply security, such as those carried out by telecommunications and hospital sectors which already invest in significant amounts of back-up generation. Their activities need to be highly reliable to guarantee high availability and continuity of service, even in case of black outs. We collaborated with demand aggregator Kiwi Power and found out that several sites in the telecommunications industry have generator capacity higher than their typical load (see details in Annex 1). From this capacity clients in this sector are able to provide on average 82% 'apparent load reductions' with fast response times and high reliability. Their response is in many cases limited by their load at the time. With an export licence the full capacity of their stand-by generators could be used. The ease with which such licences can be obtained may well be worth reviewing in the light of the possible system benefit of this already present resource.

2) Flexibility in activities associated with HVAC loads means that some service sector industries, such as hotels and offices, can provide response capacity. Compared to stand-by generators above, the load reduction under current arrangements are more modest. For a sample of over 100 sites we found evidence for load reductions of 38% in response to 10-20 minute warnings. This is less than for those sites with back-up generation (82%), but given the number of sites nationally the potential load reduction under DSR programmes could be significant. For the warehouse sector in the UK we have estimated additional 0.4-1GW of response capacity from the creation of tailored response conditions alone.

Given the classification of activities above, technology plays a vital role in two key areas for facilitating DSR. Firstly, the National Grid STOR programme requires minute by minute energy usage readings which necessitates installing additional monitoring and communications hardware at each site to obtain the information from participants. Most of these half hourly meters could send minute by minute readings to the supply company without additional hardware. However, this is not the case because these readings would increase system requirements to handle the extra data. If supply companies where encouraged (via regulation or incentives) to offer a minute by minute reading service, this would remove one barrier to enabling further DSR participation.

Secondly, technology plays a critical role in controlling the assets used for DSR. A key example of this is the usage of a commercial building's HVAC systems to enable a turn down DSR strategy. On the one hand, HVAC offers a high demand appliance that can be turned off to reduce demand without impacting users (normally for up to an hour). On the other hand, HVAC systems also provide an example of the DSR integration challenges faced due to their usage of proprietary systems. These challenges are listed below for HVAC, but are also generally applicable to implementation of DSR with other appliances:

- If the HVAC system is controlled via a Building Management System (BMS), then this offers the opportunities for integration and provides comprehensive control of the system that enables a controlled turndown while still maintain building services by having set temperature limits.
- If the HVAC has no centralised control and consists of a new model, it is likely to have a proprietary control system built into the main chiller unit. To provide comprehensive control options via DSR requires purchasing from the manufacturer the necessary open standard interface cards. Alternatively, the control systems sometimes offer limited external control that allows for basic setting alternation (including turning on / off or changing to new predefined temperature point). This is likely to limit the ability to maintain minimal building services.
- If the HVAC is old, which is often the case, then the interfaces can be very limited to the point that only the very basic ability to turn them on or off is available. This is often problematic for DSR as it can cause system issues when restarting and does not allow the system to maintain minimal building services.

Dr Jacopo Torriti

Dr Torriti is an Associate Professor in Energy Economics and Policy in the School of Construction Management and Engineering, University of Reading. He has been involved in the following projects in the area of DSR:

-2013-2018 Co-Investigator, EPSRC End Use Energy Demand Research Centre DEMAND: The Dynamics of Energy, Mobility and Demand;

-2012-2013 Principal Investigator, TSB project 'Assessing the Benefits of DSR Participation in a Capacity Market'; and

-2010-2013 Co-Investigator, EPSRC project 'Reshaping Energy Demand of Users by Communication Technology and Economic Incentives'.

A summary of the most significant outputs from these projects is presented in Annex I. Evidence presented in this document is largely drawn from these projects.

Mitchell Curtis

Mitchell Curtis is a Research Engineer in the Technologies for Sustainable Built Environments Centre, University of Reading. He is working on a project with KiWi Power with the title: "Understanding energy demand of Small and Medium Enterprises: The potential for Demand Response".

Annex I - ANNEX I - Summary of research outputs from work in the area of DSR

- A study on the role of demand side response in relation to new capacity mechanism schemes in the UK, Italy and France shows that the high political pressure at a national level to deliver capacity mechanisms makes a single integrated European capacity market an unlikely prospect and poses challenges in relation to market harmonisation and integration

> Torriti, J. and Grunewald, P. (2014) Demand side response: patterns in Europe and future policy perspectives under capacity mechanisms. *Economics of Energy & Environmental Policy*, 3 (1). pp. 87-105. ISSN 2160-5882 doi: 10.5547/2160-5890.3.1.jtor.

-A pathway analysis with detailed modelling of hourly balancing of electricity demand showed that to minimise the need for conventional generation to operate with very low capacity factors, a variety of DSR measures are modelled and shown to provide significant benefits

> Barton, J., Huang, S., Infield, D., Leach, M., Ogunkunle, D., Torriti, J. and Thomson, M. (2013) The evolution of electricity demand and the role for demand side participation, in buildings and transport. *Energy Policy*, 52. pp. 85-102. doi: 10.1016/j.enpol.2012.08.040).

- An analysis of existing DSR in the UK based on demand aggregators' data. The analysis suggests that present demand response measures tend to stimulate stand-by generation capacity in preference to load shifting and we propose that extended response times may favour load based demand response, especially in sectors with significant thermal loads.

> Grunewald, P. and Torriti, J. (2013) Demand response from the non-domestic sector: early UK experiences and future opportunities. *Energy Policy*, 61. pp. 423-429. ISSN 0301-4215 doi: 10.1016/j.enpol.2013.06.051)