SUSTAINABILITY FIRST - PAPER 7

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

ANNEX 2

EDF Energy EDRP Case Study

Developing a Static Household Time of Use Tariff

This case-study is in two parts

Part 1 : **Supplier : commercial interfaces, steps and arrangements**

Part 2 : **Customer : arrangements with supplier. Trial outcomes**

EDF Energy has kindly provided background to enable Sustainability First to write up this case-study.

Responsibility for any errors in this note - and for any conclusions - rests with Sustainability First.

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EDF Energy EDRP Case Study

Developing a static household ToU tariff

Introduction

1. EDF Energy has kindly provided some background to enable Sustainability First to write up this case-study. Responsibility for any errors - and for any conclusions drawn - rests with Sustainability First.

2. This case study is based on EDF Energy's EDRP ToU 'avoided evening-peak' household tariff trialled for ~200 electricity customers for a 2-year period (from June 2008 to June 2010)[1].

3. The note focuses on the **commercial steps and issues for suppliers and customers in offering a ToU tariff.** It does not set out the detailed *technical* steps and arrangements made by EDF Energy with respect to installation of a smart meter in a customer's home.

4. A tariff was designed to encourage customers to avoid peak-time usage by making electricity-use at evening-peak relatively higher-cost than consumption at other times of the day (16.30 – 19.30h daily, all year-long).

5. The aim was to understand whether a time-differentiated tariff could prompt customers to reduce the proportion of electricity they used in the peak period. This was in terms of *both* load-shifting and demand reduction.

[1] EDF trialled other interventions for EDRP, but these are not covered here.

Part 1 - Supplier : commercial interfaces, steps and arrangements

Key tariff features

6. The tariff had 3 rates (prices) applied in 4 separate time bands (lowest rate at night & highest during peak time). There was a standing charge for the tariff as a whole.

   Day 06:00 – 16:30h (Rate 1)
   Peak 16:30 – 19:30h (Rate 2)
   Day 19:30 – 23.00h (Rate 1)
   Night 23:00 – 06:00h (Rate 3)

7. The trial tariff was designed to encourage both demand-reduction and peak-shifting. The tariff was designed to be 'cost-neutral' for the customer's bill – so to not result in a 'penalty' where a customer's consumption during peak-time remained unchanged. In effect, the customer could achieve a rebate / discount on their bill by either shifting or reducing their normal-use pattern to times outside the peak-period (16.30 – 19.30h). Overall, customers could use the same amount of electricity as pre-trial (or even more), and yet still have a lower bill. During the trial, rates changed with the rise and fall in EDF Energy Energy prices.

8. Trial customers had an electronic 'smart' meter with three import registers plus a communications hub (zigbee and GSM).

9. To support awareness of their consumption in the different price / time-bands customers also received :

   - A simple, single-line in-home display unit to help them view their consumption and see when price bands changed throughout the day – plus a user-guide.

   - A fridge magnet to remind them of the times at which each rate changed (which customers found helpful).

Supplier interfaces in introducing new ToU Tariff

10. In order to offer its new ToU tariff to their trial customers, EDF Energy procured new meters and associated equipment.

11. EDF Energy needed new working arrangements within their own business, as well as new agreements with equipment suppliers, with other market actors – and their customers. These new interactions / interfaces included :

    - **Within EDF Energy – new and old commercial and technical interfaces.** Customer Field Services (CFS) ; Customer Services ; Retail Teams (Marketing) ; Retail Pricing and IT ; Customer Service Process Training (call causation, post installation support, out of hours, change of supply) ; collection and analysis of all half hourly data ; meter installers ; on-site maintenance for wall display unit and communications hub.

    - **Market Actors** - Elexon ; Distribution company (for meter registration and switching times).

    - **Meter & equipment manufacturers**

    - **Communications providers**

    - **Third parties** – Sussex Energy Group, Univ. of Sussex (helping with customer selection and monitoring results) ; National Energy Action ; recruitment agent

    - **Customers** - customer recruitment process ; agreement to new Terms and Conditions.

12. Although the focus of this note is on commercial steps, two key *technical* areas to resolve in introducing the new ToU tariff were :

    - IT changes necessary to upload new tariffs and prices

    - Manufacturer pre-sets in the meter affecting tariff set-up and time-periods.

Supplier choice of tariff - and in-house cost-considerations

13. Meter-related pre-requisites for a ToU tariff are :

- **A meter with more than one register in order to separately record units consumed at different rate**. The ~5 million Economy 7 meters in situ already have two registers which separately record day- and night- units. Otherwise, for the ~17 million 'unrestricted' Load Profile 1 customer meters which have just one single register, a new meter is required. Clearly, for the future, this will be a smart meter. SMETS2 has a requirement of 48 tariff registers (i.e. for half-hourly recording of imported electricity)[2].

- **A capability to switch the meter registers on- and off at particular times-of-day or year**. This could be by an in-built timer – or by remote communication (eg by teleswitch or, for the future, by smart meter communications).

14. EDF Energy sought a simple ToU tariff for two key reasons :

- To minimise costs associated with adapting IT systems for customer billing

- To support customer understanding

15. Hence the EDF Energy choice of 3-rate 4-time periods. This is effectively a 'basic' static ToU tariff – potentially more widely replicable.

Cost implications of adapting supplier IT systems for customer billing in introducing a ToU Tariff

16. **IT systems for customer-billing are a major cost component for suppliers in developing and offering new ToU tariffs to their smaller / household customers.** A basic cost-consideration in a small-scale trial such as this one was therefore **to avoid major changes to existing Billing systems**. The time, personnel and spend associated with major IT changes could represent a very material constraint. More so, for example, than the process of tariff design and / or issues relating to meter capability.

17. **Current billing systems for small / household customers are commonly designed around three meter registers.** This in turn places a ***physical*** limit of three separate rates (prices) which can be charged in a ToU tariff - albeit up to five time-bands can be applied [3].

[2] DECC. Smart Metering Implementation Programme. Smart Metering Technical Specifications. September 2012.

[3] Night, day, peak, day, night.

Even with smart meters, which as noted will have 48 registers with SMETS2, current billing software would prevent small or household customers being billed at more than three different rates (prices) - even where the meter could record consumption at half-hourly intervals.

18. EDF Energy's billing IT systems therefore led to development of a ToU tariff which involved billing at three separate rates / prices[4]**.** A meter can be configured for the registers to be switched by : ToD ; day-of-week ; (month-of-year). As noted, this can be pre-set within the meter and / or remotely switched, as per the present Teleswitch, or, in the future, by smart meter communications.

19. **Billing Software and Databases -** EDF Energy arranged to take the data from each of the three meter registers by remote meter reads into its billing system to generate an ordinary bill. Most suppliers will have multiple databases. Some of these may be interconnected in-house by automation, or, possibly manually, to accommodate a trial. Trialling a new tariff can lead to in-house challenges on data input, data recording and data quality. For example, some data may need to be manually updated across several internal systems (e.g. for billing from actual meter-reads), or, with regard to production of new bill formats. Once a new tariff becomes business-as-usual, automation of processes can follow.

20. With smart meters in mind, new billing systems are now being designed / introduced to bill from multiple registers (i.e. more than three). Suppliers are presently devoting very considerable time and effort to introducing major new billing systems. Such new billing software will enable suppliers to develop and offer more complex ToU tariffs to their small and household customers, without incurring the significant costs liable to be associated with interim IT changes.

21. Larger business customers may already have 5- or 6- rate Seasonal Time of Day tariffs – because more complex billing systems are already in place for those customers.

[4] The necessity to switch at the same time each day was a constraint within meter registration configuration for settlement – and not a constraint of the Billing IT.

Tariff design

22. Against the constraints of their billing IT at the time, EDF Energy therefore designed their simple ToU tariff with three basic features :

- **Three Rates** : to record units used at three different tariff rates / prices.

- **Four time blocks** : Same all year round. Two day blocks and 1 night block – plus one 'peak' period to coincide with EFA Block 5 (EFA (Electricity Forward Agreement) - creating a broad match with an existing 4-hour trading block in the electricity wholesale market (EFA Block 5 is 16.00h – 20.00h). The four time-bands were matched to the supplier's own time-related cost curve - to understand how costs were likely to be recovered within each time period. Fixed costs were also calculated to identify a separate standing charge

- **Tariff approach to be 'cost neutral' to the customer**. Aim was (1) to develop a tariff which was commercially realistic in its peak : off-peak differential (so based on what was realistic from a wholesale energy point of view – so not 'extreme' or 'unrealistic' in relation to underlying costs)[5] and (2) that customers should not lose financially, should they fail to reduce their use at peak – so in effect, the tariff offered a discount for shifting load. Conversely, a customer *increasing their load within the peak time-band,* risked paying more (unless they made a larger reduction at other times).

Meter manufacturer

23. A meter manufacturer confirmed that they could source a suitable meter with three registers.

24. Time-clocks needed alignment. The time-clock internal to the meter is GMT for settlement purposes. Time clocks in the in-home display must follow BST.

[5] Unlike the later Ireland electricity smart meter trial, the EdF ToU tariff was ***not*** designed to test customer response / price-elasticity to a range of different peak / off-peak price differentials.

The very helpful Frontier Economics paper for the NPG-BG Customer-Led Network Revolution Trial (Domestic and SME tariff development for the Customer-Led Network Revolution. Frontier Economics. June 2012) discusses at length the design and structure of a 'realistic' ToU retail tariff for 2020 – and in particular how expected network and supplier costs for 2020 informed the relatively modest peak-off-peak price differentials selected for different trial-tariffs.

Settlement interface

25. For an individual supplier, 'accessing' any value created from a ToU tariff is both commercially and competitively important. Wholesale energy purchases – including for peak-related energy - represent a substantial portion of total supplier costs (overall, of the order of 40-60%).

26. Settlement arrangements therefore needed a modest adjustment to enable EDF Energy to capture the value of any wholesale or other cost reductions created by their trial customers' response to the ToU tariff. Without this adjustment, any economic value created by EDF Energy's own customers from their reduced peak-load could not be 'recognised' in the settlement process. Rather, under the 'volume allocation' process for each supplier[6] any benefit of reduced peak-load would simply have transferred as a *generalised* benefit to all suppliers with customers connected to that distribution network.

27. The EDF trial illustrates how it is feasible today for a supplier to adequately capture much of the economic value created by the reduced peak load of an individual non half-hourly metered customer *within Load Profile 1*. This can be done ahead of full half-hourly settlement – and without a new Load Profile.

28. Suppliers have a number of 'Standard Settlement Configurations' (SSC), based on standing data in the Elexon settlement systems. Suppliers can choose their SSCs, or can create new ones if they follow the correct industry processes. The SSC comprises fixed 'Time Pattern Regime' identities **for each meter register** which is registered with the meter registration system [7]. The SSC of each supplier aligns with the meter-switching pattern of a customer's meter registers.

29. For a supplier, the SSC seems to have two key functions.

    - **In-house -** it informs each supplier's purchasing algorithm - against which suppliers plan / make their forward wholesale energy purchases – and

    - **In the settlement system** - it determines the customer volume allocations (kWh) against which each supplier is settled in any given half-hour.

30. In practice, a supplier is able to agree new 'standing data' with Elexon in the settlement system for its SSC. This can reflect a separate population / sub-group of meters 'configured' with multiple switching times *within* the standard Load Profile 1 population.

[6] See draft Paper 7 – Annex 1

[7] presently administered by each distribution company.

Separately, the supplier also notifies the switching times for each register for each customer to the meter registration system (and which presently sits with the distribution company). [8]

31. Elexon is the able to adjust the supplier's Standard Settlement Configuration for that separate population[9] . This then enables the supplier to capture much of the economic benefit from that customer's reduced peak-load.

32. EDF Energy therefore notified Elexon that they wished to make some alterations to the standing data in relation to their trial population – to record their consumption against three separate registers in their new meters. In effect, for the trial customers, Elexon could record customers' consumption ***against fixed, pre-notified time-blocks at the same time every day within Elexon's existing arrangements for recording the meter data of Load Profile 1 customers*** (i.e the 3-hour 'peak' block ; the two 'day' blocks of 10.5 and 3.5 hours each; the 7-hour 'night' block)[10].

33. The individual adjustments for the Load Profile 1 trial customers were then registered by by Elexon in such a way that EDF Energy's Standard Settlement Configuration could reflect that EDF Energy had a population of meters which were differently configured within Load Profile 1.

34. The SSC adjustments enabled at least two distinct and positive commercial developments for EDF Energy in respect of their non half-hourly settled Load Profile 1 trial customers :

- **The supplier's in-house energy purchasing algorithm could be adapted to reflect the time-related usage of their 200 trial customers more closely than before –** instead of reflecting customers' estimated half-hourly usage – as generally indicated by the standard curve / normal distribution of Load Profile 1. **This better knowledge of their customers' time-varying usage in turn would allow EDF Energy to fine-tune / obtain a closer match in their wholesale electricity purchases – in particular at peak.**

[8] until such time as the DCC takes on meter registration, expected 2-3 years after 'go-live'.

[9] i.e. individual customer as identified by their MPAN - Meter Point Administration Number – in Elexon's ECOES system. The ECOES system can record consumption in pre-agreed time blocks against separate registers in a single meter.

[10] In principle, provided there is a separate register, a rate could be applied to just one single half-hour – but it would need to be 'static' i.e. the same time each day – so not 'dynamic' – and not suited to CCP or Triad-type tariffs.

- **The supplier can benefit from improved estimates in the 'volume allocation process' in settlement.** (i.e. improved estimates across the half-hours of the peak and non-peak time-blocks for the ToU population)[11]. **In turn, this improved estimation gives a better, somewhat more accurate, basis for charging - for both imbalance energy and for the supplier's industry charges for system operation, transmission and distribution [12] [13].**

35. Adjustment to **a supplier Standard Settlement Configuration (and** the**ir** SSC-TPR**)** seems to offer a practical, low-cost and ready solution for both the supplier and for Elexon within the current settlement set-up.

[11] Albeit, notably, not for the customer's *actual* use in a given half-hour – only for consumption within that time-block – eg x units consumed in 3.5 hours over the peak period.

[12] i.e. suppliers billed with greater accuracy *across a shorter time-block* (half-hourly consumption still *assumed*) – rather than against *assumed* usage for each customer spread over 48 half-hours in Load Profile 1 (on the basis of their 'annual advance'). In turn, this can result in reduced industry charges for the supplier. So, for example, where the trial customers had a *recorded **lower** kWh consumption between 16.30 and 19.30h*, the supplier could derive a benefit from a reduced Transmission Energy Consumption tariff

[13] **Transmission Network Charges**. Almost three-quarters of transmission network use of system charges are levied from demand (rather than generation). Load Profile 1-8 customers are responsible for ~half of all annual electricity consumption – i.e. 167 TWh of 322 TWh in 2011.

For non half-hourly metered Load Profile 1-8 customers, annual transmission network use of system charges incorporate a pence/kWh locational charge (ie *energy*-related) which incorporates a peak-time element (16.00h – 19.00h all year).

The **transmission energy consumption tariff for non-half hourly metered customers** is based on the annual energy consumption for each supplier in each zone (as per settlement) during the period 16.00 – 19.00h each day (settlement periods 33-38) over a (financial) year. Annual transmission network use of system charges for non half-hourly metered customers incorporate a locational pence/kWh charge (ie energy-related) with a peak-time element (16.00h – 19.00h all year) For example : North Scotland Zone – 1.48p/kWh ; Southern Zone – 4.34p/kWh (NG Demand Charges from April 2012

By contrast, half-hourly metered customers pay demand charges (£/kW) in 14 Distribution zones via locational TRIAD charges – so charges are based on ***actual*** metered usage in those half-hours. (2012-13) (North Scotland zone - £10.74p/kW ; London zone - £31.17/kW - plus a non-locational charge (£22.83p/kW in 2012-13 irrespective of zone).

Distribution company interface - and meter registration process

36. A distribution company is presently responsible for the meter registration process in its geographic area - and for notifying the identity of each individual meter and its registers to the Elexon systems (but is not responsible for recording and transmitting the actual meter data).

37. EDF Energy therefore needed to register their new meters and the planned changes to the SSC-TPR with the appropriate distribution company : new meter identity, electricity units to be recorded on three separate registers, in four time blocks). The distribution company then processed EDF Energy's proposed SSC-TPR changes in the meter registration system.

38. Completely separately from the meter registration process, a distribution network may anyway wish to be aware of potential changed consumption patterns by groups of customers on their network – not least, at particular locations on the network, the DNO may find reduced usage at peak times of potential benefit.

Supplier commercial view-point – conclusion

39. From first developing their three-rate ToU tariff proposal, it took some time for EDF Energy to successfully register the SSC adjustments with both Elexon and with the distribution company, to implement the changes needed to the EDF Energy billing systems.

40. However, once beyond the 'development' stage, the EDF Energy EDRP ToU trial demonstrates how it was practical for a supplier to successfully introduce a ToU tariff for small / household customers currently classed in the Elexon system as Load Profile 1. As noted, a meter must have more than one register – and a means to switch the registers on and off at pre-specified times. (For the future, a smart meter).

41. Thereafter however, the necessary 'back-office' steps proved relatively fairly straightforward, relatively low-cost – and replicable in principle.

42. From a supplier commercial perspective**,** the ToU tariff should produce cost-savings by allowing EDF Energy (1) to purchase wholesale electricity - and (2) to settle more accurately at the individual customer-level on the number of units recorded by the separate registers in the meter – rather than against the standardised half-hourly volume allocations based on Load Profile 1.

43. The smart meter also enabled EDF Energy to bill their customers more accurately using current billing-software for a three-rate ToU tariff with three (or more) time-blocks.

Commercially, this can improve internal cash-flow ; reduce individual cost-to-serve ; and generally improve customer relations**.**

Part 2 - Customer : arrangements with supplier and trial outcomes

44. Following the steps outlined above, EDF Energy was then in a position to put in hand arrangements to approach their customers**.**

Trial Recruitment

45. 200 credit and monthly direct debit customers were recruited to the trial in London and the south-east, to reflect the required demographic profile for a representative sample. Customer feedback suggested a lack of understanding on customers' part as to why a supplier might help customers to save money – which made recruitment a challenge.

46. The ToU trial tariff was offered for 2 years. Post-trial customer feedback was generally favourable. The tariff could be altered by EDF Energy on a business-as-usual basis if needed - and the customer was free to leave the trial at any time.

Trial Outcomes (AECOM pp 144-6)

47. The AECOM analysis for the EDF Energy ToU tariff found that :

- **Load Shifting** – there was a significant ($p<0.05$) overall reduction in the percentage of consumption that occurred in the peak tariff period.
- Estimates of the magnitude of shifting vary between AECOM & EDF Energy. **AECOM suggests this was 'up to 10%' (EDF Energy analysis suggests ~7%).**
- There were effects on shifting load from the peak period.
- There was a stronger load-shifting effect at weekends than on weekdays. The weekday effect was similar each day.
- **The effect was stronger with smaller households** (1 or 2 people age 16-64). With each additional person in 16-24 age group, proportion of

consumption during peak-time increased by 4.3 % (& 3.7% for each additional child under 16). So, peak load for the ToU tariff group was reduced for smaller households - but for larger households , relative peak time consumption actually increased. Tipping point seemed to be 3 people.

- **Persistence** : ToU tariff customers made significant reductions in year 1 – but these did not persist (possibly attributable to lack of on-going messaging / advice).

- **Demand Reduction** – EDF Energy found a small but significant difference in electricity consumption between ToU trial group & control group, not accounting for baseline consumption. Comparing with baseline (AECOM, not EDF Energy analysis), there was a large reduction in energy use but it was not statistically significant (or meaningful) because the sample size was too small for households where both in-trial and pre-trial data were available. The effect on overall consumption is therefore noted as 'unproven but plausible'.

- AECOM wider analysis noted generally that for ToU tariffs : 'the limited evidence from the UK suggested only small reductions in overall electricity demand (3% or less) should be expected'.

Feedback from Customer Focus Groups (EDF Energy)

48. **Post-trial customer research showed that customers liked** :

- Simple interfaces ;

- 'Real-time' data ;

- Getting the basics right - such as education on how to get the best out of the product ;

- 'Actual' billing.

49. Customers rated the EDF Energy ToU tariff high both in terms of 'engagement' and 'impact on behaviour' but rated the tariff with its somewhat basic display as 'neutral' on 'usability'.

50. From a customer perspective the following were regarded as successful features of the trial by EDF Energy :

- The technology very largely worked successfully.
- Customer concerns regarding estimated bills & access by meter readers were addressed.
- Some behavioural change prompted.
- Often only one household member interacted with the Smart Meter. Leaves an open question of how to get multiple household members to interact ?
- Compared with other trial interventions, customer cost-saving motivation most directly met by ToU Tariff.
- Immediacy of ToU preferred to some other interventions (eg enhanced billing)
- How to convey £ savings more clearly to re-inforce benefit of using smart meters.
- Trial participation successfully persuaded those who were sceptical beforehand.
- Forecasting future energy use and offering bespoke customer 'targets' worthy of more exploration.

51. **Customer Understanding of the ToU Tariff –** a limited customer understanding of a ToU tariff - and the notion that costs vary at different times of day in the electricity system - was initially a deterrent to trial recruitment. EDF Energy customer services successfully explained the TOU concept – and wholesale cost issues etc to the EDF Energy trial participants. EDF Energy obtained explicit customer consent for access to / use of their customer meter data for the purposes of the trial.

52. **Customer concern that ToU Tariff could adversely affect their bills** - Shortly after the start of the trial, some customers with smart meters received estimated rather than accurate bills in error. These problems were quickly resolved – but from customer reaction to the estimated bills it was evident that **ToU trial participants had a concern that the ToU tariff might have an adverse impact on their bills.**

53. **Other interventions to support ToU tariff –** A fridge magnet with a simple display of the time-blocks turned out to be an effective customer communication tool for this simple static ToU tariff – and more so than the somewhat basic in-home display also used. A fridge magnet would not suffice for dynamic tariffs eg CPP – high / low CPP – where a communication tool more sophisticated than a fridge magnet would be needed.

54. **Customer drop-out from ToU trial -** the ToU trial, compared to other interventions trialled in EDRP by EDF Energy, showed a relatively low loss rate (on average there was a collective loss-rate on all interventions of around 17% over the trial period).

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.

Sustainability *First*'s trustees are: Ted Cantle (Chair); Phil Barton (Secretary); Trevor Pugh (Treasurer); Richard Adams; Sara Bell; John Hobson; Derek Lickorish; Derek Osborn; David Sigsworth. 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.

Sustainability First
10 Dean Farrar Street
London
SW1H 0DX

www.sustainabilityfirst.org.uk

Email info@sustainabilityfirst.org.uk

Sustainability *First*