Sustainability First

1. Sustainability *First* is a small environment think-tank and charity. It undertakes research, publishes policy and discussion papers, organises workshops and high level seminars to promote new thinking on sustainability.

2. Since 2006, Sustainability First has undertaken a series of multi-sponsor studies on GB household smart energy meters. These studies have served to develop knowledge and insight in the fields of energy efficiency, smart metering, smart energy tariffs and demand response.

GB Electricity Demand project – *realising the resource*

3. Sustainability First began a major new multi-sponsor three-year project in April 2011 on GB Electricity Demand. The project was supported in its first year under one of the Low Carbon Network fund projects[1] and thereafter for a further two years via a multi-sponsor group[2].

4. The project aims to understand the GB electricity demand-side resource - across all sectors of the economy. We are evaluating both the scope for (1) demand reduction and (2) demand response – including the demand-side role of distributed generation. We are looking to understand the economic value of this resource - to both customers and market actors – over a 10-15 year horizon.

5. The project has a strong practical focus on customer, consumer, commercial, regulatory and policy issues, informed by the experience of our project partners. The project is co-ordinated via a Smart Demand Forum, comprising our sponsors, major consumer bodies[3] as well as colleagues from Ofgem and DECC.

6. Project papers completed so far are published at 'GB Electricity Demand' on www.sustainabilityfirst.org.uk.

7. This consultation response to DECC reflects the views of Sustainability First, and not those of our project sponsor group or of the Smart Demand Forum.

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[1] Northern Powergrid's Customer-Led Network Revolution project.

[2] Northern Powergrid, Scottish Power Energy Networks, UK Power Networks, National Grid, British Gas, E.ON UK, EDF-Energy, Cable & Wireless, E-Meter, Elexon, BEAMA, Ofgem.

[3] Consumer Focus; National Energy Action; Which? ; Energy Intensive Users Group

DECC Consultation on Electricity Demand Reduction

8. Sustainability First very much welcomes the DECC initiative to encourage greater electricity demand reduction. This is central both to promote system-wide cost-efficiency and in delivering cost-savings to customers. Electricity demand reduction is especially important for large electricity users and / or for the fuel-poor with inflexible demand, and for whom industry levies on end-bills may prove particularly onerous.

9. On the basis of the research carried out for our three-year GB Electricity Demand project, we have focused in this consultation response on why measures to target permanent reductions in peak-electricity load across all sectors may offer most value for overall cost-efficiency in the electricity system, for carbon and for supply security. This is especially so for the commercial and household sectors.

10. We have focused on these time-of-use issues in particular, because this is one area where DECC's own analysis for the Electricity Demand Reduction consulation, says relatively little. We have also focused on how these time-of-use considerations relate to the financial incentives and mechanisms under consideration, including their scale-ability.

11. The consultation raises important questions about the value of non-financial measures to promote electricity demand reduction, and also about approaches to monitoring and verification. Clearly these are very important issues in the delivery of cost-efficient, permanent electricity demand reduction, but we do not comment on these.

Why targeting peak-load matters in considering new measures for permanent electricity demand reduction.

11. Presently, outline proposals to incorporate the electricity demand-side into a capacity market design, focus on incentives designed to promote :

    - Temporary load-shifting
    - Temporary load-reduction[4].

12. In considering suggested incentives for electricity demand reduction, this note therefore outlines why, in our view, there would be sound reasons for DECC to look

[4] So, perhaps a TRIAD-type response (half-hourly settled customers only in today's GB market), or, akin to the (former) I&C Eirgrid SO Winter Peak Reduction Scheme in the Ireland market).

at incentives which can promote (1) **permanent electricity demand reduction at peak periods** and which therefore (2) **target certain day-time load.**

13. The Impact Assessment[5] for the DECC Electricity Demand Reduction consultation describes how in the modelling under the three selected scenarios :

    'Additional runs of the DDM have been used to investigate the importance of the time of day at which demand is avoided in driving the value of the levelised benefit of demand reduction. This is important in understanding whether all the electricity demand reduction policy options would lead to similar financial benefits. These included runs where the demand reduction was modelled using only a reduction in domestic/ non-domestic load profiles (to approximate an EDR policy focused on the domestic/ non-domestic sector), and a run where only overnight demand was reduced (to consider whether the benefits of demand reduction would be maintained if the only measures incentivised were about reducing overnight wastage e.g. through turning off office lights).

    The conclusion was that the financial value of demand reduction is broadly equivalent across the different scenarios. *The value of electricity demand reduction overnight was around 20% lower than during the day, which is probably not large enough to require that time of day issues need to be incorporated within policy design. However, none of the scenarios considered demand reduction at times of system peak only; the financial value of reducing demand at the peak specifically would be expected to be higher than the benefits of reducing demand across the day as a whole*. Hence the results of this modelling work do not affect conclusions reached in other work that Demand Side Response can move demand from periods of higher prices to periods of lower prices, therefore improving the efficiency of the system'. *[our italics]*.

14. We question the conclusion of the DECC Impact Assessment that the relative value of electricity demand reduction during the day-time (compared with overnight reduction) 'is probably not large enough to require that time of day issues need to be incorporated within policy design'.

15. In practice, as the text of the impact assessment seems to acknowledge, there may well be sound reasons for considering time-of-use in respect of the incentives being proposed to promote electricity demand reduction in the consultation document. This is because :

    - A 20% differential between potential average 'day-time' and 'night-time' cost-savings[6], may well be material in practice in terms of improvements to

[5] Electricity Demand Reduction initial impact assessment. 29 November 2012. Annex A. Internal Modelling of EDR impact on system costs. p. 34

[6] We assume some 'read-across' from the modelled levelised cost-savings to prospective wholesale energy cost-savings. We also assume any network savings would be additional.

electricity system cost-efficiency overall[7]. As the impact assessment notes, cost-savings made at system peak would in all likelihood be higher (say 17.00h – 19.00h daily).

- As noted in para 11 above, the capacity mechanism as presently conceived, is looking to incentivise 'temporary' electricity demand reduction – but seemingly not 'permanent' electricity demand reduction.

16. All things being equal, permanent electricity demand reductions at peak-periods ought to offer :

    - The most cost-efficient demand reduction for the electricity system overall – assuming that the electricity cost-curve (both short-run and long-run) largely matches the demand curve[8], [9].

    - The greatest carbon reductions [10].

[7] The saving to the electricity system is distinct from any benefit which might pass to end-customers via their retail tariff. Customers on flat / averaged tariffs will receive the same benefit for the saving they make, regardless at what time of day they permanently reduce their electricity demand.

[8] See Ofgem 2010 modelling of electricity system cost-savings for a 10% & 5% shift (not reduction) in peak-load (daily wholesale, annual capital cost, annual network savings, expected carbon savings). Ofgem. 82/10. Demand Side Response. Pp16-31 & Annex 2.

[9] All things being equal, wholesale prices might be expected to reflect both the short- and the long-run costs of energy (commodity costs ; existing operational & capital requirements ; costs of plant replacement / new plant). Network-related costs are additional to wholesale costs : long-run Transmission & Distribution costs should also reflect the costs associated with new peak-related investment and/or constraint management.

Ofgem (Ofgem. 174/11. Promoting Smarter Energy Markets. December 2011. p.19) note that for 2011 the 'within-day' peak- / off-peak wholesale price-differential, between the most expensive and least expensive times of day, was 20% on average. This arguably modest 'within-day' differential is likely to be shaped by a number of complex factors, including, for example : (1) the fact 'scarcity' is not presently a particular feature of the GB electricity system – and so today's wholesale prices are very largely shaped by short-run cost-considerations ; (2) a weak short-run signal for imbalance and (3) somewhat limited wholesale market liquidity.

[10] Assuming fossil plant at the margin. Gas presently more marginal than coal, so as of today, perhaps less CO2 benefit – but post-2016 that should change with coal closures (due to LCP & IE Directives).

From now to 2030, the UK carbon-price floor means that carbon-intensive plant will become increasingly more expensive to run relative to less carbon-intensive plant – and (all things being equal), should therefore result in lower UK carbon emissions (and should also improve the likely value associated with electricity demand-side actions at peak). In practice however, so far as reduced carbon emissions at an EU level to 2020 are concerned, the volume of 'permitted' UK electricity carbon emissions are already capped to 2020 under the UK's national allocation plan, under the EU Emissions Trading Scheme. The EU-wide cap will not change unless or until discussions on EU ETS reform make more progress at EU-level - in particular on whether the current EU-wide cap might be tightened (or EUA permits retired early) in Phase III.

17. Looking beyond 2016 or so, the GB electricity-system is widely expected to face (1) greater constraints on capacity than today – and (2) higher energy / commodity costs. Within-day wholesale price differentials may therefore be expected to increase above today's levels – and therefore the value to the electricity system of permanent peak-period electricity demand reductions should similarly increase.

18. Therefore, looking ahead[11], permanent electricity demand reductions at peak-periods should help to support avoided capacity costs – especially if peak-load grows faster than average load. So, reducing peak-load so far as possible today, may serve to create some 'head-room' for expected future 'peak-load' growth (EVs, heat-pumps) without necessarily requiring additional peak-related investment.

19. Separately, permanent electricity demand reduction at peak, *especially at particular locations*, may in the long-run support avoided network investment (both transmission and distribution). Today's networks are already designed and built largely to accommodate system peak. However, for the future, incentives for peak-related permanent demand reduction might also help to support avoided network investment. This is likely to have greatest value at particular locations[12], [13].

20. Importantly, and in contrast to the generally beneficial effect on system cost-efficiency and system security of demand reduction at peak periods, significant electricity demand reduction at periods of general low demand (say, over-night) or at summer system 'minimum', could perhaps result in expensive system operator payments to constrain-off 'must-run' plant off the system (eg nuclear, wind). Ultimately, any such additional balancing costs could very likely pass to consumers.

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[11] Until such time as wholesale prices are predominantly wind rather than peak-driven.

[12] Distribution networks (~20% of customer end-price) : mostly already built to accommodate today's peak load – but will benefit from incentives which may help to reduce peak-load at particular locations in the lower-voltage networks, to avoid the high costs associated with network reinforcement.

[13] Transmission networks – generally sized to accommodate today's system peak, The TRIAD is a price-incentive to existing half-hourly I&C load (~40-50% of annual volume) for a *temporary* reduction at *maximum* winter evening peak (three half-hours p.a.). So, targeting winter evening peak-load for *permanent* reduction instead – both for half-hourly (117,000 customers) and for non half-hourly customers (29 million), could also help to avoid new *load-driven* transmission investment (most benefit likely to be in the south).

Incentive mechanisms proposed by DECC to encourage electricity demand reduction.

20. It will be helpful for DECC to clarify the specific aims and desired outcomes of the possible new incentives proposed. In particular, whether a main aim is chiefly to deliver :

    - Cost-savings to end-customers (similar to Green Deal and ECO)
    - Avoided carbon (so, seeking possible equivalence with FIT CfDs)[14].
    - Supply security (so, seeking possible equivalence with the capacity mechanism).
    - A more cost-efficient electricity system overall (with a likely spin-off of lower carbon too).

21. If near-term cost-savings to end-customers are the main goal of the EDR initiative : then an incentive designed to achieve the greatest overall kWh demand reduction may be an appropriate way forward (so, a Premium Payment ; a Supplier Obligation (for I&C customers). As noted, with our present flat / averaged retail tariffs, most of today's 29 million non half-hourly customers are indifferent as to which electricity demand they reduce – day-time or night-time. So, in practice, customers are most likely to reduce the electricity demand which is most 'convenient' to reduce. Much of this electrical load may be at non-peak times, or, in the night.

22. For supply security, cost-efficiency and carbon reduction : an incentive designed to reduce peak use, and possibly to reduce certain targeted daytime use, may produce most overall long-run value to the electricity system and to consumers alike because :

    12. Permanent demand-reduction *at peak times* (i.e. at highest cost times) is likely to maximise both system cost-savings and carbon savings. So, an incentive would be needed which was capable of promoting capacity-related reductions (kW)) – rather than reductions at mainly other, lower-cost times day or night (i.e. rather than energy-related reductions (kWh)).

    13. Electricity retail tariffs are flat / averaged. So, if new incentives succeed in significantly reducing average electricity demand *at non-peak times* – but *not at peak-times as well* – suppliers could arguably face a possible short-fall in their *total* long-run cost-recovery: especially for *fixed-costs relating to peak-supplies* (generation, networks). In turn, this may place suppliers and their customers in an unfortunate spiral where a supplier may need to increase the basic flat-rate / averaged retail tariff

[14] See footnote 10 on carbon.

– to enable recovery of their *total* costs across fewer units (kWh) – in particular for peak-related investment[15].

23. On the assumption that the most cost-efficient permanent electricity demand reduction for the foreseeable future is likely to be either at peak times[16] (evening, morning) - or at certain other times of day – five considerations follow :

- The proposals for incentive design outlined in the consultation are likely to produce quite different outcomes with respect to time-of-use – and therefore for their overall impact on the electricity system.

- Some of the proposed incentives are more likely to support delivery of avoided-peak/ kW/capacity (so, capacity market ; sector / technology specific / targeted financial support). Some of the other incentives may support avoided energy in general (kWh) (so, Premium Payment, Supplier Obligation for I&C customers, (and perhaps if targeted at general kWh - sector / technology specific / targeted financial support)).

- All of the proposed incentives seem scaleable, at least in principle. A mechanism which enables scope for third party involvement (eg for aggregation), may also support scale.

- I&C load : In its discussion of different end-uses, the consultation seems to give some priority to I&C load for reduction measures. This is on the grounds that permanent reductions of this load may not yet be covered by present policy. It is worth noting that ToU tariffs are already available to the largest half-hourly settled customers. So, in principle at least, permanent day-in-day-out I&C peak-load reductions (i.e. permanent I&C kW reductions) can already be incentivised by ToU tariffs. I&C customers may contribute to around 16% of evening peak[17].

- In focusing somewhat on I&C load, the consultation possibly risks overlooking the relatively higher system-costs associated with meeting household and smaller commercial peak-period load. Household load may contribute to around one-half of evening peak load, year-long[18]. Pre-2020, so far as practicable, it will remain important to incentivise permanent peak load reductions for the non half-hourly sector (so, for both households and smaller commercial users) because there are less likely to be ToU incentives *at scale* for these customer groups before the 2020's (i.e. pending

[15] For example, see 'The Energy Market Death Spiral – Rethinking Customer Hardship'. Paul Simhauser & Tim Nelson. AGL Energy Ltd. AGL Appplied Economic & Policy Research. Working Paper No 31. June 2012. Brisbane.

[16] As noted in the DECC Impact Assessment. p. 34

[17] Ofgem. Op cit. (also depends on I&C customer definition).

[18] Demand Side Response. A Discussion Paper. Ofgem. 82/10. p.50

smart meters and half-hourly settlement). Collective and community schemes to permanently reduce peak-load may also have a high potential value at particular locations, especially in the lower voltage distribution networks. Also, permanent reduction of household and commercial peak-load by lowering the peaks generally, may also, in the long-run, help to reduce peak-related costs for half-hourly I&C customers too.

Sustainability First conclusion on why targeting peak-load matters in introducing new incentives and measures for permanent electricity demand reduction.

24. Where practical / feasible, it therefore seems desirable for electricity demand reduction incentives to be designed **to enable permanent peak electricity demand reductions to take at least some precedence over electricity demand reductions at other times of day, and certainly at night**[19]. Thereafter, certain day-time savings also seem desirable e.g. from 07.00h to 10.00h.

25. From the viewpoint of system cost-efficiency, carbon and system security, for the 29 million commercial and household customers for whom ToU tariffs are not likely to be on offer *at scale* before 2020, it seems to make sense to target certain peak period end-uses to support permanent demand reduction – say between 16.00 and 19.00h.

26. The end-use modelling for Sustainability First by Brattle[20], suggests that the loads most likely to lend themselves to permanent demand reduction at evening and morning peaks are : 'on-peak' heat (commercial, household); lighting (commercial, household). Improvements in refrigeration efficiency could also make a material impact at peak-times (commercial and household refrigeration), provided old inefficient refrigeration equipment was scrapped.

27. Both the capacity market and targeted measures could in principle support such targeted peak-period permanent demand reductions at scale, especially if third parties are able to aggregate load.

28. DECC's consultation raises other important questions. For example, on approaches to monitoring and verification. Without more clarity on the nature of the preferred incentive – and more clarity on the main desired outcome in terms of what electricity demand is to be targeted for permanent reduction - it is hard to address the detail of

[19] i.e an incentive which might encourage 'turn-off ' between 00.00h to 06.00h could produce welcome savings for the customer – but may not necessarily support the goals of electricity system cost-efficiency, lower carbon and / or supply security.

[20] **See Annex 1 to this Submission** (based on : Sustainability First Paper 2. GB Electricity Demand – 2010 and 2025. Initial Brattle Electricity Demand-Side Model – Scope for Demand Reduction and Flexible Response. Serena Hesmondhalgh. The Brattle Group and Sustainability First. February 2012. ww.sustainabilityfirst.org.uk

M&V approaches. Clearly, a balance will be needed between obtaining value from incentivising demand reduction which is permanent and 'assured' - and the cost and time involved in dependable M&V (especially if there are to be penalties for non-delivery).

29. Non-financial measures to promote electricity demand reduction noted in the consultation, such as labelling and product standards remain extremely important in delivering electricity demand reduction for all sectors. These measures will help to permanently reduce (or at least delay load-growth) both for overall kWh consumption (so average load-growth) as well as peak-load growth. Regulated and administered measures such as these, need to be regarded as a continued high priority by government, including in discussion at an EU-level.

30. Initiatives to improve the quality and availability of information and awareness on electricity demand reduction also continue to be extremely important from a consumer viewpoint, and will need to underpin delivery of whichever incentive is adopted.

Sustainability First
February 2013

Annex 1

Understanding GB Electricity End-Use

From the outset, the GB Electricity Demand project has aimed to produce a systematic overview of how different sectors in GB presently use their electricity across the day, week & seasons (Industry, Services, Households). However, electricity end-use data – including official DECC data (eg DUKEs, Energy Consumption in the UK), is somewhat limited & the modelling was somewhat historic (although welcome steps are now being taken by DECC to update and improve on some of their data sources).

We have built a 'best picture' of GB electricity demand which draws on: official UK data ; our own end-use model - developed by Brattle Group ; an Industry survey ; a review of household data and trials. Increasingly, new empirical end-use data from trials and studies will start to improve this understanding over the next few years.

Without a good grasp of when and how customers actually use their electricity, efforts (1) to engage customers in the electricity demand-side risk being poorly focused, and (2) decision-making on policy-measures, priorities & interventions risk being poorly informed.

All-Sector Electricity End-Use Model

Brattle group have developed an all-sector electricity end-use model for the Sustainability First GB Electricity Demand project[21]. This estimates likely time-of-day and time-of-year when electricity is used – and therefore adds some major insights to the analysis carried out for the DECC Electricity Demand Reduction consultation.

In particular, for both electricity demand reduction and for load-shifting the Brattle model finds that :

- At average winter weekday evening peak (January 16.00h-19.00h) : ~one-third of load (2010) may have the ***technical potential*** to permanently reduce and / or to shift (so, 18GW of 54 GW).

- Of this load, main end-uses *likely* either to reduce or to shift would seem to be - **on-peak electric heat[22] and lights[23]** (In both the Household & Commercial sectors).

[21] Paper 2. GB Electricity Demand – 2010 and 2025. Initial Brattle Electricity Demand-Side Model – Scope for Demand Reduction and Flexible Response. Serena Hesmondhalgh. The Brattle Group and Sustainability First. February 2012. www.sustainabilityfirst.org.uk.

[22] **Commercial 'on-peak' electric heat** – accounts for 15% of demand on a January weekday evening peak – 16.00h – 19.00h (~2% on an August weekend. 16.00h-19.00h). Possibly up to 12TWh of commercial load is used for direct-acting space heating – so perhaps could have some technical scope for flexibility / shifting / reduction / substitution. **Source :** Paper 2. Op Cit.

- Other load – motors, compressors, household wet and cold appliances. Unclear how far this other load may either reduce or shift in practice, and in what time-scales. The DECC Electricity Demand Reduction analysis offers some useful background.

- Household load – is the main contributor to evening peak – in *both* winter & summer. This load builds gradually from 16.00h towards 19.00h. Household load represents around half of daily winter evening peak load (kW), but only around one-third of average annual consumption (kWh).

- Morning peaks : there are morning peaks in both winter and summer. There may be some unexploited potential – either to reduce or to shift that load.

Household 'on-peak' electricity as main heating source – ~ 8 TWh p.a. 562,000 GB households (2.4%). 'On-peak' electric heating – our 'on peak' definition inludes all usage between 07.00h– 23.00h (so, includes 17.00 – 19.00h). Likely to be smaller homes – esp flats (older & new-build) ; private rental / owner-occupied; single households ; lower incomes (EHS 2009). **May be scope either to reduce / substitute – or to shift some electric 'on-peak' heat** – e.g. to Economy 7 (& so reduce winter evening peaks). But, would need good insulation - as well as 2-rate meters & new heating system. **'Top-up' electric 'on-peak' heat** - less likely either to reduce or shift. No knowledge of how much of the 8TWh p.a. 'on-peak' heat - is 'top-up'.
Source : Sustainability First. **Paper 3 – 'What demand side services could customers offer - Household Demand'.** April 2012.

[23] **Lighting** : accounts for around 19% of total estimated demand on a January weekday evening peak, of which around 39% is domestic lighting and 56% commercial lighting. On an August weekend, the commercial share of lighting rises to ~70%. This suggests considerable scope for more efficient lighting and / or better lighting controls (in particular in the commercial sector). Source : Paper 2. Op cit.

This chart illustrates the high-level picture which Sustainability First has gradually built since the start of the GB Electricity Demand project in April 2011. It draws from our Brattle model and other of our project papers – and offers a very high-level summary of the potential for permanent electricity demand reduction, the daily load characteristics of each sector (industry, commercial and household) through-out the day and the year, and the likely scope for flexibility and load-shifting.

Sector	**Customer numbers / percent annual usage** (323 TWh – 2011)	**Key Characteristics of Load** (as suggested by our Brattle end-use model)
Industry **Half-Hourly settled.**	• **~117,000** • **50 %**	• **Demand reduction potential** – many cost-effective electricity efficiency measures already taken – esp for those businesses where electricity costs >10% of their operational costs. • **Fairly flat profile** - across the day, night & seasons. Chemicals, food & paper ~40% of consumption. • **DSR potential** - fairly 'bespoke' - driven by process needs.
Services / **SMEs** **Load Profiles 3-8**	• **~2 million** • **16%**	• **Demand reduction potential** - lighting (significant) ; on-peak heat. • **Morning 'rise' – but thereafter relatively flat profile through the day.** Slowly tails off through evening . • **DSR potential** – poss. scope to reduce or stagger morning 'rise'. Perhaps limited scope to load-shift at winter evening peak – but -some services load may be suited to Balancing Market.
Households **Load Profiles 1-2**	• **~27 million** • **34 %**	• **Demand reduction potential** – lighting ; 'on-peak' electric heat ; product standards. • **Greatest contribution to winter evening peak (say around half of total peak)** - Lights, cooking, electronics. Load which might **reduce** ? Lighting efficiency ; Some on-peak heat ? product standards – wet / cold appliances. • **DSR potential** : other than on-peak heat, what *other* household load in use betw 5-7 pm might shift ? (so, wet appliances? fridges? hot water ?).

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