Sustainability First

GB Electricity Demand Project – *realising the resource*

The electricity demand-side and local energy : how does the electricity system treat 'local' ?

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Today

1. **GB Electricity Demand Project – Overview**

2. **Paper 10 : The electricity demand-side and local energy: how does the electricity system treat 'local' ?**

Views expressed are those of Sustainability First –
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Sustainability First – GB Electricity Demand Project

- SF is a small charitable environment think-tank.
- **Three-year multi-partner project** to understand :
  - GB electricity demand-side resource - across all sectors of the economy.
  - Scope for (1) **demand reduction &** (2) **demand response –** incl role of Distributed Gen.
  - **Economic value** of this resource - to both customers & market actors.

  10-15 year horizon.

- **Strong practical focus**. Informed by our project partners (incl LCNF projects).
- **Main focus** : customer, consumer, commercial, regulatory and policy issues.
- **Smart Demand Forum –** project coordination :
  - **Sponsors –** Northern Powergrid, Scottish Power Energy Networks, UK Power Networks, National Grid, British Gas, E.ON UK, EDF-Energy, Elexon, Vodafone, Siemens (E-Meter), BEAMA, Ofgem.
  - **Consumer bodies –** Energy Intensive Users Group ; Which ? ; Consumer Futures; National Energy Action
  - **DECC**
- **12 project papers** – see 'GB Electricity Demand' at **www.sustainabilityfirst.org.uk**

GB Electricity Demand project papers – www.sustainabilityfirst.org.uk

1	GB Electricity Demand – context and 2010 baseline data.
2	GB Electricity Demand 2010 and 2025 – Initial Brattle Demand-Side Model : scope for demand reduction and flexible response.
3	What demand-side services could customers offer? • Household Customers • Industry Customers .
4	What demand-side services can provide value to the electricity sector?
5	The electricity demand-side & wider energy policy developments.
6	What demand-side services does Distributed Generation bring to the electricity system?

GB Electricity Demand project papers – www.sustainabilityfirst.org.uk

7	**Evolution of commercial arrangements for more active customer & consumer involvement in the electricity demand-side.**
8	**Electricity demand and household consumer issues.**
9	**GB Electricity Demand – 2012 and 2025. Impacts of demand reduction and demand shifting on wholesale prices and carbon emissions. Results of updated Brattle modelling.**
10	**The electricity demand-side and local energy: how does the electricity system treat 'local'?**
11	**How could electricity demand-side innovation serve the electricity customer in the longer term?.**
12	**The household electricity demand-side & the GB electricity markets - realising the resource (to be published June 2014).**

Paper 10 - GB Electricity Demand Project

The electricity demand-side and local energy : how does the electricity system treat 'local' ?

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‘Local-Match’ : supply & demand

‘we ***just*** need to match *local* blocks of demand with *local* supply to deliver greater electricity system efficiency at the distribution level’

So near… & yet so far …

Paper 10 aims to explore what ***‘just’*** might mean in practice.

We tried to understand what it may mean to be a small local generator or micro-generator; or an individual customer or a local group of customers (be that at street, neighbourhood, or wider community level) looking to make a demand-side contribution ***at a particular place or location***.

The paper aims to answer two basic questions :

(1) How might the electricity demand-side play a more active role *at a local level* ?

(2) How might a better local ‘match’ be achieved between local generation and local electricity customers ?

Paper 10 : The electricity demand-side and local energy : how does the electricity system treat 'local' ?

Paper 10 :

- Took a detailed look at **underlying commercial and regulatory areas to be tackled before a *local* GB demand-side is likely to be realised at scale.**
- **Discussed what 'local' presently means to different market actors** : to suppliers, the transmission networks, system operator, and the distribution networks.
- **Considered how today's centralised electricity industry commercial frameworks, charges and administrative arrangements treat local generators and end-customers** - *in terms of their physical impacts on the distribution networks and their location*.
- **Discussed how for the future some underlying 'industry plumbing' may need to adapt** to facilitate more *local* demand-side activity, and / or *local matching of supply and demand* (assuming this is both cost-efficient and generally beneficial for consumers).
- **Considered some high-level consumer issues in a more 'localised' electricity world -** including potential fairness issues of a more 'local' electricity system.
- **Set out an overview of current actions by Ofgem and the Distribution Networks -** to innovate and improve the 'local match' between supply and demand
- **Explored the reality of six local and community electricity demand-side case-studies.**
- **Concluded with some suggestions for Ofgem, DECC, & market actors -** in their quest to develop 'firm' demand-side actions as an alternative to new network and / or supply-side investment

Six community demand-side case studies

Case studies include:

Case-study 1 : Self-contained island balancing (peak reduction).
Isle of Eigg

Case-study 2 : Overall electricity demand reduction at local substation.
Community Competition for Energy Demand Reduction. SSE EDRP.

Case-study 3 : Committed local community.
Ashton Hayes

Case-study 4 : Location-specific I&C demand turn-down scheme.
Thames Valley Vision. SSE.

Case-study 5 : Community self-balancing: wind to storage heaters.
Nines Project. Shetland. SSE (Northern Island New Energy Solutions)

Case-study 6 : Private wire : self-balancing.
Community Energy Scotland

Timeline for a better 'local-match'

There is a *timeline* to obtaining a better 'local-match' of supply & demand - & we are still some way off. We are likely to need some (or all) of :

- Smart meters
- Flexible household load (& at scale, what might that be ?)
- Retail tariffs to incentivise customer flexibility
- Controllable load (incl two way communications).
- Data management capability – i.e. knowledge of customer load, location – also for validation.
- Individual-level half-hourly settlement (possibly for some 'dynamic' DSM ; to target 'specific' customer groups).
- Market actor business case – otherwise no 'value proposition' for customers.
- Consumers – 'engaged' / willing ; appropriate safeguards.

Ofgem's Smarter Markets team & DECC Ofgem Smart Grid Forum WS6 addressing.

We need to understand the *dependencies* : early 2020's - may all 'come together'.

Other assumptions we made

- **Suppliers** – large & small - *will* become more active in DSM *in time* (but depends on prev. slide)
- **Retail tariffs – which are time-related and / or price-related** – *also* central for electricity system cost-efficiency in long-run (Paper 7)
- **Transmission system** – a continued need for bulk power transfers.
- **Low-carbon DG** – ***commercially*** will continue to be 'must-run'.
- **Flexible load** – **HPs, EVs** – still to come forward *at scale* to offer local flexibility. (and, if not, where will we find *local* DSM capability to 'match' local generation ?).
- **Storage** – is a *key* enabler to efficient match between local generation output & local customer demand at scale. A major break-through is needed in both storage technology & costs to make 'local balancing' at scale a reality.
- **Demand-side will find its 'worth' at a national 'system-level' - & at a 'local-level' :** DSM 'savings potential' extends *right through* the electricity system. **DSM will offer different value to different parts of the electricity system in different time-scales** (balancing, capacity, network management etc). So, in the end, DSM 'price-discovery' & visibility needed *across the full electricity system* to support *cost-efficient* demand-side participation *system-wide*. **(but Paper 10 focus is distribution networks).**

Why location matters to market actors 1

- Locational efficiency is a significant technical and cost consideration for market actors – **mostly for the networks**.

- In general terms, a good locational match between supply and demand should help to :
  - Reduce the costs of managing physical constraints & bottlenecks in the electricity networks and
  - Reduce losses (& associated costs).

- And therefore may help **to defer or save on unnecessary new network capacity or reinforcement, and/or save on other costly measures to overcome network constraints**.

- This is so for both distribution – and transmission.

Why location matters to market actors 2

- For the future, far greater levels of distributed generation & low-carbon technologies, will make a good *local* match between supply and demand *potentially far more material than today* for electricity system cost-efficiency.

- Initially, these local efficiency considerations *are chiefly for the distribution networks.*

- In time, if volumes of distributed low carbon generation - and levels of demand-side activity – remain 'unmanaged' – and become *so significant*, their *physical* impact may also create major new costs in the wider electricity system for :
  - Balancing
  - Transmission networks - peak management, unpredictable flows at the distribution / transmission boundary.
  - Suppliers (potentially) - unpredictable / unforeseen patterns of usage leading to imbalance at particular locations.

But these wider impacts may be some way off.

Balancing : national, regional & local ?

Cross-industry working groups are starting to discuss how balancing may interact at different 'levels' in the electricity system in future : national, regional, local.

- **System operator -** is responsible for *national* balancing of frequency and voltage in real-time. SO needs more granular information at the 'regional' level (GSP) about the location, output & despatchability of distributed generators - and, longer term, about demand-side actions - to avoid unnecessary balancing costs (forecast error) – paid for by all customers.
- **DNO licence duties -** already require cost-efficient & economical management of constraints & losses on their networks. DN price controls incentivise this – including innovative approaches in DPCR 5 & RIIO-ED1.
- **DNs making rapid technical & commercial strides -** new approaches to managing constraints & losses *more efficiently* - & so defer / avoid needless network investment e.g. Automated Network Management, Non-Firm Connection Agreements etc.
- **Local DSO balancing role ? Aims ? & When ?** Sensible start-point : clarifying what gaps exist in *current* DN duties, capabilities & DN 'tool-kit' for the *core* DN tasks of managing constraints and losses. [SGF Workstream 7 (technical issues). SGF Workstream 6 (commercial issues).

How location treated in industry charges 1

- Many smaller generators – and virtually all customers – have little real choice in where they connect into the electricity system.

- Nevertheless, industry network charges *do* recognise locational impacts and cost-efficiency - for both generation and demand.

- The charges are designed to reflect the ***knock-on investment costs*** **for the networks of** ***constraint management*** via :

  - **Connection charges** - (both T&D) – whereby the costs which may arise from connecting a new generator or demand customer at a particular place on the network are 'shared' - at least to some extent ;
  - **Use of system charges** - (TNUOS (p/kW & p/kWh)) & DUOS (p/kWh) which incorporate cost-recovery for fixed costs of network provision (and which take account of location).
  - **A capacity element** - incorporated in use of system charges (p/kW - T&D) which takes account of either the export capacity (larger generator) or maximum import capacity (large customer) at their location.
  - **Treatment of losses in TNUOS, BSUOS & DNUOS** - (a geographic (so locational) adjustment to reflect the cost of losses across the system (p/kWh).

- **Essentially, the larger the generator - or the customer - the stronger the locational signal they face as a result of the *combination* of these different charges.**

How location treated in industry charges 2

- Locational approaches vary somewhat between Transmission, Distribution & Balancing charges :
  - **Transmission charges** - are fairly cost-reflective. TNUOS **adjusted by zone** depending on where suppliers' customers are located. Broadly, suppliers' 'demand' charges are generally twice as high in the south as in the north (both I&C and smaller customers). (The opposite for generator charges) TNUOS charges include an adjustment for losses. Transmission connection charges for generators also reflect the cost of connecting at a particular location.
  - **Distribution charges** – less explicitly cost-reflective. DUOS varies both *between* distribution networks and *also* by voltage of connection. (In part, reflects location – urban, rural etc) . Also adjusted for losses - so incorporate a locational element to some extent. **EV charges give big customers an explicit locational signal.** HV and LV DUOS charges do *not* give customers connected at those voltages an equivalent locational signal. (For larger customers, but not small ones, that is done by the connection charge).
  - **Balancing charges** (BSUOS) are adjusted for losses – so incorporate a locational element to some extent.

How are network charges paid ?

- **Network charges presently amount to ~20 % of the end-price of electricity to consumers.** (Transmission – 4% ; Distribution - 16%).
- Network customers (DG included) are not directly 'billed' for these network charges.
- Instead, *suppliers pay T & D charges to the networks* for moving their customers' power (& to the system operator for Balancing).
- Suppliers' charges mostly calculated on a *standardised* basis per customer - which suppliers recover from their end-customers.
- So, cross-industry network charges – including how these reflect *location* - are passed-through by suppliers *unseen** to their end-customers. **So, no 'locational' signal in end-customer retail tariffs**.

* - not 'unseen' for many large I&C customers

Do distribution charges treat the 'costs' & 'benefits' of location 'efficiently' ?

At a high level, (both Connection and DUOS) treat 'local' costs & benefits as follows :

***Costs* associated with customer location** - are generally already factored into distribution charging frameworks for :

- **Larger distributed generation**
- **Larger Loads** (Half-hourly & Load Profiles 5-8)
- **Existing household loads and small businesses** (Load Profiles 1-4)

For smaller customers, locational costs are not at present comprehensively factored into distribution charges with regard to :

- Micro-generators <3.68 kW
- Additional or new loads installed by households and small business customers (Load Profiles 1-4). (e.g. power showers, storage heaters, heat pumps, EV chargers)

***Benefits* associated with customer location -** are generally already factored into distribution charges for : **Distributed generation – for larger DG via the 'embedded benefits' they receive from a supplier** via a power purchase agreement ; (and, arguably, via FIT deemed export tariff).

- **But, locational benefits are not *systematically* factored into charging approaches for what demand-side activity could offer** – e.g. there is presently no 'embedded benefit equivalent' for demand-side actions (be that for DSR, demand reduction or for storage). (So, potential recognition of any avoided costs of transmission, balancing).
- **But NB - benefits *are* available for demand-side actions via 'ad hoc' bilateral agreements for demand-side services offered to DNs** (mostly I&C customers).

Distribution charges – visibility

Distribution charges – payable by suppliers - & generally poor visibility of locational (or other) signals

- **Larger customers (DG & I&C customers) :** charges do convey some ***visible*** signal about their location:
  - **Connection charges** – (may apply to **distributed generators >3.68 kW and I&C loads down to Load Profiles 5-8)**
  - **DUOS charges** - the separate capacity and ToU elements *within* DUOS charges (but **only half-hourly metered generators and customers).**

- **But, for all other network customers – locational signals are not visible in distribution charges**. So, for :
  - **350,000+ plus small micro-generators <3.68 kW and**
  - **29 million end-customers**
  - **Community or local groups wishing to take group or collective action.**

Even where locational signals do exist (within the distribution charges paid by suppliers), signal is anyway weak, at best.

It would be helpful to debate (1) the merits of making network charges more separate & visible to end-customers and (2) when 'timing' might be right to do this ?

Distribution charges & smaller customers : should we send stronger signals about the costs and / or benefits of local demand-side actions ? (1)

Paper 10 discusses some *long-run* **pros & cons of more cost-reflective approaches to distribution charging directly to smaller customers - micro-gen, new loads -** (Connection, DUOS).

- **The aim** : to support more cost-efficient network management at the local low-voltage level.
- **The question** : how far would we wish to drive any such cost-reflection *to smaller end-customers* ?.
- **The task** : to signal to end-users the costs & benefits / value of *their* patterns of electricity use (individual; collective) – including demand-side activity and local-balancing actions – ***perhaps including at a particular place*.**

- **Potentially, 'nearish-term' options could perhaps include :**
  - **connection charges for micro-generators*** and perhaps
  - **explicit 'capacity charges' for small customers** - to better reflect back to them the costs associated with connecting big new loads (& which could be supportive of demand-side management retail tariffs). (Industry working groups already looking at such options (incl. poss ToU DUOS charges at each distribution voltage).

- **Such steps may prove contentious / difficult to introduce retrospectively**

* Ofgem have clarified they do not plan to change before end-ED1 (so, not pre-2023).

Distribution Charges & smaller customers : should we send stronger signals about the costs and / or benefits of local demand-side actions ?(2)

We conclude that somewhat more cost-reflection in distribution charges for small customers likely to be supportive of a better local match between supply & demand in the long-run .

Approaches to developing sharper demand-side signals in distribution charges may include :

- **Making network charges direct to individual customers** : somewhat more cost-reflective signals to *individual* customers about the potential value / costs of their demand-side activity (SF view that connection charges, capacity payments may be most 'practical' long-run options (see prev .slide))
- **Signalling network 'hotspots' where demand-side actions could support network cost-efficiency :** DNOs to 'signal' DSM value *at particular places where there was value in local* network customers offering demand-side activity ? (eg auctions for demand-side services ?)
- **Local groups or communities :** DECC Community Energy Strategy wishes to encourage. Question : how to recognise *institutionally* in distribution charges the benefits which ***collective*** demand-side actions might bring in matching local supply (? E.g Demand-side 'embedded benefits' – but wld need DACUSA changes ?).
- ***Explicitly locational*** **network charges ?** E.g. post-code charges, nodal network charges etc. **We did not look in detail – <u>but we are not advocating these</u>. Issues raised against were : fairness & distributional impacts ; complexity ; inefficient / unforeseen outcomes.**

Supplier interest in local match ? 1

- Suppliers have a developing interest in customer demand-side response (commercial advantage ; longer-term : imbalance ; capacity).

- But, seem largely 'neutral' on customer *location* – so, on *whereabouts* their own customers live or work.

- Possible reasons for this may be because : (1) GB electricity markets – generally contract / trade / balance *on non-geographic basis* and (2) the network charges which suppliers pay to the networks are largely *'passed-through'* to their end-customers (so not 'absorbed' by suppliers).

- So, suppliers seem to have few *underlying commercial drivers* to promote ***local*** demand-side activity. This is so for :
  - Almost all their supply customers (29 m. - small, large)
  - For the power purchase arrangements suppliers may have with embedded generators (and therefore for DG 'embedded benefit' arrangements) .
  - The 350,000-plus micro-generators, for whom suppliers administer the quarterly FIT payments.

Small supplier interest in local match ?

- **Smaller suppliers -** may arguably have a *stronger* commercial interest in their customers' location - if close links with a local generator & / or they wish to supply a particular community.
- **'Licence Lite' arrangements** - to encourage small new entrant suppliers – may also support 'local balancing' and 'local-matching' at community level.
- **A local distributed generator** who wished to match their output with local demand - & sell *direct to local customers* (be that to neighbours / community building etc), may presently:
  - **Become a Licence Lite supplier** (but this implies a certain scale) - or more likely
  - **Sell their output under a PPA to a supplier willing to buy it**. Could be direct to a large supplier - or to Licence Lite supplier – who may or may not have a *'local'* focus.
- **Local authorities, community co-ops & companies - could offer strong geographic / local focus to their 'customer offer'** – & may therefore have an interest in **'local-match'** of supply & demand.
- **BUT NB : Despite 'lighter' responsibilities - Licence Lite suppliers may still face complexity & financial risk in making local-balancing work** (e.g transaction costs ; potential imbalance risk ; administrative 'silos' noted on development of 'prosumers' ; how to handle unmetered spill etc).

Suppliers – what might it take to develop a more 'local' focus ?

In future, what might motivate suppliers to support 'local-matching' of their customers demand with local generation ? Some possible drivers (esp after half-hourly settlement) might be :

- **If network charges split-out in end-customers' bills ?** (Transparency, visibility vs billing-costs). But, perhaps little point ahead of universal half-hourly settlement ?
- **If suppliers face *unexpected* 'physical imbalance' in a particular region or at a particular grid supply point** eg due to major unmetered spill (PV, say) or unpredictable demand-side activity.
- **If suppliers were *strongly* incentivised *on behalf of the networks* to encourage their customers to reduce peak demand at particular locations** (e.g., benefit-share at v. constrained 'hot-spots' (e.g. when RTS ends ?).
- **Data : once suppliers have access to far more detailed & accurate data (once smart meters) – about customer usage patterns & *location* of those customers – *plus* the *location* of micro-generation clusters – suppliers may be able to take a far greater *commercial* interest than today in *local* balancing approaches.**
- **As a first step, this is likely to require dismantling of some key administrative 'ring-fences'**. For example : **FIT Administration & Supply ring-fence - to better promote individual customer** 'self-balancing' actions ; **Data protection and information sharing arrangements –** to enable basic information-sharing among market actors about location of PV clusters, HPs, EVs

Consumers : what might greater cost-reflection in distribution charges mean for them ?

Some potential customer & consumer questions in a more 'localised ' electricity system :

- **Greater cost-reflection in some network charge components – designed to send stronger & more cost-efficient *local* demand-side signals – may adversely impact some consumers** – (especially if network charges become *directly* payable by end-customers). This is why connection charges (for micro-gen or new loads) or capacity charges (for new loads) – may be appropriate *in the future* – but not retrospective.
- ***Explicitly locational* price signals** : **we do not favour.** Could be (1) controversial in regions, areas or places where individual customers, groups of customers or particular communities are *not* able to respond and (2) anyway may not produce a good 'local match' with network 'hotspots' (LCNF example) – w. those customers / groups who are willing or able to respond.

Consumers – what might more *local* approaches to electricity supply mean for them ?

In a world much more dominated by ***local*** supply, some wider questions of principle would arise, both for ***local consumers*** & for ***consumers in general***. E.g. :

- **Network re-inforcement at particular places may prove a 'firmer' and less risky option** - both for the networks & for customers – than demand-side actions. Unless, likely cost-savings prove very substantial (& we presently have little notion of savings available to share with customers).
- For some customers, **being 'interconnected' to the wider electricity system** may always be a more cost-efficient option than being dependent on local suppliers (eg customers with strong peak load characteristics, may not wish to be dependent just on local intermittent output).
- **Those customers not able** (for whatever reason) to participate in ***local*** energy markets - might be faced over time **with paying for a higher proportion of the overall fixed costs of the electricity system** (eg costs of transmission, balancing & higher-voltage distribution) - & fairness questions would arise.

While looking to achieve a better local match between supply & demand may seem generally desirable, such 'in principle' issues need to be better understood.

Local demand-side & the electricity system : some possible next steps

- Success of supply-side incentives for low-carbon (e.g. FIT) are presently running somewhat 'ahead' of a comprehensive demand-side solution-set / took-kit to off-set local network impacts. This is creating some interim cost-challenges for the distribution networks.

- Ofgem, DECC & market actors have many technical & commercial initiatives in hand to address these challenges – via LCNF, RIIO-ED1 incentives etc.

- In the longer term, these measures will also help to support the local demand-side – and so in the longer term help to improve the local match between supply & demand.

Local demand-side & the electricity system : some possible next steps

Our paper notes some 'gaps' in current incentive arrangements – which, if addressed, could help to support a better balance between local supply and local demand *now*. We propose some modest 'near-term' actions as follows.

- **Encourage PV households to use more power on-site** – e.g. by linking FIT-eligibility to thermal storage (eg a switch to divert 'electricity spill' to hot water cylinders (CLNR) & / or storage heaters).
- **Subsidies for EVs, heat-pumps to be tied to a requirement for a smart meter** - plus offer of a ToU tariff – to overcome local 'cluster' problems for networks.
- **Incentive-support for more household-level thermal storage** (hot-water, storage heaters) – an overlooked 'near-term' demand-side solution **(see Paper 11).**
- **Community-level demand-side schemes at 'network hotspots'** - fund some limited 'set-up' activity to enable this (e.g.DECC Community Energy Strategy, Distribution Networks).
- **An electricity sector 'one-stop' advisory service -** to provide early advice and generalised help to interested communities and local groups, to help bridge the 'silos' these groups may find in dealing with networks, suppliers and the system operator.

Contacts

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Project papers at

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