Grid Edge Policy

Regulation · Energy · Consumers

Distributional Impacts of a Move to Half-Hourly Settlement

Maxine Frerk and Daniel Kenway

27 March 2019

The Authors

Maxine Frerk is Director Grid Edge Policy and an Associate with Sustainability First. Until 2016 she was Senior Partner Networks at Ofgem responsible, among other things, for network charging. Earlier in her time in Ofgem she led Ofgem's work on vulnerable customers and was a member of the government's Fuel Poverty Advisory Group.

Contact: maxine.frerk@gridedgepolicy.com

Daniel Kenway is an intern at Grid Edge Policy

Acknowledgments

An earlier draft of this paper was discussed with colleagues at Sustainability First and we are grateful for their input.

Distributional Impacts of a Move to Half-Hourly Settlement

Introduction / Overview

Ofgem are currently seeking evidence on the distributional impacts of a move to half-hourly settlement as part of a wider call for evidence on the consumer impacts of such a change. As we set out in our assessment of the impacts of Ofgem's Targeted Charging Review, it is vital that Ofgem ups its game in relation to how it assesses distributional impacts given its commitment to protecting the interests of consumers in vulnerable circumstances.

Assessing the impacts of a move to half-hourly settlement is significantly more complex both conceptually and in terms of the data required. However, it is vital that Ofgem invests in building a richer understanding of the impacts to inform its policy making but also that it is clear on what data it will need to monitor what is actually happening in the marketplace – and the impacts on vulnerable consumers – as half-hourly settlement is introduced.

While Ofgem has posed the question in terms of the impacts of a move to half-hourly settlement, it is important to recognise that what this involves is simply a means for reflecting back to suppliers what the actual "costs to serve" are for a customer given their actual profile of usage over the day rather than an average profile – in terms of both network charges and wholesale energy costs. Aside from the paucity of data around time-of-use consumption linked to socio-demographic indicators it is very far from clear what should be assumed about the levels of charges that should be assumed in any assessment. The extent of 'peakiness' of network charges, for example, will be hugely dependent on the outcome of Ofgem's Access and Forward-Looking Charges review. The profile of wholesale costs is determined by the market and is much more volatile (i.e. it is not simply a case of peak prices being higher). The extent to which these charges are then reflected in suppliers' end prices will depend in part on the regulatory framework (e.g. the role of price caps) and in part on the market.

Given the additional complexity it has not been possible for Grid Edge Policy to carry out its own analysis (unfunded) in the way that it did for the Targeted Charging Review. What we have done, however, is to set out a conceptual framework and to bring together the evidence that we are aware of to try to draw some preliminary conclusions. In doing so we have focussed on the question of "to what extent different customers would be impacted by a move to a charging structure with a higher peak rate". A move to half-hourly settlement could lead to other price structures (e.g. more dynamic tariffs) but these are even harder to assess in terms of distributional impacts – we have therefore set out the sorts of factors that might result in them impacting differentially on different customer groups.

Our key conclusions are that:

- It is important to look at both the distributional impacts absent behaviour change and taking account of behaviour change;

- There is not a clear pattern in the way that there is between average income and average consumption. All groups on average have a similar pattern of consumption based around the evening peak;

- However, within these averages there are still individual customers who have very different profiles and who would stand to gain or lose materially as a result of such changes. Even if there is no pattern to this Ofgem should be mindful of the fact that increases will be more difficult for customers on low incomes to absorb;

- Intuitively, one might expect that consumers at home all day (e.g. the elderly) would have flatter profiles (and more flexibility) and hence might stand to gain while working families with school age children might be expected to have peakier profiles (and less flexibility) and hence might stand to lose. This is not really evident from the data but that may well be a reflection of the paucity of the current data which is just linked to broad socio-demographic categories, often at postcode level.

On the question of data, Sustainability First and the Centre for Sustainable Energy have been running a project to promote debate on these issues – the smart meter data Public Interest Advisory Group[1] – of which Ofgem is one of the sponsors. This work has highlighted the need for an improved dataset for modelling distributional impacts as one of its potential use cases and has identified how this data could be collected by government under its existing powers and linked with other government data to provide a representative dataset for modelling purposes. The challenges that are highlighted by this report in evidencing the distributional impacts of critical changes should add weight to the case for more to be done to build policy-makers' capabilities in this area.

A conceptual framework

As set out above, it is important in looking at the impacts of a move to half-hourly settlement to look at both the impacts excluding behaviour change and the impacts of any behaviour change.

In the most recent distributional impacts assessment that Ofgem produced (done by CEPA[2]) Ofgem only looked at the impacts of behaviour change. Its argument for so doing was that customers would have a choice as to whether to sign up to time of use tariffs – assuming that only those who stood to benefit would do so Ofgem argued that there would only be "winners" and no "losers" from the change. This is clearly flawed:

- Firstly, if those who sign up to TOU tariffs are those with flatter profiles and who therefore contribute less to the costs of the system, once they are taken out the average amount left to be paid by remaining customers will be higher. This is analogous with what happened with water metering where those who opted into metering were those with low consumption so remaining customers saw their bills progressively increase over time;
- More fundamentally, if you think of the network and wholesale costs as a "cost to serve" as we did in the Smart Fintry report[3] then suppliers will increasingly be looking for ways to avoid serving or to push up charges for customers with higher costs to serve (even if they remain on a conventional rather than time-of-use tariff).

In a competitive market the pressures are for the prices charged to reflect the costs of serving individual customers. While we are far from having a perfect market, Ofgem is wrong to dismiss the idea that over time charges to individual customers will move to reflect the costs of serving them. As such, it is vital to understand the scale of these potential impacts, absent behaviour change – if only as an indicator of how much of an issue this could be.

A simple metric – proportion of peak usage

As noted above, one of the challenges in looking at the distributional impacts of time-of-use tariffs is the complexity involved and most studies have used quite complex statistical techniques and have

[1] https://www.smartenergydatapiag.org.uk/
[2] https://www.ofgem.gov.uk/publications-and-updates/distributional-impacts-time-use-tariffs
[3] http://smartfintry.org.uk/wp-content/uploads/2018/04/Smart-Fintry-Innovation-Report-final.pdf (section 6.1.1)

also made various assumptions about the tariffs to test. This makes it quite hard to understand what is going on and to present it in a way that facilitates informed dialogue.

In the Smart Fintry project, we came up with the concept of using a simple metric which provided a good indicator of the change in the costs to serve as a result of a move to half-hourly settlement. Analysis by Strathclyde University confirmed the intuitive conclusion that the best metric for understanding how significantly a customer will be affected by a move to TOU charging is the percentage of their annual usage that occurs during the peak hours, taken here as being between 1600 and 2000 (but noting that the peak hours for DUOS charges currently vary between regions).

In a comprehensive review of the distributional impacts of TOU tariffs by Sustainability First[4], it is noted that in the case of the CLNR project, a customer using 24.7% of their usage in the peak would expect to see no effective change in their bill, whereas a customer using 30% of their electricity in the peak would see a 7% increase in their bill, and a customer using 20% would see a 6% decrease in their bill (all assuming no behavioural change). As well as allowing us to categorise customers by how they would be impacted relatively easily, this metric also shows the high sensitivity regarding both how these customers would be affected without a behavioural change and how even slight behavioural changes could benefit the customer under a TOU tariff.

The Evidence – Little difference on average between different socio-demographic groups

The majority of evidence seems to suggest that there is little correlation between demographic factors and the extent to which a customer would be impacted by the switch to a TOU tariff. This is exemplified by the results of the Sustainability First study referenced above which examined the average proportion of electricity used in the peak, as well as the resultant gain/loss (shown below). We can see that there is little variation on average between these groups in terms of the proportion of energy used at peak times and hence the annual gains/losses. However, if anything, more

CLNR classification	Average annual consumption (kWh)	Proportion used at peak	Annual gain/loss from changing to a ToU tariff without behaviour change[62]
£14,999 or under	2928	24.3%	+£2.94
£15,000-£29,999	3573	24.9%	-£0.94
Over £29,999	4227	25.0%	-£1.24
High thermal efficiency	3479	25.1%	-£1.85
Low thermal efficiency	3640	24.3%	+£3.36
Medium thermal efficiency	3509	24.8%	+£0.30
Non-renter	3717	25.0%	-£1.63
Renter	3185	24.1%	+£4.20
Rural	3731	24.8%	+£0.25
Rural off-gas	5266	25.2%	-£4.75
Suburban	3588	25.1%	-£2.07
Urban	3451	24.6%	+£1.46
With <5 or >65	3206	24.2%	+£3.67
Without <5 or >65	3825	25.1%	-£2.55

(Source: Sustainability First, using data from CLNR: http://www.networkrevolution.co.uk/project-library/dataset-tc1a-basic-profiling-domestic-smart-meter-customers/)

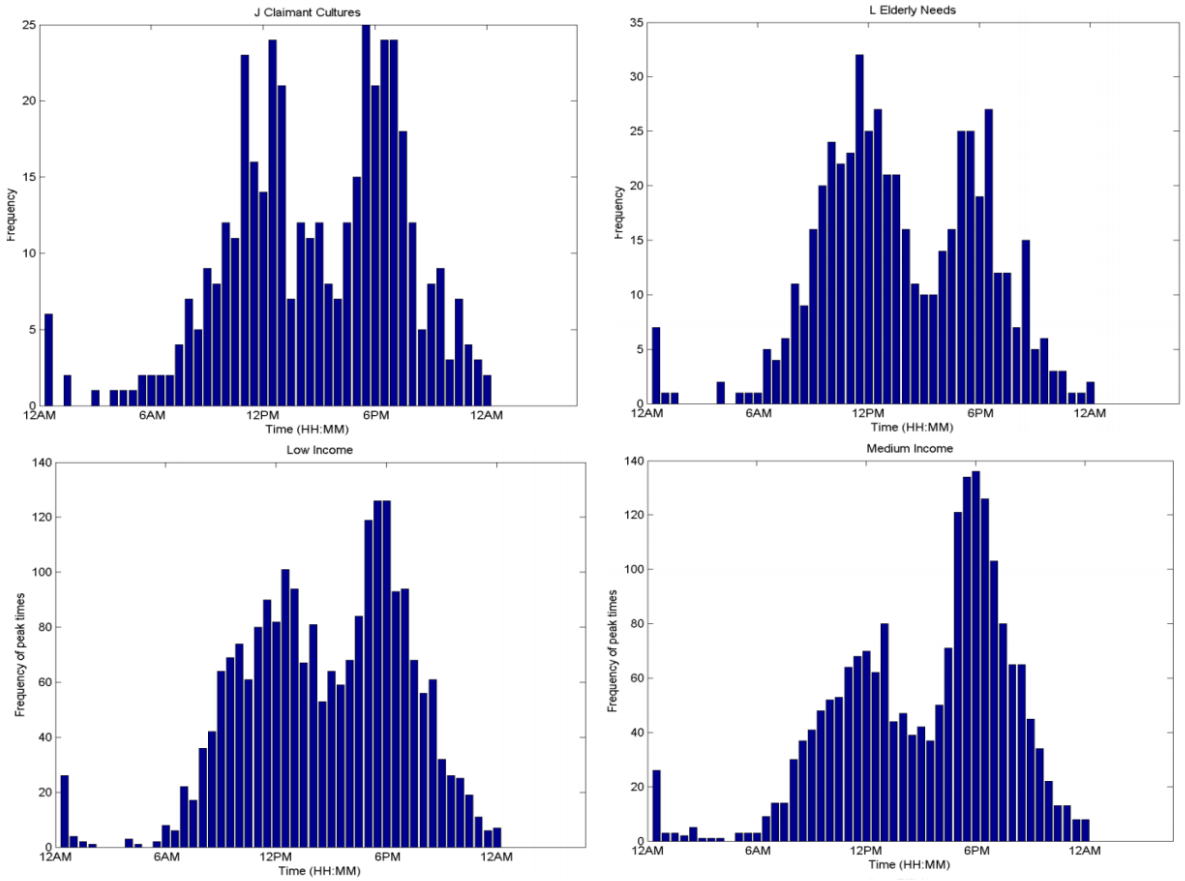
[4] https://www.sustainabilityfirst.org.uk/images/publications/other/Sustainability_First_-_Discussion_Paper_by_Jon_Bird_-_Smarter_fairer__Cost-reflectivity_and_socialisation_in_domestic_electricity_prices_-_FINAL.pdf

vulnerable groups (e.g. those with incomes under £15k or with small children or pensioners) may actually benefit by a small amount on average as a result of the change.

This is also reflected in the results from the CLNR project which examined the frequency of customers whose peak usage occurs during any given half-hour time slot[5]. This analysis showed similarities across all CLNR demographics and Mosaic groups both in January and August.

The only obvious exceptions to this were in the case of the 'Elderly Needs' and 'Claimant Cultures' Mosaic groups, who both show a greater proportion of customers using their peak amount of electricity in the mornings (shown below), when a peak tariff would not apply. This suggests again that both of these more vulnerable groups may be less affected by the change, matching the intuitive expectation that those not in work would be less likely to focus their electricity usage around the early evening period.

However, overall the strong similarity between the groups supports the notion that there is limited correlation between socio-demographic factors and the proportion of usage during the peak (i.e. how the customers would be affected)



Mass function of peak times for 'J' and 'L' Mosaic groups; Low-Income and Medium-Income customers reflecting the number of individuals whose peak usage occurred during any given half-four time slot from the sample group.

[5] http://www.networkrevolution.co.uk/wp-content/uploads/2015/02/Insight-Report-TC1a.pdf

The evidence – significant variations within groups

Simply looking at the average usage profiles across these different groups tells us little about the underlying variation in profiles behind these averages. Even if there is no systematic pattern of vulnerable customers being particularly impacted on average, it is still important to understand the scale of individual impacts that there might be, and to remember that the impacts on a low-income household of an increase in their bill can be harder to manage than for those on higher incomes.

Looking again at the CLNR data in the charts above, what is striking is the very broad distribution of the hours during which peak usage occurs. This supports the notion that there are a wide range of profiles that are hidden behind averaging, with a large number of customers using their peak amount of electricity outside of the average peak hours between 1600 and 2000, and some even in the early hours of the morning.

Early work from the Centre for Sustainable Energy[6] (CSE) explored the variation in demand profiles by producing different clusters of usage patterns, and highlighted three patterns of usage for which a TOU tariff would impact the customer differently (with bills varying by +/-10%). Though this study did not attempt to link these profiles to different socio-demographic factors, the work highlights the fact that behind the averages there are marked variations in the patterns of usage, and hence a wide variation in how different customers would be affected by the change.

A similar approach (but incorporating socio-demographic factors) was taken by Yunosov et al. [7]who identified 20 different clusters (a number arbitrarily chosen for the purposes of the analysis) by estimating electricity usage from activity diaries and then examining the sociological similarities between households in these clusters. Though certain demographic patterns were spotted between groups, the paper concluded that the distributional impacts were minimal as no particular demographic factor seemed to have a specific influence. This was exemplified by the fact that two demand profiles with similar socio-demographic make-up showed different demand profiles and hence different resultant changes in energy bill.

The smallest cluster in this study had both the lowest income and the highest median age, and consistently lost out as a result of the change to a TOU tariff which does not match the hypothesis articulated earlier that more vulnerable groups might be expected to generally benefit from the change. This result was dismissed as being statistically insignificant as the cluster group only makes up 1.4% of the population. However, when looking at extreme cases, and remembering that even within this cluster there will be consumers who are worse off than the cluster as a whole, it is important to acknowledge that this group that could lose out significantly has a socio-demographic background that would make them particularly vulnerable to financial strain.

[6] https://www.ofgem.gov.uk/publications-and-updates/investigating-potential-impacts-time-use-tariffs-domestic-electricity-customers-smarter-markets-programme

[7] http://centaur.reading.ac.uk/79505/1/yunusov_et_al_Role_of_household_activities_in_peak_electricity.pdf

Work examining the impacts on smaller groups of individuals has also demonstrated the extent to which individual customers can have very different demand profiles and hence could have a markedly higher cost to serve. Shown below is a table taken from the aforementioned paper by Sustainability First of eight randomly selected individual case studies and their proportion of electricity used during the peak time, as well as resultant annual gain/loss from a TOU tariff. Though these are simply individual cases and hence lack statistical significance (as well as assuming no behaviour change), they do highlight the fact that there is significant variation between individual customers' existing patterns of use and hence how they would resultantly be affected by the change as well as that certain individuals more likely to be under financial strain could see a steep rise in their electricity bill.

Identification no.	Acorn demographic type	Annual consumption	Proportion of peak time use	Annual gain/loss from changing to a ToU tariff without behaviour change
MAC005566	Career climber	3818kWh	20.0%	+£36.65
MAC005567	Difficult circumstances	951kWh	20.5%	+£8.18
MAC005562	Countryside communities	2019kWh	24.7%	+£0.45
MAC000019	Student life	1117kWh	24.4%	+£0.92
MAC000026	City sophisticate	2261kWh	17.3%	+£33.88
MAC000020	Starting out	1111kWh	27.7%	-£6.40
MAC000674	Striving family	2742kWh	26.5%	-£9.23
MAC000664	Student life	2993kWh	28.1%	-£19.63

(Source: Sustainability First, using data from LCL: http://data.london.gov.uk/dataset/smartmeter-energy-use-data-in-london-households)

What is clear from this small sample is that the variation in the proportion of peak time use is much greater than the variation in the table earlier comparing the averages for different socio-demographic groups.

Similar conclusions were reached by the Smart Fintry project that found a significant variation in the charges that would be incurred (i.e. the "cost to serve") across a group of 62 customers, with a lowest time-of -use weighted network charge of 3.73p/kWh and a maximum of 8.20p/kWh.

Another source of evidence is the CLNR study which carried out a "shadow pricing" exercise[8] to determine how much worse off customers could have been on a TOU tariff (having committed to customers in the pilot that they would be compensated for any difference). While the average increase in bill for those who would have been worse off was £18 pa this was highly skewed with some customers losing between £100-200 pa. While such customers clearly would not opt for a TOU tariff, if suppliers are aware of the higher cost to serve these customers, they will have a strong incentive to either encourage them to change their behaviour (which is the rationale for moving half-hourly settlement) or to increase charges in some way even if the customer does not want a TOU tariff.

It is clear that, though some work has been undertaken to explore the variation in usage profiles between different socio-demographic groups, there still remains a question of what level of variation exists beneath these averages. It would be beneficial as a starting point to conduct further research into the extent of variation in the proportion of usage within the peak, as an indicator of the

[8] http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/CLNR-L243-High-Level-Summary-of-Learning-Domestic-Smart-Meter-Customers-on-Time-of-Use-Tariffs.pdf

differences in cost to serve (which might be expected to ultimately be reflected in bills). As the metric is quite simple this would allow for a more accessible analysis of the differences between and within different demographic groups.

Overall, however, there is a real need for more detailed datasets on when customers use their electricity linked to the demographic background of these customers. Robust data is not currently available to policy makers but could be obtained as more customers take-up smart-meters.

As CEPA set out in their report there are significant issues with even the limited data that is currently available much of which is linked to demographic data at a postcode rather than household level. As they rightly point out:

"ACORN is the segmentation of residential neighbourhoods in the UK. It classifies each postcode in the country into one of 6 categories, 17 groups and 62 types, and gives a detailed socio-economic profile of each area. A household level version is also available which makes that classification for each household, but the anonymised EDRP data is classified at postcode ACORN level. The smaller LCL dataset uses household ACORN, and thus provides more precise sociodemographic information. But in practice we have to use these datasets alongside each other so the relative imprecision of the EDRP sociodemographic information pervades much of what we are able to say."

As noted above, Sustainability First and CSE have been working together on how smart meter data could be used for the public interest to inform public policy decisions such as this. They have established a smart meter data Public Interest Advisory Group involving industry, consumer groups and wider government to consider these issues through a series of workshops informed by research papers on a range of related topics. Further information is available from the microsite www.smartmeterdatapiag.org.uk

Further examination of the sorts of activity diaries used by Yunusov et al. – or other forms of consumer research - could also allow for a more thorough understanding of what drives certain patterns of usage, and hence also the flexibility that different customers may have to adapt to the new tariffs.

The Evidence – Taking account of behaviour change

All of the evidence examined thus far has only aimed to look at the potential distributional impacts assuming no behaviour change. Though this is an important issue to address for the reasons given above, it is equally important to understand how different groups of customers may change their usage in response to the new tariffs, particularly given that this is the ultimate goal of the move to half-hourly settlement.

As discussed above the range of potential end user tariff structures that could emerge following a shift to half-hourly settlement makes it hard to assess the implications. Instead we set out below a range of factors that could impact a customer's likelihood to adapt their behaviour, and which could be explored in more depth.

Arguably the most significant factor would be the customer's flexibility to change their usage patterns. This flexibility will be determined by a range of considerations such as work and family situations, and cannot be predicted for any one group with great ease. For example, whereas an out-of-work single person might have great flexibility, a single mother working a low-income job may have very little whatsoever, despite both being potentially vulnerable customers.

Flexibility can also be facilitated by owning smart appliances capable of automated responses to dynamic tariffs. It is likely that these sorts of appliances would generally be less accessible to low-income customers, on cost grounds, and hence they would not be able to benefit from this type of flexibility. There may also be issues around the technical skills and confidence of certain groups of vulnerable customers which may affect their willingness to accept and get the most from smart appliances.

A customer's likelihood to adapt their behaviour will also be largely determined by how motivated they would be to do so, with low income customers being more likely to adapt their behaviour so as to make small savings than better-off customers. This, inevitably, will not be possible for all vulnerable customers due to the potential lack of flexibility noted above.

Customers will also need to understand the range of tariffs available and that it is possible to make these savings, and to switch to the TOU tariff if it benefitted them. The evidence from Ofgem's wider work is that vulnerable customers are typically less engaged in the energy market and hence may be less likely to take up these opportunities even if they would stand to benefit. These customers could be motivated to do so by their suppliers but it is unclear if suppliers would actively target customers who could benefit from the scheme, especially if they were seen as "sticky" customers who were unlikely to switch.

The study into the distributional impacts of TOU tariffs by CEPA for Ofgem examined customer responsiveness to the tariffs (both in terms of uptake and elasticity) by socio-demographic factors and found little correlation. The correlation they did find suggests that mid-income earners would be most responsive, whilst low and high-income customers would be least responsive. However, this was based on the results of two specific trials where not all the above factors would have come into play.

While the CEPA report focussed on the impacts after allowing for behaviour change it did also reinforce the findings above on the limited variation between socio-demographic groups but with significant variation within groups. The range of impacts without behaviour change was found to be +/- 15% although the report repeats the Ofgem line, that we do not accept for the reasons set out above, that customers would not adopt a TOU tariff if it would leave them worse off and hence there would be no losers.