Sustainability First

GB Electricity Demand Project – *realising the resource*

Paper 7

Evolution of commercial arrangements for more active customer and consumer involvement in the electricity demand-side

By Maria Pooley, Syed Ahmed and Judith Ward
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Sponsored by : BEAMA ; British Gas ; Cable & Wireless; Consumer Focus ; EDF Energy ; Elexon ; E-Meter (a Siemens business); E.ON UK ; National Grid ; Northern Powergrid ; Ofgem ; ScottishPower Energy Networks ; UK Power Networks.

Smart Demand Forum Participants : Sponsor Group ; Energy Intensive Users' Group ; Consumer Focus ; Which? ; National Energy Action ; Brattle Group ; Lower Watts Consulting ; DECC ; Sustainability First.

Preface

Sustainability First

Sustainability First is a UK environmental think-tank with a focus on practical policy development in the areas of sustainable energy, waste and water. Sustainability First undertakes research, publishes papers and organises policy seminars. It is a registered charity with independent trustees – www.sustainabilityfirst.org.uk.

Since 2006, Sustainability First has produced a series of major multi-sponsor studies on GB household smart energy meters and brings significant knowledge and insight in the fields of energy efficiency, smart metering, smart energy tariffs and demand response[1].

The Sustainability First project on **GB Electricity Demand** began in April 2011. It was supported in its first year under the Northern Powergrid Low Carbon Network Fund project - and thereafter for a further two years to April 2014 via a multi-sponsor group.

Sponsors include : BEAMA ; Cable & Wireless; Consumer Focus; British Gas ; EDF Energy; Elexon ; E-Meter (a Siemens business); E.ON UK ; National Grid ; Northern Powergrid ; Ofgem ; Scottish Power Energy Networks ; UK Power Networks.

Work is coordinated through a **Smart Demand Forum** whose participants also include a number of key consumer bodies: Energy Intensive Users Group, Consumer Focus, Which?, and National Energy Action and DECC, plus the sponsor group members.

The project aims to identify the potential resource which the electricity demand side could offer into the GB electricity market through demand response and through demand reduction. The project aims to:

- Evaluate and understand the potential GB electricity demand-side resource across all economic sectors (including the role of distributed and micro-generation) ;
- Develop a clearer understanding of the economic value of this resource to different market actors and to different customers over the next 10-15 years ;
- Evaluate the key customer, consumer, commercial, regulatory and policy issues and interactions.

The project is developing a substantive knowledge-base, and provides visibility and thought-leadership for GB electricity demand-side issues. The project is undertaking work relevant to:

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[1] Sustainability First published smart meter papers are available on the website – www.sustainabilityfirst.org.uk

- GB smart meter deployment.
- Low Carbon Network Fund projects – emerging lessons and insights from the LCNF projects will be fed into the project.
- Proposals for Electricity Market Reform.

The work programme is being delivered through the Smart Demand Forum, through wider stakeholder events, and through twelve published papers. The project is run by Sustainability First. The Sustainability First team is Judith Ward, Gill Owen, and Maria Pooley.

Additional expertise and inputs are provided by Serena Hesmondhalgh of Brattle Group who has developed a quantitative all-sector demand model. Stephen Andrews is supporting the project on Distributed Generation and Micro-Generation. Sharon Darcy is providing additional expertise on consumer issues.

Key themes for the project include:

- **Customer Response and Consumer Issues –** A key focus for the project is to understand successful and cost-efficient demand-side participation from a customer and consumer perspective (household, industry, commercial and public sectors). This will include experience provided through the LCNF trials (e.g. tariffs, remote control of appliances, technologies such as micro-generation, electric vehicles etc.) and other similar initiatives in the UK and elsewhere. For households, this will include any particular issues for the fuel poor and potential distributional impacts.
- **Commercial** - Practical realisation of demand-side services - given different roles and requirements in the value chain. Issues likely to include : the nature of commercial agreements, the role of third parties,(DNOs, ESCOs, aggregators) the kind of information-sharing likely to be necessary between parties etc. – drawing from practical experiences of the LCNF Trials and other developing experience in the UK and elsewhere.
- **Regulatory** – near and longer term regulatory factors that impact upon development of an active electricity demand-side for Great Britain – including current agreements between market actors, statutory codes, incentives in price controls, settlement, and third-party requirements. This will include experiences within the LCNF trials, and also feed into future considerations for price controls including RIIO-ED1 and other thinking on innovation incentives.
- **Public Policy Issues** – likely economic value and potential contribution of the demand side to: cost-efficiency across the electricity sector; security of supply; carbon-emission reductions. Business models, approaches and incentives for integrating the demand side into the electricity market, including its interactions with Electricity Market Reform, smart meter roll-out and energy efficiency schemes such as the CRC Energy Efficiency Mechanism, Green Deal and Energy Company Obligation.

The project also draws upon relevant information from demand side developments in other countries (notably the EU, US and Australia) to inform its work.

Papers published by the project to date are:

Paper 1 - GB Electricity Demand in 2010 - baseline data and context. Published October 2011.

Paper 2 - GB Electricity Demand 2010 and 2025 – Initial Brattle Electricity Demand-Side Model: Scope for demand reduction and flexible response
Published February 2012.

Paper 3 -What demand-side services could GB customers offer in 2010?
Industry paper - published September 2012.
Household paper - published May 2012.

Paper 4 -What demand-side services can provide value to the electricity sector?
Published June 2012.

Paper 5 -The electricity demand-side and wider policy developments
Published November 2012.

Paper 6 –What demand-side services does distributed generation bring to the electricity system?
Published January 2013

Paper 7 – Evolution of commercial arrangements for more active customer & consumer involvement in the electricity demand-side.
Published April 2013

All papers are available from our website:
http://www.sustainabilityfirst.org.uk/gbelec_documents.html

Our subsequent paper in Year 2 will be:

Paper 8 – Electricity demand and consumer issues.

Future topics for Year 3 papers are likely to include:

- Longer-Term Demand-Side Innovation and Realisation
- Active I&C Customers
- Active Household and Micro-business Customers

Sustainability First
April 2013

Paper 7

Evolution of commercial arrangements for more active customer and consumer involvement in the electricity demand-side

Contents

Part I – Overview : Some Initial Headlines & Conclusions

Summary

1. This paper argues that for long-term development of a cost-efficient electricity demand-side, it is important to be able to reflect some form of ToU or other signal of 'value' to both end-users – and also, if feasible, with respect to micro-generators. This signal needs to bear at least some relation (however this may be done) to underlying costs on the supply-side.

2. We have used four case-studies to test this proposition and to explore how far it is presently practical, feasible or desirable, under present commercial arrangements to incorporate some element of ToU or other time-related pricing.

3. We conclude that :

   - **ToU incentives are already available to : half-hourly settled / larger customers : and to larger distributed generators (via PPAs).** Many associated commercial obstacles are already under consideration and being addressed by Ofgem, DECC and market actors. **For half-hourly customers - it is feasible today to offer sophisticated / complex time-related tariffs to customers (ToU, CPP, seasonal, Balancing services etc).**

   - **Some large non half-hourly business customers** - can participate today in balancing and / or peak-avoidance services through bilateral agreements, but need suitable meters.

   - **For household customers it is already feasible and practical to offer a basic static ToU retail tariff** – subject to a suitable meter, suitable billing IT and - most important from a supplier view-point - for some modest settlement adjustments within Load Profile 1. For the long-term, with smart meters and with potential half-hourly settlement, many of the practical obstacles to offering ToU tariffs to households – including more complex tariffs such as CPP / household TRIAD – could expect to resolve, say in or around 2020.

     <u>NOTE</u> - customer willingness on household ToU tariffs - and related consumer issues - are a very important and separate matter – which we will address in Paper 8 in May 2013.

   - **ToU household tariffs are not just important for electricity load-shifting to other times of day – but will increasingly be important for incentivising cost-efficient :**

     - **Peak-period demand *reduction***

     - **Matching day-time PV output (or other micro-gen) with willing customers who are able to use it at the time of day it is produced.**

- **Storage**.

- **For small PV generators incentivised by the FIT** (and for some other small generators) – we have found that it may not prove practical or economically beneficial to attempt to introduce time-varying payments via the FIT. We have explored some ‘straw-man’ approaches to possibly adapting the FIT and / or to developing ToU retail-tariffs, with the aim of improving the price signal to PV-generators in such a way as to help improve cost-efficient operation in the electricity system overall.

Background to case-studies

4. The cost-curve of today’s GB electricity-system very largely mirrors the electricity load-curve – i.e. in broad terms, higher costs coincide with periods of peak-demand – and lower costs match periods of lower-demand.

5. On the supply-side, wholesale costs and prices already include some element of cost-reflection (including via some network charges), and so are broadly able to reflect supply-side ‘scarcity’ and / or network bottlenecks at peak periods among and between different market actors.

6. On the demand-side however, most customer-facing incentives are almost universally *flat* / *averaged* - so, most retail tariffs, the FIT and RHI – do not provide an equivalent ‘scarcity’ signal to end-customers and consumers (e.g. to reduce demand at peak times or to increase demand at off-peak times) – or indeed to owners of micro-generation.

7. Our initial and basic argument in this paper therefore is that :

   - Scope to reflect some form of ToU or other time-related signal to end-users is desirable in achieving an electricity demand-side which is *cost-efficient to at least some extent* – and to help encourage a ‘rational’ economic response (however this may be achieved).

   and that therefore

   - A main *commercial* obstacle to development of a more active *cost-efficient* GB demand-side *is lack of scope to offer time-related signals – both to end-users and, in principle at least, with respect to some micro-generators.*

8. A *locational* signal or incentive is also important for both supply- and demand-side cost-efficiency in the electricity system – *but we do not consider this here*. End-users do not enjoy that degree of ‘choice’ in respect of their location. Micro-generators or storage *could* be incentivised by some kind of locational signal –

and, to a limited extent some larger distributed generators already are, through the structure of Generator network charges.

9. **Annex 1 to this paper discusses the importance of a ToU and time-related signal in promoting cost-efficiency in the electricity system in more detail. It also explores what might be the likely 'commercial pull' in the future for market actors to offer voluntary static ToU tariffs and / or other time-related retail tariff approaches to their customers in the future.**

10. This paper has used four demand-side 'case-studies' to examine **some practical and commercial obstacles to achieving time-related signals - on a working assumption, as noted above that these seem to be a necessary step to creating a cost-efficient electricity demand-side.** In so doing, the case studies also examine associated commercial arrangements**.** The case studies are :

    (1) **Distribution network –** half-hourly settled load contracted to provide *location-specific* demand-response.

    (2) **Balancing system -** half-hourly settled load contracted to provide demand turn-down.

    (3) **Static household ToU tariff** – households incentivised to both shift *and* reduce load at evening peak.

    (4) **Small-scale PV and Demand-Side Interaction :** small-scale PV generating when the sun-shines with a FIT incentive for own-use and / or exporting 'spilling'.

11. This paper does not look at storage or at the RHI incentive – but the general in principle of a likely need for a ToU / time-related signal to end-users for the cost-efficient development both of storage and for use of heat-pumps seem equally relevant.

12. Thanks to those who have helped in providing case-study material. Responsibility for all errors and the broad findings of this paper sit with Sustainability First.

Some initial headline findings from case studies

13. Our headline findings from the case-studies are as follows.

14. **Half-hourly Settled Load :** No major barriers for suppliers in offering a time-varying tariff to their half-hourly customers – (or, for other market actors to reflect the commercial value available to a customer for providing non-time varying demand-side services (e.g. for Balancing or network fault insurance)).

15. There are of course very many technical, logistical and transaction-related challenges associated with delivering demand services from half-hourly load – but most of these seem solvable.

16. From a retailer / supplier perspective, one possible commercial question to address seems to relate to a possible risk to a supplier of potential energy imbalance - against their wholesale contractual position, (as notified at gate-closure). Our limited understanding is that in respect of half-hourly load this is *not* a problem - either in case-study 1 (Network DSR) or in case-study 2 (Balancing).

17. However, for large business customers (LP 5-8) who may provide 'down-turn' services – *but who are not yet half hourly metered / settled -– and whose supplier is not aware / notified* - then that supplier could perhaps face unexpected imbalance energy costs in case study 1 (Distribution Network DSR). This does not seem to be a material risk for case study 2 (Balancing Services).

18. **Non Half-Hourly Settled Household / Small Customer Load :** Three main current obstacles to offering a ToU signal to an end-user :

    - **Meter** - needs a meter with 2 or more registers, plus capability to be switched.
    - **Supplier Billing IT** - needs capability to bill customer from 2 or more registers
    - **Settlement** - needs modest adjustment within Load Profile 1 (to adjust supplier 'volume allocation' for settlement of that individual customer's units against LP 1).

19. **Smart meters and associated adaptations to supplier Billing IT** - will resolve the first two by 2019 if not before – **and eventual half-hourly settlement** after, say, 2020, should resolve the rest. This latter will potentially open the door to new small-user / household tariffs which can be more dynamic such as CPP / TRIAD-related.

20. **Smaller PV with FIT Incentive** - PV output offers a relatively weak correlation with times of either generally high / low customer load. The FIT is designed first and foremost to incentivise 'own-use' – regardless of time-of-day. We conclude that own-use is likely to be the most cost-efficient use for that PV electricity for the foreseeable future, because it can :

- Displace centrally produced energy
- Reduce losses ; and
- Avoid unintended knock-on costs of un-metered spill (networks, imbalance energy).

21. **We also conclude that much PV output may not lend itself to time-related despatch** for two key reasons:

- *physical characteristics* – e.g. PV generates as & when weather is 'right' (perhaps some limited correlation on cold winter anti-cyclonic days – but very poor correlation in summer when day-time demand is low unless and until there is a significant GB summer cooling load).

    in combination with

- Flat-structure of small-generator FIT generation and export payments – a 'must-run' incentive designed to incentivise micro-gen to run whenever it can – to support investor pay-backs and reduce CO2 emissions.

22. **From 2019** - All smart meters will have an **export register**. We have therefore explored how in the long-run, possibly evolving the FIT incentive to encourage greater on-site PV use, could perhaps better support the efficient use of small-scale PV.

23. We have also tentatively explored a number of 'strawman' approaches **to introducing some form of time-related element for the future into PV FIT arrangements** in order to potentially create (1) a better match between PV output and local demand – and, as national PV output grows (2) develop possible incentives for somewhat more cost-efficient operation of PV in the electricity system for networks, suppliers, and, by 'knock-on', for the system operator too. These four possibilities are by no means definitive.

24. The options considered include : a **FIT with some form of ToU element** (eg perhaps in the export element of the tariff) ; **A FIT requirement for on-site storage** (be that thermal storage (heat, hot-water) or battery) ; **A single 'within-premises' PV balancing tariff** – which would require a far more 'joined-up' customer approach than seems possible today[2] between (1) the administration arrangements for FIT payments (i.e. via FIT Licensee arrangements) – and (2) the consumer's *wholly separate* arrangements with their electricity retailer for their electricity supply ; **Some form of community / very local, perhaps post-code, ToU retail tariff – i.e some form of PV-Twinning Tariff** - designed to encourage very local uptake of PV metered and unmetered spill electricity (and so to minimise possible 'disturbance' impacts / costs of spill in the electricity system). These issues are complex, and we do not have all the answers.

[2] Including by data protection rules

25. **Demand reduction –** *cost efficient* demand reduction could equally-well be incentivised by introduction of a household ToU tariff (see above). From a supplier view-point, it seems commercially important for demand-reduction *to be incentivised at peak times* – rather than *outside* peak-hours. Otherwise, suppliers may face a short-fall in their *total* cost-recovery from retail customers – in particular in respect of *their continued peak-related costs*. This in turn could place suppliers and their customers in an undesirable spiral of a supplier needing to increase their basic flat-rate retail tariffs - in order to ensure recovery of their *total* costs (fixed and variable). By contrast, with ToU incentivised demand-reduction, customers should be incentivised to reduce load *at peak* so : customers would obtain a higher p/kWh benefit ; and, suppliers should not face a potential cost-recovery problem.

26. **Storage –** Needs to be incentivised by a ToU customer retail-tariff. With flat-FIT payments and with flat retail-tariffs, cost-efficient storage (say, thermal hot-water, EVs) needs a direct *customer* incentive – *on the retail side*.

27. For a selection of electricity demand-side actions / technologies, Table 1 below indicates the potential economic benefit to the overall electricity system, which, *in principle at least*, some kind of ToU signal could bring. We also note the key commercial enabler / obstacle – and possible solution - to introduction of a ToU signal for each demand-side action / technology listed.

Table 1 : Electricity demand-side actions and technologies : 'in-principle' economic benefit to the electricity system of a time-related signal ; key enablers ; potential obstacles ; and, next steps.

Demand-side action / technology	How a time-related signal could incentivise a more cost-efficient response in the electricity system	Key commercial enabler / obstacle to introducing some form of time-related signal ?	Solutions / Next Steps ?
Electricity demand reduction	**Demand reduction at peak** : is likely to produce greatest cost-savings : both for the electricity system overall - & for individual customers.	**Enabler:** **Non HHly :** Availability of retail ToU tariffs **HHly –** Retail ToU tariffs already available	**From 2014** : smart meters, updated billing IT, & SSC-TPR settlement adjustments. **Post-2020** : half-hourly settlement.
Electricity load-shifting (system-wide)	**Peak-avoidance** i.e. shifting 'discretionary' loads from peak periods to lower-priced periods instead : both existing load ; & new load (so, EVs, Electric Heat (with thermal storage)) . **HHly Customers** – already doing ~1GW of TRIAD response.	**Enabler:** **Non HHly :** Availability of retail ToU tariffs (and / or load management tariffs). **HHly –** ToU tariffs already available	**From 2014** : smart meters, updated billing IT, & SSC-TPR settlement adjustments. **Post-2020** : half-hourly settlement
Location specific load-shifting / turn-down / DG (i.e in a network**)**	**Location-specific requirement : may not be peak- / time-of-day related** (but could be).	**Enabler** **HHly & Non Hhly** Bilateral agreement for available load with right characteristics; sufficient value on-offer to warrant 'inconvenience'; suitable metering & remote switching.	**Current industry discussions & trials** Improvements in cross-industry notification / coordination
Balancing Services – Load Turn-Down	**Balancing is not directly time-related. Instead, an *ad-hoc requirement*** to 'turn-down' load (e.g. frequency, fast reserve, STOR). (But, STOR windows tend to be *around peak times* for ramp-up & down). Payments are for	**Enabler** **HHly & Non Hhly** Load with right characteristics	**From 2015** Clarify interaction with proposed capacity market

Demand-side action / technology	**How a time-related signal could incentivise a more cost-efficient response in the electricity system**	**Key commercial enabler / obstacle to introducing some form of time-related signal ?**	**Solutions / Next Steps ?**
	availability (£/MW/pa) plus for some reserve services a payment for *energy usage* (£/kWh). **No need for time-related payments.**	available ; sufficient value on-offer to warrant turn-down; suitable metering & remote switching.	/ auctions.
FIT incentivised micro-generation and small DG <30kW	Response to supply-side scarcity / excess - at different times of day in response to changes in load. So, to run at peak-times to meet high-loads – but to be deterred from 'must-run' at periods of low-load – which can create unintended costs for the electricity system associated with unmetered spill (networks, suppliers). **Key Question : Is there a place for time-related payments in the FIT ?** **Output of much FIT micro-gen :** may have relatively weak correlation with times of either high / low load (unless summer air-con). **The FIT is designed first & foremost to incentivise 'own-use' – and regardless of time-of-day.** Own-use is potentially the most cost-efficient use for that electricity, because it can : • Displace centrally produced energy • Reduce losses ; and • Avoid unintended knock-on costs of un-metered spill (networks, imbalance energy).	**Obstacles :** **Much FIT output may not lend itself to time-related despatch** for two key reasons: (1) *physical characteristics* – e.g. PV, wind, some bio-gas – generate as & when weather and / or other physical conditions are'right'. (albeit *some poss.* correlation between higher loads and : PV output & cold anti-cyclonic days ; windy winter days). ***combined with*** (2) Flat-structure of small-generator FIT generation and export payments – designed to incentivise micro-gen to run whenever it can.	**From 2019** - All smart meters will have an **export register**. Thereafter, FIT export payments could perhaps become based on 'actual' export, rather than 'deemed' export - and so improve on any present 'over-reward' for export. **Some micro-gen *may be* 'despatchable'** – so for the future *perhaps* worth exploring **whether able to respond to a ToU element in FIT payments (**for generation / export) (Unclear which types micro-gen may be well-suited to being despatched). **A new time-related FIT incentive may prove uneconomic and / or impractical for many types of micro-gen –** so, PV, wind, micro-gen, some bio-gas - due to poss adverse impacts on (i) investor pay-backs (ii) CO2 emissions **Time-related curtailments** (eg at low summer demands) - could prove costly in terms of constraint costs – but could perhaps offset un-intended costs of 'must-run' from unmetered spill - for distribution networks, suppliers et al. **Evolving the PV FIT to**

Demand-side action / technology	How a time-related signal could incentivise a more cost-efficient response in the electricity system	Key commercial enabler / obstacle to introducing some form of time-related signal ?	Solutions / Next Steps ?
			incentivise greater on-site use and / or adopting time-related retail tariffs – may be a poss helpful next-step in reducing costs of unmetered spill (so, reducing imbalance energy, network costs, losses etc).
Larger DG >30 kW **Peak Avoidance**	**Peak-avoidance** : Response to supply-side scarcity / excess - at different times of day in response to changes in load. So, to run at peak-times to meet high-loads – but deterred from 'must-run' at periods of low-load – which may create unintended costs for the electricity system associated with unmetered spill (networks, suppliers).	**Obstacle : Where receive FIT** – No time-varying incentive in FIT - Just as for micro-gen above. **Enabler :** export meter required – so already paid on basis of *actual* export - not *deemed*. **Enabler :** If FIT-funded, availability of export metering. Or possibly, **Power Purchase Agreements from supplier – may perhaps reflect time-varying value.** **Enabler –** Larger DG may be more likely to be Despatchable / reliable output (so, not PV, wind)	Large DG already plays active demand-side role for peak-avoidance (TRIADs) – **but future interaction with capacity market not clear (commercial, technical).** From SF Paper 6, commercial development of DG demand-side would benefit from: • **Better DG data-base** • **Survey of capability of stand-by diesel DG**
Larger DG **Balancing / Ancillary Services**	**Balancing is not directly time-related. Instead, an *ad-hoc requirement*** to run to help regulate the electricity system (e.g. frequency, fast reserve, STOR). (STOR windows tend to be *around peak times* for ramp-up & down). Payments are for *availability* (£/MW/pa) plus for some reserve services a payment for *energy usage* (£/kWh). **No need for directly time-related payments.**	**Enabler** Available DG with right characteristics *in right location* ; sufficient value for DG to warrant running / curtailing on-site use; suitable metering & remote switching.	Already able to play active demand-side role for Balancing – aggregators developing DG demand-side market further. As above, future **interaction with capacity market not clear (commercial, technical).** **Current discussion on mandating frequency relays** – needs to take account of costs to DG

Demand-side action / technology	**How a time-related signal could incentivise a more cost-efficient response in the electricity system**	**Key commercial enabler / obstacle to introducing some form of time-related signal ?**	**Solutions / Next Steps ?**
			and commercial rewards available.
Storage	Potential to respond to supply-side scarcity / excess - at different times of day.	Without a ToU signal to retail customers, **what are the incentives to store** excess electricity from micro-gen in periods of excess supply – and discharge at peak- high-cost times?	**Eventually to link FIT eligibility for non-despatchable micro-gen to on-site storage ?** – eg hot-water, heat, battery (incl EV) etc **Development of general retail tariffs to encourage use for lower-cost storage – eg hot-water :** Eg ToU static tariffs, dynamic tariffs - to encourage load to 'twin' w wind / PV output.
Heat pumps	Shifting load to charge in lower-priced periods (assumes some thermal storage for comfort).	RHI 'flat' payment structure	Not considered in this paper – but should be more straight-forward to incorporate a time-related element, than for FIT ?

28. Tables 2 and 3 below set out a likely time-line for implementation of key ‘enablers’ and measures noted in Table 1 above (smart meters, half-hourly settlement etc) necessary for the adoption of time-related price-signals at scale, including any major gaps / obstacles.

29. The largest I&C electricity customers (117,000 customers of a total of ~29 million) are already half-hourly metered and half-hourly settled. Depending on their supply agreement with their electricity supplier, this group of customers already have access to a variety of time-related pricing – and so are not included in the Tables.

Table 2 : Timeline for implementation of measures enabling commercial time-related tariffs (Load Profiles 5-8)[3].

Policy measure	Role in enabling time-related tariffs	Timeline
Smart Meter Rollout	Advanced metering systems will record half-hourly consumption data. This is a key input to enabling both static ToU and dynamic time-related retail tariffs (eg critical peak pricing) to be offered at scale.	**Load Profile Classes 5-8** (**industry** customers) must be supplied through advanced metering systems from 2014.
DCC Setup	DCC will manage data flows from smart meters. Suppliers and other third-parties will be permitted access to half-hourly meter data **subject to explicit customer consent** **Half-hourly data opens the way for suppliers to bill individual customers accurately** for the different volumes (kWh) of electricity they *actually* use against a time-varying rate / price.	DCC licence to be awarded in 2013 DCC will ‘go-live’ in 2014. DCC will handle new smart meter registrations 2-3 years after ‘go-live’.
HH Settlement	Half hourly settlement takes half-hourly meter-data to produce an accurate half-hourly ‘back-office’ match / reconciliation of the industry’s cost allocations in each half-hour - with an individual customer’s half-hourly kWh usage. This accurate half-hourly match of the	**Load Profile 5 – 8 :** Not currently known – decision on whether to mandate HH settlement is pending. ELEXON have proposed making full HH settlement for profile classes 5-8 mandatory from April 2014. The Balancing and Settlement Code (BSC) Panel has rejected this modification. The proposed modification (272) is currently pending Ofgem’s decision.

[3] Load Profile 5-8 customers are the group of around 160,000 larger electricity commercial customers Some but not all of this customer-group may already have half-hourly meters, and may already have access to some limited form of time-related pricing.

Policy measure	Role in enabling time-related tariffs	Timeline
	industry's underlying costs against the time-related use of an individual customer (so, kWh in each half-hour) - opens the way for suppliers to offer time-varying tariffs, including ToU and dynamic tariffs at scale.	

Table 3 : Timeline for implementation of measures to enable smaller commercial and household time-related tariffs (Load Profiles 1-4)[4]

Policy measure	Role in enabling time-related tariffs	Timeline
Smart Meter Rollout	Smart meters will record half-hourly consumption data. This data is a key input to enabling both static ToU and dynamic time-related retail tariffs (eg critical peak pricing) to be offered at scale.	**Loads Profile 1-4 :** Smaller commercial and domestic smart meter rollout to commence 2014, to be completed by 2019. SMETS 1 compliant meters will be rolled out from 2014, SMETS 2 compliant meters from 2015.
DCC Setup	DCC will manage data flows from Smart Meters. Suppliers and other third-parties will be permitted access to half-hourly meter data **subject to explicit customer consent** **Half-hourly data opens the way for suppliers to bill individual customers accurately** for the different volumes (kWh) of electricity they *actually* use against a time-varying rate / price.	DCC licence will be awarded in 2013 DCC will go live in 2014. DCC will handle new smart meter registrations 2-3 years after 'go-live'.
HH Settlement	Half hourly settlement takes half-hourly meter-data to produce an accurate half-hourly 'back-office' match / reconciliation of the industry's cost allocations in each half-hour - with an individual customer's half-hourly usage. This accurate half-hourly match of the industry's underlying costs against the time-related use of an individual customer (so, kWh in each half-hour) - opens the way for suppliers to offer time-varying	Considerable cost and complexity in moving to half-hourly settlement at scale for 29 million customers. Currently not clear whether HH settlement for Load Profile 1-4 customers will be adopted – and if so in what time-scale. Ofgem plan to produce a consultation in late 2013 and a next-steps document in early 2014[5].

[4] ~27 million household customers (~22 m Load Profile 1. ~5 million Load Profile 2 (2-rate Econ 7 meters) – plus ~2 million Load Profile 3 & 4 customers - likely to be smaller 'commercial' customers.
[5] Ofgem letter from Partner for Retail Markets and Research. 26 March 2013.

Policy measure	Role in enabling time-related tariffs	Timeline
	tariffs, including ToU and dynamic tariffs at scale.	
Export registers SMETS 2 design will have a single export register	May permit small micro-generators (eg domestic PV) to record total export accurately – (rather than 'deemed' as now). May be enable **estimation** of export on a half-hourly basis – but will not meter half-hourly export accurately.	Domestic smart meters rolled out from 2014-2019 will have a single export register.

Some tentative conclusions

30. In principle at least, development of ToU tariffs for large and small retail customers alike will help to support development of a cost-efficient demand-side.

31. For households, some progress could be made *now* in making static basic ToU tariffs more available (eg for evening peak-avoidance) – so from now onwards, as smart meters roll out. New smart meters are necessary[6], but it is not necessary to await full half-hourly settlement. Some customers who are able to respond to a ToU signal, stand to benefit[7].

32. **Supplier issues** – For suppliers, ahead of half-hourly settlement, the case-studies seem to throw up two particular questions of a commercial nature. These each relate to a supplier's imperfect knowledge of the time-varying consumption of some of their individual Load Profile 1-8 customers :

- **A need for improved industry notifications / channels of communication**: to avoid unexpected charges for a supplier in creating potential imbalance risk - should a Distribution network or other third party contract for demand-response from a customer, *without their supplier's knowledge*.

- **A seeming growing risk of energy imbalance due to PV – especially once PV is at scale** - either (1) relating to a PV owner's *own* consumption (arguably

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'Way forward on longer-term settlement reform'

[6] Or, at the very least, a two-rate off-peak / Economy 7 meter.

[7] Economy 7 tariffs enjoy only a relatively limited popularity because a customer needs a large **overnight load** (probably storage heaters) plus a limited day-time load to benefit.

predictable, so a supplier could make a Load Profile 1 settlement adjustment) – or (2) from PV unmetered 'spill' – the knock-on costs of which are presently not directly accounted for in industry cost-allocations and so absorbed (socialised) across the general non half-hourly customer base.

33. From around 2020 onwards, half-hourly meters and the potential for half-hourly settlement may at least provide the basic tools by which to address some of these information and cost-allocation problems.

34. However, even with smart meters and half-hourly settlement, and as explored in Annex 1 of this paper, the commercial 'pull' in the market for suppliers to offer voluntary static ToU tariffs at scale, other than for reasons of market differentiation, may be somewhat limited due to a combination of complex and inter-acting factors.

35. **Distribution charging** - some complex issues in respect of current approaches to network charges and cost-allocations were also thrown up by the PV case-study – both on the generator and supplier (customer-side) which we could not examine in detail. These related to the complex physical interactions of small low-carbon generators such as PV ; extent of customer on-site use ; plus, potential metered export / unmetered spill – and how far these activities are presently able to be recognised commercially and / or incentivised efficiently in distribution charges at different times-of-day and / or at different locations.

36. The distribution charging issues cut across the generation side (connection, use of system and losses) — and the supply-side (i.e because the costs of network re-inforcement associated with micro-generation are presently met via the general body of customers ; the lack of incentives to micro-generators to either reduce or increase output at particular times of day depending upon local demand or network conditions etc). Such interactions are very complex – and the question of how distribution incentives and charges for a cost-efficient demand-side may one day fit together in an overall, coherent picture will need to be addressed. Work Stream 6 of the DECC / Ofgem Smart Grid Forum is starting to work systematically through some of these cost-efficiency issues.

37. **Tariffs** - Once there are both smart meters and half-hourly settlement, we are likely to see development of more complex / sophisticated retail tariffs (i.e. more dynamic tariffs such as CPP, household TRIAD, wind-twinning) for small and household customers, but these do not seem likely at scale much before 2020. And, in any case, likely value to market actors from such tariffs before this, is also not clear.

38. This paper shows how suppliers could perhaps offer household customers with smart meters basic / static ToU tariffs today. These tariffs could be designed, for example, to avoid evening peak – or, perhaps, to encourage greater PV use in the day-time.

39. Such basic static ToU tariffs are feasible today without a major change to present settlement arrangements. ELEXON and some suppliers seem open to developing basic ToU tariffs in this way as an interim step. Other than an important wish to differentiate themselves in the market, the commercial value and ‘pull’ for suppliers to offer voluntary static ToU tariffs at scale is however not altogether apparent. Annex 1 to this paper discusses this topic in more detail.

40. Market actors also told us that they are understandably reluctant to see piecemeal settlement initiatives (eg piecemeal development of additional new Load Profiles) as these risk detracting from the very considerable effort and resource presently already being devoted to smart meter implementation, new billing and other back-office systems – and – importantly, development of eventual half-hourly settlement.

41. In the medium term, in principle at least, ToU and time-related retail tariffs should offer an increasingly important tool in promoting customer-led cost-efficiency in the electricity system.

42. This ‘in principle’ incentive role for ToU retail tariffs extends well beyond simple peak-shifting. ToU tariffs can promote a cost-efficient ‘match’ between retail customers and the output of small-scale generators, and micro-generators in particular. Similarly, time-related tariffs are needed for promotion of cost-efficient demand reduction - and – for the future for cost-efficient operation of EVs & HPs and to promote a variety of customer responses with respect to storage.

43. Notwithstanding the seemingly somewhat limited value and commercial ‘pull’ for suppliers today, it nonetheless seems to make some sense to try out basic static ToU tariffs now - in a modest ‘toe-in-the water’ way - under the present Load Profile 1 settlement arrangements, so that impacts on a variety of customers can be better understood. It will also mean that some lessons can be learned now, so that we are well- prepared by the time universal smart meters and the settlement system allow far more sophisticated or complex tariffs from 2020 onwards.

44. The potential role of ToU and time-related tariffs in helping to support market-wide cost-efficiency will evolve in the 2020s. In developing this paper, it also seemed that for the longer term suppliers may incline more towards tariff and incentive approaches which can perhaps offer an element of demand-side predictability and certainty in the wholesale markets, and which voluntary static ToU tariffs may not offer to an equivalent degree. So, perhaps critical peak pricing (effectively a household TRIAD), and a variety of approaches to automated load-control. Greater ‘certainty of outcome’ could both could promote greater end-use cost-efficiency by way of improved wholesale market procurement, and, at the same time, help to narrow the potentially expensive ‘gap’ between what suppliers may predict / expect their customers to do – and what their customers may actually do in practice.

45. In Paper 8 (May 2013), we will look in detail at the many important consumer issues arising from ToU and other 'smart' tariffs – including consumer safeguards, and also, potential distributional impacts. We will also look at how far development of ToU and load-management tariffs may be inhibited in the near-term or not, by the requirements of the Retail Market Review to offer 'simpler, clearer, fairer' tariffs.

Part II – Case Studies

Part II of this paper discusses the following case-studies

(1) **Distribution network –** half-hourly settled load contracted to provide *location-specific* demand-response.

(2) **Balancing system -** half-hourly settled load contracted to provide demand turn-down.

(3) **Static household ToU tariff** – households incentivised to both shift *and* reduce load at evening peak.

<u>See Annex 2</u>[8] for the case-study of the EDF Energy EDRP household static ToU trial - on which this case study draws.

(4) **Smaller PV Units and Demand-Side Interaction -** PV units generating with a FIT incentive for own-use and / or ‘spilling’.

<u>See Annex 3</u>[9] for the full Illustrative PV Case Study (both > 30 kWe & <30kWe) – on which this summary is based.

[8] Published as a separate Sustainability First document. April 2013.

[9] Published as a separate Sustainbility First document. April 2013

Case Study 1: Distribution network – half-hourly settled load contracted to provide location-specific demand-response

<u>Context</u>

46. As part of the Low Carbon Network Fund, Northern Powergrid (then CE Electric), carried out a trial for the provision of demand-side response by industry or commercial customers, known as the ‘I&C flexibility trials’.

47. The **aim** of the trial was to test the ability of I&C customers to provide a post-fault demand-response service, by reducing their demand at a signal from the distribution network. If this post-fault demand response can be demonstrated in a firm manner, it has the potential to allow a distribution network to defer network reinforcements at particular points in the network, if they can contract with sufficient I&C capacity (to provide headroom on the network) instead of reinforcing the network.

48. Northern PowerGrid defined their product specification as follows:

    - **Season** was defined as November to February (2011-2012).
    - **Availability Window**: Monday – Friday, 15.00-19.00.
    - **Indicative number of calls**: max of 10 consecutive working days called once every three years.
    - **Response time**: within 15 minutes.
    - **Response duration**: 4 hrs/ day.

49. Regarding the indicative numbers of ‘demand-response’ calls – although the majority of faults would be resolved in fewer than 10 working days (indeed many are resolved within a day) – in extreme circumstances the DNO may require the flexibility to call on a reserve provider on several consecutive working days.

50. Northern PowerGrid contracted with an aggregator in order to approach I&C customers to take part in the trial, and to establish a commercial relationship with those selected to take part in the trial.

51. **Operationally**: during the trial, in order to call a demand turndown event Northern PowerGrid gave a signal to the aggregator, who in turn signalled to the I&C customers.

Commercial issues surrounding the I&C flexibility trial

52. Although different types of I&C customers participated in the I&C trial (including those with on-site generation), for the purposes of this case study, we will consider only the example of one half-hourly metered business customer who is providing reserve services **through demand-response** - not through an increase in own generation.

Commercial drivers for Northern PowerGrid in running the I&C flexibility trial:

- Avoided network reinforcement / investment;
- To test the reliability of potential demand response resource;
- To establish and test the commercial relationships with customers and with aggregators required to run this and similar schemes.

Commercial drivers to I&C customers to participate in the trial:

- To generate an additional revenue stream;
- To test the potential for participating in this type of service without compromising their own primary business activity;
- To explore the potential for participating in this type of service without risk of breach of their contract terms with their supplier.

Commercial issues for suppliers – settlement:

53. The I&C trial creates a bilateral commercial relationship between the customer and the DNO (or the customer and an aggregator contracted to the DNO). Therefore, the customer's supplier may not, in principle, be aware of this new arrangement. **However**, I&C supply contracts (for half-hourly customers) are very likely to require such customers to notify their suppliers of material changes to their load. If suppliers are advised of their customers entering into such an agreement, they can potentially adjust their short-term wholesale advance purchasing accordingly, and so avoid being out of balance and facing unexpected charges for energy imbalance.

54. However, since a DNO will not know in advance when a fault will occur, it may become more difficult for a supplier to forecast their wholesale purchases with accuracy. In this case, and in the case of any customer groups not required to notify their supplier of a change in material load (perhaps load profile 5-8 customers), suppliers could potentially find themselves out of balance, due to customers providing demand response at a signal from the DNO. This would only be likely to be a material problem where the DSR services were being contracted at scale.

55. In this case, one solution may be for an additional communication channel to be established between the DNO, the supplier and their customer, such that when the DNO issues a signal to I&C customers to reduce load, the supplier is notified of it. This way, in so far as possible, it will in time become factored into a supplier's Final Physical Notification (FPN) contractual position ahead of gate closure (supplier Final Physical Notification at one-hour gate closure).

Possible Solution

56. If necessary, to establish an additional communication channel between the DNO, the I&C customer (or aggregator) and the supplier, to notify suppliers of when the customer is called upon to reduce their demand, so that the suppliers can modify their short-term position in the wholesale market at Final Physical Notification ahead of gate closure.

57. We understand that supply contracts for large HH metered customers, particularly fixed-price contracts, commonly have 10% variation tolerance bands built in – so that if a customer's monthly electricity demand varies by more than 10% from what it was expected to be, the supplier may revisit the terms of the contract. This may potentially inhibit a customer from providing demand-response services to a distribution network or aggregator above a certain level - i.e. the customer could provide demand-response so long as they did not exceed the 10% variation threshold – but it may be difficult to balance the two requirements, which may make customers nervous of entering into bilateral agreements with DNOs and / or third parties such as aggregators.

Possible solution

58. The solution to the above may be for supply contracts to have more flexibility, such that customers are able to re-open / re-negotiate the terms of their off-take to allow them to take advantage of participation in a demand-side scheme without unreasonable penalty.

59. At the same time, suppliers could be protected from unexpected imbalance charges by ensuring they are notified of a customer's additional DSR activities – by establishing an additional communication channel as outlined above.

Case Study 2: A Balancing Service - e.g. an I&C demand turn-down customer.

Context

60. In order to balance the electricity system, National Grid routinely contracts for additional power from a variety of sources through its Balancing Services. One of the most well-known balancing services is Short Term Operating Reserve (STOR), through which National Grid procures the majority of its requirement for extra power. STOR can be provided by Balancing Mechanism and non-Balancing Mechanism units, and companies wishing to provide STOR (known as 'reserve providers') take part in a tender/auction process operated by National Grid.

61. In selecting non-Balancing Mechanism reserve providers for STOR, National Grid does not make a distinction between additional power provided by demand response or through increased generation.

62. In 2001 National Grid participated in the Ofgem Demand Side Working Group, and in the discussion about the lack of demand-side provision in balancing services, it was highlighted that demand side response was disadvantaged by the short notice periods required of reserve providers for balancing services including STOR. It was therefore decided to run a Demand Turndown Trial[10], specifically formulated to have longer response times[11].

63. The Demand Turndown Trial carried out two pilots to investigate the provision of contingency reserve: the first during critical periods in Summer 2004, the second during critical periods in Winter 2004/05.

64. The design of the scheme aimed to encourage the then novel concept of 'aggregators' providing a service by aggregating demand from disparate sites.

65. Financial incentives included:

- **availability payment** (£/MW/h) – payment during the service windows, dependent on whether declared availability was accurate to within 10% of the metered MW. The accuracy was assessed from the daily metered demand profiles submitted post event by the providers;

- **standby payment** (£ per day on Standby) – fixed fee bilaterally negotiated with National Grid paid when the service was selected to Standby;

[10] Report on the Demand Turndown Trials (March 2006), National Grid. Available from: http://www.nationalgrid.com/NR/rdonlyres/AC39024C-C5A2-42E9-BF5F-88DE7A86F733/16873/Demand_Turndown_TrialReport.pdf
[11] In the Summer trial the notice period was 2 hours for the designated Service Delivery Windows. For Stand-By, 8 hour-notice was given prior to Service Delivery Windows.

- **utilisation payment** (£/MWh) – payment based on bilaterally negotiated utilisation price for energy delivered, when service was utilised.

66. The Summer and Winter trials differed in some ways – after feedback from the Summer trial, the Winter trial was designed to offer a more flexible demand-side product for reserve providers.

Trial conclusions

67. The trials successfully demonstrated the concept of aggregators delivering reserve services.

68. However in both trials, service providers under-delivered compared to their declared availability – the actual volume of demand turndown delivered, compared to the declared availability, was in the range of 47-83%. Therefore, at the time, the trial provided somewhat limited confidence in service delivery[12].

69. An economic assessment was carried out, comparing the cost of the demand turndown services offered with the costs of other actions (BM synchronisation) to create reserve in contingency timescales[13]. Demand turndown was found to be the more expensive option compared to using Balancing Mechanism units, in practically all the relevant half hour periods[14].

70. Penalties for non-delivery: there was no provision within the Demand Turndown Trial for financial or other penalties for non-delivery of declared reserve.

[12] At the time of the trial, aggregators were a new concept. Since then (2004/2005), aggregator activity has increased significantly, and aggregators have established a track record in delivering demand response.
[13] Up to 4 hours ahead of real time.
[14] For the Summer trial, the economic assessment found that Demand Turndown was potentially cheaper than BM synchronisation on 7 occasions, but the reserve requirement in these situations was greater than 100MW – in which case BM action would still have been needed, and therefore the cost of BM action would not be avoided – and so Demand Turndown would still fail to be economically competitive.

Commercial issues surrounding the Demand Turndown Trial

71. For the purposes of this case study, we consider 'reserve providers' to be half-hourly or non-half-hourly metered customers who are providing reserve services through demand-response (not by increasing their own generation).

Commercial drivers for System Operator in offering Demand Turndown Trial:

- To procure a reliable service;
- An equivalent or lower price than if the system operator obtained that service from the Balancing Mechanism – so from B-M providers – so at or lower than the B-M price paid by the system operator in a given half-hour to procure that service – so ensuring value-for-money overall;
- Using a fair and transparent procurement mechanism - plus technically straightforward for system operator to run.

Commercial drivers for industry customer in participating in Demand Turndown trial:

- To generate an additional revenue stream - without compromising their primary business activity;
- To test the potential for participating in this type of service without risking breach of their contract terms with their supplier
- *Potentially* without compromising their technical or commercial ability to provide other demand-side response services e.g. frequency response – or fault insurance and / or peak avoidance to the distribution networks.

Commercial issues for suppliers – **settlement**:

72. At present, suppliers may be unaware if their customers are engaged in a Balancing Demand Turndown Trial. Therefore they will have taken a wholesale purchasing position some months ahead, and may then find this does not match the actual demand of their customers, if these customers have been called upon to provide demand response.

73. **Half-hourly settled customers** - We understand that large half-hourly customers are likely to have terms in their supply contracts requiring them to notify their supplier of any material change in their load. In the case of a half-hourly customer contracting to provide the system operator with a Demand Turndown service, the supplier may be able to modify their wholesale position accordingly (although not 100% accurately, as they could only be notified of the service/call windows, and not whether an individual

customer will be called upon on a specific day). These windows will tend to be around peak periods of the day (so, ramp-up, ramp-down) – rather than peak – and vary in timing as peak-periods move with the seasons. There is a significant weekend requirement. The requirement is also locational.

74. Additionally, we understand that half-hourly customer supply contracts commonly have a 10% demand variance tolerance built-in – so that if a customer's demand varies more than 10% from the expected demand (based on previous year's HH data), the supplier may revisit the terms of the contract. This could understandably lead to customers being nervous of engaging in bilateral agreements with National Grid or aggregators to provide demand turndown / demand-side response, if the provision of this demand turndown means they are likely to put at risk the terms of their supply contract.

Possible solution

75. In order to encourage freer participation of customers in the provision of balancing services, customer contracts with suppliers would need to become more flexible, so that customers do not risk the terms of their contract by participating in balancing services. Suppliers in turn would need protecting from potential unexpected imbalance charges – therefore we suggest an additional communication channel to ensure that suppliers are made aware of customers' engagement with balancing services, and can therefore modify their demand profiling & purchasing accordingly.

76. **Non Half-hourly customers (Load Profiles 5-8).** We understand that the requirement to notify suppliers of material changes in load may not be a common feature of the standard supply contract conditions for non-half hourly I&C customer (Load profiles 5-8). Also, for these customers, the supplier will forward purchase electricity on the basis of the appropriate load profile. If the customer then engages in e.g. Demand Turndown and changes their expected demand, in the absence of HH metering, the supplier might not be aware of this. However, in practice, the volume allocation process in settlement for the LP 5-8 customer group means that the costs of any unexpected imbalance to a supplier may be relatively modest, being largely socialised across that customer group (and, because, they would be over- not under-contracted).

Possible solution

77. We propose that if an additional channel of communication is created allowing suppliers to know when their HH metered customers are engaging in e.g. balancing services, this additional communication be extended to non-half hourly customers, so that the supplier can be notified of their engagement in balancing services / other DSR services as well.

78. In this way a supplier would be more able to change their wholesale purchase position prior to gate closure, and avoid unexpected imbalance charges due to an unanticipated drop in their customers' demand.

Case Study 3 - Household ToU Case Study

This case study draws from material in Annex 2 about the EDF EDRP ToU Trial (published as a separate Sustainability First document)

Practical and commercial issues for suppliers and their customers in developing a ToU tariff

Supplier view-point

79. In developing a static ToU tariff for non half-hourly metered customers, a supplier is likely to have a number of commercial and business aims. In general, the following characteristics are likely to be important :

- A realisable economic benefit for the business from more efficient wholesale energy purchases.
- Commercially realistic proposition.
- Potential for mass appeal / readily understood by the customer.
- In a competitive retail environment, capable of both *retaining* current customers - and *attracting* new ones.
- Better insight into customers' peak consumption, including their readiness – and flexibility – to reduce peak load.

80. In principle, at least, a supplier will look to a static household ToU tariff to have the following impacts on their underlying costs :

- **To reduce costs associated with *day-in day-out* energy purchases associated with peak-related energy**[15].
- **To reduce their share of industry upstream 'fixed-charges' – calculated from settlement data** - for system-operation, transmission and distribution.

81. In offering a new ToU retail tariff, a supplier will seek to promote a better physical match between their customers' time-varying electricity use – with their own

[15] **short-run variable costs** : wholesale energy purchases ; trading / hedging to reduce imbalance charges; **long-run fixed costs**: peak generation plant. (i.e not just on a handful of 'critical' peak days).

underlying costs - in particular with respect to avoided peak-related costs, (assuming these are the highest–cost element of their overall input-costs / cost-base).

82. The full case-study for the EDF Energy EDRP household static ToU trial (Annex 2) - and the ELEXON note (Annex 1 – section 2) - show in more detail how some relatively modest practical adjustments at the level of an individual customer - within the industry's current framework for payment reconciliation / settlement arrangements - can support development of static ToU tariffs today, ahead of eventual development of full half-hourly settlement[16].

83. In offering a voluntary static ToU retail tariff, suppliers will wish their customers to reduce demand at peak as expected. Otherwise, a supplier risks creating a poor match between their notified contractual positions for wholesale electricity at gate closure - and the basis on which they are finally settled for imbalance energy payments. In particular, a supplier would wish to avoid finding themselves *under-contracted* in the market.[17]

Customer view-point

84. In a competitive retail market, in opting for a simple static ToU tariff, small / household customers will look for reassurance on :

- **Lower bills** - from shifting or reducing, compared with their current flat-rate / two-tier tariff. So, no penalty for conduct of 'normal' life[18].
- **Potentially, no increase in bills for higher consumption overall** - provided that extra usage is outside of peak times i.e. at lower-cost times of day.
- **A supplier's readiness to share at least some of the cost-benefit created by their customer's avoided peak-use**.[19]

85. In turn, this means that customers need a very clear grasp of :

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[16] See Annex 1 – sections 2 & 3 for more detailed explanation.

[17] i.e. This is complex - see Annex 1 for more on the 'match' between the current half-hourly customer load profiles against which suppliers contract and settle for wholesale energy – and a supplier's imbalance energy payments. The potential for inadvertently making this 'match' worse with a voluntary ToU tariff – in particular the risk of being under-contracted in the wholesale market - is viewed by some as a potential risk in offering ToU tariffs today - and therefore presently perceived by some suppliers as a potential barrier to developing ToU tariffs more widely.

[18] In practice, the customer benefit will prove highly dependent on : current daily usage pattern (i.e already low at peak times) ; peak-time flexibility ; no unforeseen lifestyle change which prompts more use at peak (e.g at home more).

[19] EDF EDRP initial trial recruitment showed that their customers did not have a basic understanding of how avoiding peak-use could lower their *supplier's* underlying costs. This led to considerable customer scepticism that a supplier would wish to help the customer reduce their bill - or for them to use less energy.

- **How reducing peak-time electricity usage could help to reduce their end-bill :** The EDF Energy EDRP trial suggests that when initially contacted, customers did not have this basic understanding. Namely, they do not necessarily understand that (1) avoiding peak-time electricity use and / or (2) by being flexible as to what time-of-day they choose to do certain tasks **could help their supplier reduce some of its under-lying costs – especially certain peak-related costs.**

- **The tariff time-bands and related-prices - and therefore how their electricity-use *at particular times of day* could reduce their bill.** The customer needs a very clear understanding of what to do at what times of day – ***and especially what activities they ideally should avoid at certain times of day*** – to get the benefit of a lower bill.

- How the benefit to the supplier of avoided or reduced-peak use is shared with their customer **via the structure of the ToU tariff.**

86. **Terms & conditions** – customers need to be extremely clear on what basis they :

    - Sign-up to a particular tariff
    - Accept a smart meter
    - May opt out of either one or both.

Summary of commercial steps to be taken by a supplier in introducing a household ToU tariff.

87. The Table below offers an initial high-level view of the key commercial steps for a supplier in developing a static ToU tariff to offer to a customer today – and some barriers to over-come in possibly offering ToU tariffs, including in the future at scale. This draws on experience of the EDF Energy EDRP household static ToU trial (Annex 2) and the ELEXON note (Annex 1).

Supplier – basic commercial steps to introducing a small customer / household static ToU Tariff	**Basic requirement today for a supplier to offer a ToU tariff**	**Barrier today?**	**Key changes required for future implementation at scale**	**Timeline for every household customer**
Meter	Meter must have more than one register – and a capability to be switched at different times.	~22 million 'unrestricted' Load Profile 1 'dumb' meters have a *single* register and no 'switching' capability – so a new meter required (but 5-million Economy 7 meters do have two registers).	From 2014, SMETS2 meters will have multiple import registers and remote communications capability	By 2019
Billing IT **(Households / small customers)**	Current supplier billing software needs capability to bill a customer from up to three separate registers	Current billing software likely to limit any ToU tariff to a maximum of three rates / prices (but can recognise more time-bands).	New billing software in development for smart meter roll-out will incorporate capability to bill from more than three registers – so for tariffs with more complexity than just three rates.	From ~2015
Tariff Design I – **Static ToU Tariff**	Based on a maximum of three rates / prices (see Billing). Time-band choices - to reflect underlying costs.	A static ToU tariff which is broadly reflective of a supplier's underlying costs *today* - may not point to a very material price-difference between peak &	Possibly, a higher peak- / off-peak cost differential to enable material customer savings. This will depend on very many factors (future wholesale prices (fossil, wind), growth of peak-load, cash-out review, capacity market	From today onwards – provided customer wishes to opt for a ToU tariff. Significant value from avoided peak

Supplier – basic commercial steps to introducing a small customer / household static ToU Tariff	**Basic requirement today for a supplier to offer a ToU tariff**	**Barrier today?**	**Key changes required for future implementation at scale**	**Timeline for every household customer**
		off-peak periods.	developments etc etc).	load ? Say, from mid-2020's onwards ? (Imperial (Aug 2012) – suggest by 2030).
Tariff Design II – Dynamic Tariff **Critical Peak Pricing** (eg Household TRIAD), **Wind-twinning**		**CPP and dynamic tariffs** - cannot be readily delivered by just three meter registers – nor by basic SSC-TPR adjustments (see Settlement below).	**CPP** - likely to need half-hourly settlement. Very dynamic tariffs (eg 'real-time' and more frequent than half-hourly) may need settlement at far more frequent resolution than half-hourly.	
Settlement **(in particular arrangements for Volume Allocation to each Supplier)**	Adjustment to SSC-TPR[20] so that *each meter register* records usage by an individual customer in Load Profile 1 *at the separate rates for each pre-set time-period* (needed both for settlement (volume allocation) - & for supplier billing).	SSC-TPR adjustment is likely to suffice for the time-being as an interim step for ToU tariffs for Load Profile 1 customers – pending eventual full half-hourly settlement. (SSC-TPR is broadly adequate for implementing basic static ToU tariffs at scale).	Full half-hourly settlement will obviate the need for SSC-TPR adjustment. For very understandable cost & resource reasons, ELEXON and suppliers would not wish to see piece-meal arrangements to develop some new interim Load Profiles – and which might detract from eventual half-hourly settlement .	Likely to be from 2020

[20] Standard Settlement Configuration-Time Pattern Recognition

Supplier – basic commercial steps to introducing a small customer / household static ToU Tariff	**Basic requirement today for a supplier to offer a ToU tariff**	**Barrier today?**	**Key changes required for future implementation at scale**	**Timeline for every household customer**
Meter Registration	Changes need to be notified / inputted to the meter registration process. This is maintained by distribution companies (new meter ID, separate registers, time-bands).	No – other than time taken for registration changes - and accuracy of input of data about the meter registers. (data accuracy possibly a challenge if at scale).	DCC will handle new smart meter registrations in the future (~2-3 years after 'go-live').	?from 2016?
Customer	Bespoke T&Cs for every customer for: • ToU tariff • Smart meter	Two key customer elements for ToU tariff success : • Customer understanding of tariff - & readiness to respond *plus* • Whether enough flexibility in their peak-use to ensure a bill which reduces (or at least is not relatively more).	Consideration of opt-in / opt-out approaches for ToU tariffs. What steps / re-assurances will be needed from suppliers – to satisfy present regulatory concerns on tariff complexity - in order to offer ToU tariffs at scale in the future – i.e beyond the present tariff simplification requirements of the Retail Market Review (RMR) ?	Post RMR time-scales for offering ToU tariffs at scale ? **(Future smart tariff development - and interaction with RMR will be considered in SF's forthcoming Paper 8 on Consumer Issues).**

Illustrative Case Study 4 :

Smaller PV Units & Demand-Side Interactions

Annex 3 is a full version of this PV case study
(published as a separate document).

(Small (below 30kW) & Large (over 30kW)).

Summary

88. The PV case-study explores in a very initial way some of the key physical and commercial interactions of photovoltaic (PV) units on the electricity system. The issues raised in relation to the export of PV electricity and its impact on the demand-side and the wider electricity system are complex and as yet not well-understood.

89. In high-level terms, the majority of PV output offers :

- A source of low-carbon renewable electricity typically at the site of demand.

- A characteristic day-time profile correlating generally with sunshine hours, tending to peak towards the middle of the day[21]. Output can fluctuate, depending on cloud cover, time of year, latitude etc.

90. From a demand-side perspective, given the UK's 'darkness-peak' characteristics of both system load generally and household load in particular [22], two key questions follow for the PV case-study and for Paper 7 :

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[21] For discussion of PV output generation profiles, see : . *Initial Load and Generation Profiles from CLNR Monitoring Trials December 2012 SDRC Report*, Durham University Energy Institute. Customer Led Network Revolution website

[22] See Sustainability First. Paper 2. GB Electricity Demand – 2010 and 2025. Initial Brattle Electricity Demand-Side Model. Scope for Demand Reduction and Flexible Response.
The most significant system peaks are in the early evening from around 17.00h from November to February, as darkness falls, lighting load kicks-in, commercial load is still high and household load increases.
Load Profile 1 – Household Load: shows a pronounced evening peak with a lesser morning peak – and generally lower consumption levels in the middle periods of the day. The most extreme load-peaks are at the onset of darkness in winter. Commercial load by contrast has a morning rise – and a relatively flat consumption profile during the day – so could provide a good match with PV output. However, unlike much household load, and unlike most domestic PV units, larger commercial load may be connected to a different LV circuit , and so may not be a direct 'near-neighbour' in terms of direct spill-uptake.
Industrial load has a generally flat profile through the day and year.

- How does PV output currently interact with the electricity demand-side - in particular with respect to PV export / unmetered spill in the lowest voltage networks ?

- Could PV become better incentivised to achieve a better match with electricity consumption generally – and therefore make a more *cost-efficient* contribution in the electricity system overall ?

91. The detailed case-study focuses chiefly on domestic scale PV systems – so those without a negotiated power purchase agreement and / or an export meter. The case-study does not discuss the added complexity of incentives for on-site use of PV for tenanted property with PV units on the roof (tenants of social landlords, for example). This is clearly a significant matter – but not considered in our case-study.

92. The full text of our PV Case Study is published in Annex 3 as a separate Sustainability First paper. The case study explores in a preliminary way, whether for the longer term it may be feasible to achieve a better alignment than now between the physical electrical output of PV electricity - and approaches to incentivising its more cost-efficient use. If feasible and / or practicable, the aim would be to incentivise PV electricity to make a somewhat more cost-efficient contribution to the electricity system overall by achieving, where possible or feasible, a better match in PV output, and for unmetered spill in particular, with periods of high and low electricity demand.

93. The case-study explores the mechanics of the Feed-In Tariff for PV; the present state of knowledge from available data about installed PV units and PV generation out-put ; current poor insight into the split between PV on-site use and unmetered spill, including time-related spill. The paper discusses whether the single export registers in household smart meters will help to address some of these uncertainties in the future.

94. PV output in GB, as currently incentivised by the Feed-In Tariff (FIT), is presently :

- **Most cost-efficient where on-site consumption is maximised**[23].

- **Generally not responsive to the demand-driven needs (and associated costs) of the electricity system, due to its largely 'must-run' nature** [24].

- **Liable to result in at least some unmetered export / 'spill', unless all output is consumed 'on-site'.** This spill tends to flow to the 'nearest

[23] Because the cost-saving to the PV owner *from avoided import to the home* considerably exceeds the export component of the FIT tariff.
[24] 'Must-run' due to : a combination of : (1) sun-related (2) relatively long paybacks required on PV capital investment, and because (3) both the 'generation' and 'export' elements of the FIT tariff are paid at a standard flat-rate, irrespective of time-of-day.

neighbour' on the same electrical phase, (or, possibly, 'uphill', back to the nearest transformer).

95. As of today, PV makes a relatively modest contribution to total GB electrical output.

96. Should PV installations - and PV output - grow substantially in the coming decade, then some of the basic operational characteristics of PV may need closer examination in terms of :

  - **Incentivising as much on-site PV use as possible -** to the extent that this is the most cost-efficient use.

  - **Improving the match of local PV export and / or unmetered spill with local electricity consumption** (including options for storage).

  - **Encouraging more cost-efficient operation of PV in the wider electricity system, especially in relation to any additional costs which may be caused by PV connections and / or spill.** At present, any such additional costs to the distribution networks or suppliers are simply shared across all non half-hourly consumers on a 'socialised' basis (so, shared amongst Load Profile 1-8 customers). In effect, and unlike for larger distributed generators, there is not presently a mechanism which can (1) recognise any additional costs caused by a PV connection and unmetered spill or (2) allocate those additional costs back to the PV units which may cause them[25]. These costs may manifest themselves in different parts of the electricity system as follows :

    - **Distribution Networks** – the costs of network reinforcement necessary to accommodate PV, especially PV clusters (i.e. the costs associated with PV output / spill onto the local network due to voltage fluctuation, harmonics, transformer overload).

    - **Suppliers** –the unexpected / unaccounted-for costs of potential imbalance due to unmetered PV export / spill, should suppliers find themselves over-contracted in the wholesale electricity market, unless and until action is taken on adopting PV customer 'profiles'.

    - **System Operator** – in the future, if there are significant new volumes of PV output, the possible costs of constraining-off 'must-run' low-carbon plant at periods of extremely low demand (especially in summer).

97. The case-study discusses some of these longer-term uncertainties for market actors and considers some key questions which arise for the electricity demand-side. For the future, if PV output markedly increases, some of these issues will

[25] This picture may well eventually change should there be an eventual requirement for metering / and or data recording of *actual* PV exports.

become more material / pressing than today. Looking ahead, some key considerations are :

- **On-site consumption of PV electricity – is presently the most cost-efficient use of that power[26] - both for the PV household - and for the electricity system in general.**

- **There is a potential poor match between the characteristic daily shape of GB PV output -** against the highest and most costly periods of GB electricity demand.

- **The inefficiencies of unmetered spill** – and in particular the knock-on costs which may arise in different parts of the electricity system – and the current poor allocation of those costs back to where they originate.

- **The current administrative and commercial split of customer 'hats' for (1) receipt of PV FIT payments – and (2) being a retail-customer**. In effect, with a PV unit on the roof, it is perfectly feasible to be a single 'prosumer' in electrical terms – but it is not yet feasible to be 'joined-up' as a single 'prosumer' in *commercial* terms.

98. As installed PV volumes grow - the potential for such inefficiencies to add to costs in the future in the overall electricity system will also grow. The concluding section of the case-study therefore explores whether for the long-run it may be possible to sharpen the FIT incentive to encourage greater on-site consumption wherever cost-efficient, as a way of improving overall cost-efficiency - **both for the PV owner and for electricity system**.

99. Also, in line with the general proposition explored for the other case-studies in Paper 7, a key aim is to try to understand whether some form of time-related price signal – either reflected (1) to the PV-owner and / or (2) possibly to communities or households immediately adjacent to PV units with unmetered spill[27] – might eventually support somewhat more cost-efficient PV operation at the very local level on the lowest-voltage networks.

100. The case-study therefore also explores at a high level four possible 'strawman' approaches to introducing some form of time-related element for the future into FIT arrangements. These four possibilities are by no means definitive. They are :

- **A FIT with some form of ToU element (eg perhaps in the export element of the tariff).**

- **A FIT requirement for on-site storage** (be that thermal storage (heat, hot-water) or battery)

[26] Unless and / or until there is a very dramatic rise in wholesale and retail electricity prices
[27] And on the same electrical phase

- **A single 'within-premises' PV balancing tariff –** this would require a far more 'joined-up' customer approach than seems possible today[28] between (1) the administration arrangements for FIT payments (i.e. via FIT Licensee arrangements) – and (2) the consumer's wholly separate arrangements with their electricity retailer for their electricity supply.

- **Some form of community / very local, perhaps post-code, ToU retail tariff – i.e some form of PV-twinning tariff -** designed to encourage very local uptake of PV metered and unmetered spill electricity at an immediate neighbourhood level (and so to minimise possible 'disturbance' impacts / costs of spill in the electricity system).

101. These and other PV tariff approaches face many unknowns : due in part to the nascent nature of the PV market in GB – but also due to the limitations discussed elsewhere in Paper 7 regarding development at scale of ToU and time-related retail tariffs.

102. The thinking behind such possible incentive approaches is to create : (1) greater encouragement for on-site use (i.e. where this is the most cost-efficient use of that PV); and (2) a potential better match between PV output and local demand ; and thereby, as national PV output grows (3) encourage somewhat more cost-efficient operation of PV in the electricity system for networks and suppliers, and, by 'knock-on', for the system operator too. Such approaches are therefore worth further consideration.

103. Work Stream 6 of the DECC / Ofgem Smart Grid Forum is starting to consider these cost-efficiency issues from a distribution network perspective, which will be very helpful.

104. As PV output grows, others such as DECC, market actors and the relevant trade bodies, will also wish to consider how to incentivise an improving match of PV output with (1) on-site and (2) local electricity consumption, in order to improve general PV cost-efficiency in the electricity system overall.

[28] Including by data protection rules

Paper 7 : Annex 1

Annex 1 is in three sections, as follows

Section 1. **Importance of a time-related retail price signal in promoting cost-efficiency in the electricity system.**

Section 2. **Background Note : Settlement, Load Profile 1 Customers and ToU Tariffs**

Section 3. **ELEXON Note: Time of Use Tariffs: How can the currently non half hourly settlement processes facilitate an avoided 'Winter Evening Peak' type tariff.**

Paper 7 : Annex 1

Section 1 :

Importance of a time-related retail price signal in promoting cost-efficiency in the electricity system

How a time-related retail signal can promote cost-efficiency

1. In general, highest short- and long-run costs in the electricity system relate to the fixed and variable costs of peak provision – be these generation or network related.

2. It therefore seems reasonable to assume that significant cost-savings in the GB electricity system from the electricity demand-side are likely to be achieved, for the medium term at least, from reduced winter evening peak-usage.

3. Today, around 50-60% of the end-price of electricity relates to wholesale costs (fixed and variable costs of generation and supply), and around 20% to the networks (distribution and transmission) [29]. This suggests that there could be worthwhile wholesale cost-savings available to electricity suppliers from day-in day-out load-shifting or permanent load-reduction at winter evening peak.

4. On this basis, load-shifting or permanent electricity demand reduction *at peak-periods* ought to offer :

    - *The most cost-efficient* benefit for the electricity system overall – assuming that the electricity cost-curve (both short-run and long-run) largely matches the demand curve[30], [31].

    - The greatest carbon reductions [32].

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[29] Ofgem Factsheet. Household Energy Bills Explained. 16 January 2013.

[30] 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.

[31] 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.

[32] Assuming fossil plant at the margin. Gas presently more marginal than coal, so as of today, perhaps less CO_2 benefit – but post-2016 that should change with coal closures (due to LCP & IE Directives).

5. Looking beyond 2016 or so, the GB electricity-system is widely expected to face (1) greater constraints in generating 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 either load-shifting or permanent peak-period electricity demand reductions should similarly increase.

6. Therefore, looking ahead[33], load-shifting or 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.

7. Separately, load-shift or 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 load-shift and / or permanent demand reduction might also help to support avoided network investment. This is likely to have greatest value at particular locations[34], [35].

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.

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

[34] 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.

[35] 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).

Are the potential cost-savings available from time-related / ToU retail pricing 'worthwhile' for suppliers ?

8. Recent research suggests that there may be only modest cost-savings / value available to both energy suppliers and to their retail customers from wholesale cost savings in the GB electricity market associated with avoided peak electricity – both today – and even in the early 2020's[36].

9. Ofgem 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[37].

10. Further, recent DECC modelling for the Impact Assessment for the Electricity Demand Reduction (Nov 2012) indicated an average 20% 'within-day' cost differential between average day and average night (wholesale) prices[38] – but the modelling did not look at the peak / night-time cost-differential, which DECC acknowledge would in practice be higher.

11. The arguably modest 'within-day' wholesale cost differential is likely to be shaped by a number of complex factors, including, for example : (1) the fact that '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 rather than long-run cost-considerations [39]; (2) a relatively weak short-run price-signal associated with imbalance and (3) much wholesale market activity involving integrated actors who are likely to 'self-hedge' within-day[40].

12. Looking ahead however, assuming less 'spare' capacity on the system for contingency than today[41], and with Ofgem's plans to review the present basis for cash-out prices, plus

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[36] See for example : 'Domestic and SME tariff development for the Customer-Led Network Revolution'. A report prepared for Northern Powergrid by Frontier Economics (June 2012) ; DECC Electricity System Analysis : Future System Benefits from Selected DSR Scenarios. Redpoint Energy, Baringa and Element Energy. August 2012.

[37] Ofgem. 174/11. Promoting Smarter Energy Markets. December 2011. p.19

[38] They used levelised costs

[39] As of today, these short-run factors are likely to reflect, inter al, the poor outlook for GB electricity demand growth (both average & peak load growth), the volume of currently moth-balled plant, the recent glut of low-cost coal. Also, the fact that today's T&D networks can, for the most part, readily accommodate today's peak-demand, reflects in today's network charges.

[40] It is unclear how bi-lateral forward electricity contracts may in practice influence the within-day price differential. A large share of today's wholesale electricity purchases are made via bi-lateral contracts and, especially for integrated players, this may enable an element of self-hedging against within-day price movements.

[41] i.e. a significantly lower operating plant margin than today.

Ofgem's requirement for day-ahead auctions to boost wholesale market liquidity, a greater within-day peak : off-peak wholesale price differential may manifest itself. This in turn could result in an increasing value / cost-saving in the wholesale market for energy suppliers (i.e. a higher value than today) from actions taken to encourage their retail customers to avoid peak-time usage[42]. So, in the future, there could be more value available to suppliers than today in encouraging their customers to adopt ToU tariffs.

Are potential cost-savings available from time-related / ToU pricing 'worthwhile' for household and smaller consumers ?

13. 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 is estimated to represent around half of daily winter evening peak load (kW), but only around one-third of average annual consumption (kWh)[43].

14. Interestingly some customer trial evidence to date suggests that (notwithstanding the apparent lack of readily realisable 'value' available to suppliers today (as noted above)), some household customers *will* respond to a ToU retail tariff (Ireland, EDF EDRP and early LCNF-trial pointers). Interestingly too, *such response is not necessarily related to the size of the peak / off peak differential reflected in the ToU retail tariff.* **It would seem that it may be sufficient, for certain consumers simply to be on a peak-related retail tariff to encourage a response** (i.e. response is not necessarily linear)**[44].** Other interventions, in combination with a tariff (feedback, other information, displays) also support customer price-response.

15. In very high-level terms, household customers who responded to tariffs offered on those trials saw a saving on their bill : an average 7% to >10 % peak-shift and a 2-3% electricity demand reduction. Clearly, such findings should not be over-interpreted – and were certainly not applicable to every customer on those trials[45]. Feedback from those trials also suggests that some customers grew to like the ToU tariff and indicated some willingness to continue.

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[42] This point assumes that the highest costs in the GB electricity system continue to remain associated with winter evening peak for some time to come. At some future point, with an electricity system where costs are increasingly dominated by managing wind intermittency, that assumption may change – but we do not make any assumptions on this here.

[43] There are also morning peaks in both winter and summer – split between household and commercial loads, and there may also be some unexploited potential – either to reduce or to shift that load

[44] See also Demand Side Response in the Domestic Sector – a literature review of major trials. Report for DECC. Frontier Economics & Sustainability First. August 2012.

[45] This is an over-simplification for the purposes of this note. Trial customers must be assumed as self-selecting to some extent. In the Ireland and EDF EDRP trials, there were issues about whether the peak-shift and / or the saving was statistically robust, whether it was sustained, and which households were able to respond to the incentive. In fact, some customers ended up *increasing* their use at peak – and so were at risk of *higher* bills.

16. From the supplier view-point, both the EDF EDRP trial and the LCNF Customer-Led Network Revolution trial, also demonstrate that suppliers *can in practice* offer a basic static TOU tariff as of today - on a relatively straightforward basis : the customer needs a smart meter (or at least a two-register meter (ie like an Economy 7 meter)) ; the supplier needs appropriate billing software, capable of billing at two or more rates; and, Elexon needs to record the total electricity units consumed in a particular 'time-block' against the correct meter-register to enable supplier volume allocation for settlement within today's Load Profile 1.

17. So, it would seem that :

- At least some customers and consumers would be interested in the opportunity of a basic static ToU tariff today, were these to be offered by suppliers, **notwithstanding the somewhat modest / limited savings which may result to the customer.**

- Suppliers could start to offer basic static ToU tariffs today (i.e. ahead of half-hourly settlement).

- Half-hourly settlement could support more 'dynamic' tariffs such as critical peak pricing of particular half-hours

Commercial 'pull' for suppliers in offering a basic static ToU retail tariff ?

18. Despite some customers seemingly open to basic ToU retail tariffs, there may nonetheless be some understandable reticence on the part of suppliers today in offering ToU tariffs to their customers at any meaningful scale. The reasons seem to straddle at least some of the following factors.

- **Relatively modest wholesale cost savings available today to suppliers from avoided peak production / peak energy** - see section above.

- **Awaiting smart meter roll-out and greater clarity on settlement -** Suitable meters with multiple registers capable of recording customer usage at different times of day will become available with the smart meter roll-out at scale – and will in due course enable a variety of new tariffs to be offered, including 'dynamic' tariffs. Half-hourly settlement is likely to be needed to support more dynamic tariffs at scale, such as critical peak pricing and other non-static tariffs. Greater clarity on likely arrangements for the future of settlement are therefore needed to point the way towards potential longer-term tariff development. Such clarification may still be some way off [46].

- **Retail Market Review –** Some uncertainty on supplier approaches to tariffs resulting from Ofgem's requirement for four basic retail tariffs, given the Ofgem wish for 'simpler, clearer and fairer' retail market tariff arrangements.

[46] Ofgem Letter. 26 March 2013. Smarter Markets 'Way forward on longer-term electricity settlement reform'.

- **Balancing Mechanism : risk of unexpected under-contracting.** Where a supplier finds itself *over-contracted* in the wholesale market, any residual imbalance charges are likely to be relatively modest – especially where the market itself is also 'long' / over-contracted[47]. However, a more significant financial risk *may* arise where a supplier unexpectedly finds itself *under-contracted in the wholesale market* at 'gate-closure' – especially if, at that point, the market is also *short.*

  This latter could happen if static ToU retail tariff introduces a new unintentional risk of imbalance for a supplier. For example, **should a ToU customer fail to reduce their peak-load in response to the ToU incentive as desired - then the supplier risk / exposure may increase unexpectedly in terms of being under-contracted at gate-closure in the wholesale market - and therefore increase a supplier's potential liability for higher imbalance charges.**

  In the future, half-hourly meter data, may allow a supplier (1) more accurate knowledge of / understanding of their customers' actual (historic) half-hourly usage – and (2) enable use of / development of more sophisticated predictive tools than today - from which to predict ahead-of-time how their customer might use their electricity at any given time of day. **But, even with improved prediction, a supplier's risk of *being under-contracted* where customers are on a voluntary static ToU tariff may remain – subject to their customers' actions.** In this sense, more accurate meter data may offer a benefit in terms of improved prediction / insight of what a customer *may do generally* – but not necessarily more certainty against what customers may *actually do* in practice – and so, may not adequately address supplier concerns of finding themselves under-contracted.

  Looking ahead to possible half-hourly settlement, the supplier risk associated with being either under- or over-contracted may grow, should supplier predictions not have a close match with what their customers *actually do.* This is because suppliers would settle against *actual consumption* - and not against the half-hourly supplier volume allocations as now (eg against Load Profile 1 for households). So, with half-hourly settlement, a supplier is likely to look for *even more* customer certainty, given that the risks and costs associated with imbalance could increase[48] [49].

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[47] For example, where customers reduce demand at peak today, *below the curve* of the present half-hourly Load Profile 1 curve, a supplier may find itself over-contracted for those half-hours. See section 2 of this Annex for a more detailed explanation.

[48] Example – recent March 2013 cold snap. If customers on a TOU tariff had used an electric fire at 17.00h to boost their heat, due to the extreme and sustained cold spell, the supplier might have found themselves under-contracted / short due to a prediction based on historic data informed by that customer's historic half-hourly data. In effect, half-hourly meter data may allow suppliers to develop a more sophisticated view than today of their customers' *actual* half-hourly consumption by which to inform / predict their *wholesale energy procurement*. However, this may still not fully address a supplier's risk of being *under-contracted* at gate-closure, and being liable for high imbalance charges in the Balancing Mechanism, *should their voluntary ToU customers not reduce their electricity-use at peak as predicted.* Supplier procurement algorithms presently link to the standardised load-profiles, and incline the market to be 'long' because no peak-reduction is assumed. Suppliers perhaps face relatively *modest* imbalance liabilities in being over-contracted against Load Profile 1, as

- **Future Capacity Mechanism - Risk of Non-Delivery -** In the future, looking ahead to DSR participation in capacity market auctions, there may be some new demand-side 'pull' for suppliers (and therefore their customers). However, a static voluntary ToU tariff may similarly not deliver the degree of certainty which a supplier or an aggregator would wish for from a customer, to avoid the risk of being penalised for demand-side non-delivery[50]. DSR bid into a capacity auction almost certainly needs 'guaranteed' delivery and so a static voluntary TOU tariff may involve an undesirable risk of penalty to a supplier (or aggregator) for non-delivery

19. **From a supplier perspective therefore, the combination of some or all of these rather complex factors, may amount to a relatively weak commercial 'pull', to look very actively, currently, towards development of static TOU tariffs at scale for households and smaller customers, other than perhaps for reasons of potential market differentiation.**

20. **Instead, and looking somewhat further ahead from a supplier perspective, time-related tariffs and incentives which incorporate a greater element of *certainty* and / or 'control' of their customer load are far more likely to support underlying commercial imperatives. Greater certainty in DSR delivery could help avert the financial risk of being under- (or over-) contracted in the wholesale market at gate-closure – and / or in the future – the risk of penalty for non-delivery in the capacity mechanism.**

21. Looking ahead, this suggests that a DSR provider – be this a supplier or other third party – may not look first and foremost to a voluntary static ToU tariff as a preferred customer incentive to support delivery of peak-avoidance – either for delivery of day-in-day-out cost-savings in the wholesale market - or for peak-avoidance in the capacity mechanism.

22. Instead, certainly for purposes of certainty in peak-avoidance, one can imagine that suppliers and aggregators may wish to look to approaches which involve critical peak pricing and / or automation as a preferred tool for achieving greater certainty in delivery[51].

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of today. With half-hourly settlement, supplier risk will increase if they are under-contracted against what their customer actually does – and so suppliers will seek as much 'certainty' as possible.

[49] In the current half-hourly I&C market, supply contracts may include terms which require customers to keep their half-hourly consumption within a given 'tolerance' (eg +/- 10% of contracted demand) – precisely to help reduce supplier procurement and imbalance risk. However, it is very hard to see how such terms could be applied to smaller customers and / or to households on a voluntary static ToU tariff.

[50] Were suppliers *required to participate in the DSR auctions, that would amount to a DSR obligation* – but we assume that in the initial 5-year demand-side trial, such a requirement is extremely unlikely.

[51] In the GB market, this calls into question exactly what household load, might be automated at winter peak : most likely to be heat and EVs. Somewhat less likely perhaps to be lights, cooking, cold appliances.

Conclusion : Development of time-related signals in household retail tariffs to promote greater cost-efficiency in the electricity system

23. Some household customers seem relatively open to the possibility of basic static ToU tariffs today, provided these suit their way of life - and leave them with savings on their bills – rather than higher bills.

24. Suppliers could in practice introduce limited basic static ToU tariffs today. As noted, universal smart meters should make some of the practicalities relating to data-recording and billing easier, and eventual half-hourly settlement should also pave the way for more complex tariff approaches.

25. From a supplier view-point however, there still seem to be a number of uncertainties and risks in incentivising day-in-day-out peak reduction for households and smaller customers via voluntary static ToU tariffs, and which smart meters and half-hourly settlement may not necessarily fully address or over-come. As noted above, these include :

    - The seemingly modest wholesale cost-savings available to electricity suppliers today from reducing their customers' usage at winter evening peak-periods.
    - Some uncertainty, as suppliers see it, created by the Ofgem retail market review.
    - The potential for uncertainty in *predicting what customers may do in practice* may persist with static ToU tariffs, despite more accurate and more detailed historic meter data becoming available via smart meters. With a voluntary ToU tariff, suppliers could perhaps continue to face wholesale procurement / commodity risk and imbalance risk (especially should a supplier find themselves under-contracted). Moreover, Balancing risk is likely to increase from a supplier perspective in a fully half-hourly settled world.
    - The potential financial risks for suppliers associated with DSR non-delivery in the Capacity Market (i.e. prospective penalties for non-delivery).

26. So, suppliers seem likely to look for :

    - Ways to improve their predictions of individual customer demand and their knowledge of their customer usage patterns (eg monitoring customer data, complex algorithms etc) – and –
    - As much certainty as practicable in delivery of their customers' demand-side actions against supplier predictions.

27. In turn, this latter point may well prompt suppliers to look towards the kind of customer incentives and tariffs most likely to deliver most 'certainty of outcome' – and in preference to voluntary ToU tariffs - so as to better manage the financial risks and

uncertainty which could be associated with demand-side provision – both in the Balancing and Capacity Mechanisms.

28. From a supplier perspective, **and should customers be well-disposed[52],** more 'certain' demand-side incentives might perhaps include[53] :

- Critical peak pricing tariffs designed to reduce the relatively small number of extremely expensive peak half-hours in the year – in effect a household 'TRIAD'.

- Automated dynamic load-management tariffs to allow suppliers, aggregators or other third parties activation in critical half-hours of the load limiters in customers' smart meters, or for other high cost periods in the future (eg low wind periods)[54].

- Automated load-response / load-control at fixed times of day – for day-in-day-out peak-load reduction — **and subject to customer willingness and availability of suitable loads**.

29. **Suppliers may therefore incline in due course towards tariff and incentive approaches which perhaps may offer the prospect of greater predictability than voluntary static ToU tariffs. Greater 'certainty of outcome' could both could promote greater end-use cost-efficiency by way of improved wholesale market procurement, and, at the same time, help to narrow the potentially expensive 'gap' between what suppliers may *expect* their customers to do – and what their customers *may actually do* in practice.**

[52] **Paper 8 will consider these consumer acceptability issues in more detail.**

[53] The first two of which are likely to require half-hourly settlement.

[54] **Paper 8 will consider the topic of load limiters in more detail.**
Eg France & Italy – retail customers 'subscribe' / sign-up to a supply of eg 3kW, 5kW etc.
See Ofgem statement on Load Limiting Capability of Smart Meters. Letter from Philip Cullum. 17 December 2012. 'We expect suppliers to continue to meet the commitment they made as part of the Spring package last year to seek to input on proposals from both Ofgem and Consumer Focus prior to utilising any load limiting facility. **We expect this commitment to apply where suppliers are planning to utilise load limiting functionality in any form in the domestic sector, including where a supplier intends to run a trial utilising load limiting functionality'.**

Paper 7 : Annex 1

Section 2 – Settlement, ToU Tariffs & Load Profile 1 Customers

Purpose of profiling non-half hourly metered customers in settlement [1]

A meter reading has two uses for electricity suppliers :

- As a basis to bill their customer - and
- As a basis for being settled for that customer's consumption in the industry's settlement / payments system.

The wholesale electricity settlement system depends upon detailed management of customer meter data. This includes : data collection, data accuracy and validation ; data aggregation ; and volume allocation - and consequential data flows.

Settlement involves metering and reconciling the actual positions of generators and suppliers for every half-hour in the wholesale electricity market [2] against their contracted wholesale positions at gate closure – and to settling any financial imbalance where actual delivery of generation - or the electricity supplied - does not match pre-notified contractual positions[3]. Half-hourly reconciliation for each day usually takes place some 29 days later – and final financial reconciliation within 14 months. ELEXON administers the wholesale electricity balancing and settlement arrangements under the GB Balancing and Settlement Code.

For suppliers, aggregated half-hourly kWh meter-data for supplier portfolios in each Grid Supply Group Point Group of each Distribution Network area is the start-point for the calculation of how much each individual supplier owes for :

- Imbalance Energy – and -
- The charges payable by each supplier towards their 'upstream' fixed costs of the electricity system. So, for the calculation of each supplier's payments to the system operator, and their transmission and distribution charges.

[1] Good non-technical description of the role of profiling in 'Electricity Distribution Systems Losses. Non-Technical Overview'. Report for Ofgem by Sohn associates. March 2009.
[2] And interconnectors
[3] Imbalance settlement is essentially a charge or payment to each of the various trading parties in the electricity system for any difference ('imbalance') between the contracted position of that trading party and the out-turn metered position - be that for generation, or, in the case of a supplier, for its customer demand. The imbalance price changes with each half-hourly settlement period and is calculated by reference to the prices of trades in the balancing mechanism and on the power exchanges for those half-hours. Imbalance prices are likely to be higher in peak- than in non-peak periods, as a reflection of scarcity.

For the purposes of settlement in the wholesale electricity market, electricity volumes[4] are allocated to each supplier **for every half-hour** for :

- ***Actual* volumes of electricity used by the 117,000 half-hourly metered customers (100 kW-plus customers – or customers that have elected to have half-hourly settlement) –** by volume these represent around one-half of all electricity consumed each year - and these volumes are deducted from the aggregate kWh meter-read at the Grid Supply Group point - and allocated directly to the relevant supplier.

- **The residual electricity volumes for the 29 million household and business customers who are non half-hourly metered** (settled). For these customers, half-hourly consumption volumes are allocated to each supplier for every metered customer[5] using an estimate of each customer's annual consumption (generated by the ELEXON systems)[6] - and which in turn is spread - on an estimated basis for each half-hour - over a standardised daily load-shape (statistically-derived) for one of eight Load Profiles[7].

The purpose of profiling is to estimate for each type of customer what fraction of their year's worth of electricity is used in each and every half-hour of the year. This allows the Settlements process to calculate an estimated volume of electricity consumption for every half-hour for non half-hourly metered customers - and to allocate that estimated volume to suppliers – for matching and / reconciliation with each Supplier's pre-notified half-hourly purchase / contract position in the electricity wholesale market[8].

[4] The total annual split of electricity consumed (322 TWh in 2011) between customers who are 'half-hourly settled' and those who are not (ie those in Load Profiles 1-8), is roughly 50:50.
[5] Via their individual Meter Point Administration Number
[6] Estimated Annual Consumption (EAC) / Annual Advance (AA)
[7] Each customer's expected annual consumption is allocated / attributed in each half-hour period by the Elexon systems according to their standardised, statistically derived daily load-curve for their Load Profile class.
[8] 'Profiling' is used to allocate into half-hours the electricity consumption of all non half-hourly metered customers. A profile is an estimate - and not intended as a precise record of the electricity used by each customer in each half hour. In practice, to reduce the volume of data, Data Aggregators group data for consumption of consumers of the same Load Profile class - and calculate the total of the half hourly volume for that customer class – and assign this to a supplier at the level of the Grid Supply Group ('super-customer consumption).

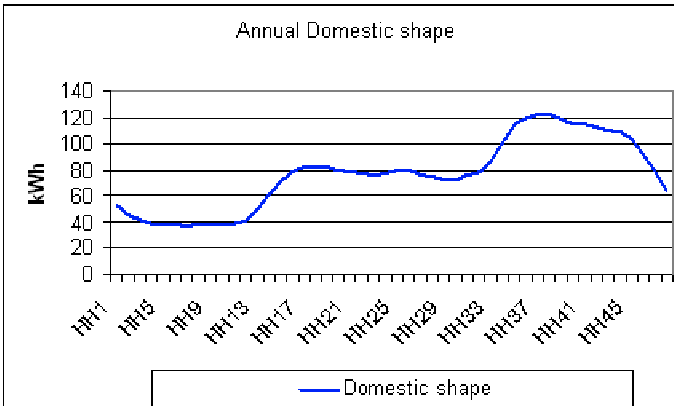
Profiles are not used by suppliers as a basis for customer billing – which is handled completely separately by the suppliers' own processing of the customer meter readings.

Paper 7 : Annex 1

Section 2 : Load Profile 1[55] – Some practical and commercial issues for suppliers in developing a ToU tariff

1. There are around 22 million customers classed as Load Profile 1, consuming roughly one third of all annual electricity. The shape of the normal distribution for Load Profile 1[56] shows a distinct year-round early-evening peak, reflecting the average consumption patterns for small and household customers.

2. Load Profile 1 illustrated below is the statistically derived 'normal distribution', representative of the daily load shape for all *'unrestricted'* household and small customers. For all their Load Profile 1 customers, suppliers settle *for every half-hour of the day against this daily Load Profile 1 shape / load-curve for that day*. The figure below shows a typical Load Profile 1 customer usage (averaged over the year to remove seasonality).



3. **Where the meter of a Load Profile 1 customer *has only a single register*** (22 million customers currently) - which records units on a wholly 'unrestricted' basis – i.e. only at a single rate (so, not by time-of-use) - it is not presently feasible for an individual supplier to capture / obtain a cost-

[55] This note concentrates on LP 1 – but LP2 also covers households and includes a further 5 million customers. The issues covered in this section can apply equally to Load Profile Class 2 customers.
[56] i.e. the Load Profile for the vast majority of small / household customers whose meters have only one single register by which to record their consumption – therefore known as 'unrestricted'.
Non half-hourly customers with a standard electricity meter, with a single register, have their units of electricity recorded by the meter register on an 'unrestricted' basis - i.e. usage is not differentiated by time-band. For Load Profile 1, this amounts to around 22 million meters. There are a further 5 million LP2 customers.

reduction benefit by encouraging their customers to reduce their peak consumption - for example by offering them a ToU tariff.

4. In the absence of time-varying meter data, the supplier can only settle in every half-hour against the standard Load Profile 1 load-shape – and cannot settle against a flatter curve at peak-time - even where some of their customers might actually reduce their electricity-use at peak-time in response to an incentive (i.e. ToU tariff ; other incentive).

5. In practice, the lack of time-related meter data for an individual customer's consumption, on a generally risk-averse basis will prompt suppliers to :

    - Contract for their wholesale electricity purchases against the standard distribution of the Load Profile 1 load curve.

    - Avoid encouraging their customers' consumption to deviate significantly from the Load Profile 1 shape – because this would increase their risk of higher payments for imbalance energy against their contractual positions in the wholesale market notified pre-gate closure. (In fact, should a supplier encourage customers with single meter registers to reduce or shift their load at peak, they would create new financial risks for themselves by becoming over-contracted in the wholesale market).

6. **The single register in a meter is therefore widely acknowledged to be a material barrier / deterrent for suppliers in offering ToU tariffs to small / household customers today. With smart meters and SMETS2, every meter will have multiple registers for import – which should open the door to suppliers offering more ToU tariffs to their customers.**

7. **Further, where the meter of a Load Profile 1 customer has *more than one register***, suppliers can in practice already make adjustments today **within existing settlement arrangements for those Load Profile 1 customers** to allow them to settle for **an individual customer's usage against the multiple registers.** In effect, suppliers can ***already*** settle today against a load-curve which ***varies*** from the standard distribution of the Load Profile 1 load curve. As well as EDF Energy's EDRP ToU tariff, at least one other trial is also recording their ToU tariffs against multiple registers in Load Profile 1[57]. ***So, successfully managed under Load Profile 1 – and not a new Load Profile***.

8. Clearly, should ToU tariffs this develop at scale within Load Profile 1 – ahead of full half-hourly settlement - it would have wider implications - including, eventually, possibly beginning to change the shape of Load Profile 1 – but we are some long-way off that

[57] Northern Powergrid and British Gas tariffs for Customer Led Network Revolution Trial

moment. A load-shape for Load Profile 1 which is more representative of *actual* half-hourly customer consumption would generally be a welcome development in improving suppliers' management of their wholesale electricity purchases.

9. From a supplier point of view, time-differentiated settlement under LP 1 does *not* entail major new settlement-related IT investment for a supplier. Nor does there seem to be a material time- or cost-implications for ELEXON.

10. Separately, as noted, a supplier needs appropriate billing software to bill for a static ToU tariff. It seems that commonly-used SAP billing software already incorporates an in-built ToU capability – and updates will augment the ToU Billing capability in the future.

11. **A small customer Critical Peak / TRIAD tariff - would apparently be far more complex for a supplier to settle under Load Profile 1 arrangements today.** A single register in the meter would need to be fully dedicated to recording ***just*** CPP events. Say, ten events per annum – and even then, seemingly not straight forward. The events would (1) need flagging in advance to the customer and (2) the register would need to be remotely switched in real-time to record usage in just those ten periods (3) a supplier would need a compatible billing system for CPP (ie compatible with the pre-programmed ToU capability in the billing software (so, unlikely)), and (4) CPP timings would need to be notified to ELEXON for settlement to accommodate such tariffs. **Nevertheless, a critical-peak or household TRIAD tariff may become of more interest to suppliers once capacity auctions are up and running in the new capacity market, beyond 2015-16.**

12. **A dynamic CPP tariff** - would become of commercial interest to suppliers at a future point where wind-output drove such extreme volatility in wholesale prices that it pushed a supplier's commercial interests in tariff design away from static peak-load management - towards tariff approaches which incentivised customers towards automated load-switching and wind-twinning at scale (say, mid-2020's to 2030 on ?) - by which time smart-meters and half-hourly settlement will be in place. (Dynamic CPP events would need 'notifying' in the settlement system). In fact, UKPN and EDF Energy are presently trialling a day-ahead dynamic wind-twinning tariff as a part of their LCNF Low Carbon London trial[58]. Looking to the longer-term **in a heavy wind system, the question may arise as to how far resolution at half-hourly intervals may be sufficient for dynamic retail prices.**

13. So, for the interim, prior to full half-hourly settlement, both from an ELEXON and supplier viewpoint, **it seems feasible and practical for the time-being to develop simple, static ToU tariffs through continued use of limited Load Profile 1 'adjustments'**.

14. **For the long-run**, there is a general wish to work towards full half-hourly settlement (could be either incremental or big-bang – for consideration by market actors and other

[58] Announced 13 February 2013. 1,100-plus households with smart meters.

stakeholders). Or, possibly even a big-bang of multiple new load profiles (rather than full half-hourly settlement for all 29 million customers). On this latter, market actors would need to make a valid business case to the BSC for any new Profiles to be developed. Introduction of new Profiles would have a major impact on both suppliers and settlement.

15. In discussion, both ELEXON and some suppliers would regard a half-way house, whereby ***interim*** new load profiles are developed in a piecemeal way (so, LP 9, 10 etc) as highly impractical and undesirable. Not least, as existing Profiles cover the entire meter population, any new Profile would require consequential overhaul of all existing Profiles too. Such an approach could prove very expensive for ELEXON and for suppliers alike (IT, software, billing etc) – and, most importantly, a major distraction, potentially from the core work of moving towards new billing systems in tandem with the smart meter programme, and, possibly, eventual full half-hourly settlement.

16. On 27 March 2013, Ofgem published a letter to outline its expected way forward on longer term electricity settlement reform. As a part of their smarter markets work, Ofgem indicate that they plan to consult on problem definition and scope in late 2013 and to produce a next-steps and conclusions document in early 2014.

17. In the meantime, both ELEXON and suppliers seem open, in principle at least, to developing SSC TPR adjustments further and to give this more prominence – as a practical way to develop and offer basic static voluntary ToU tariffs ahead of any move to full half-hourly settlement in / or around 2020.

18. A concluding question is therefore whether suppliers would wish to do more by way of offering / developing static voluntary ToU tariffs today - under these ‘adjusted’ Load Profile 1 settlement arrangements.

19. **In Paper 8, we will look at the related question on how far in the near term, in terms of suppliers offering ToU tariffs, may / may not be inhibited by considerations relating to the Retail Market Review and a wish to establish simpler tariffs – especially as illustrated by this case study, it would not be necessary to await full half-hourly settlement for suppliers and their household customers to obtain the commercial benefit from wider uptake of ToU tariffs.**

Paper 7 : Annex 1

Section 3 : ELEXON Note

Time of Use Tariffs: How can the current non Half Hourly Settlement processes facilitate an avoided 'Winter Evening Peak' type tariff

1. The existing profiling and Non Half-Hourly Settlement processes can facilitate Time of Use (ToU) tariffs. This paper describes how this is achieved [59]. We believe that to facilitate dynamic ToU tariffs (where the times of the tariff vary day to day, or where there is short notice of a change in the tariff's time) then Half Hourly (HH) data recorded by the meter and hence HH settlement is required. We have previously published a thought piece on smart meters and tariff innovation, Smarter Settlement.

2. In Non Half-Hourly (NHH) settlement there is a process colloquially known as 'chunking' that allows the energy recorded on a meter with a number of registers to be allocated to specific times of the day where the register is on. These meters are read periodically (e.g. quarterly). To facilitate a Time of Use Tariff, the Supplier would be required to fit the customer with a meter with at least two registers that is 'configured' to record energy at specific times of the day (note: these could be varied by both month and day-type depending on the meter capability). An example configuration is demonstrated in Figure 1 below.

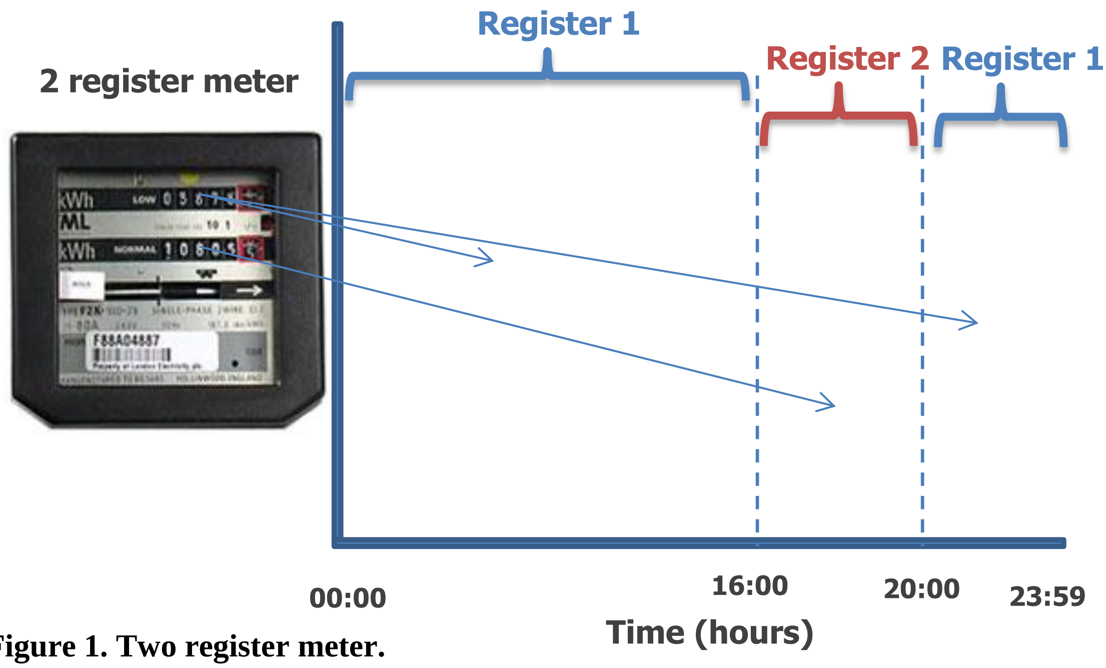


Figure 1. Two register meter.

[59] *This process has existed since the start of the profiling arrangements in 1998 and has been used for traditional ToU tariffs such as Economy 7 or 10.*

3. In Figure 1 the meter register on which the energy is recorded are set to switch from one to the other at 16:00 hrs and 20:00 hrs. In a smart world this could be achieved by programming (configuring) the meter remotely. Currently, this would be achieved with a timeswitch or could be achieved more dynamically using a Teleswitch (a device that sends signals, on a daily basis, that tells the meter when to switch from one register to another and may switch load as well).

4. The Supplier then sets up some 'standing data' in the settlement system that reflects that it has a population of meters 'configured' in this way. The Supplier would then have to register all his customers that have this configuration in the meter registration system that belongs to the Distribution business. These processes are represented in Figure 2 below.

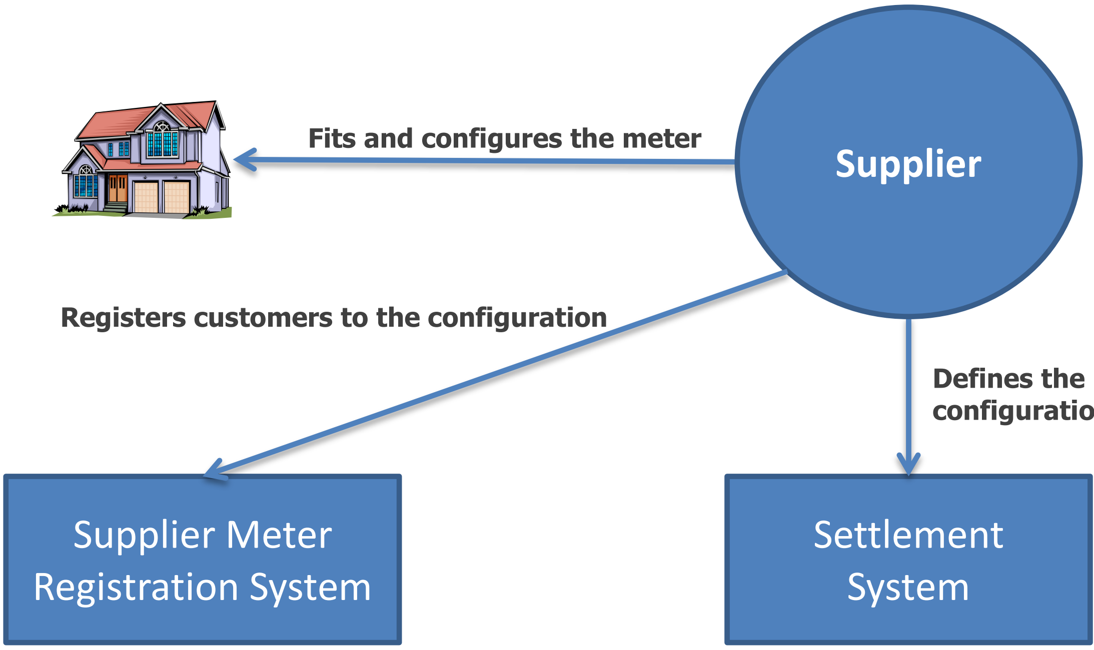


Figure 2. Fitting and registering ToU type meter.

5. The Supplier can incentivise the customer to reduce his energy during the peak period (16-20:00 hrs) through the tariff, price signalling or other arrangement. If the customer acts on the incentive then the volume of energy recorded on the customers meter register, that is active during the peak period, will reduce. The Supplier will schedule his customer's meters to be read by its agents. The meter reading data is then processed and aggregated for all the Suppliers customers on the new configuration (these are derived from the supplier meter registration system data). This data is then submitted to the Settlement system. The Settlement system processes allocate the meter advances[60] (the number units used between meter readings) for all the Supplier's customers, on the new configuration (defined in the standing data), to a load profile according to the times that each meter register is active. The process is represented in Figure 3.

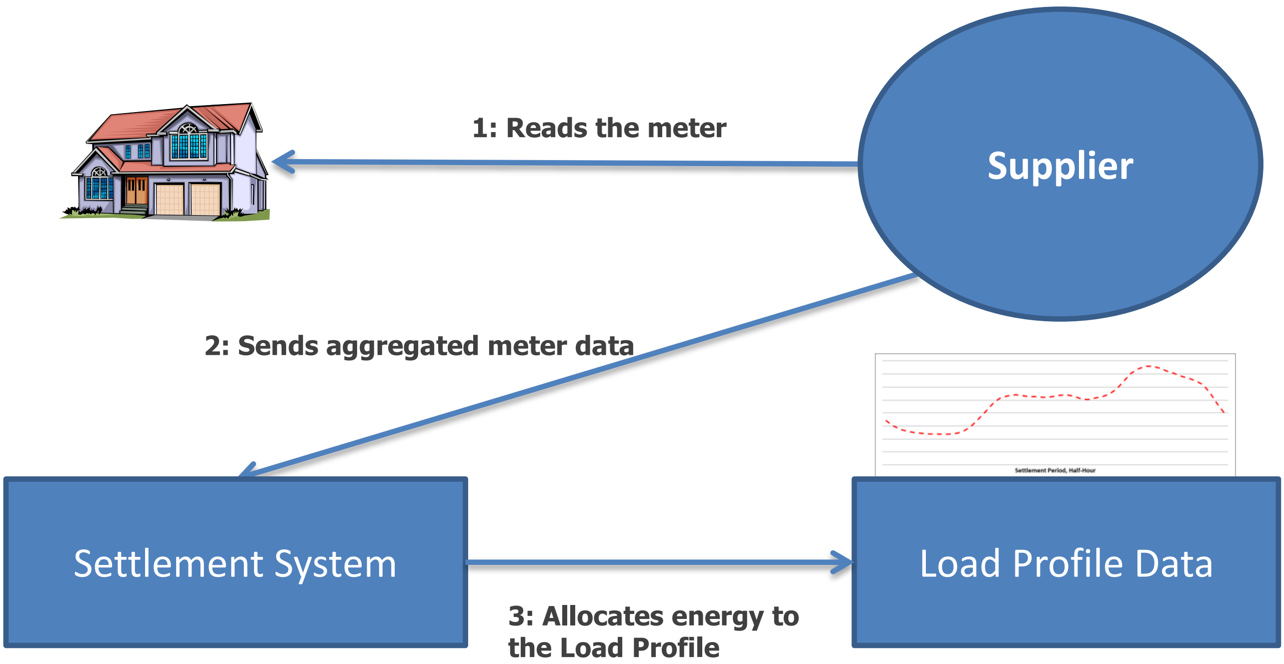


Figure 3. Use of meter data and the allocation of demand using a load profile.

6. The customers will be billed on the actual meter readings taken from their settlement meter registers according to their tariff. If in aggregate the Suppliers customers have reduced their load during the peak period then this will be reflected in the volume of energy allocated, to that Supplier, during that period. Some of the energy may be 'shifted' to other parts of the day (not modelled below). An example of the allocation for the new configuration is shown in Figure 4.

[60] *The mechanism by which this is achieved uses 'profile coefficients' and annualised advances which are an extrapolation of the meter advance*

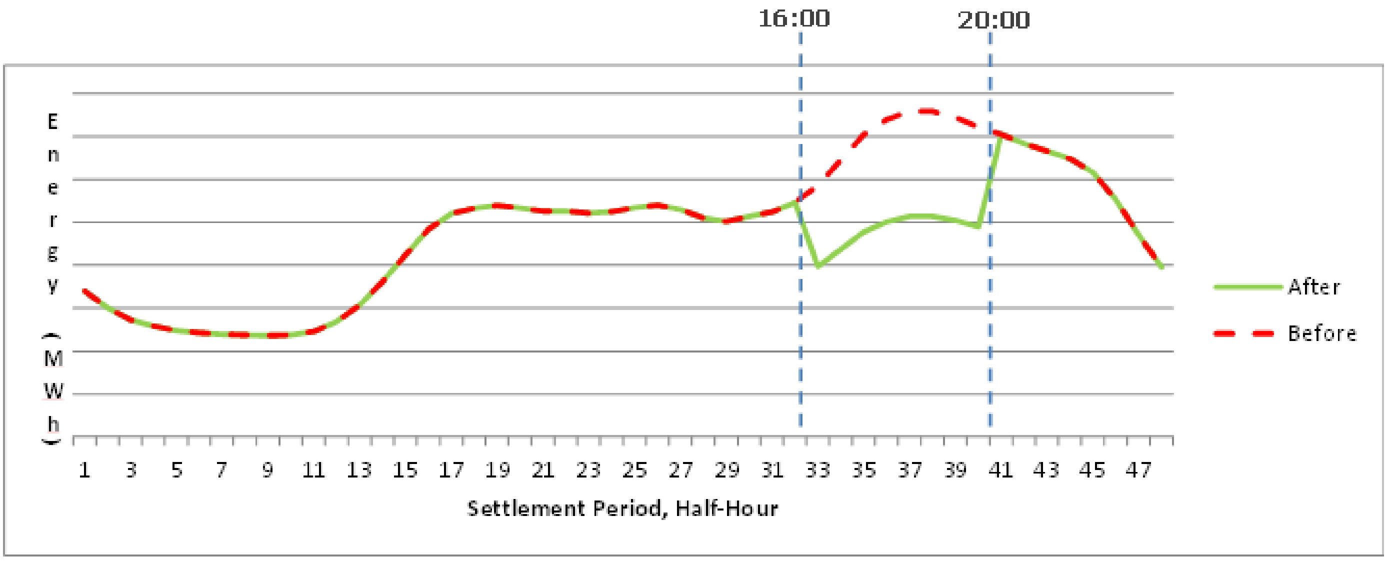


Figure 4. Example of reduced demand in winter peak.

7. The meter configuration set up by the Supplier could be quite complex as they can be defined by month and day of the week or could be set remotely (e.g. by tele-switching the meter). The Suppler could benefit from such tariffs as it will not be required to purchase as much energy during the peak period. Additionally, there are benefits to everyone (i.e. 'GB plc') that could accrue as significant levels of customers react to such tariffs. For example, there would be both carbon savings and a potential reduction in expensive peak generation requirements, such as reduced need for oil fired power stations. Additionally, the wholesale price of electricity would also be likely fall during the peak periods as there is less peak demand.

ELEXON ECOES SYSTEM SCREEN SHOT : Shows how the ELEXON systems presently record meter data from the single register on an 'unrestricted' household meter.

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Very Important

Future changes to the current registration details, and detailed information relating to a future registration, will not be displayed until the effective from date of the change. This data reflects what is held on the MPAS or Meter Operator system and is not guaranteed to be correct.◆ Updates that have been rejected by the MPAS/Meter Operator will not be displayed.

MPAN Details

Here are the 'current registration details' for the requested MPAN

S	01	801	902
	12	0004 1962	089

Last Update 14/12/2012 **by MPAS** LOND

MPAN	Distributor	GSP Group	GSP EFD	LLF Class	LLFC EFD
1200041962089	LOND(London Power Networks plc)	_C (London)	1/4/1996	902	1/4/1996

GROUND FLOOR
[redacted]

		EFD			EFD
MP status	Traded	1/4/1996	**Measurement class**	A	1/4/1996
			Profile class	01	1/4/1996
			SSC	0393	1/4/1996
			MTC	801	1/4/1996

Supplier ID	LOND (EDF Energy)	1/4/1996	**DA**	LOND (Edf Energy, Energy Field Services)	N	1/4/1996
			DC	LOND (Edf Energy, Energy Field Services)	N	1/4/1996
Energisation status	Energised	1/4/1996	**MOp**	LOND (Edf Energy, Energy Field Services)	N	1/4/1996

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Meter Details

Meter Serial Number	MPAN	Meter Type	MAP ID	Date of Meter Installation	Number of MPAN's Associated With MSN
F00A 04014	1200041962089	N	LOND	4/10/2000	1

MPAN History

Supplier	Trading Name	General Access Number	Start Date	End Date	Registration notes

http://ecoes.co.uk/MpanResult.asp?GUID={1519C444-55AF-47CF-ACF3-CAF7636... 14/12/2012

Some Settlement Definitions (source – ELEXON website).

A Standard Settlement Configuration (SSC) - is a standard Metering System configuration, recognised by the Supplier Volume Allocation Agent (SVAA) System. Each SSC is related to a fixed set of Time Pattern Regime Ids that relate to Settlement Registers on the Metering System.

Example SSCs include:

- Unrestricted
- 7-hour E7
- Evening/Weekend

An SSC is linked to one or more Profile Classes.

A Time Pattern Regime (TPR) - relates to Settlement Registers on metering systems. Each TPR is associated with a pattern of switching behaviour that defines the times at which the register is operational (i.e. recording energy data).

Switching between TPRs occurs either through fixed "time switches" or dynamically via "Teleswitching instructions" i.e. a radio signal. TPR Ids are assigned to Standard Settlement Configurations IDs.

A Profile Class (PC) - is a classification of profiles which represents an exclusive category of customers whose consumption can be reasonably approximated to a common profile for settlement purposes. There are eight generic Profile Classes, chosen as they represent large populations of similar customers.

Sustainability *First*

Sustainability *First* was set up to develop new approaches to sustainability. Its primary focus is on policy and solutions within the UK, but draws on experiences and initiatives both within and outside the UK.

Sustainability *First* develops implementable ideas in a number of key policy areas – notably, energy, water and waste - where it can make a difference. It undertakes research; publishes policy and discussion papers; organises high level seminars and other events. Sustainability First is a registered charity.

 Its projects are developed by the trustees and a number of associates and consultants.

Sustainability *First's* Director is Judith Ward.

Sustainability *First*'s associate is: Gill Owen.
Maria Pooley is Sustainability *First*'s research officer.

Sustainability *First* is a registered charity number 107899.

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Sustainability *First*