Sustainability First

GB Electricity Demand Project – *realising the resource*

Paper 8

Electricity Demand and Household Consumer Issues

By Gill Owen, Sharon Darcy & Judith Ward
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Sponsored by : BEAMA ; British Gas ; Consumer Focus ; EDF Energy ; Elexon ; E-Meter (a Siemens business); E.ON UK ; National Grid ; Northern Powergrid ; Ofgem ; ScottishPower Energy Networks ; UK Power Networks; Vodaphone.

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** is a three-year project (2011-2014) focussing on the potential resource which the electricity demand side could offer into the GB electricity market, through both demand response and demand reduction.

Key themes for the project include:

- Customer Response and Consumer Issues.
- Commercial and Regulatory Issues.
- Public Policy Issues.

The project 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 ; Vodafone (previously Cable & Wireless); Consumer Focus; British Gas ; EDF Energy; Elexon; E-Meter Strategic Consulting (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 include the sponsors together with DECC and key consumer bodies: Energy Intensive Users Group, Consumer Focus, Which?, and National Energy Action.

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

The project is:

- Evaluating and understanding the potential GB electricity demand-side resource across all economic sectors (including the role of distributed and micro-generation) ;
- Developing a clearer understanding of the economic value of this resource to different market actors and to different customers over the next 10-15 years ;
- Evaluating 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:

- 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 the electricity demand-side (DSR & electricity demand reduction) in Electricity Market Reform.

The work programme is being delivered through the Smart Demand Forum, through wider stakeholder events, and through twelve published papers.

Additional expertise and inputs are provided by Serena Hesmondhalgh of Brattle Group who has developed a quantitative all-sector electricity end-use demand model. Stephen Andrews is supporting the project on Distributed Generation and Micro-Generation.

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

GB Electricity Demand - Publications to date

	Project papers – www.sustainabilityfirst.org.uk
1	**GB Electricity Demand – context and 2010 baseline data**
2	**GB Electricity Demand 2010 and 2025 – Initial Brattle Demand-Side Model : scope for demand reduction and flexible response .**
3	**What demand-side services could customers offer?** **Household customers. Industry customers.**
4	**What demand-side services can provide value to the electricity sector?**
5	**The electricity demand-side & wider energy policy developments**
6	**What demand-side services does Distributed Generation bring to the electricity system?**
7	**Evolution of commercial arrangements for more active customer & consumer involvement in the electricity demand-side.**
8	**Electricity demand and household consumer Issues** (July 2013)

Paper 8 : 'Electricity demand and household consumer issues'.

July 2013

The remaining four papers under Year 3 of the project will be as follows:

9	**GB Electricity Demand 2010 and 2025. Which electricity demand-side measures might offer most 'bang for your buck'?.** This paper will revisit and expand the electricity demand-side model developed by The Brattle Group for the project's Paper 2.
10	**The electricity demand-side and local energy: bringing locational value to the electricity system**
11	**How might innovation and connected-customers and consumers transform the electricity demand-side in the longer term?**
12	**Bringing it all together: how can the electricity demand-side play in the electricity market?**

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July 2013

Executive summary

An active electricity demand-side offers the potential for customer benefits and more cost-efficient operation of the electricity system.

This paper considers the key household consumer issues of developing demand response in the electricity market. The paper examines three main types of electricity demand response product - static time of use tariffs (TOU), critical peak pricing tariffs (CPP) and direct load control (DLC). These are the three DSR products examined in the Redpoint/Baringa/Element Energy work on DSR in 2012 for DECC.

Parts 1 and 2 of this paper discuss the likely costs and benefits to household consumers of DSR, including possible winners and losers.

Part 3 discusses a number of areas where further thought is likely to be needed on protections for household consumers, especially the more vulnerable, as ToU and other 'smart' tariffs and services begin to be offered.

Costs and benefits of DSR

We reviewed a number of key reports to identify costs and benefits of demand response. Although benefits have been modelled no one (apart from some work by Ofgem) has attempted to quantify the costs of DSR and most reports say very little about costs. This is because costs are considered hard to quantify and also because it is assumed that some costs are being incurred anyway (e.g. smart meters) and therefore should not be attributed to developing demand response.

A robust estimate of the costs of introducing DSR was beyond the scope of this paper. However, we have undertaken a qualitative analysis of the cost items (and risks to market actors including customers) that should be attributed to demand response.

We take the benefits to be those assessed by Redpoint/Baringa/Element Energy.

These are some of the key cost/risk items that we consider can be attributed to DSR (i.e. over and above any costs assumed as part of the smart meter roll-out).

- Customers - upgrading to smart appliances or retrofitting control devices; time to research and switch to DSR and the inconvenience of participating. The main risk is that they do not make a financial saving on their bills in switching to a DSR product.
- Suppliers - costs related to changes in billing systems; costs in developing, marketing and recruiting customers to DSR tariffs.

- Distribution network operators - operational and capital costs associated with re-designing and building parts of their networks to facilitate DSR.
- Settlement - changes to the settlement system.
- If customers respond by shifting usage to lower priced off-peak periods or reducing total demand, then this reduces revenues for suppliers and DNOs.
- However, networks are allowed to recover revenue up to their regulated revenue cap (this might involve rebalancing charges between customers).
- Many suppliers should be able to reduce costs (lower network costs and reduced wholesale purchasing costs) such that lost revenue is not a problem.
- For suppliers who also own generation however, revenue may also be lost on the generation side – impact will depend upon effects on variable and fixed costs, and scope for profits from generation at high priced peak demand times (latter may be important to balance profit fluctuations on the retail side).
- If suppliers can replace profit lost in selling fewer units by selling DSR equipment or services, then DSR could become more profitable for them.

Voluntary TOU tariffs for households - who wins and who loses

Allowing consumers to choose TOU or other DSR tariffs if it suits them sounds initially very good from a consumer perspective. However, those with peaky demand/large loads may be less likely to choose a ToU tariff. If only those with non-peaky demand choose DSR, this will not deliver value to the electricity system as this requires people with peaky demand changing their behaviour.

What about households who remain on non-DSR tariffs in a voluntary DSR world? In theory they would neither lose nor benefit but in practice the effects will depend upon impacts of DSR tariffs on supplier revenues and whether they choose to rebalance DSR tariffs or other tariffs if the impact is negative. This in turn will depend upon the effectiveness of competition for different types of customer - for example would the non-adopters of ToU tariffs tend to be "sticky" customers?

Universal TOU tariffs would ensure that everyone pays based on costs they impose on the system - those with peaky use would have an incentive to reduce or shift to off-peak times. But this would create large numbers of winners and losers. In parts of California and Victoria in Australia the customer backlash led to cost reflective pricing being halted.

Mandating ToU retail prices for everyone is likely to be a non-starter politically. However, if widespread TOU and other DSR pricing is considered desirable, there may be no need to

mandate at retail level. Rather, by changing underlying industry incentives on retailers - such pricing would become more the norm in the future.

Retailers do not currently face time varying costs – wholesale or network - for household customers. However, once smart meters are rolled out this will increase the ability of retailers to match wholesale costs to particular households' demand profiles (half hourly settlement). Furthermore, as more wind comes onto the system the potential savings in wholesale costs from DSR are likely to increase. In addition to half-hourly settlement, if network charges to household customers were to become capacity based or locational or time varying (as they already are in the I&C sector) - this may further incentivise retailers to offer DSR tariffs to more customers. This is under early discussion in the common charging methodology group.

DSR offers to household customers - issues arising

In Tables 5-7, we explore issues to consider from a consumer viewpoint for three main types of DSR tariff – ToU, CPP, DLC. The consumer issues include:

- Simplicity of tariff design & ease of tariff comparison;
- Consumer choice & suitability of tariffs for different consumer groups;
- Impact on ability to switch / degree of consumer 'lock in'.
- Remote control / automation;

Some principles for customer focused DSR

The development of smart markets could represent the biggest change in the energy sector for domestic consumers since the introduction of competition. Ensuring that the regulatory regime is ready for such a significant change is important if consumers are to be empowered and protected. We propose a set of principles – on a 'straw man' basis - by which to judge the DSR market and particular offers:

1. **Clear objectives and consumer outcomes** (e.g. lower prices, accuracy of billing, reduced energy consumption, protections for vulnerable consumers etc.)
2. **Distributional impacts** - have these been taken into account?
3. **Clarity** - how clear / simple is the DSR proposition?
4. **Appropriateness of the tariff** to the consumer's circumstances
5. **Information** - adequacy, accessibility, comparability and privacy issues

6. **Flexibility** to switch between tariffs without significant penalties
7. **Choice** – on matters such as: automated response and controls and over-ride facilities; data sharing.
8. **Timing** – of offers - e.g. are they part of a wider energy efficiency scheme or on the back of new tighter product standards?
9. **Intermediaries and aggregators** – can customers access these and provide data to them if they wish; regulatory and consumer protections.
10. **Dispute resolution and remediation** - clear responsibilities and processes.

The paper's main recommendations include:

- The implications of DSR - and possible gaps in consumer protections - need consideration by regulators and policy makers alongside the Retail Market Review and in advance of DSR offers being widely marketed.
- The distributional impacts of the DSR market, particularly for vulnerable households, need to be kept under review. This will include the implications of unwinding cross subsidies and tariff rebalancing.
- The differences between automation for DSR and load limiting for debt control need to be clearly articulated and communicated to avoid consumer confusion and potential negative reactions to DSR automation options. Ofgem's vulnerability strategy will provide the opportunity to consider issues relating to vulnerability in this market.
- Automation may provide many benefits to consumers and help market actors more readily obtain value from DSR. However, a number of important consumer issues need further understanding, including: consumer willingness to accept automation; how frequently consumers wish to over-ride automated response; the practicalities of over-ride features – and the consequence for consumers' bills if regularly used.
- Consumer in-put is needed into the development of Automated Frequency Response. This should include household consent, consumer rewards for agreeing to frequency response, any impact on product functionality.
- Opportunities to support vulnerable customers - e.g. by using the Green Deal and the Energy Company Obligation (ECO) should be explored. One option may be to extend the ECO so that DNOs can install energy efficiency measures for vulnerable consumers on constrained parts of their network.
- In a world where DSR offers may be more prevalent, Ofgem will need to understand the competitiveness of the DSR market, including any differences in switching rates for customers on DSR and standard tariffs.

- Given the UK does not have much of a peak problem pre-2020 suppliers should mainly continue to trial DSR tariffs such as TOU, CPP and DLC rather than rolling them out more widely in the short term.

- In the short term, DSR tariffs are likely to be most appropriate for people with electric vehicles, heat pumps and solar PV. In return for a low-carbon incentive (FIT, RHI, other), these customers could perhaps be required to sign up to DSR products together with a smart meter. Extra protections may be needed by vulnerable consumers, particularly when such technologies have been installed by a third party such as a social housing provider.

- A phased development of DSR could provide a window to 2019 to do more on demand reduction – and to focus on measures that will reduce peak as well as overall demand. Another area for short term action might be increasing availability and take up of DSR ready appliances - for example via incentives or appliance standards.

Conclusions

Many of the issues raised in this paper are complex and challenging. We see this as the start of a wider discussion which others will wish to take forward as we move forward to smart meter roll-out and beyond.

Finally, there is the question of whether the recent concern about generation capacity shortages may change the short term prospects for DSR - i.e. do concerns about higher and / or more volatile gas prices and plant closure create a new impetus to reduce peak and overall demand before 2020? This may also reinforce the case for more work on demand reduction – particularly to reduce usage at peak times. Clearly however, should UK gas prices benefit in the medium-term from rapid global growth in non-conventional gas, this position may change again.

Introduction

The purpose of this paper is to consider the key household consumer issues in developing the electricity demand side.

Three broad areas are covered in the paper:

- **Part 1 - Costs and benefits of a household demand side in the electricity system.**
- **Part 2 - Who wins and who loses.**
- **Part 3 - DSR offers to household customers : issues arising and what consumer safeguards may be needed.**

This paper looks at electricity demand response only (not demand reduction) and we examine three main types of electricity demand response product - static time of use tariffs (TOU), critical peak pricing tariffs (CPP) and direct load control (DLC). These are the three DSR products examined in the Redpoint/Baringa/Element Energy work on DSR benefits in 2012 for DECC.

Many of the issues raised in this paper about evolution of the electricity demand-side as seen from a largely householder perspective are complex and challenging. We see this paper as the start of a wider discussion – and which others – including the regulator, government, market actors and the consumer bodies will wish to understand and take forward at a practical level, as we move forward to smart meter roll-out and beyond.

Three important areas not covered in this paper, but which also warrant consideration are:

- The potential implications of moving to more cost-reflective retail tariffs across all electricity customers – industry, commercial and household – and therefore the associated impacts of unwinding any hidden cross-subsidies which may exist between and within these groups of consumers .
- The household consumer issues likely to arise from development of dual-fuel and gas smart markets.
- Consumer concerns with data privacy and protection.

Contextual issues that will influence domestic consumer behaviour

The context in which DSR is introduced could have a significant impact on consumer willingness to respond to DSR offers. Residential users will not see DSR offers in isolation but as part of a series of changes. Previous papers from the GB Electricity Demand project have explored some of these issues in detail. However, it is worth highlighting four key energy market contexts likely to shape the development of DSR – smart meters, the retail market review, Green Deal and ECO, and adoption of low carbon technologies.

Smart metering

Experience with the smart metering roll-out could impact on willingness to engage with DSR. Many consumers may not distinguish between smart meters and the new tariffs that meters make possible. For example, if the roll out leads to disruption or inaccurate bills this may make some consumers view DSR in a less favourable light. Ensuring that consumers understand the information on in-home displays and how this relates to bills will be essential. Privacy concerns need to be addressed to avoid risks of a backlash that could reduce willingness to engage in DSR.

States such as California which introduced ToU tariffs at the same time as smart metering have felt this effect acutely. GB has chosen to separate out the two changes and ensure that consumers are able to exercise choice. In GB, whilst suppliers will have a right of access to monthly data for billing, consumers will be able to opt out of sharing their daily energy consumption data and will be required to give explicit (opt-in) consent to suppliers to access half-hourly energy consumption data, or to use data for marketing. This staging and giving people control over data should improve consumer perceptions of DSR offers.

Ensuring that lessons are learnt from smart metering trials and the Foundation phase of the roll out should help mitigate the risk of a negative impact on the potential take up of DSR measures. The new Central Delivery Body (CDB) being established by DECC by end-June 2013 will clearly play a critical role in building consumer understanding and support.[2] However, the extent to which changes can be made as the programme progresses will be limited in some areas, as key decision points, such as meter specifications, will have passed.

Although the remit of the CDB is the smart meter roll out, it may also become involved in the development of DSR. Divisions in the roles and responsibilities between the CDB and Ofgem will need to be clear.

[2] Smart metering implementation plan, Government response to the consumer engagement strategy, DECC, December 2012.

Ofgem's Retail Market Review (RMR)

Tariff complexity and proliferation, and the resultant consumer confusion and distrust in the supply market, was one of the driving forces behind Ofgem's RMR. If the review increases consumer confidence in the market, it could have a significant impact on the development and take up of DSR tariffs.

It is too early to say what will be the impact of the RMR proposals, given that they will not come completely into effect until March 2014. Although the proposal is to restrict core tariffs to four for electricity and four for gas, once online and offline offers and different payment methods have been taken into account, this will still leave consumers facing a choice between 48 core tariffs, even before the additionally permitted dual fuel, bundle discounts and regional variations have been taken into account.

DSR offers will sit alongside and in addition to these core offers. Suppliers will be able to offer four tariffs per fuel (four electricity and four gas) for each type of ToU meter that can support them, including Economy 7, Economy 10, Dynamic Tele-switching (DTS) and any other smart meter type (e.g. SMETS 1 or 2). Following concern from the industry that such limitations would stifle innovation in ToU tariffs, Ofgem will also allow derogations for the trial of novel ToU tariffs, providing certain conditions are met to ensure it is a true trial. These include the extent to which the tariff is marketed and whether it is only available in a limited geographical area.

Ofgem has committed to review the impact of the RMR changes by no later than 2017, and may review specific issues such as smart markets developments before then. An earlier stock take may be necessary if providers start marketing DSR offers in the early stages of the smart meter roll out, to ensure that consumer interests are protected at such a crucial and informative time.[3]

The Green Deal (GD) and the Energy Company Obligation (ECO)

Two policies which could have a particular bearing on domestic consumer views of DSR are the GD and ECO. Although these policies currently do not include DSR measures, Sustainability First's Paper 5[4] has explored the scope that they could play in terms of achieving DSR in on-peak electric heating. To maximise the impact of this, attention should be given to the way in which DSR is integrated with these programmes. Regulatory change may be necessary as there may be little incentive on suppliers to extend their ECO packages to include DSR. In other jurisdictions, such as Ontario in Canada, smart tariffs have benefited from being introduced as part of a longer term (three year) energy efficiency plan. Others have recommended that ECO should be extended to allow behaviour change

[3] RMR –final domestic proposals, Ofgem, March 2013.
[4] Sustainability First. GB Electricity Demand Project. Paper 5. The electricity demand-side and wider policy developments. November 2012.

programmes to compete for subsidy if they can demonstrate energy saving which could also have a beneficial effect on DSR uptake.[5]

Low carbon technologies

Sustainability First GB Electricity Demand project Papers 5, 6 and 7 explored the potential demand side roles for technologies such as PV and Electric Vehicles (EVs). These are important for a number of reasons.

Once residential consumers start to engage in these technologies they move from being passive consumers to 'prosumers', actively participating in the market, as a producer or potential source of local energy balancing or storage (as is hoped will be the case with EVs). With higher knowledge levels and a personal stake in the energy demand / supply balance, these consumers are more likely to be interested in participating in DSR. As early adopters, there is potential for them to help champion DSR in their localities.

However, there is a significant risk that this potential could be overshadowed by the down side of DG and EVs in the energy supply / demand balance. When these technologies are installed in geographical clusters they can cause or contribute to constraints on the electricity network at peak times. The costs of the reinforcement necessary to deal with these are currently socialised and smeared across the customer base. If the wider public becomes sensitised to this, there could be a backlash against people using these technologies, many of whom (if they have installed the technology themselves rather than having had it installed as part of a social housing programme) tend to be better off. If they are seen as free riders, personally reaping the benefits of the technology but not paying their fair share of the costs, they are unlikely to be viewed as credible advocates of DSR initiatives. Growing political concern around paying for environmental initiatives could accentuate this problem further.

One way round this would be for people with DG or EVs to pay more to cover these costs, as we began to explore in Paper 5 and consider further in this Paper. However, in the absence of data on who has these technologies and is using them at peak, this will be difficult. Smart metering should improve the availability of this data.

[5] Smarter, greener, cheaper, Policy Exchange, January 2013.

Part 1 - Costs and benefits of demand side response by households

We have reviewed a number of recent key reports on DSR to identify costs and benefits of demand response. In doing so we have found that although benefits have been modelled (e.g. Redpoint Energy, Baringa and Element Energy for DECC in 2012; NERA/Imperial for DECC 2012) no one[6] has attempted to quantify the costs of introducing DSR and most reports say very little about costs.

The Redpoint Energy, Baringa and Element Energy analysis was focussed on the benefits of DSR and did not attempt to estimate the potential costs for DSR as a whole or the different DSR products. They noted that there is a need for a "greater understanding of the costs that might be involved for all agents."

Nera/Imperial said: "We do not consider the cost of DSR explicitly in the study given that the cost of the main enabling infrastructure (i.e. the smart meter rollout) will have already been incurred before 2020…. Further infrastructure investment may be needed... However, estimates of these costs are currently unknown and it was beyond the scope of this analysis to build this evidence base." [7](p.3)

A 2006 Foresight study for BIS found that "To support the implementation of DSM, various sensors and advanced measurement and control devices will be required, accompanied by much more sophisticated energy metering and trading functions…here needs to be a comprehensive analysis of the costs and benefits of installing such a sophisticated infrastructure." [8]

Thus costs of DSR have not to date been assessed mainly because the costs are considered hard to quantify and also because it is assumed that some costs are being incurred anyway (e.g. smart meters) and therefore should not be attributed to developing demand response.

In view of the many unknowns, it would require considerable detailed work to build up a robust estimate of the costs of introducing DSR and this was beyond the scope of this paper. However, we have undertaken an assessment of what costs should and should not be attributed to the three DSR products for the household sector – ToU, CPP and DLC. This produces a qualitative analysis of the cost items that should be attributed to demand response, together with some indications of possible costs or the materiality of costs, using such information as is available. We have separated out costs into:

- Upfront and ongoing costs of implementing (for suppliers and networks) and participating in (for customers) DSR.
- Risks of DSR for the various market actors – networks, suppliers, customers.

[6] Apart from Ofgem in 2010 who had figures for some costs
[7] NERA and Imperial – understanding the balancing challenge. August 2012
[8] Strbac, 2006 Demand-side management: benefits and challenges. Foresight paper for BIS

This analysis is summarised in Tables 1, 2, and 3.

As regards the benefits of the three DSR products for the household sector we use the Redpoint Energy, Baringa and Element Energy figures.[9]

1.1 Benefits of DSR

In 2012, Redpoint Energy, Baringa and Element Energy considered the benefits associated with three different household demand side response (DSR) tariffs (TOU, CPP and DLC) up to 2030.[10] The analysis considered estimates of the take up of DSR tariffs and consumer response (load shifting) as a result of the tariff. A number of scenarios and sensitivities (extent of electrification of heat and transport) were modelled to calculate the potential generation capex savings, generation operation savings (fuel and carbon price, operation and maintenance and start costs) and distribution network savings.

In the modelling, DSR had very limited impact on transmission costs so these are not included in the benefits. However, it was noted that transmission cost savings might increase in the future if there are more intermittent renewables.

The different DSR products considered by Redpoint Energy, Baringa and Element Energy were:

- **Static Time of Use (TOU) tariff**; different unit prices defined for different blocks of time across the day. The same peak tariff window was considered for all years modelled.

- **Critical Peak Pricing (CPP)**; a pre-specified high tariff for usage during periods of stress on the system. Consumers receive notice of the critical peak period e.g. one day ahead. This tariff applied for 30 days a year for a 3 hour peak on top of the STOU tariff.

- **Direct Load Control (DLC)**; an incentive based tariff (e.g. customers offered a bill discount for agreeing to load control), where consumers electrical equipment can be remotely controlled. Two variants were modelled; LC1 where load control is only available for 30 critical days and LC2 where it is available every day.

[9] We note that there are other estimates of benefits such as those by NERA/Imperial and no doubt there will be further estimates produced in future. For ease of analysis in this paper we needed to choose one set of benefit figures.

[10] Redpoint Energy, Baringa and Element Energy (taken from Annex F of DECC Electricity System: Assessment of Future Challenges – Annex)

The results were found to be very much dependent on the level of electrification of heat and transport, the take up of the different tariffs and consumer responses to the tariffs. Redpoint Energy, Baringa and Element Energy note that "the results and findings of this work should be approached with a degree of caution; however, we have aimed to present the main caveats and uncertainties."

The majority of benefits in the model from household DSR are associated with avoiding building additional generation capacity (OCGT) and not reinforcing the distribution network (linked to peak reduction). The load control tariff (LC2), however, produces greater generation operational savings (£40m to £160m in 2030) as it flattens the demand load profile rather than just reducing the peak. This is potentially a more direct and real time benefit from DSR.

Redpoint/Baringa/Element only modelled one product (static ToU) for 2015, probably reflecting a view that there is limited value in DSR in the short term and also that limited DSR activity is likely to occur until smart meters have been rolled out to most customers (2019). In 2015, the static ToU tariff would produce benefits of £15m in reduced generation operating costs. There are no savings in generation capital costs or network costs, which reflects the fact that reductions in capital costs will only be realised longer term when new investment is required (to meet demand increases, or for replacement). Although Ofgem has warned that the UK may face a power generation shortage in the next couple of years, it is unlikely that sufficient DSR could be developed in such a short period to make an impact on short term investment requirements.

In 2015 the above cost savings would give a benefit of £7.50 per customer who takes up TOU (assumed that 2 million take it up), or £0.55 if shared amongst all customers. In both cases, Redpoint/Baringa/Element assume that all cost savings are passed through to customers. In practice, of course, it is likely that some of the cost savings would be retained by suppliers and/or networks.

For later years (2025 and 2030) the annual savings in costs produced by the modelling are much more significant for generation costs than distribution costs. For example:

- In 2025 savings under the LC2 product are £50m in avoided distribution costs, £160m in avoided capital and fixed costs of peak generation capacity (OCGT) and £50m in unconstrained generation costs.
- In 2025 savings under the TOU product, are £30m in avoided distribution costs and £115m in avoided capital and fixed costs of peak generation capacity (OCGT) and £25m in unconstrained generation costs.

The analysis finds a reduction in the average wholesale price of around £1.3/MWh or 2% in 2030 for the load control tariff. The annual wholesale purchase costs savings (as seen by suppliers) ranged from £7 (STOU) to £34 (LC2) per household on the DSR tariff in 2030.

These price reductions could be considered as a proxy for the incentive for suppliers to undertake DSR.

If cost savings were equally shared amongst all household customers the average saving across all three types of DSR product per household would be £10 in 2025 and 2030. Savings are higher in high demand as opposed to low demand scenarios and range from £5 (low demand, ToU) to £16 (high demand, LC2)

If all the system savings are passed *only* to households who participate in DSR then these households will receive larger annual savings – *but all other households would see no benefit*. These targeted savings range from £15 per customer p.a. on a static ToU tariff to £90 in the high demand LC2 scenario in 2030.

Redpoint/Baringa/Element also found that there could be the risk of creating new peaks as the number of heat pumps increases. In the modelling, to avoid the peak period (5-8 pm) some heat pump demand was shifted to the 3-5pm period, but this coincides with the non-domestic peak and hence increases the system peak. To resolve this would probably require automatic control to stagger the times of heat pump demand or increasing the level of storage in heat pumps.

1.2 Costs of introducing DSR

In this section we assess the cost items for introducing DSR in terms of investments of time and money upfront or ongoing costs to provide it. We bring all these together in Tables 1, 2 and 3.

Ofgem noted that many costs of introducing DSR are one-off and upfront, although some are more ongoing.[11] Redpoint/Baringa/Element identified that costs associated with DSR would include the cost to consumers (in terms of the loss of utility and infrastructure needed), and costs to suppliers and other players in the market (i.e. IT systems and advertising).

Some of the costs of developing DSR are included in the costs of installing smart meters. This clearly includes the meters themselves, associated IT and communication systems (so, DCC) and installation costs. Although not stated explicitly, the April 2012 Impact assessment suggests that many of the costs of introducing or participating in static TOU and CPP tariffs are included in the assumed costs of smart meters, but that this is less likely to be the case for the costs of DLC. "Other tariffs could also include automation, for example through remote control of appliances by a third party or programmable appliances, and could be driven by price or non-price factors (such as network conditions). Although automated TOU tariffs may have the largest potential for load shifting, consumers' willingness to use

[11] Ofgem DSR discussion paper 2010

such automated tariffs has not yet been fully tested, while communications requirements and protocols are yet to be fully costed."[12]

However, whilst infrastructure costs for TOU and CPP would appear to be largely captured in the smart meters costings,[13] a number of other costs of new tariffs appear not to be included, as we note under each item below where appropriate.

1.2.1 Costs of DSR for different market actors

Customers - upgrading to smart appliances or retrofitting existing time-flexible appliances with dynamic demand control devices. If they are rolled-out to the mass market Ofgem's view was that these technologies are likely to add about £5 to the production cost of an appliance and are likely to decrease over time. At present however, the costs for some such controls may exceed the benefits, particularly due to the lack of market-ready availability of some technologies, as has been found by the Northern Powergrid Customer Led Network Revolution (CLNR) project. Frontier Economics noted that the cost of DLC control for refrigeration, for example, was considered to be in excess of the value to be obtained from controlling it, in the CLNR trial (and hence this option was excluded from the trial) [14].

Customers - the time involved in researching and switching to a DSR tariff and the inconvenience of participating. Ofgem's research into the energy market has revealed that many customers consider the level of expected savings from switching tariffs to be not worth the hassle of switching tariffs. Many people stated they are too busy to think about switching.[15] As discussed in Part 3, there will be some inconvenience associated with varying the times at which household activities are carried out, such as using appliances or cooking meals. However, should automated devices become widespread, the inconvenience should reduce. Thus in terms of DSR products, TOU could be considered least convenient (because it requires a day in day out response), DLC most convenient (as most of the response is automated) and CPP in the middle (as the response is required on a smaller number of days or times than static TOU). Alternatively, some consumers might find it easier to provide the same response day in day out rather than only on some days. Frontier Economics and EA Technology, in work for the DECC / Ofgem Smart Grid Forum, valued customer inconvenience costs to achieve demand response at 20p per kWh shifted.[16]

[12] DECC smart meter IA , April 2012 (p.52)
[13] Redpoint/Baringa/ Element note that there would be some additional "smart system" requirements for CPP such as an upgraded IHD and an addition consumer gateway for the Consumer Home Area Network.
[14] p.82-3
[15] Ofgem. Energy Supply probe 2008 findings and other reports
[16] Cited in Neuberg, Consumer Focus. Smart grids and consumer issues. Position Paper p. 40

Suppliers may incur costs related to changes in their billing systems with the introduction of new tariffs, although many of these costs may already be being incurred through the introduction of smart meters. More specifically (and probably not included in the smart meter costs) **suppliers will incur costs in developing, marketing and recruiting customers to DSR tariffs**. These costs are likely to be similar to the costs incurred more generally in changing tariffs.

Distribution network operators will incur costs to facilitate DSR. Ofgem noted that these will include **incremental operational costs and capital costs** associated with re-designing and building parts of their networks to allow DSR to facilitate an increasing proportion of variable and distributed generation on their networks**.** Strbac noted potential ICT costs to facilitate the control of generators, loads and various network devices.[17] ICT costs could be incurred integrating the electrical delivery system and the information system (communication, networks, and intelligent equipment) that controls it. Strbac also noted that "DSM-based solutions tend to increase the complexity of the system operation when compared with traditional solutions – *e.g. o*perating the power system with a corrective control approach. However, the reduction in costs of DSM technologies, should in future make DSM significantly more competitive." DNOs might also face costs in adapting (reinforcing) local networks to facilitate upstream DSR in transmission networks.

Settlement – Ofgem noted that some static tariffs that encourage DSR can be accommodated within the current settlement system arrangements. Smart meters will facilitate a greater range of tariffs and once they are widely rolled out, the settlement system is likely to be revised to provide more frequent (up to half hourly) settlement for all customer groups. Changes to the settlement system are likely to be made when smart meters have been widely rolled out and Ofgem is just at the start of a consultation process. Settlement costs do not appear to have been included in the smart meter IA costs. Sustainability First's Paper 7[18] explores how basic static ToU or load-control tariffs could be introduced today with some modest low-cost adjustments within existing settlement arrangements. Tariffs such as CPP and / or more dynamic tariffs would however require fundamental changes in settlement, and most likely full half-hourly settlement.

Regulation - Ofgem may incur costs as its policies and procedures adapt to the complexity of DSR, to put in place consumer empowerment and protection measures and meet the challenge of protecting vulnerable consumers in smart markets.

[17] Strbac, G. 2006 Demand-side management: benefits and challenges. Foresight paper for BIS

[18] Sustainability First. GB Electricity Demand Project. Paper 7 'Evolution of commercial arrangements for more active customer and consumer involvement in the electricity demand-side'. April 2013

1.3 Risks of DSR

In addition to looking at the costs of introducing or signing up to DSR it is also important to understand any risks that may be faced by suppliers or DNOs or customers.

For customers the main risk is that they do not make a financial saving on their bills by switching to a DSR product. Customers could find that they are no better off and in the worst case might even be worse off. This could happen if they have much peakier demand than they thought they had and/or do not shift or reduce their demand sufficiently to reduce their bills. It may take some time for a customer to work out whether or not they are benefitting. Concerns about whether or not they are likely to benefit or whether changed usage patterns can be sustained will make some customers wary of taking up DSR products.

If customers respond to DSR products by shifting usage to lower priced off-peak periods or reducing total demand, then this will result in lower revenues for **suppliers and DNOs**. Frontier Economics in a paper for the Australian Energy Markets Commission (AEMC) modelled the impacts of a range of time of use tariffs and found that "changes in tariffs and demand response are likely to diminish the revenues earned by retailers and network businesses… in the short term where these tariff levels are fixed there will be "lost revenue" from all customer types who move to time-sensitive tariffs and reduce their peak load."[19]

As regards the impacts on **networks** Frontier considered that "For network businesses, most costs represent capital investment decisions that are already sunk and which cannot be reversed or altered. Network businesses would find it difficult if not impossible to reduce costs in line with reductions in revenue due to lower consumption in the short term. Absent any other measures, this would be likely to lead to reduced profit for the network businesses in the short term and may lead to under-recovery of costs for the businesses."

However, as Frontier note, the **networks** are regulated businesses and therefore "regulatory arrangements would ensure cost recovery by allowing increases in revenue from other areas (for example via higher fixed charges on customers who remain on time-invariant tariffs)." This means that customers would in effect compensate networks for any lost revenue and this might mean differential impacts on different customers (see box below for details of how network charges are structured). Over the longer term however "new capital investments would be made with regard to reduced peak demand levels leading to lower overall costs to meet demand"

Frontier noted that many **suppliers** should be able to reduce costs such that lost revenue is not a problem "For retailers of electricity, who pass-through network costs and can control energy costs via prudent financial derivative contracting and wholesale energy purchases, it will be relatively easy to adjust to altered levels of consumption by customers in short term.

[19] Retail tariff model. A report prepared for the AEMC. Frontier Economics. August 2012

As such, retailers should be able to match reductions in revenue due to reduced consumption with reductions in costs in the short term."

Other risks for **suppliers** are associated with non-delivery of the demand side – be that in the Balancing Mechanism or in the future Capacity Market, as we have previously noted in Annex 1 of our Paper 7.[20] Where a supplier has over-contracted in the market, their imbalance charges are likely to be relatively modest – especially where the market itself is also 'long' / over-contracted. However, if DSR customers fail to reduce their peak load as expected a supplier could face a significant financial risk (higher imbalance charges) due to being under-contracted at gate-closure – especially if the market is also short. In the capacity market, there will be penalties for non-delivery. This will mean that suppliers will face penalties if they under-deliver the DSR they have bid into the market.

This all reinforces the point that DSR may require upfront extra costs by market actors and customers that may or may not deliver benefits over the medium to longer term.

[20] Sustainability First. GB Electricity Demand Project. Paper 7 'Evolution of commercial arrangements for more active customer and consumer involvement in the electricity demand-side'. April 2013

Box 1: Network charges

Network charges

Ofgem sets the total amount of revenue that the distribution and transmission companies can collect from customers over a price control period, but does not directly control how this is apportioned between customers. Network charges to suppliers (and on to customers) are determined by an industry agreement according to a common methodology, which has to be approved by Ofgem. For customers with half hourly meters, (large and medium businesses) some of the network charges are time varying (based on three different time bands) and some are based on capacity and thus reflect peak related costs. For household customers and small businesses, network charges are a combination of a fixed charge per customer and a unit related charge (not time varying). Once smart meters are rolled out, this would create the potential to develop network charges for all customers that vary according to capacity or time of day, although the extent to which this would be reflected through in the retail price to the customer will depend on the nature of their tariff or energy contract with their supplier.

If a business customer pays capacity charges or time varying charges, then they can reduce the network charges they pay by opting for a lower capacity limit or shifting usage to off-peak periods. In these cases, the network (DNO) would recover lower revenue from those customers, and would have, in the short term, the ability (within its overall revenue allowed by Ofgem in the price control period) to rebalance charges to customers, using the common methodology to recover the lost revenue. DNOs can change their charges at any time but typically do so no more than twice a year. However, given that around 87% of use of system charges are unit-related, the impact on other customers would be small. Moreover, at the next price control period, the benefit of any reductions in future network costs (capital investment or operating costs) due to reduced peak demand should be passed through to customers in the form of lower allowed revenue, which in turn will result in lower network charges to all customers.

Tables on costs and benefits for those involved in demand response[21]

Table 1 : Costs and benefits for stakeholders involved in Time of Use pricing

Potential benefit ***Materiality***	**Benefit recipient**	**Potential costs** ***Materiality***	**Bearer of costs**	**Potential risks**	**Bearer of risks**
Potential bill savings – passive if most use is off-peak; or if can shift time of use or reduce usage *Materiality – depends how much use is peak or off-peak and how much can be reduced or shifted*	Household customer who opts in to time of use	Search and switching costs; costs of changing behaviour *Materiality – depends how much use is peak or off-peak and how much can be reduced or shifted*	Household customer who opts in to time of use	Potential bill increases if a lot of use in peak periods and cannot shift for some reasons	Household customer who opts in to time of use
Flatter demand profile leading to enhanced network utilisation	DNO	Costs of introducing time varying network charges (to charge to suppliers and on to customers)	DNO	Demand doesn't flatten enough to reduce costs	DNO (and on to customers in network charges)
Scope to defer or avoid network augmentation costs if peak demand reduced or growth is slower *Materiality depends on : (i)Scale of load reduction at peak (ii) firmness of customer response (iii) Relative cost of augmentation (iv) impacts on system losses*	DNO (& pass through to supplier and end customer through lower network charges)	Costs of introducing time varying network charges *Materiality – not likely to be material relative to the scale of the benefits*	DNO	Demand doesn't flatten enough to reduce costs; impacts need to be very localised to produce value for DNOs	DNO (and on to customers in network charges)

[21] These tables are based on similar tables that were prepared by NERA in Australia and published in - 'Revised Demand Side Response and Distributed Generation Case Studies'. NERA, August 2007

Potential benefit ***Materiality***	**Benefit recipient**	**Potential costs** ***Materiality***	**Bearer of costs**	**Potential risks**	**Bearer of risks**
More cost reflective charges for using the distribution network (and less need to pay for use at peak times)	Suppliers (& pass through to end customer in time of use tariffs)	Costs of designing, marketing and recruiting to time of use tariffs *Materiality – not likely to be material relative to the scale of the benefits over time (assuming benefits are realised)*	Suppliers		
Reduced peak electricity purchasing costs (a potential benefit if not sufficiently hedged against peak prices)	Suppliers (& pass through to end customer through lower wholesale costs)		Suppliers	Reduced peak sales revenue (if peak units are profitable)	Generators and Suppliers
		Settlement system modifications	Suppliers	Risk of imbalance charges if demand not sufficiently reduced at peak	Suppliers

Table 2 : Costs and benefits for stakeholders involved in Direct Load Control

Potential benefit ***Materiality***	**Benefit recipient**	**Potential costs** ***Materiality***	**Bearer of costs**	**Potential risks** ***Materiality***	**Bearer of risks**
Potential bill savings from allowing load to be reduced at peak times *Materiality – depends how much controllable load the customer has (but assume only customers with sufficient load would be offered this and opt in)*	Household customer who opts in to DLC	Search and switching costs; costs of changing behaviour Costs of controllable appliances *Materiality – depends whether any subsidy available, whether costs are mainly incremental costs for new appliances being bought anyway. Costs may be higher for early adopters but then reduce.*	Household customer who opts in to DLC		
Flatter demand profile leading to enhanced network utilisation	DNO	Capital set up and implementation costs for DLC	DNO	Demand doesn't flatten enough to reduce costs; impacts need to be very localised to produce value for DNOs *(risk likely to be lower for DLC than TOU)*	DNO (and on to customers in network charges)
Scope to defer or avoid network augmentation costs if peak demand reduced or growth is slower *Materiality depends on : (i)Scale of controllable load at peak (ii)extent of any customer over-ride (minimal if managed through aggregation and diversity) (ii) Relative cost of augmentation (iv) impacts on system losses*	DNO (& pass through to supplier and end customer through lower network charges)	Capital set up and implementation costs for DLC including any kit required in customers' properties as well as the network. *Materiality – could be substantial particularly in early phases where learning is still taking place.*	DNO	Demand doesn't flatten enough to reduce costs *(risk likely to be lower for DLC than TOU)*	DNO (and on to customers in network charges)

Potential benefit ***Materiality***	**Benefit recipient**	**Potential costs** ***Materiality***	**Bearer of costs**	**Potential risks** ***Materiality***	**Bearer of risks**
Cost reflective load control network charges	Supplier (& pass through to end customer who opts in)	Costs of designing and marketing and recruiting to DLC tariffs *Materiality – not likely to be material relative to the scale of the benefits over time (assuming benefits are realised)*	Suppliers		
Reduced peak electricity purchasing costs (a potential benefit if not sufficiently hedged against peak prices)	Suppliers (& pass through to end customer through lower wholesale costs)		Suppliers	Reduced peak sales revenue (if peak units are profitable)	Suppliers and Generators
		Settlement system modifications	Suppliers	Risk of imbalance charges if demand not sufficient reduced at peak *(likely to be lower than risk for TOU)*	Suppliers

Table 3 : Costs and benefits for stakeholders involved in Critical Peak Pricing

Potential benefit *Materiality*	**Benefit recipient**	**Potential costs** *Materiality*	**Bearer of costs**	**Potential risks** *Materiality*	**Bearer of risks**
Potential bill savings –if can shift time of use or reduce usage at CPP times *Materiality – depends how much can be reduced or shifted*	Household customer who opts in to CPP	Search and switching costs; costs of changing behaviour *Materiality – depends how much can be reduced or shifted*	Household customer who opts in to CPP	Potential bill increases if demand not reduced at CPP times	Household customer who opts in to CPP
Scope to defer or avoid network augmentation costs if peak demand reduced or growth is slower *Materiality depends on : (i)Scale of load reduction at peak (ii) firmness of customer response (iii) Relative cost of augmentation (iv) impacts on system losses*	DNO (& pass through to supplier and end customer through lower network charges)	Costs of introducing capacity based or CPP network charges *Materiality – not likely to be material relative to scale of benefits*	DNO	Demand doesn't flatten enough to reduce costs; impacts need to be very localised to produce value for DNOs *(risk likely to be lower for CPP than TOU)*	DNO (and on to customers in network charges)
Cost reflective CPP network charges	Supplier (& pass through to end customer who opts in)	Costs of designing marketing and recruiting to CPP tariffs *Materiality – not likely to be material relative to scale of benefits over time (assuming benefits are realised)*	Suppliers		
Reduced peak electricity purchasing costs (a potential benefit if not sufficiently hedged against peak prices)	Suppliers (& pass through to end customer through lower wholesale costs)		Suppliers	Reduced peak sales revenue (if peak units are profitable)	Suppliers and Generators

Potential benefit ***Materiality***	**Benefit recipient**	**Potential costs** ***Materiality***	**Bearer of costs**	**Potential risks** ***Materiality***	**Bearer of risks**
		Settlement system modifications	Suppliers	Risk of imbalance charges if demand not sufficiently reduced at peak *Likely to be lower for CPP than TOU*	Suppliers

Part 2 – Who wins and who loses from DSR

2.1 Impacts of voluntary TOU tariffs on household customers who take them up, and those who do not

Within the GB context it is assumed that DSR products will be developed by energy suppliers and introduced on a *voluntary* basis, with customers choosing whether or not to take them up. This differs from some other countries (usually where retail prices have not been de-regulated or have only been partially de-regulated) where ToU or capacity based tariffs are mandatory for all customers. However, in one market where prices have been de-regulated – Ireland – the regulator (CER) has signalled its intention to mandate time varying pricing for all electricity customers with smart meters and is currently working on options for implementation of the mandate.[22]

As the Redpoint/Baringa/Element work shows, if the benefits of DSR were to be shared between all customers then the estimates of amount saved per customer potentially becomes very low (in 2025 or 2030 possibly only £5 per annum, as opposed to £15-90 per annum if just shared with the participating customers). To get customers to be willing to provide DSR will probably require the benefits being shared just with those customers – and indeed this is how one would expect DSR to be delivered, with different tariffs for those on DSR and those who are not. What does this mean for those who do not take up DSR tariffs? In theory their rates/bills should not rise - they will just not get a benefit. However, there are a number of possible impacts on those who do not take up DSR.

To assess this we examine the example of voluntary ToU tariffs (see box).

Participants in DSR tariffs will potentially be divided into three groups – those who save money; those who pay more; those who see no change. Here is a hypothetical worked example.

The following assumptions are used (some of them chosen purely for simplification purposes):

- 30% response rate to offer of ToU tariff (based on Ireland trial response rate).
- Customers who do not take up the tariff continue to pay the same as before.
- 3.5% bill saving for those who benefit (average saving in Ireland)[23].
- For this example we assume those who lose pay 3.5% more.

[22] Commission on Energy Regulation. Decision on the National Rollout of Electricity and Gas Smart Metering. July 2012. Smart meters are to be rolled out to all customers by 2019.
[23] Trial peak-shift : ~8.4%

- We assume a significant bias in take up towards customers who win from the switch to a voluntary ToU tariff (as those who think they are likely to lose are unlikely to switch).
- We assume average revenue from switchers and non-switchers pre ToU is the same (to simplify the example).

Box 2: Worked example of a voluntary TOU tariff

Worked example of voluntary TOU tariff:

- Supplier revenue earned for 100 customers pre ToU (covers costs and margin) - £50,000 or an average of £500 per customer.
- 70 customers do not change tariff (do not take up ToU) – so revenue still £35,000.
- 30 customers change to ToU tariff of which :
- 20 save money by switching to ToU – pay £482.50 (3.5% reduction) instead of £500 = £9650
- 6 pay the same - £3000.
- 4 pay more - £517.50 (3.5% increase) each so - £2070
- Total revenue from ToU tariff customers - £35,000+£9,650+£3,000+£2,070 = £49,720.
- Supplier has now lost £280 of revenue (0.55% of revenue) (or an average of £2.80 per customer over the 100 customers).
- If costs reduce by at least £280 = cost recovery and profit remain intact.
- If costs reduce by less than £280 supplier may face loss of profit (and in worst case may not recover all costs).

In the example in the box, if supplier costs (network charges; wholesale purchasing) have decreased by at least £280 (£2.80 per customer) then costs are still recovered. However, to go to the effort and cost of offering and running the tariff, it is likely that suppliers would be expecting costs to reduce by more than £280 so that there is some reward – extra profit – for developing, marketing and recruiting to the tariff. Prior to around 2020, as Redpoint/Baringa/Element have shown, these savings would need to come from reductions in generation operational costs as there will be limited impact on distribution and generation capital costs in the short term.

If supplier costs have decreased by less than £280, the supplier either has to accept a lower margin or recover revenue in some way. Accepting a lower margin may not be sustainable, so this means rates either to participants or non-participants (or both) will rise. There are a number of options as to how suppliers might respond in these circumstances.

- Suppliers may be more likely to raise rates to non-participants, because raising rates on the TOU tariffs would be likely to reduce take up.

- Suppliers might also be more likely to raise rates to those not on ToU tariffs as such customers might tend to be the least engaged and hence more "sticky" (i.e. less likely to switch supplier)
- However, the supplier might also decide to abandon TOU tariffs if they are not delivering value – in that case raising rates on TOU tariffs might make more sense to get customers to switch back to flat tariffs.
- Supplier behaviour will also be affected by the behaviour of competitors (who may or may not have time of use tariffs) and the competing offers that disgruntled customers might switch to.

A further important consideration for suppliers who also own generation is that revenue may also be lost on the generation side – the impact of this will depend upon the extent to which the loss is balanced out by a reduction in variable costs (e.g. fuel input, carbon price) or if it reduces recovery of fixed costs, or if it reduces the scope for profits from generation at high priced peak demand times (the latter may be particularly important to balance profit fluctuations on the retail side of the business).

However, there is a possible "silver lining" here – if suppliers can replace some or all of the revenue or profit lost in selling fewer units, by selling DSR equipment (e.g. controllable appliances; more high-tech IHDs etc.) or other demand side services (e.g. insulation, solar PV, heat pumps etc.) To customers on DSR tariffs. In that case, DSR tariffs could become more profitable for suppliers.

The above example considers some possible customer responses and customer and supplier impacts of voluntary time of use - there are clearly other possible outcomes. Customers who take up ToU tariffs may tend towards having larger or smaller than average consumption – bias in either direction could have different impacts on suppliers. Customers who take up ToU tariffs may reduce their demand or shift to off-peak periods by greater amounts. This could reduce revenue for suppliers further but may also offer the scope for greater cost reductions – but probably not in the very short term. The other option is that customers reduce or shift demand by lower amounts meaning that there is less impact on revenue but also less impact on costs – and suppliers could face the risks of unexpected imbalance charges through being under-contracted / "short".

2.2 Voluntary (opt-in) versus universal TOU tariffs

In the Great Britain market where customers have choice of suppliers and tariffs, it is assumed that DSR tariffs will be optional for customers. This raises the question of who is likely to sign up for such offers. In general, if one assumes rational behaviour, only those who will be likely to benefit would sign up. There are two ways of benefitting – passively if the customer has little peak demand; and actively, if the customer thinks they can shift demand. Unfortunately, the passive beneficiaries will not deliver any value to the system – they will in effect be free riders. Although of course, one can also consider them being

legitimate winners in a move to greater cost reflectivity – rewarded for their less peaky demand

In the Northern Powergrid CLNR trial many who have signed up to TOU think they already use most electricity at off-peak times. But the key may be in the word "think" – as reality may be different from perception, In practice it is likely that many customers have a limited knowledge of their usage at different times of day and therefore that many who opt into TOU will in fact be more peaky in their usage and have to shift demand to benefit.

However, perhaps the more serious problem will be people with large peaky demand who stay on flat tariffs to avoid time of use charges. This could be a particular problem with electric vehicles as, for the sake of convenience, many may prefer to charge them up whenever they wish without thinking about the cost.

Allowing consumers to choose TOU if it suits them sounds initially very good from a consumer perspective – but if the tariffs are to deliver value to the electricity system then this requires people with peaky demand going onto them and changing their behaviour.

In contrast to an opt-in approach, universal cost reflective pricing via TOU tariffs might ensure that everyone pays charges based on the costs that they impose on the system and those with peaky use would have an incentive to reduce or shift usage to off-peak times – but clearly this would create large numbers of winners and losers. **In a number of cases where TOU pricing has been introduced on a universal basis (e.g. parts of California and Victoria in Australia) it has led to a major customer backlash leading to cost reflective pricing being halted, at least for a period.**

Universal time varying pricing (such as TOU or CPP) would remove a degree of choice from customers but, putting that issue to one side, what would be the impact on suppliers? In these circumstances, suppliers might be expected to design time varying tariffs that would ensure their revenue does not fall below the level of cost recovery (including margin). Clearly this is not a perfect science, but with reasonable data on the range of customer daily profiles (which will become more available with smart meters), suppliers should be able to do this reasonably accurately.

Turning back to the impact on customers, we would expect to see a mixture of winners and losers rather than the expected bias to winners under voluntary ToU. However, as we saw above, if the winners on voluntary TOU reduce revenue for suppliers below cost recovery levels, this could potentially impact on those who do not take up TOU as well – there could therefore be losers among the general body of consumers even if ToU is voluntary.

2.3 Conclusions and recommendations on Parts 1 and 2

Universal static TOU tariffs for households are not likely to be a desirable or practical option in GB in the foreseeable future. Suppliers do not currently face time varying costs that can easily be attributed to particular household customers. Network charges for household customers are not time varying or capacity based and the lack of data on individual household daily demand profiles means it is not possible to attribute time varying wholesale costs to particular household customers.

However, the costs and risks of introducing voluntary static time of use tariffs could exceed the realisable benefits from DSR (based on Redpoint/Baringa/Element values) or at least to be so close as to negate the value, in the short term (pre-2020). There is likely to be more value in voluntary CPP or DLC (provided people with large flexible loads can be sufficiently incentivised to switch to them), but there will be additional costs to provide these forms of DSR (particularly DLC), including the need for half-hourly settlement for tariffs with a dynamic element.

This all suggests that whilst suppliers (in partnership with networks and others) are likely to trial DSR tariffs in the next few years, they are unlikely to roll out such tariffs on a widespread basis. Once smart meters have been more widely rolled out however, this could start to change as this will increase the ability of suppliers to match wholesale costs to particular households' demand profiles.[24] Furthermore, as more wind comes onto the system the potential savings in wholesale costs from DSR are likely to increase in future.

Another change that could help to facilitate more widespread use of DSR tariffs, would be if network charges to household customers were to become capacity based, or time varying, or to some extent locational. This would then further incentivise suppliers to offer DSR tariffs to more customers.

This would mean that, if universal DSR tariffs are considered desirable, there may be no need to mandate them at the retail level to achieve fairly universal use of such cost reflective pricing. It is likely that suppliers would turn most of their tariffs into ones that are time varying or capacity based, if faced with such cost reflective wholesale and network costs and the ability to attribute those costs to particular customers.

A number of options to consider are therefore:

- Network charges for household customers could move to a capacity and/or time varying basis. DNOs currently operate half hourly and capacity charges for all customers with half hourly meters, so presumably this could be done for everyone when smart meters have been rolled out. This would be for the industry group

[24] When smart meters installed on widespread basis, interval data is likely to be used for settlement.

(charging methodology) to work out. We understand that some of these issues are now under discussion. The feasibility of more directly reflecting the locational impacts of large new loads and / or low carbon clusters in approaches to distribution charges may also warrant consideration.

- Given we do not have much of a peak problem pre 2020, it may make sense to concentrate more on DLC and CPP for those with large loads in the short term rather than voluntary static TOU tariffs. DLC and CPP (price or rebate) could work as targeted options. CPP could be a cheaper way of getting most of the DLC benefits (though less firm). Both CPP, and DLC if dynamic, would seem to require half-hourly settlement.

- Suppliers should continue to trial static TOU, CPP and DLC.

  In the short term some DSR tariffs are likely to be most appropriate for people with EVs and heat pumps and solar PV. In return for a low-carbon incentive (FIT, RHI, other), these customers could perhaps be required to sign up to DSR products together with a smart meter. Extra protections may be needed by vulnerable consumers within these groups, particularly when such technologies have been installed by a third party such as a social housing provider, for example.
- DLC will have to be offered with an override capability to secure take up – CPP could be used alongside it to dis-incentivise too much use of the peak over- ride facility. Households could therefore have an override but might have to pay a peak price to use it.

- A phased development of DSR as outlined above could provide a window to 2019 to do more on demand reduction – and to include a focus on measures that will reduce peak as well as overall demand.

- Another area for short term action might be to examine ways of getting more DSR ready appliances available in the market on a voluntary (e.g. incentives) or mandatory (via standards set for new appliances) basis, albeit sensitive handling would be crucial[25]. (The Australian Government is currently consulting on a proposal to mandate the inclusion of 'smart appliance' interfaces in air conditioners, pool pumps, water heaters and electric vehicle chargers.[26]) See also appendix on the ENTSO-E proposals on the Demand Connection Code.

Finally, there is the question of whether the recent concern about power generation shortages may change the short term prospects for DSR - i.e. do concerns about higher gas prices and

[25] See Annex 2 on ENTSO-E Demand Connection Code. See also 27-28 April 2013. Daily Telegraph; Mail on Sunday 'Big Brother to Switch Off Your Fridge'.
[26] DRET. Consultation Regulation Impact Statement: Mandating 'Smart Appliance' Interfaces for Air Conditioners, Water Heaters and other Appliances. http://www.energyrating.gov.au/products-themes/demand-response/

plant closure create a new impetus to reduce peak and overall demand before 2020? In this context it is worth noting that the impact on OCGT investment is assumed to be a main effect of DSR by Redpoint/Element. This may also reinforce the case for more work on demand reduction – particularly to reduce usage at peak times. Clearly however, should UK gas prices benefit in the medium-term from rapid global growth in non-conventional gas, this position may change again.

Part 3 - DSR offers to customers – issues arising and what consumer safeguards may be needed

Part 3 of this paper is organised as follows. It begins by examining the willingness of domestic consumers to respond to DSR offers and accept changes in usage patterns. The role of automation, digital connectivity in the home, direct control and customer over-rides are discussed. The consumer issues that are raised by different types of DSR offers are then explored along with the question of how consumers make choices in smarter markets.

The regulatory and other safeguards which may be needed to protect and empower consumers, particularly the vulnerable, in a smarter world are then examined

Part 3 concludes by noting those areas which in our view require further consideration and discussion by Ofgem, the government, market actors and the consumer bodies.

Annex 1 discusses DSR offers and consumer behaviour. Annex 2 briefly sets out the current position on the ENTSO-E Demand Connection Code.

3.1 Consumer willingness to engage in DSR offers

As noted in the introduction of this paper, four key developments in the energy sector are identified as having a potentially significant impact on DSR uptake and may act to 'frame' the consumer response:

- The success of the smart meter roll out;
- Changes in tariffs following Ofgem's Retail Market Review and whether they are able to rebuild confidence in the energy sector;
- The success of the Green Deal / Energy Company Obligation; and
- The uptake rate of low carbon technologies.

The analysis in Annex 1 shows that there are often strong correlations between the drivers likely to influence consumer willingness to participate in DSR. For example, low income households in the private rented sector may be less able to engage in DSR. However, it is difficult to draw generalised conclusions about how particular groups of consumers will react to DSR.

Table 4 is a simplified summary of the potential willingness of different consumer segments to engage in DSR and the likely future trends for each factor (in arrows in brackets).

Table 4 The potential willingness of different consumer segments to engage with DSR

Driver of behaviour	**Most willing**	**Least willing**
Household income	• Consumers on low incomes with flat load profiles (↑) • The 'squeezed middle' who are interested in financial saving (↑)	• Consumers on low incomes who want certainty for financial planning and are loss averse (↑) • Consumers on high incomes who are not interested in saving money (↓)
Household size and composition	• Single person households (↑) • Homeworkers (↑) • The technologically savvy (↑)	• Large families (↓) • Families with young children (↑) • Vulnerable older consumers (↑) • People with medical conditions that require reliable supply (-) • The technologically averse (↓)
Household stability	• Settled households (↓)	• Households undergoing transition (↑)
Tenure	• Homeowners (-)	• Tenants in the Private Rented Sector (↑)
Type of heating	• Electric heating with storage (↑)	• Electric heating without storage (↓)

Source: Sustainability First

In order to realise the potential of DSR, providers will require a much more sophisticated understanding of consumer behaviour in a smarter world. This has been recognised by the Thames Valley Vision LCNF project which is seeking to explore versatile customer segmentation. It is important that such modelling work is shared widely and that the implications that it has for consumer safeguards are understood by regulators and policy makers.

3.1.2 Consumer willingness to accept changes in usage patterns

The willingness of consumers to change their usage patterns will depend to some extent on whether their usage is discretionary or not. The definition of discretionary load is likely to vary between different groups of consumers and at different times of the day and year.

The Cambridge Electricity Policy Research Group (EPRG) survey in 2010 found a significant willingness amongst consumers to accept changes in appliance usage patterns.[27] In another European survey[28] the degree of demand shifting that was acceptable varied across household appliances but was generally high (77% accepting a shift of three hours for washing machines and tumble dryers). This survey did reveal that people were concerned about leaving laundry for a longer time as it might go mouldy or become creased and that dishwashers on timer delays could make a noise during the night. There were also some objections to smart operation of fridges and freezers due to concerns about safety and the potential for a reduction in food quality.

Both of the above studies have tested people's *attitudes t*o the idea of load shifting. Whether these stated intentions would be borne out in reality is another question. Many respondents to surveys display 'optimism bias' which is not always matched by actual behaviour. However, direct experience from the UK would seem to show that many consumers are willing to change their appliance usage patterns in response to tariff signals. Consumer Focus found that 50% of Economy 7 & 10 customers deliberately run appliances, other than water and space heating systems, at off peak times to save money.[29] It should be noted that many of these consumers may have been on Economy 7 or 10 for quite a long time and were not all given regular information on how to get the most out of their tariffs. With better and more regular information, even more load shifting may have been possible.

Willingness to change usage patterns will also be influenced by whether the financial rewards are enough for the inconvenience that may be caused. The first half of this report has described how if all of the savings from DSR identified by the Redpoint, Baringa, Element Energy analysis were shared out equally amongst households this would lead to marginal financial savings. Many consumers may not consider a saving of £1.73 per week adequate compensation for having their load remotely controlled.[30] Financial savings at this level may be insufficient to spur and sustain behaviour change. However, if energy prices increased significantly above those used in the modelling, this could lead to greater potential financial savings.

[27] Quoted in Pollitt et al, op cit.
[28] Cited in Demand-Side Response in the Domestic Sector – a literature review of major trials. Frontier Economics and Sustainability First. August 2012. Report for DECC
[29] From devotees to the disengaged – Economy 7, Consumer Focus, October 2012. Economy 7 & 10 tariffs give 7 or 10 hours at lower rates – the former at night-time only, the latter gives 7 hours at night and 3 hours in the afternoon. Households historically had these tariffs to run electric storage heating and heat hot water, but can also run other appliances at the lower rates in the off-peak periods.
[30] Electricity System Analysis – future system benefits from selected DSR scenarios. Redpoint Energy, Baringa & Element Energy. August 2012. op cit.

3.2 Automation

Although consumers may be willing to try and shift their load, the extent to which they do this in the absence of automation or remote control, is open to question. Automation offers the potential to make DSR more firm (reliable) and hence give it greater value to suppliers and networks – this means customers could potentially be paid more for automated than non-automated DSR. However, for automation to play a part in DSR, consumers need to either buy smart systems and appliances or buy and use adaptors (such as smart plugs) and communications devices to help their existing appliances work in a smarter way. As noted in Part 1, this may represent a potential additional cost to the customer.

The Redpoint, Baringa, Element Energy analysis for DECC[31] assumes that by 2030, the contribution of normal appliances to demand shifted by customer intervention is just 20% for consumers on standard ToU tariffs whereas for smart appliances it is 40%, for consumers on standard ToU tariffs and 60% for consumers on CPPs. This modelling assumes that automation helps improve customer response.[32] Many trials have also found that automation improves customer response. It should therefore help ensure longer lasting and more persistent behaviour change.

European Directives such as the Energy Related Products Directive will enable electrical appliances that work in more automated ways. However, it will clearly take some time before all households have appliances which meet these standards given the stocks of old appliances and average length of appliance life. Whether consumers replace old appliances at the rates DECC have forecast, particularly in the current austere financial climate, is open to question.[33]

Research for Defra and DECC has shown that the main concern consumers currently have when purchasing new appliances is price (81%) and only then energy efficiency (52%).[34] A recent survey by Consumer Focus found that over a quarter of consumers were not concerned by the energy savings of new products, compared to other aspects of the purchase. White goods are likely to be replaced out of necessity - primarily because they are broken (56 per cent) or because of moving house (15 per cent) [35] - rather than for running-cost or environmental considerations.

[31] Redpoint, Baringa & Element Energy. August 2012. op cit.

[32] Redpoint, Baringa and Element Energy. Electricity System Analysis for DECC. August 2012. Load control tariffs are assumed in the modelling to contribute 100%. In practice, as they may have to be offered with an override facility to secure take up, they may actually deliver somewhat less than 100%.

[33] For example, on the 27th March 2013, The Daily Telegraph reported that DECC have calculated that people will replace their washing machines every 12 years but that data from the White Goods Trade Association would suggest that a good quality appliance can last for 10,000 hours. This would mean it would need to be used for 15 hours a week to wear it out in this amount of time.

[34] Pollitt et al, op cit.

[35] Under the influence – consumer attitudes to buying appliances and energy labels, Consumer Focus, December 2012

Whether consumers are willing to accept remote control of their appliances is another issue. Deliberative research by Ipsos MORI for Ofgem[36] in September 2012 indicates there is likely to be a reluctance amongst some consumers to accept direct control of appliances. Scenarios involving the restricting of power to certain appliances were seen by some as impractical and unfair particularly in respect of possible impacts on vulnerable consumers, those who work 9-5 and those with young families. Panelists argued that different individual appliances were critical to their lives, and this would vary by personal preference and life-stage. They indicated that they would not be happy to allow what they would see as company dictating their lifestyle. The preferred option put forward by participants was that they should be able to choose which appliances to turn on and off.

Research by Accenture found a limited appetite for 'usage adjustment,' defined as changing the time that you use appliances either through manual or automatic turning on and off of the device. Only 1% of people interviewed in the UK attached importance to this as part of an electricity management programme, compared to 27% of people in the US.[37]

The study by the Cambridge Energy Policy Research Group was more positive and found over 20% of respondents would agree to white appliances being interrupted in exchange for only 1% reduction of the electricity bill. Different demand response activities seemed to have similar acceptance rates with no significant difference between extending appliance cycles, interrupting white appliances, and presetting wet appliances.[38]

As heat pumps (HPs) and electric vehicles (EVs) are new technologies, introducing automation from the outset may be more acceptable than for appliances that consumers are used to dealing with through manual controls. However, consumers sometimes have low levels of confidence in new technology and may conversely be unwilling for this to be automatically controlled until they have become more familiar with it and understand how it works. It is worth noting that HPs and EVs will not necessarily come with in–built functionality to enable remote control. For HPs to be directly controlled, they will need to have smart thermostats. For EVs, the charging stations will need to have functionality so that they can communicate with the smart meter by the HAN.

The extent to which consumers would accept remote control of their HPs remains to be seen. However, it should be noted that the 501,000 consumers on radio tele-switching tariffs (RTS) already allow remote controlling of their storage heaters. Consumer Focus have said caution should be exercised around extrapolation from this to other consumers as many of those who are on RTS have not had a choice as to either the tariff or the type of heating system that they use. [39]The CLNR and LCL Low Carbon Network Fund trials will be testing acceptance of direct control of EVs and HPs and the I2EV will be assessing remote control of EVs.

Although remote control should in principle make DSR easier for the consumer and more financially rewarding due to its greater value to the electricity system, there may be

[36] Consumer priorities for electricity DNOs, Ipsos MORI research for Ofgem, September 2012
[37] Accenture op cit.
[38] Energy Policy Research Group. Cambridge. Pollitt et al, op cit.
[39] Consumer Focus. Smart Grid position paper. op cit.

significant consumer resistance. For example, in April 2013 there was a backlash in some of the GB press against frequency control, which for many could be conflated with other DSR interventions.[40]

This all suggests that:

- The products where consumers may be most open to automatic control may be heat pumps and electric vehicles. If their up-take is not as substantial as assumed in DECC projections, we may see a more limited role for automated response.
- Allowing some scope for consumers to manually over ride remote control is likely to be essential to achieve the benefits of firmer demand reduction without causing consumer backlash. Over ride could be used as a way of reframing the choice debate.

In principle at least, product standards may be the most effective way to deliver automatic control. ENTSO-E, established under the Third EU Energy package, has proposed in the draft Demand Connection Code to make the provision of certain types of in-built frequency response obligatory in some household devices like fridges and HPs. This is explored in more detail in Annex 2. Ensuring that there is consumer in-put into proposals will be extremely important, especially regarding customer acceptability, available benefits and how these are shared, as well as product functionality. Up-front incentives to buy such appliances might help to secure take-up alongside clarity about the frequency-responsive role and how the benefit is being shared with the customer.

The full potential of automation may be enhanced through a Home Energy Management System (HEMS). Various versions of these are already on the market, primarily for heating systems working through smart thermostats. Some can be controlled by text message from a mobile phone.

For suppliers to be able to directly control domestic load, they will need to communicate with a consumer's EV, HP and smart appliances either directly – or through the Home Area Network (the smart metering HAN for EVs and HPs and the consumer gateway HAN for smaller appliances). Interoperability is needed to maximize effectiveness and minimize confusion. Significant work is on-going in this area. Clarity will be needed on the exact roles and responsibilities, to build consumer confidence. For example, if there are problems with performance, will it be down to the supplier, the communications company or the consumer themselves to resolve?

[40] E.g. Daily Telegraph & Mail on Sunday. 27-28 April 2013. ('Big Brother to Switch Off Your Fridge' etc). BBC Radio 4 Today Programme. 29 April 2013 on ENTSO-E Demand Connection Code.

High speed broadband connections may also be important. Although fixed line broadband uptake in the UK is 67%,[41] this is still patchy, with many remote areas either not able to access it or only at slow speeds. The Government is aiming for everyone in the UK able to access broadband speeds of at least 2 megabits per second (Mbps) and 90% of the UK receiving far greater speeds (at least 24Mbps) by 2015.[42] If these plans are realized, this should make automated DSR easier.

The integration of household energy devices with digital communications systems may however, present new risks around data privacy and cyber security. Although these issues are not within the scope of this paper, experience in this area could have an impact on consumer willingness to engage with DSR offers.

Box 3: Early data communication lessons for DSR from the CLNR

Early data communication lessons from the Consumer Led Network Revolution (CLNR)

The CLNR trials are being run by Northern Powergrid and British Gas in the NE of England to test the value of DSR to the network and supplier and consumer acceptance. The residential trials for this project required the installation of HAN hubs and gateways to communicate with installed monitoring/intervention technology. These have raised various issues. For example, for the 'ZigBee' communication network, the location of the hub has in some instances been a challenge as existing routers can be out of sight and therefore wireless communication paths are obscured. The trial also found some consumers switch broadband off at various times for reasons ranging from energy efficiency to fire safety. Other problems with routers have included not having a spare ethernet ports for other connections and password maintenance.

Compatibility between hub devices from different suppliers is a consideration where more than one technology is required. (E.g. whole house monitoring, smart appliance, communications hub). Should connected home services become widespread, this may also influence choice as customers may not want numerous hub devices linked to different appliances in their home.

Although Smart Plugs have extended the range of the ZigBee network in homes, they are prone to accidental removal by customers or signal paths being interrupted by furniture / personal belongings. Hard wired Smart Switches are a more secure option in that they cannot readily be removed. However install times are increased and damage to decorations may result. .[1]

Source: CLNR LCNF progress report to Ofgem 2012

[41] Ofcom Communications Report August 2011
[42] Stimulating Private Sector Investment to achieve a transformation of broadband in the UK, DCMS, February 2013.

Box 4: Customer over-ride – impact on demand response

Customer over-ride – impact on demand response

The LIPA Edge Direct Control Programme applied automation without an accompanying peak price signal. Air conditioning units were externally controlled during critical peak events while the tariff structure remained unchanged so consumers did not have an economic incentive to shift their demand. Consumers had the ability to override and there was no financial penalty associated with this. Overriding rates were low, despite the lack of financial penalty.[1] More typically, in many trials, customers can override but would pay a higher unit rate for electricity used in the peak period.

The CLNR LCNF trial is exploring how consumers may react to and understand an override facility. Use of an over-ride facility could be more complex in larger households where people may end having to query their usage if different people in the house had exercised this without others knowing. Teenage children on their own in the house when their parents were still out at work in the early evening peak could be one such example.

3.3 Different types of DSR offers

In Tables 5-7, we explore possible issues to consider *from a consumer viewpoint* for three main types of DSR tariff – ToU, CPP, Load-Control. These include:

- Simplicity of tariff design.
- Degree of consumer choice.
- Remote control / automation.
- Impact on households' ability to plan.
- Extent to which the tariff may be unsuitable for certain consumer groups.
- Ease of tariff comparison.
- Extent of data protection concerns.
- Impact on ability to switch / degree of consumer 'lock in'.

It should be noted that the Tables relate to possible impacts *on the consumer*. For example, "planning" refers to planning activities in the household, and not planning from the suppliers or DNO's point of view. Similarly, reductions in bills are assumed as a direct financial saving to the household who signs up to a DSR product.

The extent to which different types of tariff may impact on consumers in a positive or negative way will clearly be influenced by the tariff design. For example, a tariff which only has 10 peak events in a year, where the consumer is given a day's notice of the change, will have a far less intrusive effect on people's lives than a tariff which may have 4 peak events in a week where only several hours notice is given. Systematic testing and trialling of different tariff designs will help in understanding how far they meet key consumer protection criteria.

Finally, it is important to note that some of the issues explored in Tables 5-7 are based on likely consumer perceptions – *rather than attempt to summarise hard evidence from consumer smart trials and pilots*.

The analysis in the Tables indicates that it is important that a common understanding of tariff terminology is agreed on to avoid confusion.

However, there is scope for even greater variation and complexity within each category. For example, tariffs can be varied by duration of price signal, frequency of signal, notice period, price point and weather conditions. In Italy, for example, Enel's smart meters enable six different tariffs, eight different daily periods, eight different types of days (including public holidays), three different weekly structures and eight different annual periods.[43]

Marketing of the different tariff types may add further complexity for the household consumer. DSR offers presented as lifestyle tariffs, pricing plans or energy or carbon saving tariffs can make it more difficult for the user to assess what is exactly on offer. If consumers are offered multiple or concurrent deals from suppliers, networks, aggregators etc. this is likely to complicate decision making further.

Another area which could add potential complexity is where consumers have tried a DSR offer and decide that this is not for them. Clarity will be needed as to the default tariff they would switch back to, unless they have made a positive choice of another tariff.

[43] Enel, smart metering conference, op cit.

Table 5 Static ToU tariffs – possible consumer issues to consider

Tariff Type	Variation	Consumer issues – pros	Consumer issues - cons
Static ToU	Fixed time bands set by company	• Some reductions in bills possible • Relatively simple to understand • Easier to predict whether this is a good deal	• More difficult for households who find it difficult to change usage patterns e.g. families with children and some older consumers • Takes time to adjust to new routine
	Time bands chosen by consumer from menu set by company	• Small reductions in bills possible • Relatively simple to understand • An element of consumer choice as own routine can influence time bands • Limited disruption to usage patterns	• Social norming more difficult if greater variety of time bands • Harder to predict if this would be good deal if it is a fully tailored tariff

Source: Sustainability First

Table 6 : Critical Peak Pricing tariffs – possible consumer issues to consider

Tariff Type	Variation	Consumer issues – pros	Consumer issues - cons
Critical peak or critical day pricing	Peak times advised ahead	• Some reductions in bills possible • Relatively simple to understand • If only limited number of peak events, little disruption to usage patterns	• Could make household planning relatively difficult if numerous critical peaks /days • Slightly more difficult if need a routine • Harder to predict impact on usage and if a good deal • Possible data protection concerns • More difficult for households who find it difficult to change usage e.g. with children & some older people • May lock consumer in for a specific period of time
	Peak times advised ahead combined with static ToU	• More significant reductions in bills possible • Bills likely to be lower than previous options under such a tariff	• Makes planning difficult • Difficult if need a routine • Hard to understand interaction between 2 tariffs • Hard to predict impact on usage and if a good deal • Possible data protection concerns • More difficult for households who find it difficult to change usage e.g. with children and some older people • More difficult for large households where communication of tariff details could be challenging • May lock consumer in for a specific period of time

	Shifting peak or fully dynamic tariff – e.g. wind twinning or modified pass through of day ahead prices	• More significant reductions in bills possible	• Planning very difficult • More difficult to understand / Complex tariff • Not good for consumers who need a routine • Need some degree of automation and HEMS - affordability? • Hard to predict impact on usage and if a good deal • Possible data protection concerns • More difficult for households who find it difficult to change usage e.g. with children and some older people • May lock consumer in for a specific period of time

Source: Sustainability First

Table 7 : Load Control Tariffs – possible consumer issues to consider

Tariff Type	Variation	Consumer issues – pros	Consumer issues – cons
Load control	Remote control of load for a limited number of days	• More significant reductions in bills possible • Relatively simple to understand • Consumer needs to take fewer actions themself to realise benefits • If only limited number of controlled days, little disruption to usage patterns • If only certain types of load are controlled (e.g. EVs) disruption to usage patterns is contained • Tariff can be constructed in such a way as to provide a minimum level of service that won't be controlled that could help certain vulnerable groups (type of PSO)	• Lack of control (unless over ride available) • Difficult to plan • Need high degree of automation and HEMS – affordability? • Harder to predict impact on own usage and if this would be good deal • May not be suitable for certain vulnerable groups • Risk of disruption if communications problems • Possible confusion – is change due to load control or appliance not working? • More difficult for large households and with children • May lock consumer in for a specific period of time

	Remote control of load every day	• Significant reductions in bills likely • Consumer needs to take fewer actions themself to realise benefits • If control is exercised consistently, relatively simple to understand • If control is exercised consistently, would enable planning • If only certain types of load are controlled (e.g. EVs) disruption to usage patterns is contained • Tariff can be constructed in such a way as to provide a minimum level of service that won't be controlled that could help certain vulnerable groups (type of PSO)	• Lack of control (unless over ride available) • Takes time to adjust to new routine and whether this is possible will depend on if control is exercised consistently • Need high degree of automation and HEMS – affordability? • Could lead to significant impacts on lifestyles • Harder to predict impact on own usage and if this would be good deal • Not suitable for certain vulnerable groups • Significant risk of disruption if communications problems • Possible confusion – is change due to load control or appliance not working? • Difficult for large households and families with children

Source : Sustainability First

3.3.1 Moving from selling electricity to selling energy services

Companies may not market DSR offers in isolation. In order to maximise behaviour change and energy management, consumers will need a high degree of digital connectivity and automation in the home. This could lead to the bundling of these different services providing a single point of contact that might be beneficial for consumers. The development of energy service companies in the household sector has been something of an elusive holy grail to date. Bundled services could in theory make this type of service offering more realistic.

New Entrants - joining the market, perhaps with experience of other sectors, such as the communications sector, could also have a beneficial effect on competition and innovation.

Bundled services – may not necessarily work in the interests of consumers, however. If DSR has little cost reduction value to suppliers, for example, due to the lack of guaranteed firm response, there is concern that bundles may be used primarily as a way of maintaining or increasing market share by making desirable consumers more 'sticky'. With more 'tie-ins', consumers may judge that the perceived if not the actual costs of moving are too great to make the switch. Bundled services can potentially make it more difficult for consumers to judge new products and compare offers. 'Confusion marketing' is common in more complex markets. It can lead to the development of service 'features' that the consumer does not understand and may not need or want but which serve to make choice more complex.

Switching - The roles that providers play in the switching process will be important to minimise barriers to switching. For example, in the mobile communications market, providers have taken advantage of the PAC code transfer process as a chance to make a better offer to get their customer to stay. The tools from behavioural economics which can be used to encourage engagement in the market, such as 'structured choice architecture', can also be used in this way to discourage change. As discussed in the section on regulation below, this will require more joined-up regulatory approaches in the smarter world.

3.4 Retail Market Review (RMR) - from simplification to sophistication

Concerns about tariff proliferation have contributed to the low level of trust in energy suppliers and are one of the main reasons behind Ofgem's Retail Market Review (RMR). The RMR aims to reduce and simplify the number of tariffs available. How DSR offers will develop within this landscape remains to be seen. Under the RMR proposals, in addition to their core standard tariffs, suppliers will be able to offer four tariffs per fuel (four electricity and four gas) for each type of ToU meter that can support them, including Economy 7, Economy 10, Dynamic Tele-switching (DTS) and any other smart meter type (e.g. SMETS 1 or 2). If these options are developed to the maximum extent possible, there clearly still is potential for consumers to be faced with a considerable number of tariffs in the new smart world.

The speed at which more sophisticated tariffs emerge could have an impact on the extent to which they are accepted by consumers. Waiting for the impact of the RMR reforms to be felt before developing ToU tariffs could be a sensible strategy for suppliers. However, given the smart metering roll-out there could be an argument that if suppliers do not follow up fairly quickly with DSR initiatives, they will have lost an opportunity while customers are still potentially actively interested in their energy use.

One option is for suppliers to take a gradual and evolutionary approach to the development of DSR. It will be important that market players 'don't over promise and under deliver.' If the industry starts by developing simple DSR offers (e.g. simple static ToU and simple load-management tariffs) and ensures that it learns from this experience and adapts accordingly, it is less likely to raise public concern about a new wave of tariff proliferation. Simple tariffs should also lead to cheaper billing systems and should be in the wider consumer interest. However, collectively, suppliers may feel that offering a limited number of simple DSR offers does not fit with the increasingly sophisticated customer segmentation approaches available to them, and which smart meter data could facilitate.

Some of the LCNF projects do seem to show that there is an interest amongst certain consumers to take up some DSR offers. For example, the CLNR project has enjoyed a high level of interest from residential customers wishing to join their ToU trial. Early conclusions are that 'The insight gained through the recruitment process here is contrary to the current perception that consumers require fewer options and reduced complexity in the tariffs system'.[44] In contrast, Consumer Focus has found that another current trial involving a dynamic tariff is finding it a challenge to sign up users as 'they have no way in advance of being able to predict what their bills will be (or conversely what sort of changes they will have to make to keep their bills at a certain level) on the tariff as they don't know in advance when the cheaper and more expensive times will be.'[45] In Annex 1 we discuss questions around how far trial participants may be 'self-selecting'. However, it is worth noting that commercially-driven tariff offers in the future may not offer the kind of safeguards common in trials e.g. (no 'losers') and customer inducements (to secure sign-up).

[44] CLNR Project progress report 4, June – November 2012
[45] Smart grids, Consumer Focus, March 2013.

3.5 How can consumers make good choices?

Good quality and timely information and advice is crucial to ensure that consumers get the most out of DSR offers. The energy efficiency guidance given at the smart meter installation visit should start to build consumer confidence in their energy supplier and engagement with their energy supply. With DSR products, similar upfront information will be important so consumers understand what is involved before they sign up. Consumers will also need regular feedback on their energy use.

Decisions and choices on whether a DSR offer is appropriate to a consumer's needs will become an increasingly complex task.

Data - Consumers will need to be willing to share quite significant amounts of data on their consumption patterns and maybe what types of appliances they have with potential providers - to be able to choose an appropriate tariff. They may also need to consent to have intelligent plugs on their big ticket items to collect usage information. Information on the state of digital interconnectivity will also be needed.

Providing at least nine months to over a year's worth of data to ensure that seasonal usage patterns are taken into account may also be important. For this to happen, consumers will have to opt-in to sharing half hourly meter data and have had a smart meter in place long enough to build estimates about future use.

How might consumers inter-act with their data? Many questions are still being considered as part of the smart metering programme. How will a consumer's past data become available to them (e.g. via the internet)? Might this include appliance-level information as well as half-hourly meter data? If via a supplier's (or other) web-site, will this lead to issues of data access, data security and trust? How will consumers download data to analyse usage and perhaps also control their HPs, EVs and appliances – be that via a mobile phone or other device? How might consumers be charged for their data and its use? Given that iPhones and HCT phones do not use Zigbee chips which are in many HANs, might this prove problematic?

Predicting DSR outcomes on consumer bills - Even with extensive data sharing, predicting impacts will be difficult given the number of variables. For example, the significant difference in GB temperatures between March 2012 and March 2013 (temperatures in London ranged from 21 degrees in 2012 to 3 degrees in 2013) will have had implications not only for heating usage but also behaviour, with more people choosing to stay at home and use electrical appliances. If less predictable weather patterns persist, consumers may find it difficult to assess whether future bill projections are realistic. Changes in wholesale market costs will also have an impact on dynamic DSR tariffs. If DSR bills do turn out significantly different to prior projections, consumers may perceive that they have been put on an inappropriate tariff and trust may be eroded.

Locational differences and tariff comparisons -. Network operators are likely to have an interest in DSR with a specific geographic / locational impact (to tackle network constraints

and/or avoid or defer investment). However, if DSR tariffs were offered on this basis, it could potentially make DSR tariff comparisons more difficult. Consumer Focus has found that regional variations are already significant for Economy 7 tariffs, ranging from 15 to 45 per cent for electricity used at off-peak hours. Supplier websites and price comparison sites do not clearly explain this, nor its implications for consumers in making accurate comparisons.[46]

Comparison sites – may be challenged with a high penetration of DSR and more variation between tariff types and structures. Similarly, if multiple DSR offers do develop, it will be increasingly difficult for Ofgem to prescribe a standard format in which these tariffs should be presented (as it is proposing through RMR.)

Sources of impartial / trusted advice on tariff comparison - any new complexity may bring about changes in who consumers seek out as providers of information and advice. Some research points to consumers being less trustful of information provided by a commercial company than a public body.[47] Accenture found that whereas globally 28% of consumers say that they trust their electricity providers to inform them to optimise their consumption, this falls to 16% in the UK. [48]

Some trial experience suggests that some consumers may indeed be sceptical as to why their supplier might wish to help them reduce their bills.[49] Sharing large amounts of detailed information may also require a strong sense of trust in their supplier. Consumer concerns around data privacy are not examined in this paper. However, it is worth noting that Logica have estimated that 34% of customers always opt out of allowing sharing of their data.[50] The Cambridge EPRG study in 2010 found that around half of respondents said that they would not agree to have their consumption data recorded by their energy providers.[51]

Working with trusted third party intermediaries, such as Citizens Advice and the Money Advice Service, local councils and social housing providers, is one way in which suppliers can get their messages more effectively across, giving people assurance that they will be helped through the process of choosing and using the new tariffs. These sorts of organisation are often adept at using local champions to promote behaviour change and facilitating peer to peer networks to provide advice and support.

To help consumers navigate their way through the different DSR choices, new comparison and intermediary services may also need to develop. We may see the emergence of 'fourth party' intermediaries - businesses who take on some of the functions of regulators and consumer groups and fulfil a far more active and tailored role for both individual and groups

[46]From devotees to the disengaged – Economy 7, Consumer Focus, October 2012
[47] Pollitt et al, op cit
[48] New Energy Consumer, Actionable insights, Accenture, 2011
[49] Sustainability First. April 2013. Paper 7. Annex 2. EDF EDRP static ToU household case study.
[50] Eco Environment and Consumer Attitude Survey, Logica, 2012
[51] Pollitt et al op cit.

of consumers in choosing their energy services.[52] However, such organisations could pose further regulatory challenges.

New bodies could of course emerge from the existing trusted third party intermediaries who already help many consumers with their switching decisions, whether this is on an individual or collective basis. These might be 'virtual' groups of a consumer segment, such as the savvy newly retired, or, discreet geographic groups. The latter would enable more focused local communications using organisations who know the area well. This could also be tied in to local community distributed generation (DG) initiatives. For example, in parts of Denmark the community use ToU tariffs to match their consumption to their local DG wind output. Community based meters on a street-by- street basis give traffic light signals to show when it's windy. If the red light shows, local people know they need to reduce their usage. These tariffs successfully leverage the desire of some people to be good neighbours.[53]

Energy use patterns and consumer circumstances are not constant. The right tariff today will not necessarily be the right choice tomorrow. Consumers may not necessarily know when a particular DSR tariff is no longer appropriate for them. For example, many people on Economy 7 tariffs use gas central heating, and therefore the tariff may not now suit them, depending upon how much electricity they use at night (e.g. summer hot water and appliances such as washing machines).54 Although consumers should clearly take responsibility for their own usage, a change in a consumer's circumstances (for example, a new heating system) may trigger the need for a review of the suitability of their tariff. One way of doing this may be to build upon recent proposals in the RMR for suppliers to advise certain customer groups of the Market Cheapest Deal. For example, an annual DSR tariff 'health-check' might assess suitability of a DSR customer's tariff against their usage pattern over the past year. This would require a sophisticated approach to customer relationship management, data analysis and timely communication.

Customer communication - A well thought-through consumer communications strategy may help to ensure that engagement is sustained and demand response is firm and persistent. There is some evidence that too much information can inhibit behaviour change. The SSE EDRP trial suggested that the provision of an IHD and web information *reduced* responsiveness of consumers to economic incentives. In many trials, simple sources of information such as fridge magnets and stickers have proved the most popular as they are clear, concise and durable. [55]

The information provided needs to extend beyond an explanation of the tariffs to also include interaction with heating systems or digital control devices and appliances. Information on how to use devices or timers without affecting functionality will be important. Without this,

[52] Consumer empowerment round table, Ofgem, March 2013.
[53] Smarter, cleaner, greener, Policy Exchange, 2013.
[54] Consumer Focus found this to be 66% and the CLNR 19% (Progress report, op cit). These households (or a previous occupant) may have used electric storage heating in the past and this is why the Economy 7 tariff was chosen originally.
[55] Demand side response in the domestic sector, literature review of major trials, DECC, Frontier Economics and Sustainability First, August 2012.

there is a risk that consumers will buy new efficient appliances but may use them in a way which could increase their overall or peak energy usage. For example, the EST has found evidence that people are buying bigger washing machines but are still doing the same number of washes.[56]

Different groups of consumers will require different engagement approaches and often tailored advice. For example some may find it very difficult to engage with all but the most simple ToU tariffs.[57] Whilst some people may appreciate mobile messaging and smart phone apps, others will prefer receiving printed information.

Understanding different consumer uses and attitudes to energy will help to demonstrate the relevant benefits of DSR for each group, whether these are financial or non-financial, as well as recognising any barriers to take up. Targeting information will increase its effectiveness but also has clear cost implications. These factors need to be taken into account when assessing the costs and benefits of DSR.

DSR tariffs and switching levels – The possible extra time needed for making informed choices about DSR tariffs and the deeper trust needed to share data about consumption patterns and appliance usage might in the long-run impact upon switching levels.

Switching levels could also be affected by the fact that some consumers may:

- Be indirectly locked into a DSR product offer by virtue of having chosen a specific features bundled with it (e.g. a home automation system) which may or may not be compatible with those supplied by other providers.

- More directly tied in to a deal if they have a bundled service where the cost of the equipment – e.g. HEMS (Home Energy Management System), or smart appliance has been included within the bundle to spread the cost. Indeed, in other countries with DSR, longer term contracts tend to be more prevalent.

However smart metering itself should make switching easier and quicker. Safeguards could also be put in place to ensure that consumers are able to exit deals. For example, bundled tariffs agreements could contain a provision that the consumer is able to leave the deal at any time they wish providing they pay back the cost of any smart appliances or HEMS.

[56] The elephant in the living room, EST, 2011.
[57] One-fifth of the population leave school functionally and numerically illiterate. The Sheffield report - The levels of attainment in literacy and numeracy of 13- to 19-year-olds in England, 1948-2009, University of Sheffield, Professor Greg Brooks, September 2010.

3.6 Vulnerable households

Thinking through how protection for vulnerable households can be put in place before DSR offers are more widely marketed will be vital. Ofgem's vulnerability strategy will provide the opportunity to consider issues relating to vulnerability in this market[58]. However, just because someone is on a low income or elderly, for example, does not mean that they will automatically need specific protections from a DSR perspective. It is also worth noting that everyone can be vulnerable at certain points in their life (e.g. through illness). This type of 'dynamic' vulnerability may be more accentuated in a scenario in which DSR is more prevalent. These points raise the following questions:

- Given the range of customer groups and the 'dynamic' nature of some forms of vulnerability, is it possible or desirable to develop specific DSR tariffs aimed at protecting vulnerable households?
- If so, how should these be targeted and delivered?
- What additional policy and regulatory changes may be needed to ensure that vulnerable consumers are protected?

If DSR tariffs become more prevalent, the cross subsidies that exist within the existing charging system could be gradually unwound. If vulnerable consumers are not able to take up DSR tariffs, they may see their bills rise.

3.6.1 Automated response/load management and vulnerable households

The prospect of automated response/load management raises a number of issues for vulnerable consumers. This is partly because automation/load management for DSR purposes is sometimes confused with forms of load limiting that might be used for debt prevention and debt control. **As automated response/load management could provide significant benefits to customers, it is important that this is clearly distinguished from the use of load limiting as a debt control tool.**

Load limiting as a means of debt prevention/control

Load limiting involves technical measures to reduce the amount of electricity that can be used at any one time. It is used in a number of jurisdictions around the world as a means of managing debt and minimising the risk of debt building up, whilst safeguarding some basic level of use (e.g. lighting, cooking) It is sometimes also combined with a free or reduced price allocation of electricity for low income or vulnerable households. In Italy, for example, Enel uses power limitation to ensure a minimum social supply (usually 10% of contractual load) each month (in effect, different sized houses have different limits). If consumption

[58] Consumer Vulnerability Strategy (July 2013), Ofgem. Ofgem Consumer Vulnerability Strategy

exceeds this and no additional payment is made, power is instantaneously cut off, only to be restored remotely after payment.[59]

Such forms of load limiting can be subject to the range of views often faced by prepayment metering. On the one hand, they can be seen as a way of helping people on low incomes to budget for their electricity use and safeguarding at least some supply as opposed to the alternative risk of complete disconnection for debt. On the other hand there can be the perception that this is a form of "hidden disconnection".

One particular problem for load limiting is that determining essential load in itself can clearly be contentious. It could be possible to determine different levels of essential load for different types of vulnerable households. However, as noted earlier, Ipsos Mori's research for Ofgem found that panellists would not be happy for a DNO to be allowed to decide what 'critical' means for their household.

In December 2012 Ofgem identified that there were then no plans by suppliers to introduce load limiting. At the time, a commitment was secured from suppliers that they would get input from Ofgem and Consumer Focus if they were going to introduce this in the future.[60]

3.6.2 Automation/load management for DSR purposes and vulnerable households

Automation of DSR offers a number of potential benefits to customers as noted in Section 3.2 of this paper. These benefits may be even higher for some low income and vulnerable households. For example**,** the PG&E Trial in the United States found that the provision of an in-home display (IHD) or web portal access along with a CPP tariff produced smaller percentage reductions from low-income consumers than for higher income consumers. In contrast when the CPP tariff was combined with a smart thermostat, which provided an automated response to tariff rates, peak demand reductions were higher for low-income than high-income consumers.[61] This may be because low income households were less likely to override the settings than those on higher incomes. Other factors which may be correlated with income, such as the age of participants, may also have driven this result, but this may also indicate the potential value of the approach for vulnerable groups.

There will be some vulnerable groups for whom various DSR products would not be suitable. This could include those who need to be able to use electricity throughout the day for medical reasons. To protect the interests of such vulnerable consumers in a smart world, mechanisms such as the Priority Services Register will need to be reviewed and amended accordingly. Ofgem's review of its Vulnerability Strategy is an opportunity to do this.

[59] Smart metering pre-payment in GB, Enel, Smart metering UK and Europe Summit, 2013
[60] Ofgem statement on load limiting, December 2012.
[61] Demand Side Response in the domestic sector- a literature review of major trials
Frontier Economics and Sustainability First. Report for DECC. August 2012

Using tariff design to protect vulnerable groups may be too complicated and undesirable for a number of reasons. Other mechanisms may be considered such as support through the benefits system. However, the presence of fuel bill allowances or discounts can unsurprisingly weaken incentives to reduce consumption at peak and overall (as was found in the Ireland Electricity Smart Metering trials).[62] Furthermore, given the current economic climate including welfare reform, the prospects of changing the benefit system to take account of DSR tariffs for vulnerable customers seem slim.

It may be more effective to examine the scope for expanding and amending existing programmes to ensure that they protect vulnerable consumers in a smart world. For example, ECO could help low income people install smart appliances, HPs and microgen to help them benefit from DSR products. Alternatively, DNOs could assist vulnerable households in constrained parts of the network to install energy efficiency measures and smart appliances. This may be one way of enabling DNOs to take a more strategic approach to their social obligations, as is envisaged in the ED1 price control.[63]

Facilitating new or trusted intermediaries to act on behalf of vulnerable consumers may be an effective way of protecting their interests. However, as already noted, various safeguards may be needed to ensure that these parties act in consumers' interests. For example, a review of licence requirements to ensure that any data misuse faces tough consequences.

One of the objectives of the smart metering Central Delivery Body (CDB) is to enable low income and vulnerable consumers to access the benefits of smart metering. This Body will be well placed to provide guidance on how vulnerable consumers can best be protected in terms of DSR as more experience is gained from the smart meter roll out.

[62] Frontier Economics & Sustainability First. August 2012. op cit.
[63] Strategy decision for RIIO ED1, Ofgem, March 2013.

3.7 Regulation: Principles for customer-focused DSR

The development of smart markets could represent the biggest change in the energy sector for domestic consumers since the introduction of competition. Ensuring that the regulatory and enforcement regime is ready for such a significant change is important if consumers are to be empowered and protected. Ofgem will need to work with other regulators in particular Ofcom, the new Competition and Markets Authority (CMA) and the Information Commissioner's Office (ICO) to ensure:

- Clear roles, responsibilities and accountability amongst the various regulatory and consumer protection bodies to encourage efficient decision making and help prevent regulatory arbitrage, exposing consumers to gaps in protection;
- The consistent treatment of consumer issues and safeguards;
- A comprehensive overview of the competitive health of a market which may be undergoing fundamental transition. This should make sure that sector specific regulation is aligned with fair trading rules ; and
- Consumers where possible have a single point of contact or know which organisation to go to in the event of a problem, whether this is with their energy supply, the digital hub that they use for communications and control, or, their usage profile that a third party may use.

The RMR decision document provides only limited information on how it will assess the development of DSR offers, beyond saying that 'improving the base level of consumer trust and engagement is an important pre-condition for [ToU] developments.' In order to ensure that DSR offers develop in the interests of domestic consumers, it will be important that they are able to meet certain transparent principles. In order to influence market development, these will need to be agreed before the proposed RMR review point in 2017.

The following principles are proposed – on a 'straw man' basis - for a clear and stable regulatory rule-set by which to judge the DSR market and particular offers[64]:

1. **Clear objectives and consumer outcomes** - Is it clear what the intended outcome is going to be for the consumer (e.g. lower prices, accuracy of billing, reduced energy consumption, protections for vulnerable consumers etc.) and over what period the benefits are likely to accrue?

2. **Clarity** - how clear / simple is the DSR proposition? Will consumers understand what they sign up to? Do they understand their 'baseline' consumption pattern? Is it clear whether they need intermediary advice in order to be able to make best use of this tariff?

[64] There is clearly a degree of overlap between some of these principles (such as clarity and appropriateness). There are also trade-offs between some. For example, the costs of providing a tariff which has really good information could be a more pronounced distributional effect.

3. **Appropriateness** – is the tariff appropriate to the consumer's circumstances? Is it relevant to someone with their usage profile, type of heating, degree of home automation etc.? Is it made clear to the customer whether they need to have any particular characteristics in their energy and home usage? Can the consumer make an informed comparison between this tariff and other DSR and standard tariffs? Is the information to enable comparison presented in a consistent format?

4. **Information** – is adequate, accessible and comparable information provided not just for the tariff but also potentially for the accompanying technology and appliances? Is the consumer given enough information and advice, and simple tools such as fridge magnets, to know when they need to change their behaviour? Does the provider give the consumer feedback, letting them know how they are doing against the different pricing and timing bands? Does the tariff meet the requirements of the promised smart metering privacy / data charter?

5. **Flexibility** – if the consumer decides that they do not like the tariff will they be able to switch easily back to another tariff without a significant penalty? Are 'exit' arrangements in place for bundled tariffs so that consumers can leave, providing they pay for any of the capital items they may have received as part of the deal (e.g. smart appliances or a HEMS)? Is it possible to 'trial' the tariff before they sign up? Does the supplier commit to review the appropriateness of the tariff for the consumer on a regular basis (i.e. provide a tariff checker service)? Is this activity sufficiently transparent to enable consumers and their representatives to ensure it is being done on a rigorous and sound basis?

6. **Choice** – will the consumer be given the choice as to whether and how much control the supplier has of their usage? Will they be able to over-ride supplier controls and if so are any penalties for doing so made clear in advance? Is the consumer able to opt into and out of data sharing and are stringent protections for data sharing in place?

7. **Timing** – is this the right time to introduce this offer? Is it being introduced as part of a wider energy efficiency scheme or on the back of new tighter product standards? Is it clear how much notice the supplier must give for any changes in the way that the tariff works?

8. **Intermediaries and aggregators** – are other parties able to negotiate the tariff on the customers' behalf? Do they have access to adequate data for them to be able to give the consumer informed advice? Are regulatory and consumer protection mechanisms in place (including around privacy) to ensure such parties are clearly working in the public interest?

9. **Dispute resolution and remediation** - is there a clear process for dealing with disputes which sets out the roles, responsibilities and liabilities of the consumer, the supplier, the communications provider, any other involved parties and dispute bodies

such as the Ombudsman? Is it clear what will happen in the event that the smart meter does not work and the consumer gets an inaccurate bill or the data communications technology does not work?

10. A key issue for Ofgem will be understanding the **distributional impacts of the DSR market as a whole - and particularly for vulnerable households**. This will include such matters as: how have costs been apportioned; the implications of unwinding cross subsidies and associated tariff rebalancing; the costs of adequate information provision and consumer protection?

A principles based approach to regulating DSR tariffs needs to be accompanied by a willingness to use **enforcement powers** if consumer interests are to be protected. As already noted, Ofgem will wish to work with the other relevant regulators and front line consumer bodies to collect information on market developments and the consumer experience. As customer segmentation becomes ever more sophisticated, the size of this task and the resources needed to do it effectively should not be underestimated.

Ofgem needs appropriate tools to prepare for these new energy market dynamics. Information sharing mechanisms and protocols will need to be established in advance of DSR tariffs being developed. Leaving an assessment (e.g. of data collection needs) until the 2017 RMR review point, may be too late to ensure that providers develop and market DSR offers which are acceptable to consumers.

3.8 Suggested issues for wider discussion

An active electricity demand-side offers the potential for customer benefits and more cost-efficient operation of the electricity system.

Parts 1 and 2 of this paper discussed the likely costs and benefits to household consumers of DSR, including possible winners and losers. Part 3 has discussed a number of areas where further thought is likely to be needed on protections for household consumers, especially the more vulnerable, as ToU and other 'smart' tariffs and services begin to be offered.

In this paper we have discussed only electricity smart markets – but of course smarter markets will also extend to dual fuel customers and to gas. Many of these smart market issues from a customer and consumer perspective have yet to be clearly formulated or articulated by the many actors involved.

Below we put forward a number of suggested issues for wider discussion on the basis of the topics explored in Part 3. Many of these are directed in the first instance at Ofgem, as there is a clear need for early and proactive thinking about the potential complexity and impact upon customers of DSR at scale. Other issues are perhaps more for DECC, market actors and consumer bodies to consider.

We have grouped these issues as follows.

Near Term Consumer Protections

1. **As** part of its smarter markets work, and flowing from the Retail Market Review, Ofgem may wish to consider whether there are any major gaps in customer protections in terms of the early development of ToU and smart tariffs and offers.

2. With the proposed 2017 review of RMR in mind, Ofgem may wish to consider the merit of some principles by which to assess the fairness to consumers of emerging DSR offers. We outline some suggestions for such principles in Section 3.7 above.

3. The implications of DSR - and possible gaps in consumer protections and safeguards - need consideration by regulators and policy makers in advance of DSR offers being widely marketed. Consumer behavioural modelling may help to better understand how different customers may engage with DSR.

4. In terms of DSR and consumers, the respective roles and responsibilities for the Smart Meter Central Delivery Body (CDB) and Ofgem need to be understood.

5. Early clarity is needed on arrangements for consumers who try a DSR offer but decide this is not for them (e.g. 'fairness' on default tariffs etc.).

6. The Priority Services Register may need review and reframing to ensure it is fit for purpose in a smart markets world.

Consumer Engagement and Smart Market Development

7. **Consumer confidence in an electric future** – will be important if consumers are to understand why they are being asked to adapt their electricity use, to accept greater automation within their own homes, and, how in the long-run these actions might help to save them money.

8. **Broadband -** consideration needs to be given as to how the interests of consumers with no or limited broadband access are protected in smarter markets**.**

9. **The differences between automation for DSR and** load limiting **for debt control -** need to be clearly articulated and communicated to avoid consumer confusion and potential negative reactions to DSR automation options. As per Ofgem's letter of December 2012, discussion is needed between Ofgem, consumer bodies and market actors on the use of load limiters before smart meters are installed at scale. This discussion probably needs to get under-way ahead of the planned RMR review in 2017.

10. **Automation may** provide many benefits to consumers and help market actors more readily obtain value from DSR. However, a number of important consumer issues need further understanding, including : consumer willingness to accept automation; how frequently consumers wish to over-ride automated response ; the practicalities of introducing - and communicating over-ride features – and the consequence for consumers' bills if regularly used.

11. **Automated Frequency Response** – Consumer in-put is needed in terms of the development of frequency response. This should include household consent, how the consumer may be rewarded in return for agreeing to have frequency responsive products, plus the general understanding of any impact on product functionality so far as the consumer is concerned.

12. **Market actors** – could consider an evolutionary approach to the development of DSR offers, starting with simpler options so that lessons can be learned from real-life experience rather than trials which may not be replicable at scale.

13. **New actors** –new actors such as tariff comparison agents, aggregators and consumer intermediaries will need to know the appropriate regulatory frameworks within which they will operate.

14. **Opportunities to support vulnerable customers** - thinking is needed on how the Green Deal and the Energy Company Obligation (ECO) could support DSR, especially where this might benefit vulnerable customers. One possible option may be to extend the ECO so that DNOs can use it to install energy efficiency measures for vulnerable consumers on constrained parts of their network.

15. **Early adopters of low carbon technologies** - consideration should be given to DSR tariffs for early adopters of low carbon technologies (such as heat pumps and electric vehicles) to encourage their cost-efficient operation, especially in the networks. Special arrangements may be needed for vulnerable consumers where they have been installed by third parties such as social housing providers.

Longer Term Considerations

16. **Data on household smart markets** – to ensure long-term consumer protections, Ofgem, other regulators and consumer bodies will need to consider what data will be necessary to develop a full picture of the consumer experience.

17. **Switching -** in a world where DSR offers may be more prevalent, Ofgem will need to understand the competitiveness of the DSR market, including any differences in switching rates for customers on DSR and standard tariffs.

18. **DSR customer 'health checks' –** Ofgem could consider how to extend to DSR tariffs the RMR proposals for suppliers to advise certain customers of the Market Cheapest Deal. For example, via an annual DSR-customer tariff 'health-check' to assess suitability of their DSR tariff against their usage pattern over the past year. This would require effective data analysis and timely communication.

19. **Regulatory roles** – As smart markets develop, the roles and responsibilities of the relevant regulatory bodies will need clarity, including those of Ofgem, Ofcom, the Information Commissioner, and the Competition and Markets Authority

Annex 1

The drivers of domestic consumer behaviour

Since competition was introduced consumers' engagement with the market has been variable, even when financial gains could have been made.[65] DSR offers are unlikely to change consumer engagement over-night, even on the back of a successful smart metering roll out. Some consumers will not want to be engaged no matter what suppliers offer. Others will only do so once they understand what DSR offers mean for them, in terms of costs and benefits - financial and non-financial.

Trials

DSR trials do provide some valuable indicators of how consumer behaviour is likely to evolve in this area. However, there are important caveats. Many of the international trails only have limited applicability to the UK as they are based in countries with different climatic challenges. Trials in the US and Australia have frequently used tariffs which are targeted at air conditioning use and pool pumps, large often discretionary loads that are not typical in the UK housing stock.[66] However, heat pumps do have similar characteristics and if these are taken up as projected by DECC, this international experience could become more relevant.

Other factors which make a straight read across from international experience more difficult include heating type and the degree of automation and connectivity. In some parts of Asia, for example, people tend to purchase all of their appliances from the same company, making it easier for these to receive signals from each other and their energy supplier. In other countries, the housing stock is rebuilt at a more regular rate than in GB, enabling more frequent upgrades to wiring and appliances. National perceptions of energy companies and the degree of public trust in the sector also vary.

The learning from GB based trials is clearly more relevant. A few points are worth noting about the findings from these. Firstly, some of these trials are relatively small. The EDF Energy EDRP trial for example recruited 200 domestic customers (see case study for Sustainability First. GB Electricity Demand project. Paper 7. Annex 2). This makes it more difficult to assess the potential for social norming and to draw conclusions about any specific sub group in the trial. Secondly, the larger LCNF trials, such as the Customer Led Network Revolution (CLNR) and Low Carbon London (LCL), which look at DSR impacts across higher numbers of consumers and at the interaction of various initiatives, are still at relatively early stages. It will be important that the end to end customer experience is fully understood,

[65] Wilson and Waddams Price (2007) found that half of consumers had not switched suppliers even though they could have saved money by doing so.
[66] Baringa op cit.

particularly as it evolves across various heating cycles. It will also be important to understand how the experience of consumers that do not have 'standard' smart kit evolves. For example, some of the trials are using smart meters that are not SMETS 2 compliant (e.g. LCL). This will mean that the findings and lessons learnt need to take this into account.

Even with these larger trials, there has not been a complete whole town / city / area approach to DSR where it has been fully integrated into other energy initiatives such as smart metering and energy efficiency plans in the entire area. For this reason, the Green Alliance has suggested that a 'smart town' should be established to test a whole range of DSR and other measures. Another caveat when drawing lessons from trials is that many have been relatively short and may have only covered one heating season, making it difficult to draw conclusions about persistency.

Thirdly, several of the trials that have so far taken place have been designed to be revenue neutral for the consumer (e.g. the EDF EDRP trials). Some, like the climatically relevant Irish trial, have included additional back stop measures to ensure no individual consumer lost out financially by taking part. Other trials have offered consumers inducements to participate which it would be difficult to introduce at scale. For example, LCL has offered free EV charging points to encourage sign up.[67] This could make it difficult to assess what behaviour would have been like if participants had increased usage at the peak.

Of far more relevance to GB consumers is the long term experience of the 19% of domestic users in this country that have a meter capable of DSR and may already be on some type of ToU tariff. Most of these are on variations of Economy 7 or Economy 10.[68]

This Annex now explores the factors that influence consumer energy behaviour both now and looking forward to 2030. Drawing on the lessons that can be learnt from trials and real life ToU experience, the Annex looks at the underlying drivers which can influence consumer response in this area. These include income level, household size and composition, household stability, housing tenure, heating type and payment method. Each of these points is explored in more detail below.

[67] LCL, Project report to Ofgem, December 2012.
[68] From devotees to the disengaged, Consumer Focus, October 2012.

1. Income level

The evidence about the impact of income levels on DSR is mixed. The shape of the household load profile is clearly important. Some low income consumers will have flatter loads than those on higher incomes. This could be because they are more likely to be at home in the day time or have fewer 'peaky' appliances such as dishwashers. For this group, DSR offers can be attractive. Indeed, the California trials of Critical Peak Pricing showed that on average low income households did not pay more under CPP tariffs. This was thought to be largely due to their existing flatter loads and lower overall electricity consumption levels.

The Northern Ireland Powershift Trial found that the consumers in this group, who mostly had low incomes, were found to benefit from lower off peak prices passively, without changing their behaviour. Initial incomes levels can be reasonably assumed to have an impact on behaviour change. If consumers are on very low income levels when DSR is introduced, they may choose to take the reduced costs that ToU offers can offer in terms of higher levels of warmth rather than as financial saving. [69]

Low income consumers are likely to have less discretionary load than those on higher incomes. If they do have higher peak usage, this is therefore likely to be because they regard this load as essential. This could be because of heating system, family size etc. (see following sections). It is important to note that if this is the case, some of these consumers may find it more difficult to engage in DSR. This could be because they have more inefficient electrical appliances that may be more difficult to programme to use off peak. Digital connectivity can also vary by income group. Initial findings from the CLNR trial found limited access to broadband, especially amongst social housing tenants.[70]

The introduction of smart meters could revolutionise the pre-payment meter (PPM) market, which could have a beneficial knock on effect on those on low incomes. It is worth noting that PPM consumers are already slightly more interested in smart metering than those paying by direct debit.[71] This is important as with the rise in fuel poverty, up to a third of customers in the UK may be on some type of pre-pay offer by 2020.[72] If pre pay offers do become more competitive, this may encourage some lower income consumers to more actively engage in DSR.

Response to information and automation has also been found in trials to vary by income group. Results from the Oklahoma Gas & Electric Trial showed that the provision of IHD or web portal access along with a CPP tariff had a smaller impact on percentage reductions from low-income consumers than for higher income consumers. In contrast when the CPP tariff

[69] Demand side response in the domestic sector, literature review of the major trials, op cit.
[70] CLNR progress report op cit.
[71] Smart metering pre-payment in GB, Consumer Focus, Smart metering UK and Europe Summit, 2013
[72] Consumer Focus op cit.

was combined with a smart thermostat, which allows an automated response to tariff rates, peak demand reductions were higher for low-income than high-income consumers. This suggests that the type of non-economic measure that will be most effectively combined with dynamic ToU tariffs may vary according to household income.[73]

Many people on low incomes value the ability to plan their finances and budget with certainty. With ToU tariffs, this could potentially be more difficult, particularly for more volatile tariff types such as Critical Day / Peak Prices. There is a risk that to get the certainty that they need, some low income consumers may exercise caution and cut back their usage to levels below that which is necessary for adequate warmth.

Experience in the pensions market has shown that many people on low to moderate incomes display 'loss aversion' in response to products that have a potential downside.[74] This learning is relevant to the likely attitudes of low income energy consumers in the context of DSR. If the emotional reactions to loss in pensions, including disappointment, anger and helplessness, were translated to experience with tariffs for this essential service, there could be a considerable backlash.

2. Household size and composition

Smaller households may be more likely to benefit from DSR offers than larger ones. Given that the average household size has become smaller in the last 40 years and the proportion of people living alone has almost doubled during this time,[75] this could present an opportunity for DSR offers. This trend is likely to continue. However, 42% of the projected increase in single person households between 2006 and 2031 is in the over 65 age group.[76] The EDF Energy EDRP trial found that households with one or two people aged 16-24 reduced their peak usage more than larger households and that only one household member tended to interact with the meter. This raises the question of how to get behaviour change in households with more than one person where there may be split incentives between the bill payer and behaviour changer.

GB's aging population presents various challenges for DSR. Between 2012 and 2050, the proportion of people aged 65 and over is projected to increase from 17 % to just under a quarter of the population. The fastest increases will be amongst the 'oldest old,' with the proportion of people aged 85 and over projected to go up from 2 to 6 %.[77] The need for affordable warmth is clearly a significant issue for this group. Whilst some pensioner households may benefit from ToU tariffs, other issues also need to be taken into account. The ability of the increasing numbers of people facing mental and physical frailty to benefit

[73] Smart Tariffs and Household Demand Response for GB, Sustainability First, March 2010
[74] Understanding reactions to volatility and loss, Nest, 2010.
[75] General Lifestyle Survey, ONS, 2011.
[76] Investing in the UK private rented sector, HMT, February 2010
[77] Reinvigorating work place pensions, DWP, November 2012.

from an increased range of complex tariffs, such as dynamic tariffs, is a significant issue that will need to be addressed. Provisions would need to be put in place to ensure that the interests of elderly consumers, particularly those facing any form of memory impairment, are protected.[78]

Moves in public policy to get more people cared for out of hospital and at home, potentially relying on digital telecare, also raises questions for the development of DSR and the needs for safeguards to be put in place. Smart systems can provide up to date information to identify when elderly people living alone have changed their habits (for example, not boiling the kettle for their normal morning cup of tea) and may need help. However, to be successful this type of initiative clearly needs to be introduced in partnership with trusted third parties and sensitively so that people are not put off by concerns over reliable supplies and privacy.

The introduction of 'digital by default' public services can also have implications for DSR. Many elderly consumers find using any digital devices difficult. They may be reluctant to take up DSR offers if they consider that these could put their ability to access electronic benefit payment systems etc. at a time to suit them in jeopardy.

Concerns around cold weather having a possible impact on the performance of smart meters and appliances could deter some older people from taking up DSR offers. The cold winter in 2010/11 led to some pre-payment meters not working correctly leading to some people not being able to heat their homes. In a smart world, such an eventuality could have significant consequences.

Households with children present both opportunities and challenges in terms of consumer engagement in DSR. On the downside, larger households may find it difficult to reduce peak consumption. Younger children often have fixed routines[79] such as meal and bed times which it may be difficult to change to take advantage of ToU tariffs. In the Ontario Smart Price Pilot some families with smaller children reported they found it difficult to reduce laundry during peak periods. However, in contrast the Ireland Electricity Smart Metering Trials found that educational initiatives were having a positive impact and that households with children under 15 were reducing usage more than the average.[80]

Younger adult respondents to surveys have shown that they are less likely to have switched suppliers, probably reflecting shorter histories of independent home ownership.[81] This may be indicative of their willingness to engage in DSR offers.

For the working age population, the increase in more flexible working patterns could create opportunities for DSR in terms of the ability of some people to change their usage patterns. Home workers could also be interested in load shifting. However, they may also place a high

[78] Over 80% more people aged 65 and over are projected to have dementia in England and Wales by 2030 compared to 2010, Ready for ageing? House of Lords Select Committee on Public Service and Demographic Change, March 2013.
[79] CLNR progress report op cit.
[80] Sustainability First, op cit.
[81] Pollitt et al, op cit.

value on more reliable services where they can get a guaranteed supply. The boundaries between domestic and SME consumer types in terms of DSR offers may therefore start to blur at the edges.

DSR will be particularly difficult in households with people that have illnesses and disabilities that require a reliable energy supply for medical equipment. These groups are likely to need specific safeguards in a high uptake DSR scenario.

3. Household stability

Consumers may be unwilling to engage with DSR if they are planning to move in the near future. They may not want to invest in the things that may enable them to get the most out of DSR offers, such as home energy management systems and new smart appliances, if they do not think they are going to stay where they are for a reasonable length of time. This reluctance to engage may be extended if there is uncertainty (whether real or perceived) around the compatibility and interoperability of devices. Householders will rightly want to know whether their smart investments will operate in different:

- **Types of housing**. For example, will moving to a solid wall property or a flat make a difference? ;
- **Geographical locations**. There are three main issues here. Firstly, if they move from an area with SMETS2 meters to one where smart meters were introduced prior to mass roll out, there could be potential interoperability issues. 4.7 million meters could fall into the latter category.[82] Even with SMETS 2, different providers could interpret the specification in different ways. This has significant implications for inter-operability. Rather than creating a wave of early adopters for ToU tariffs, the Foundation experience of consumers with none SMETS 2 meters could actually put people off. Secondly, consumers who move between areas could also face issues around the interoperability and compatibility of communications systems (HANs) installed prior to the mass roll out. Thirdly, broadband speeds still vary significantly by area. As long as variations exist, consumers may be reluctant to invest in these technologies; and
- **Heating systems**. Consumers may be unwilling to buy smart technologies if they do not think they will be equally suited to different heating systems.

Even if the financial cost of smart investments may be relatively modest, the perceived hassle factor of learning to use these when they may not be relevant elsewhere could put some people off. For certain groups of consumers, this fear of wasted money and time and being tied into an inappropriate set of technologies could be decisive in their willingness to engage in DSR. Concern around legacy issues is very real. Early learning from the CLNR has found

[82] Response to smart metering decision document, Consumer Focus, May 2011.

that 'shadows of technologies past shape people's energy practices today. New technologies are used with a physical or psychological memory of the old systems.'[83]

Even if people do not move house, their household can still be undergoing change. A third of those interviewed for the CLNR trial said their households were going through domestic transition (including arrival of children and multiple living arrangements).[84] These changes can make consumers more reluctant to engage in DSR as they will be unsure what their energy consumption patterns are likely to be, people will not be around long enough to learn and adapt to new behaviours and other priorities may be more pressing. In the NINES trial, for example, tenancy changes have presented challenges in terms of getting people to understand DSR.

To address this type of challenge, service providers in other areas have tailored the delivery of their services to match key 'life stage' events. For example, many local authorities link their work into triggers which require changes in service provision such as starting a family, children leaving home, people changing to working from home, redundancy, house moves, retirement etc.

4. Tenure

Differences in tenure can have an impact on consumer willingness to take up DSR offers. Split agency is an issue here, where tenants do not always make the decisions about energy supply, appliances and usage and yet are the ones whose behaviour drives consumption. In 2010, 14% of all households lived in the private rented sector. This number is likely to go up as house building has fallen significantly as a result of the recession.[85]

With higher numbers of people on low incomes (particularly the young) living in rental or shared accommodation with fixed term tenancies, one would expect that this group would be less able to take up DSR offers. Welfare reform measures, such as the 'bedroom tax,' may lead to increased geographical movement amongst those on benefits and exaggerate this situation further.

[83] CLNR op cit.
[84] CLNR, LCNF Cardiff conference, October 2012.
[85] Investing in the UK private rented sector, HMT, February 2010.

5. Heating types

The type and age of the heating system installed can have an impact on consumer engagement with DSR. People's relationships with their heating systems can be potentially complex. Getting a new system installed can represent a big outlay and people can be reluctant to change as they may reasonably want the system to last as long as possible, even if it is inefficient. The language people use to refer to their systems, such as their temperamental nature and the need to coax them, reflects the semi emotional attachment that some consumers have with them. Another factor that is that changes to heating systems can have knock on implications throughout the home, ranging from the space used for the unit itself to changes to pipes, wires and casing and the resultant cosmetic and decorative changes that may be needed to accommodate these. People may be unwilling to engage in DSR if it necessitates changes to their heating which will have a negative impact in these wider areas.

Consumers with electric heating and storage facilities will have the greatest potential to engage in DSR as they will have more flexibility to shift their loads. However, those with electric heating and no storage facilities are likely to be particularly disadvantaged. Of the 560,000 households that use electric heating as their primary source of energy, 53% are in the bottom income quintiles. This number could increase if heat pump penetration increases for this group.

Getting consumer acceptance of energy storage systems has not always been easy. The Pacific trial identified difficulties in understanding the nature of space heating in people's homes.[86] More recently, LCL has found it difficult to recruit people into its heat pump trial partly due to the amount of space needed for the technology.[87] The CLNR trial also found that people were not very attracted to join the heat pump trial. Not least, many customer homes were unable to accommodate the large water storage cylinders in use to enable storage for the trial. In the NINES trial, new-generation storage heaters and changes to some of the design features, (e.g. making the heater settings simpler and more fool proof; streamlining the outer casing), seem to have helped to address some initial consumer concerns

If the consumer does not like the type of heating system they have and their tariff is perceived as tying them to this, the two can be conflated in the individual's mind and there can be a considerable amount of resentment of the tariff itself.

Consumer Focus research on Economy 7 has shown that heating systems affect satisfaction. 12% of Economy 7 customers surveyed have had upset or discomfort, ill health or financial problems which they attributed to their tariff or heating system. This research has also found that 66% of Economy 7 consumers have decided to move away from electric heating to gas central heating, even though they were still on the now less appropriate Economy 7 tariff.

[86] The Olympic Peninsula Project, IBM, 2008.
[87] LCL op cit.

The report concluded that ToU consumers such as those on Economy 7 tariffs need more information on usage rate times as well as information on how to use their heating systems.[88]

Research has shown that the price of heating energy and temperature interact but not in a straightforward linear way. Consumer responses to ToU tariffs will therefore be conditional on both these things but the response is often ambiguous and not constant or predictable.[89]

[88] From devotees to disengaged, Consumer Focus, October 2012.
[89] Energy pricing and temperature interaction : British experimental evidence, Andrew Henley and John Peirson, October 1996

Annex 2

ENTSO-E Demand Connection Code (DCC)

ENTSO-E (the European Network of Transmission System Operators (TSOs) for Electricity) represents all electricity TSOs in the EU and others connected to their networks, for all regions, and for all their technical and market issues.

Important Europe-wide planning has been assigned to ENTSO-E. This stems from the third EU package on electricity liberalisation which, on behalf of ACER, the European energy regulators group, under the Comitology process, has placed a new responsibility on ENTSO-E to develop a number of technical codes. These will be directly legally binding, in order to facilitate completion of the single internal market in electricity.

The **Network Code on Demand Connection,** drafted by ENTSO-E, forms part of a larger package of network codes currently in development. It begins to address some aspects of the changing role of electricity demand.

Status of the Demand Connection Code

A draft Demand Connection Code was first issued in 2012 for stakeholder consultation. ENTSO-E issued a revised Demand Connection Code in December 2012.

In March 2013 ACER (the Agency for the Cooperation of Energy Regulators), issued a recommendation to the European Commission to adopt the Demand Connection Code, together with ACER's reasoned opinion. This latter suggests that the Code drafting would benefit from further clarification in a limited number of areas, and that the Commission should explore the best way to implement the DCC provisions for Demand Side Response.

Main areas highlighted for improvement include the following:

- Roles and responsibilities of different parties and processes with regards to Demand Side Response (Articles 21 to 24),
- Roles and responsibilities of aggregators as well as clarity on different possible approaches to demand aggregation,
- Clarity regarding compliance testing and monitoring for small grid users (the issue of compliance testing being overly onerous, particularly for smaller users, was raised as a concern by stakeholders at the DECC-Ofgem DCC workshops in Jan 2013, among others).

ACER recommends that these issues are addressed by the European Commission.

No dates have been issued yet for the passage of the DCC through Comitology. It is expected this will be in the second half of 2013.

Subject to the suggested areas for improvement, ACER expects the passage of the Code through the binding Comitology process to now be relatively free of complications.

Impact of Demand Connection Code on domestic consumers

The Demand Connection Code[90] has the ***potential*** to impact domestic customers in the future by requiring two types of Demand Side Response –Frequency Response and 'Active Power Control'- be provided by certain temperature controlled appliances (e.g. fridges and freezers, heat pumps).

The revised Code sets out a proposed process by which this could occur. Subject to a convincing case being made under *both* the Ecodesign Framework Directive at a European level, and also, to the member state regulator at a national level, a Transmission System Operator (TSO) **may be able to require that the provision of System Frequency Control (SFC) and Active Power control (APC) become *mandatory* for certain domestic appliances (temperature controlled appliances).**

For this to occur, TSOs will have to first make a case via the EU Ecodesign process on the merits of having frequency response built -in as standard into temperature controlled domestic appliances such as fridges or freezers.

If approved under the Ecodesign process, and frequency response is built into certain temperature controlled appliances, then the revised draft Code states that a TSO will have a right to the DSR which these devices can provide outside a deadband frequency range.

This range has to be approved by the National Regulatory Authority. At the GB level this means that the system operator would have to make a case to Ofgem to justify any request to have automatic access to the DSR from domestic customers who have 'significant' devices.

Introduction of new steps to involve the Ecodesign process and the national regulator seems to be a significant, common-sense revision of the original DCC proposals, (which might otherwise have allowed TSOs access to DSR from household temperature-controlled devices without wider debate). **The revised proposal now requires the process to involve the EU Ecodesign process and the national regulator in an assessment of costs and benefits for customers before implementation.**

[90] See revised Demand Connection Code at https://www.entsoe.eu/major-projects/network-code-development/demand-connection/ dated 21st Dec 2012

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.
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Sustainability *First* is a registered charity number 107899.

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Sustainability *First*