ofgem
Making a positive difference
for energy consumers

Annex 6 - Large users group

Overview

1.1. The current arrangements for recovery of residual charges lead to some harmful distortions in the market. They create incentives for networks users to take actions that increase system costs. We have also noticed that costs fall on consumers that are less able to take action.

1.2. Residual charges are intended for revenue recovery, and are not meant to incentivise specific actions by network users. As the system evolves, any residual charge will have some potential for some users to respond by changing their behaviour. To the extent that users do respond to them, there could be additional costs for the system, but there could also be incidental benefits from this response. However, because residual charges are set to recover a given amount of money, if some users pay less, all other users will pay more.

1.3. The ways in which consumers use energy are changing. Historically, energy consumers were considered to be largely homogenous; consuming energy in similar ways and thus interacting with the system and facing charges in a consistent manner. Differentiation was limited to broad categories of type, whether domestic or non-domestic, and by levels of consumption. However, the advent of new energy technologies has led to increasing divergence, with the customer base becoming increasingly heterogeneous and changing consumption profiles leading to a greater focus on the impact of charges and the behavioural responses they bring about.

1.4. In the domestic sector, changes have been driven by developments in energy efficiency, monitoring and smart metering technology, internet-enabled devices, access to greater switching options and wider availability of renewable energy equipment. The emergence of this new distributed energy technology for generating and consuming electricity at customer premises, combined with increasingly sophisticated monitoring, metering and increasing options for storage, have provided domestic users with a remarkable range of options beyond importing from and relying solely on the national grid.

1.5. For many non-domestic users, the reasons driving different energy consumption behaviours are similar. However, amongst larger electricity users, there are additional factors to be considered.

1.6. Increases in energy prices coupled with energy price volatility have not just increased the visibility of energy prices as an issue but have led to energy becoming an increasingly significant element of a large user’s cost base. Large non-domestic users[1] consequently respond to this by looking to drive efficiencies in their energy

[1] Large non-domestic electricity users are defined as: high consumption commercial and industrial users connected at HV, EHV and Transmission level with and without self-generation capacity

use, negotiate better contracts and identify energy supply options. This can reduce costs and insulate against the risks of a changing market whilst striving to maintain the quality of service and supply that all consumers want and many require for continuing operation.

1.7. As the nature of consumers' energy use and the ways in which they engage with the electricity market change, there is an increasing pressure on the electricity industry to reconsider the way in which it charges for electricity. The focus of the Targeted Charging Review (TCR), and the associated Significant Code Review (SCR) is on improving the overall efficiency of cost-reflective signals, while ensuring that the costs of the networks are recovered in an equitable, non-distortive way.

Aims of the project

1.8. The purpose of this research is to contribute to Ofgem's understanding of large energy users' responses to network charge changes within the current regime and how this could be applied in the design of alternative charging methodologies.

1.9. As the wider Significant Code Review proceeds with the aim of designing charging methods that could reduce distortions in the market and produce fairer outcomes for consumers, this project is focussed on setting out the potential implications to large non-domestic users to inform the SCR and future policy development.

1.10. A central aim of the project is to examine how large electricity consumers respond to changes in charging methods. Linking existing literature on large-user behaviour and using detailed engagement with UK-based large users to test existing assumptions around price-elasticity of demand and grid defection will give a more detailed picture of high-consumption-user behaviour.

1.11. The work moves on to explore the existing literature on the incentive mechanisms of various possible alternative tariff structures in other jurisdictions and their respective impacts on consumer behaviour.

1.12. The results of the research led us to develop a new framework for considering effects on large users which builds on the lessons in the prevailing literature but incorporates the understanding of the additional factors of complexity which differentiate large users from the model of domestic users used in most existing studies.

1.13. Where this work differs from earlier similar approaches to this cohort is to propose that we need to understand the specific characteristics that define or define part of the behaviour of individual large users rather than using a smaller number of 'key actors' as representative of user groupings or sectors. Moving away from the assumption that there is a single model of large users or a sectoral view, a behavioural picture of large-user responses can be constructed from this broader set of characteristics.

Scope and method of this project

1.14. The project was approved by Ofgem's Research Hub Steering Committee[2] in March 2018. The scope, agreed on project commencement in June 2018, set out to achieve the following:

a) deliver a literature review which summarised the available work to date on how large electricity users respond to changes in charging regimes and how they could be expected to respond to proposed future changes; and to

b) engage large users in a process that would help to draw out qualitative real-world experiences and responses to better inform expectations of large-user behaviour.

Literature Review

1.15. A comprehensive search process, including engagement with external academic partners, drew a collection of around 80 academic papers and documents which was refined to the 33 papers that contributed directly to this project and are referenced in the main paper.

1.16. However, the search highlighted a lack of literature that directly considered the behavioural responses of large non-domestic electricity users to changes in tariff design.

1.17. Given the lack of existing work that addresses the specific question as stated, we therefore aimed to draw together the relevant parts of the literature that set out the theoretical elements of the areas above that are relevant to our question in order to begin to develop a framework of issues which need to be addressed to consider how large electricity users respond to charges and changes in charging regimes.

1.18. These elements include but are not limited to:

a) Residual cost recovery

b) Tariff structure and design

c) Stranded assets

d) Load defection

e) Distributed energy resources

f) Industrial price responses

g) Short and long-run industrial electricity demand elasticities.

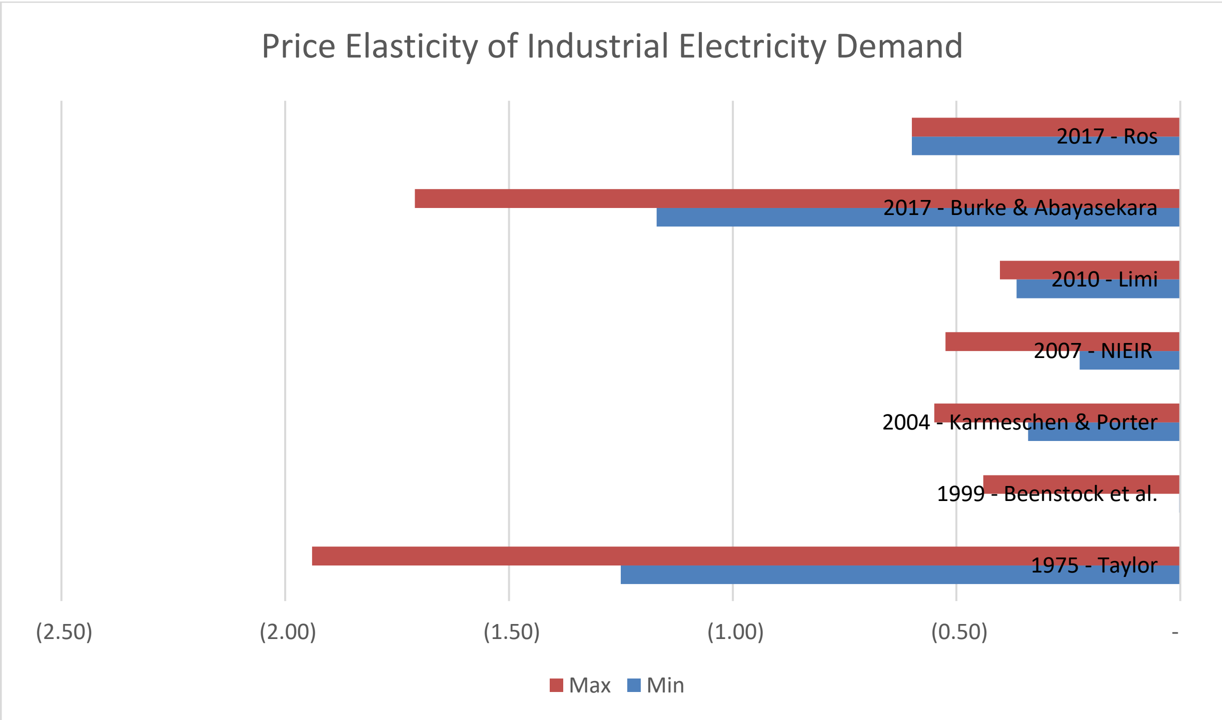
[2] The Research Hub Steering Committee was established to prioritise the research projects that Ofgem carries out. It makes decisions in line with our research priorities, which can be found here https://www.ofgem.gov.uk/publications-and-updates/call-engagement-ofgem-s-research-hub

Findings from the literature review

1.19. The literature brings together a number of competing views on the proposed charging methodologies, but provides for detailed analysis of the different basic charging options.

1.20. Any method of residual charging is likely to incentivise users to reduce their exposure to those charges to some extent. Hence completely non-distortive recovery of residual charges is not practicably possible. A more realistic objective is to derive residual charges on a basis that will reduce distortions rather than eliminate them altogether. There is often a trade-off between these principles when deciding on residual tariff design. Balancing this trade-off is one of the substantive challenges of this wider work.

Figure 1 - Price Elasticity of Demand Estimates (industrial consumers)



Source: Stated Papers[i]

1.21. We reviewed the literature covering the four 'basic' charging options as set out in the original SCR documentation. Each of the different charging options have specific benefits and issues however what is consistent is the challenge posed when applying a single methodology across different groups of consumers; domestic and non-domestic, with varying levels of consumption, different levels of resilience and different availability of alternatives. The literature is clear on the need to differentiate user groups to ensure better targeting of charging methods. There is also consistency on the need to consider multi-part tariffs to mitigate the specific detriments that an individual charging method can bring when applied across user groups.

1.22. The existing literature also says that it can be difficult to robustly estimate the demand price elasticity for large electricity users, specifically industrial users. We have tested this by collecting a range of estimations of demand price elasticity for industrial electricity users. These cover a range that does not allow for a consensus to be reached upon which robust projections could be made.

1.23. The insights gained from our literature review feed into the development of the large-user decision matrix and the conclusions that are summarised below.

Large User Engagement

Qualitative research with large users

1.24. The second substantive element of the work aimed to provide qualitative real-world information from large electricity users in response to a detailed interview scheme devised by Ofgem's Office for Research and Economics in conjunction with the Customer and Behavioural Insight team.

1.25. Using the results of the interviews with 15 large electricity users and industry leadership groups, the influential factors that could impact a consumer's behaviour were drawn out for each interviewee.

1.26. When these characteristics are taken in isolation it can be easier to identify and define them, and when aggregated they provide a more detailed understanding of the factors which weigh on a large user's decision-making process. The large users interviewed correspond to many of the sectors where high electricity consumption is concentrated and from the available information to represent the broad types of set-up that characterise large users.

Decision Matrix

1.27. This results of the literature review and engagement work was subsequently factored into a decision matrix which:

a) identifies the various factors that inform the large-user decision-making process when responding to changes in price

b) matches these factors to underlying characteristics of large users

c) estimates the absolute and relative strength of these factors in the decision-making process.

d) delivers a useable tool which can be used to categorise users or sectors based upon weighting of underlying characteristics and consequent estimates of the likelihood of certain responses occurring as a result of different charging options.

1.28. The purpose of the large electricity user matrix is to provide a framework within which to consider impacts on large users, from potential proposed changes to charging methodologies.

<u>Individual sections</u>

1.29. To build up a score, which intends to show the likelihood of defection under defined circumstances, there are different sections against which scoring is applied to build up a detailed picture.

1.30. Through review of the literature covering tariff design, charging, grid defection and industrial electricity demand elasticity, and combined with engagement with large electricity users in the UK, we developed a long list of around 30 variables which could impact on large user decision-making. These were intended to reduce overlap and duplication between the variables, and to produce 13 user characteristics which represent the most prominent factors in decision-making, identified through this process. These were then further considered against their respective impact on each of the three following outcomes: (partial) defection, disconnection and cessation.

Defection	Reduction in level of grid capacity or import due to development of Distributed energy resources (DERs)
Disconnection	Disconnection from the grid and operation in Island-mode
Cessation	Stop activity in UK - stop entirely or relocate activity outside of Great Britain

1.31. They final list of 13 characteristics is the following:

1	Grid Connection is sole electricity source
2	One of the user's primary electricity sources is grid connection
3	User has significant electricity export levels
4	User has significant electricity export levels and net export surplus
5	User has made recent 'non-energy specific' on-site capital investment
6	No long term commitments or leases to with current site
7	User supplies utilities (incl. electricity) to third parties on-site or locally
8	Market for output is local, output is difficult or expensive to transport
9	Feedstock suppliers are locally based, not available or difficult to access elsewhere
10	The user has a statutory or legal duty to provide certain services/utilities
11	User is minded to or open to distributed generation, displayed by public statements or a supportive capital environment
12	Grid Connection capacity is constrained or not available in the short to medium term
13	Non-operation or unscheduled shutdown will cause significant financial impact

1.32. Each of the variables was considered in the context of an increase in price from a change to the charging methodology chosen through the TCR SCR. Each of the 13 are scored using a 1-5 scale to weight their relative contribution to the issue of grid defection and disconnection. The factors are items which have either been defined within the existing literature or through discussions with British electricity stakeholders. The weighting factor allows for adjustments to the accuracy of how impactful each factor is on large-users' decision-making processes.

1.33. The 13 factors are a key part of this analysis, in that they set out the difference between the behavioural response of a domestic user and of a non-domestic large user and form the basis of the hypothesis that large electricity user behavioural cannot be derived solely from an assumption of uniformly higher price elasticity than displayed by domestic users.

1.34. Beyond the scoring for the user characteristics, there are several additional steps which incorporate weightings for other elements which impact user behaviour:

a) Large-User Characteristics - subjectively scored representing the extent to which the characteristic contributes towards the likelihood of defection, disconnection or cessation respectively.

b) Next, a weighting is apportioned to each characteristic under each proposed charging methodology.

c) Subsequently an overall large user weighting is applied to account for the extent to which the large users are generally likely to see costs change due to a specific charging methodology.

d) The product of the user-characteristic score and the weighted tariff score are output showing the respective scores of each element but also the aggregated scores under each methodology for defection, disconnection and cessation. The results also show a heat map and identify specific points of concern.

e) The next step allows for sector or user-specific weighting – including BEIS figures on UK energy consumption in the most energy-intensive sectors as a proxy for the extent to which an electricity cost increase will impact a user overall.

f) The 'User- or Sector-Scoring' sheet allows for user-specific weightings to be added to the final results.

g) As this work is primarily qualitative, we have included a requirement for scoring narratives in order to evidence assumptions made.

1.35. The matrix is intended to be a dynamic document which can continue to be adjusted and updated as more information is gathered and, then subsequently, as quantitative data is collected on these questions. Similarly, we have carried out a process of collaborative revisions with a project steering group before the first results were extracted. It is important to recognise the limitations of the qualitative work at this stage, noting the sample size.

Key communications from the Large User Engagement

Certainty and Periods of Price Stability

1.36. The majority of large users highlighted the value in, and their desire for, periods of charge-level price certainty (to the extent of Ofgem's capacity to do so). Whilst recognising the need for reform in charging methodologies and the benefits that this could bring to network users overall, respondents nevertheless were keen to highlight that regular changing of cost levels and formulae were not only bringing uncertainty in the short to medium term, making earlier investments redundant or expensive to maintain but also made it more difficult to plan for future investment and operation.

Impact on existing users vs. new market entrants

1.37. Some large users chose to highlight that the proposed changes to charging methodology options may disadvantage market incumbents to the advantage of new market entrants. Similar to the investment point above, some users stated that users who have significant sunk costs on the basis of an existing regime may be disadvantaged by a new regime and the costs involved in reacting to this and optimising operation, also raising a potential stranded asset risk whereas new entrants will be able to optimise entrance on the basis of a new regime.

Capital Environments

1.38. Across the large-user cohort, capital payback periods for plant investment ranged between three and five years as driven by a company's wider investment environment. However, this shouldn't be read as a barrier to large distributed energy resource (DER) plant investment as most users noted that for a large spend-to-save investment such as DER development, capital could be made available over longer periods of time on the back of a viable business plan (in the presence of a degree of regulatory certainty). The spend-to-save approach is separate from the investment to construct DER to secure continuation or quality of supply wherein large users were significantly stronger in their approach – where investment was considered necessary for continuation of activity, the investment hurdles were lower.

1.39. Despite this, however, it is important to note that the scale of energy use of the users interviewed was such that the cost of replacing a meaningful proportion of the on-site energy use that currently comes from the grid would still require an extremely significant investment appetite. Such investments are still also reliant on overcoming hurdles such as the availability of unconstrained land and fuel/feedstock and need to be able to meet environmental and planning obligations before any capital investment discussion requires to be made.

Gradual Introduction

1.40. Central to ideas of best practice within tariff design is the gradual introduction of changes to cost elements that will impact on user operations. This was also raised by a number of the large users themselves. In general, they were keen to see any changes phased in gradually with relevant notice periods to enable sufficient internal adaptation to deal with impacts of new charging regimes. Periods of notice and the opportunity to react and respond to changes is consistent with Ofgem's stated aims of introducing tariff regimes that deal with distortions in the market without causing unintended or disproportionate disadvantages to users.

Differentiated or supported regimes for challenged sectors

1.41. Some concerns were raised about the impact on users in industries or sectors where electricity costs form not just a significant part of energy costs, but of overall costs of operation, and the subsquent impact on ongoing profitability and operation. Suggested solutions involved differentiated regimes for specific sectors or for incumbents as opposed to new market entrants as mentioned above.

Grid impact and local area effects

1.42. Some large users were keen to highlight the risks and disadvantages to local networks from the impact of losing export capacity through large user defection. They also noted the impact on the local grid from losing, in some cases, large grid balancing activity if larger users were to disconnect.

Constraints on reacting to changes

1.43. A common thread which is closely linked to the cost-related elements above is that, for various reasons, many large users are not able to defect from the grid and not able to reduce grid reliance or develop substitute electricity sources. Therefore, they may be at risk of carrying a more significant burden if costs were to increase and even more so if other users were to leave and reduce the pool of potential contributors to network costs.

Wider uncertainty

1.44. Proposed decisions around changes in charging methodology will be made towards the end of 2018 and, regardless of what direction or form they take, it was noted that it would be to the benefit of large electricity users if they were introduced with certainty about their format and magnitude for at least the medium term with periods ranging between 5-10 years suggested.

1.45. This would seem straightforward but it overlaps with the one of the agreed principles around optimal tariff design, which is based upon the gradual imposition of changes. The gradual change to allow for better cost planning and smaller incremental cost or operational impacts.

1.46. Many large users of electricity, but not all, have significant levels of international linkages either within their own organisations or their supply chains and therefore are likely to experience volatility from ongoing UK constitutional change as a result of exchange rate fluctuations, supply chain interruption, distribution disruption and tariff or tax uncertainty.

1.47. These constitutional changes affecting the UK should be factored in to consideration of the factors that will influence large-user behaviour in Britain. A consideration is whether large companies will be more or less likely, or perhaps more accurately, more or less able to shift production to other sites internationally. If a company carries out activity in Britain using GB-sourced inputs selling to a domestic market, it would be reasonable to imagine that they would be at a lower risk of moving production elsewhere in the face of increased electricity charges and conversely the opposite also applies.

1.48. Discussion with large users did highlight concerns about electricity cost competitiveness in comparison to other European nations. Within this, a potential risk (though very difficult to detect) would be partial shifting of activity to non-UK sites. This would manifest itself as a reduction in activity at the UK site but could mask offshoring of part of UK-based production. These issues sit outside the scope of this project. However, they inform part of user thinking and should be noted.

Implications of large-user engagement

1.49. Having carried out detailed interviews with a number of large electricity users in the UK, our results suggest that large electricity users are significantly less homogenous in character than had been previously stated and that there is no evidence that across the cohort they would respond to price changes in a consistent manner.

1.50. What we have therefore tried to identify are the various characteristics that:

a) contribute to the likelihood of grid defection, disconnection or cessation of activity; and

b) are shared or common across large users.

1.51. The rationale for this is that as we cannot say with any certainty that all large users will act in a certain way due to the size of their capacity, their generation type or their location alone. We need to build up a more detailed, more nuanced picture of the decision-making process that large users would follow in considering defection.

1.52. If we consider grid defection on the basis of the existing literature and were to accept that large users are more price elastic with regards to electricity demand than domestic users and that large users are at or approaching price parity between the cost of grid-based supply and distributed generation; then, at the point of a price increase, we should expect to see a significant increase in the risk of grid defection across a wide range of large users - analogous with what is expected in the domestic sector when price parity is achieved.

1.53. To restate, in the current case – these two assumptions are:

a) price is the principal driver of behaviour; and

b) large users are more price elastic. Therefore - following a change to charging methodology that could potentially increase costs for large users, there would be an increased incentive to defect across all impacted users.

Conclusions

1.54. On the basis of the literature that deals with large user behaviour and from the interviews that Ofgem's Office of Research and Economics has carried out with UK-based large electricity users, we intend to challenge the assumptions of the existing literature as follows:

a) price is a key driver, but there are scenarios in which defection is either impossible, rendered very difficult or more unlikely. Therefore, the likelihood that price alone will cause a change in behaviour is diminished.

b) large users are more complex than domestic users and although they may be more aware of price changes and more in control of their energy profile this doesn't necessarily lead to more price-elastic consumer behaviour.

c) the principal reason we suggest for this is that there are a whole range of factors which a large user needs to consider before making a cost-led decision. These include, existing contracts, cost of investment in alternatives, availability of substitutes, etc.

d) a number of these considerations can be summarised simply as: the value of being connected to the grid goes beyond a source of supply and the cost of replacing the utility achieved from a grid connection is often prohibitively high.

1.55. Applying these revised assumptions, we arrive at the following:

a) large electricity users react strongly to price but face scenarios in which defection is either impossible or rendered very difficult or more unlikely. Therefore, all else being equal the likelihood that a change to price in isolation will be sufficient for a large user to defect or disconnect in the short to medium term is low.

b) overall grid defection in large electricity users is more complicated than the existing domestic-focussed literature allows for.

c) a survey of available estimates of demand price elasticity for large electricity users returns a broad spectrum of values which does not allow for a consensus to be reached upon which robust projections could be made - any quantitative analysis should therefore consider a wide range of possible responses by large users.

d) predictions of behaviour cannot be based on single factors such as capacity, generation type or location - a more detailed picture of the decision-making process that large users would follow in considering defection is required.

e) the likelihood of grid defection could be expected to be lower amongst large electricity users who:

- make significant financial gain from exporting excess electricity back to the grid.

- have statutory, legal or contractual duties to provide electricity to third parties.
- have distributed generation from intermittent renewable sources.
- face significant financial detriment from electricity supply interruptions.

1.56. The likelihood of defection could be expected to be higher amongst large electricity users who:

a) are facing grid connection capacity constraints.

b) have long term site commitments or ownership.

c) have invested significantly in a specific site.

d) have access to low cost fuel feedstocks or DER surplus output from legacy or co-located activity.

e) have organisational policies or publicly declared positions that support DERs/renewables.

1.57. The absolute risk of grid defection in large electricity users will require further engagement to fully quantify, particularly given the lack of quantitative data.

1.58. The presence of the 13 factors identified to characterise the complexity of large user decisions lower the likelihood of defection and should be incorporated in the existing estimates of defection risk.

Next Steps

1.59. The next steps are to:

a) continue to engage with large electricity users to improve the understanding of large user characteristics and their importance.

b) continue to develop the large-user matrix and methodology alongside the TCR team to assist with future application, including increasing the sample size.

c) identify the areas where this work can be developed to support the ongoing Access project.

d) identify the options for a quantitative study of large-user behaviour.

[i] **Figure 1 References**

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