University of Reading and University of Oxford response to the Ofgem Consultation ‘Creating the right environment for demand-side response’

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1 Introduction

We welcome the opportunity to respond to Ofgem’s consultation on ‘Creating the right environment for demand-side response’. As academics working broadly in the area of energy demand and specifically in demand side response, we are confident that our comments will prove useful for Ofgem and other interested stakeholders.

Dr Jacopo Torriti

Dr Torriti is a Lecturer in Energy Economics and Policy in the School of Construction Management and Engineering, University of Reading. His research combines economic appraisal tools with specific work in the area of energy demand side response. He has been involved in the following projects in the area of Demand Side Response:

- 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 Demand Side Response 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.

Dr Sarah Darby

Dr Darby is a senior researcher in energy demand at the Environmental Change Institute, University of Oxford. From 2007-2010 she held a Research Councils UK Fellowship to investigate the development of smart metering in relation to energy feedback to residential customers, and she took part in the evaluation of the EDRP smart metering trials. Since then she has been involved in the following projects:

- 2010–2013 EPSRC SuperGEN HiDEF project, (Highly Distributed Energy Futures), researching the potential for demand side response, and implications of smart metering for fuel poor households;
- 2011–2014 EPSRC ADEPT project (Advanced Dynamic Energy Pricing and Tariffs), investigating the question of how to develop electricity tariffs that are simple to understand and implement while meeting the needs of distribution networks;
- 2011–2014 ESRC EVALOC project, evaluating six low-carbon communities in the UK;
- 2011–2012 EC-funded project, SG4-GHG, to develop metrics for the carbon impact of smart grids, and to model them for six EU countries;
- 2012– DECC Smart Meter Early Assessment.

Some outputs from these projects are included in Annex I. She is also a member of the social science advisory panel for the LCNF 'Customer-led network revolution' project.

Dr Philipp Grünewald

Dr Grünewald is a research fellow at the Environmental Change Institute, University of Oxford. Between 2009 and 2012 he carried out techno-economic and socio-technical research into the future role for electricity storage in UK low carbon future systems for his UK Energy Research Centre funded PhD, which he was awarded by Imperial College London. He worked on the following demand response related projects:

- 2012–2013 Post-doc researcher, TSB project 'Assessing the Benefits of Demand Side Response Participation in a Capacity Market';
- 2011–2012 Expert panel, Carbon Trust project 'Strategic Assessment of the Role and Value of Energy Storage Systems in the UK Low Carbon Energy Future';
- 2013– EPSRC SuperGEN HiDEF project, (Highly Distributed Energy Futures), researching the household electricity demand profiles and price responsiveness, and researching business models for energy projects at the community level.

2 General comments

The consultation document covers a lot of ground and brings together a great many of the complex issues related to demand side response. Given that these complexities have already been identified, we would like to stress the importance of ensuring that they are given appropriate weight throughout the consultation process. Based on our own research and other studies on demand response in the UK and abroad, the following three areas deserve particular attention in our opinion:

1) **Distinction between different types of response provision.** Perhaps the most significant (and broad) question that Ofgem needs to address is what type of Demand Side Response is desirable for the UK. Load turndown, for instance, is arguably more challenging to stimulate than distributed stand-by generation. In this response we will illustrate the differences and their implications for appropriate regulatory frameworks based on recent research.

2) **Signals can be more than mere price signals.** The consultation document acknowledges in various places that information and education are important components of demand response delivery. We strongly support this notion and would add the provision of very simple messages and ease of access to this list. When seeking to create the right environment for demand response, the provision of more than mere price signals could lead to improved uptake and response provision.

3) **Recognising the difference between domestic and non-domestic providers.** The consultation document acknowledges the potential importance of the domestic sector in providing demand response. Presently such services are almost exclusively delivered by the non-domestic sector, yet it is the domestic sector that, according to recent modelling, could have the greater response provision potential (Darby et al. (2013) DECC (2012)). The engagement of the domestic sector is arguably the greater regulatory challenge and quite distinct from the non-domestic sector. Tariffs are already perceived to be too complex for many domestic customers in the UK and the focus in this sector should be firmly on simplicity and fairness for the end user (including not disadvantaging those with less ability to provide flexibility, due to lower consumption). Regulatory frameworks should clearly distinguish between the different needs of domestic and non-domestic providers of demand response.

Types of response provision

The term "demand response" in this consultation document recognises the existence of and refers to different types of response (transactable / non-transactable [p.8], automation [p.3], stand-by/back-up generation [p.8/20]). However, it is not clear whether these are discriminated throughout the consultation document. Establishing the right environment for demand response may be more difficult if the assessment is performed “regardless of how customers go about providing and delivering it” (Section 2.2). In our opinion, and emerging from our research, the type of demand response provision has a significant bearing on what might constitute the most appropriate and effective regulatory environment. We would like to suggest at least five distinctly different response mechanisms, which all require different stimuli:

1) Stand-by generation: Apparent demand reduction through (stand-by) generation on the customer side of the meter.

2) Automation: Response from automated loads without noticeable impact on energy service provision to consumers.

3) Behaviour: Ad hoc response from consumer behaviour change, in response to price and other signals, to reduce or shift demand.

4) Practices: Change in consumer practices, which leads to sustained changes in use patterns (consistently reduced load during peak demand hours or adoption of more flexible routines, such as the ability to take advantage of low cost night-time electricity).

5) Efficiency: Any demand reduction through improved efficiency affects peak demand and can thereby reduce the extent of reserve and/or response requirements.

A clear distinction between these different types of response may be important for future regulation, if the possible differences in their ‘preconditions’ are to be recognised. The significance of 4 and 5 can hardly be overstated: if progress is made with these, then 1, 2 and 3 can become far more manageable in scope. Price signals may be appropriate and relatively easy to implement for the first two types of DSR. For others, price signals could further complicate tariffs, which are already confusing consumers and inhibit engagement. Recently published researches show limited appetite among consumers for complex tariffs, such as real time pricing (Darby and Pisica, 2013). At this end of the spectrum the focus should be on clear and simple messages.

3 Response to specific questions

Question 1: Are there any additional key challenges associated with revealing the value of demand-side response across the system? If so, please identify and explain these challenges.

We agree that the "market environments" can play a key role in incentivising DSR [p.5]. A growing body of evidence suggest that price signals contribute towards demand response, but that these are by no means the sole factor in delivering effective consumer responses. Education, awareness and cultural factors can affect the success of response measures and their facilitation should form a complementary avenue alongside market arrangements (see for instance CER (2011), Gram-Hanssen (2004) and the 'Empower Demand' reports (Strömbäck et al., 2011; Lewis et al., 2012)).

To move from believing that high-quality electrical supply can be available at all times to accepting that end-users need to play a part in system regulation is not a step that most customers will take, without some time and assistance to allow them to understand their options, and to make informed choices. The current market environment is arguably not a helpful one, given the widespread public distrust of energy suppliers and the near-invisibility of distribution network operators (Aas et al., 2012). Trust-building and awareness-raising, respectively, are both needed.

The consultation document implies that if the value of DSR was known and made available to consumers, an economic equilibrium would establish itself in which the "right amount" of DSR is made available to the system. As with many transitions in the energy sector, a shift towards more demand response in not merely an investment decision, but requires changes in practices and long established customs and procedures. Addressing and overcoming these may require targeted measures that go beyond mere reflection of the system value through an adjustment of market arrangements.

The notion of "true value" of DSR should be broken down into what one might call the "theoretical system or societal value" of DSR and its "market value". The consultation is concerned with ensuring that the market value becomes a better approximation of the system value. Given the common-good aspects and disaggregated origins of the value for DSR and opportunities for gaming (see comment on 3.24 below), the limits of purely market-based mechanisms need to be recognised and carefully balanced with appropriate regulatory arrangements.

Question 2: Can current regulatory and commercial arrangements provide the means to secure demand-side response being delivered? If not, what will regulatory and commercial arrangements need to deliver in future?

When considering existing Demand Side Response arrangements in the UK, two main issues need to be taken into account. First, in the share of Demand Side Response under the Non-Balancing Mechanism Short Term Operating Reserve operated by National Grid there 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 (Macleod, 2012).

Second, the majority of contracted loads under the Short Term Operating Reserve in 2012 and 2013 consisted of response times of less than 10 minutes (National Grid, 2012). Such response time does not represent any problem for small generator units, but is poses a challenge for demand resources. For instance, less than 20% of STOR providers participating via energy demand aggregators in the UK deliver response entirely from load turn down (Grünewald and Torriti, 2013).

In order to understand the type of participation in existing Demand Side Response programmes, it is useful to distinguish between sectors:

1. Sectors which require high levels of supply security, such as the telecommunications and hospital sectors, already invest in significant amounts of back-up generation. Operational sites need to be highly reliable to guarantee the "five nines", i.e. 99,999% availability and continuity of service, also in case of black outs. In our collaboration with demand aggregator Kiwi Power, we found that a large number of these sites have generator capacity well in excess of their typical load. 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 (network permitting). The ease with which such licences can be obtained may be worth reviewing in the light of the possible system benefit of this already present resource.

2. Many service sector industries, such as hotels and offices, can provide response capacity especially due to some degree of flexibility in their A/C requirements. 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 Demand Side Response 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 (see also Question 6).

As these two examples illustrate, the means by which demand response is provided can differ fundamentally. This affects both the delivery of response (scale, speed, reliability) and the regulatory mechanisms by which their capacity could be enhanced (see also Question 6). A portfolio of response capacity would probably need to include highly dependable and responsive stand-by generation, as well as drawing on the turn down resources, which might ultimately constitute the greater resource nationally.

Question 5: Do you agree that signals to customers need to improve in order for customers to realise the full value of demand-side response? Does improving these signals require incremental adaptation of current arrangements, or a new set of arrangements?

Yes, we agree that 'signals' to customers need to improve (even if that doesn't necessarily mean that they will 'realise the full value'). Again, the arrangements should be tailored to the type of response desired. The consultation document recognises that 'signals' are not necessarily and exclusively 'price signals', and this is line with recent research, e.g. Reiss and White (2008) and Thorsnes et al. (2012).

Stand-by generation could be enhanced through easing the process of obtaining export licences and recognising the potential benefit (and not just the cost) of synchronising these resources. This critically applies to electricity storage resources as well. Automated demand response would benefit from more time responsive price signals, reflecting wholesale and balancing market prices. Some behaviour and practice oriented responses may require very simple and targeted messages, rather than more complex price signals. Ofgem may have an important role to play in ensuring that such messages deliver a coherent 'signal' to consumers that is aligned with the overall system needs.

Question 6: To what extent can current or new arrangements better accommodate cross-party impacts resulting from the use of demand-side response?

Current regulatory and commercial arrangements seem to favour fast respondents. In the future, the case for lower than 10 minute responses might actually increase if the demand side is to fluctuate based on the needs from wind energy. This is because the variability of wind can cause significant problems to the grid when there are 5 minute drops, posing a different challenge than longer periods of variation over 2- or 4-hours.

In the absence of experimental data, we have attempt to estimate the potential effect of changes to key response characteristics based on expert insights and site surveys for a range of non-domestic sectors. This assessment includes the availability of suitable loads for Demand Side Response and considers practices within the industry that could lend themselves to response provision or could inhibit their availability.

Figure 1 gives four illustrative examples of the potential resulting scale up for three predominantly turn-down-contributing sectors (hotels, warehouses and offices) and one stand-by generation dominated sector (communications). Relative to their present ability to provide demand response capacity, a relaxation in response time requirements could more than double the response contribution, based on this assessment. The reasons for this expansion include to a large extent the ability to run chillers and other thermal loads in anticipation of a demand response requirement. This preparatory step allows these customers to suspend a larger share of their load and also to sustain the turn-down for longer. A 24 hour 'warning' period could increase the available capacity for all three of these turn-down sectors.

Question 7: Are there any additional key challenges associated with customer awareness and access to opportunities around demand-side response? If so please identify and explain these challenges.

The consultation document refers to "Industry" as the actor to "inform, educate and persuade customers". Other actors may have a role to play in this area as well. 'Middle' actors such as local authorities, community groups and other non-commercial entities could prove an important resource, especially where trust is of great importance. These other actors should be considered, included and engaged in the development of demand response frameworks. (see Wade et al. (2013); Parag et al. (2013))

Question 8: Is any additional work needed to explore the role of third parties in helping customers to access and assess demand-side response offerings?

One of the main challenges remains around the understanding of how demand response is provided. This question was explicitly excluded from the scope of this consultation. In our opinion, a sound understanding of the mechanisms by which demand response is delivered is an important prerequisite for informed development of an appropriate regulatory framework.

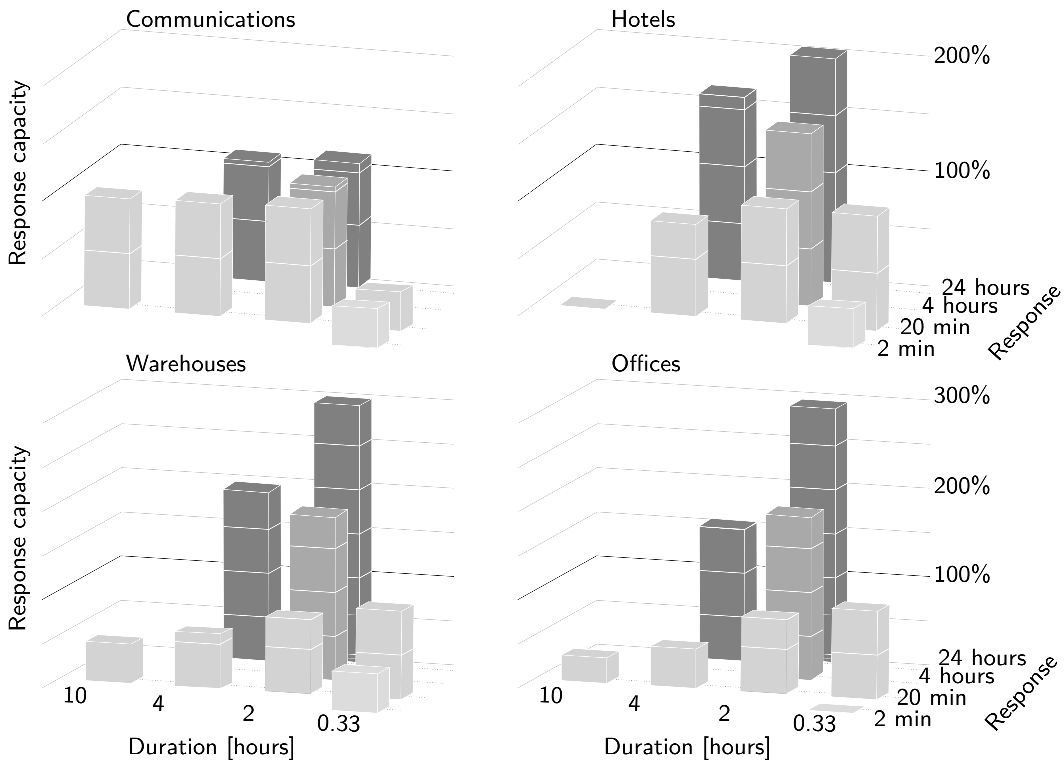

Figure 1: Illustrative examples of expected response capacity for given response time and durations relative to present provision under Short Term Operating Reserve arrangements.

4 Comments on specific sections

Section 2.5: It is worth noting that the mentioned introduction of variable generation is expected to precede the widespread introduction of electrified heat and transport by several years. This means that the possible flexibility associated with heat and transport loads will not be available to balance variable sources. Other sources of flexibility need to be ensured in the interim. Importantly, such solutions, if they are long-lived, may lock-in particular types of flexibility provision and may preclude alternative solutions.

Section 3.5: We agree that "many parties across the supply chain value flexibility." The consultation documents continues: "For demand-side response to be effective they need to be able to transmit a signal about this value to customers." Our research into the role and value of electricity storage (in some regards a very similar service to demand response) suggests that, although many stakeholders 'value' such services, we identified a lack of ownership, especially in relation to some of the 'common good' values, such as 'security-of-supply'. The resulting 'signal' may thus not be sufficient to deliver the desired response capacity. (Grünewald et al., 2012)

Section 3.12: The document rightly identifies that "routes to market for demand-side response could take many forms". The following list of options seems restricted to monetary incentives. While price signals certainly are important, complementary measures, such as consumer engagement, education, learning and awareness have shown to provide beneficial effects in DSR trials in the UK and abroad (CER, 2011; Gram-Hanssen, 2004; Strömbäck et al., 2011; Lewis et al., 2012). These are clearly recognised in later sections of this document (see 3.71).

Section 3.24: Not only is the baseline assessment 'non-trivial', we have argued in a recent paper that gaming and unintended responses need to be carefully considered (Grünewald and Torriti, 2013). For example, a response provider may be unintentionally encouraged to inflate consumption during critical periods, such that the baseline assessment makes responses look larger in scale. By so doing, consumption would be shifted to high demand periods (be it on non-critical days, but higher demand still tends to bring forward less efficient/more expensive plant).

Section 3.71 (and throughout): it is not clear what sector or group the term "Industry" refers to in this document. Is it really only Industry that has a role to "inform, educate and persuade"? See response to Question 7.

Section 3.77: The uncertainty over whether demand aggregators may extend their reach to domestic customers, should be addressed by Ofgem systematically: a) is there a net-system benefit to be gained from aggregated DSR in domestic sector? If yes, b) how can Ofgem ensure that DSR services are extended to domestic customers?

ANNEX I
Summary of research outputs from work in the area of Demand Side Response over the last three years

- 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 demand side response measures are modelled and shown to provide significant benefits. (Barton et al., 2013)

- An assessment of the impacts of Time-of-Use tariffs on a dataset of residential users from the Province of Trento in Northern Italy highlighted that Time-of-Use tariffs bring about higher average electricity consumption and lower payments by consumers. (Torriti, 2012b)

- A study on modelling occupancy variances of Demand Side Management in the European Supergrid using the HETUS database indicatively related occupancy variances to Demand Side Management programmes. (Torriti, 2012a)

- A review of existing Demand Side Response initiatives in Europe emphasised the increasing market potential of Demand Side Response in the European electricity market. (Torriti, 2010)

- A meta-analysis of the conservation impacts of feedback from in-home displays pointed to a large-scale conservation effect from feedback in the range of 3-5%. (McKerracher and Torriti, 2012)

- A review of the evidence on the costs and benefits of Demand Side Response demonstrated that the economic case for Demand Side Response in UK electricity markets is positive. (Bradley et al., 2013).

- An analysis of the concepts associated with smart grids and of the actors and potential actions associated with 'active demand', from the perspective of the electricity user. It reviews findings from demand response programmes around the world, and derives lessons on potential outcomes from demand response in cool temperate climates. Outlines the options open to end-users and demonstrates how demand response has to be worked for. (Darby and McKenna, 2012)

- An analysis of the equity implications of introducing smart grid-related technologies to European homes, showing how much depends on the specification, deployment and regulation of meters and metering; summarises the EU policy background; and examines possible equity implications. While there is the potential for fuel poor households to benefit, there is a need for careful specification and trials of smart metering and associated tariffs, with the full involvements of those in fuel poverty. (Darby, 2012)

- A study that (a) identifies smart grid functionalities that enable demand reduction and carbon benefits, (b) develops metrics to describe the state of markets and power generation in each of six representative EU markets, and (c) estimates customer demand response. The impact of SG functionalities by 2020 is modelled, using a detailed pan-European market model plus a high-level ancillary services model. Three scenarios are used: baseline (no smart metering rollout); expected (policy continues along current trajectory to 2020); and feasible (added supportive legislation). This demonstrates the significance of regulatory frameworks in enabling carbon benefits, which range from 4% potential reductions against the baseline scenario in Germany to 8% in Great Britain and Portugal. (Darby et al., 2013)
- An analysis of six focus groups, each with specific characteristics (e.g. prepayment users, early adopters of low-carbon technology) in England and Northern Ireland, discussing the concept of demand response, plus six tariffing options. (Darby and Pisica, 2013)

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