CENTRE FOR RESEARCH INTO ENERGY DEMAND SOLUTIONS

Environmental Change Institute, University of Oxford, OUCE,
South Parks Road, Oxford OX1 3QY, UK

www.creds.ac.uk

Energy Networks Association – Flexibility Consultation 2020

25 September 2020

The Centre for Research into Energy Demand Solutions (CREDS) is a UKRI-funded programme of research into the role of energy demand in achieving a net-zero carbon society. CREDS responds to consultations and calls for evidence from government, agencies and businesses, providing insight and expertise to decision-makers.

This response was written for the Energy Networks Association Flexibility Consultation 2020 on behalf of CREDS by Professor Jacopo Torriti, Dr Samuele Lo Piano, Dr Mate Janos Lorincz, Dr Jose Luis Ramirez-Mendiola, Dr Stefan Smith, Dr Timur Yunusov. All the authors are from the University of Reading.

Summary - CREDS research into this area aims to conceptualise the introduction of flexible technologies, new pricing regimes and the transformation of social-temporal orders within a single frame. In our response we outline new opportunities in terms of non-DSO flexibility services, including the implications of introducing 'core capacity' and interfaces that allow non-DSO flexibility markets to flourish and describe how differing DER types should be subject to different baselining methodologies as opposed to a simple one-size fits all approach. In the context of residential flexibility, we generally agree with the position that engaging residential flexibility is critical. Further research linking the timing of activities to electricity demand will be key to any intervention aimed at increasing residential flexibility.

The full consultation response, as submitted, is below.

UK Research and Innovation

Engineering and Physical Sciences Research Council

Economic and Social Research Council

Q1 - Do you agree with our proposals within this consultation paper and if not, please provide us with any rationale and alternative proposals? This feedback can be generic to our proposals or provided on a product by product basis.

We welcome the opportunity to respond to this consultation paper. The introduction of flexibility presents several opportunities and challenges which require thorough thinking and analysis. Research at the Centre for Research into Energy Demand Solutions (CREDS) aims to conceptualise the introduction of flexible technologies, new pricing regimes and the transformation of social-temporal orders within a single frame.

In our response we outline new opportunities in terms of non-DSO flexibility services, including the implications of introducing 'core capacity' and interfaces that allow non-DSO flexibility markets to flourish (response to Question 8). We provide our view on how differing DER types should be subject to different baselining methodologies as opposed to a simple one-size fits all approach (responses to Questions 9 and 10)

In the context of residential flexibility, we generally agree with this consultation's position that engaging residential flexibility is critical. Further research linking the timing of activities to electricity demand will be key to any intervention aimed at increasing residential flexibility (response to Question 17).

Q8 - What input can you provide to help us prioritise non-DSO Service development?

8.1 What do stakeholders want network operators to facilitate in the near term?

8.2 How can network operators facilitate non-DSO services whilst ensuring system resilience?

8.3 How do network operators create scalable interfaces that allow these markets to flourish?

Since residential customers account for nearly half of the demand experienced during peak periods, it is essential to try and engage this sector in non-DSO flexibility service provision sooner rather than later.

It is widely expected that smart meters will enable the establishment of local peer-to-peer trading of flexibility and /or network capacity services.

However, building a thriving market depends on both technical and social elements.

From the technical point of view, adequate platforms where customers can trade flexibility resources, be it directly or through third parties, will need to be put in place and/or made accessible to customers. Such trading needs to take place in financially secure space in order to avoid exacerbating equity concerns.

From the social point of view, the success of such a model would largely depend on widespread mindset shifts and trust; customers have been traditionally seen as a passive component of the energy system that needs to be catered to. However, future systems will require customers to be more actively involved, and manage their energy consumption to some degree. As with any other disruptions to the status quo, these changes may well be received with scepticism, therefore, building customers' trust will be an essential part of any reform.

This change in customers' mindset and attitudes will not happen overnight, and concerns about equity and security are likely to play a major role in the adoption of more proactive behaviours.

Thus, any changes to the current model for service provision will have to be accompanied by extensive customer education programmes that offer customers the opportunity to familiarise themselves with the options available to them, while reassuring them that every effort is being made to guarantee equitable participation and financial security.

The assimilation of the new roles is likely to be time consuming, which further emphasises the importance of making an early start so that we can reap the benefits of flexibility services provision in the residential sector sooner.

8.1 What do stakeholders want network operators to facilitate in the near term?
Promoting non-DSO services development by encouraging service providers to promote the shift from volumetric (i.e. £/kWh) to capacity-based tariff designs in the residential sector.

The need for an improved power distribution tariff design is an issue that is becoming increasingly harder to neglect, but we acknowledge that this is an important task that requires careful planning and thought.

New tariff design efforts need to be based on the principle that tariffs should be cost-reflective; they need to make sure that networks' revenue is fairly recovered from consumers, with particular care to avoid adverse impacts on vulnerable customers.

Ongoing research in the CREDS Flexibility theme has examined the concept of 'Core capacity' with a view to addressing this issue[1].

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[1] Snodin, H. , Torriti, J. , Yunusov, T. (2019) Consumer network access, core capacity. Citizens Advice https://www.citizensadvice.org.uk/about-us/policy/policy-research-topics/energy-policy-research-and-consultation-responses/energy-policy-research/core-network-access-core-capacity/

Core capacity refers to the level of power capacity that provides for consumers' basic needs and therefore cannot be readily flexed.

In the context of power provision, basic needs should be understood as the demands associated with those services that allow people to not only merely survive, but to have the opportunities and choices necessary to fully participate in society.

Core capacity estimates would allow for both customers and providers, as well as other market actors (e.g. aggregators) to better assess the potential for flexibility provision in a particular geographical area/network location.

Therefore, we believe that the introduction of this concept in the tariff design reform may prove really useful.

We are developing a theoretical framework that allows for a consistent assessment of the core power capacity requirements for different types of consumers, which can then be translated into 'hard numbers' for their flexibility provision potential and other types of actionable knowledge.

Taking full advantage of this approach would inevitably require a different tariff structure to the one currently in place.

This brings us back to the issues of mindset shifts and trust highlighted in the previous question.

Regardless of the tariff design, these new tariff structures will have to be phased in gradually, in order to give consumers the time to adapt to the new structures.

Alongside this, extensive consumer education programmes will be needed to ensure that consumers understand the implications of the changes in tariff design and can realise the benefits offered by certain tariff options. For example, the implementation of Time of Use tariffs will have to include making sure that customers understand how they could reduce their bill through shifting their energy consumption to off-peak periods. This will allow customers to align their mindsets with the new workings of the market.

Consumer education by itself is unlikely to fully establish trust on the peer-to-peer trading mechanisms for the exchange of flexibility and/or capacity services. Therefore, additional trust-building exercises will likely be needed. For example, customers may need to be given the opportunity to try out trading platforms before formally signing up to taking part.

This highlights the importance of adequate baselining methodologies, so that consumers can get a real sense of the potential benefits of taking part and adjust expectations accordingly, thus ensuring that consumers' trust can be maintained.

In addition to the potential benefits of adopting the core capacity methodologies regarding estimating the flexibility potential of residential customers under normal circumstances, it also offers the opportunity of new trading use-cases.

Examples of these additional use-cases include 'Holiday Homes' and 'Special Days'. Tariffs based on core capacity (plus any additional requirements) provision would mean that each home would be allocated a certain amount of power capacity by default whenever they contract power provision services. However, under certain circumstances, not even this essential level of capacity provision would be required, freeing up the network or allowing for this capacity to be used elsewhere. Taking the example of the Special Days use-case: some people go visit relatives to spend days like Christmas or New Year's Eve with them. In practice, that means that they would no longer be making use of their allocated core capacity, so they could trade it with their peers. Analogously, their host relatives may need to purchase additional capacity to account for the additional consumption resulting from hosting another family, which could be sourced from the locally traded capacity.

8.2 How can network operators facilitate non-DSO services whilst ensuring system resilience?

DSOs will need to work closely together with local market actors to determine where non-DSO services will need to be complemented by DSO services such as Network Constraint Management (e.g. increasing/decreasing real/reactive power flows).

While DSOs' involvement in the day-to-day management of peer-to-peer trading platforms is likely to be minimal (if existing at all), there will need to be a close integration between trading platforms and local network monitoring systems so as to ensure the correct functioning of the system. That is, market exchanges of flexibility and/or capacity service provision would have to be mediated by the safety constraints of the physical infrastructure at a particular location. Moreover, should the market transactions result in actual increases/decreases of power flowing through the network, it is essential that DSOs are aware of it so that appropriate Constraint Management measures (e.g. increase/decrease reactive power) can be put in place.

8.3 How do network operators create scalable interfaces that allow these markets to flourish?

We envision the development of at least 6 interfaces that would be critical in terms of scalability. These are:

- Consumers to Trading Platform
- DSO to Trading Platform
- Aggregators to Trading Platform

- Aggregators to DSO
- Consumers to Third Parties (e.g. flexibility brokers)
- Third parties to Trading Platform.

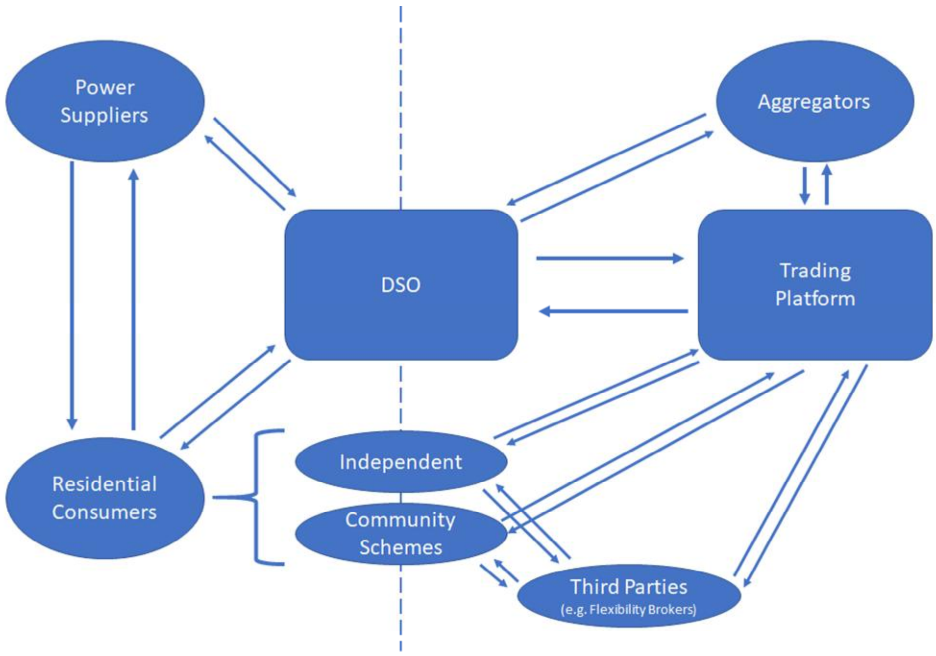

Figure 1 - Existing (left) and 'new' (right) interfaces

In order to ensure the scalability of this model, the responses to peer-to-peer and other market transactions would have to be, to a large degree, automatically generated. Therefore, substantial levels of oversight will be required during the development stages of these new interfaces.

The left-hand side of the diagram in Figure 1 represents the interfaces that are currently in place but might require substantial changes in the near future. The right-hand side of the diagram represents a number of new interfaces which are either non-existent at this point, or under development.

Ensuring that all market transactions and other interactions can be dealt with seamlessly would depend on a high degree of standardisation of the rules of engagement for the different market actors.

Since all these interactions would be mediated by the trading platform, the standardisation of such rules would necessarily have to start from this point.

Network topology considerations will undoubtedly play a key role in the scalability of the platform itself, regarding the exchange of flexibility and/or capacity services across regions.

This would require a much closer integration with the platforms or systems put in place for the coordination of DERs into Virtual Power Plants.

Q9 - What challenges are flexibility providers currently facing in respect of baseline requirements?

Flexibility can be delivered from stand-alone purpose-built DER assets (e.g. generators or energy storage) with export connection or assets located behind customers' meters. Purpose-built DER assets may be providing a particular service or delivering flexibility as part of stacking multiple services continuously. In this configuration, commonly used baselining methodologies that rely on historical data (e.g. from past 5 days) offer an effective solution to validate occasionally delivered flexibility against a typical profile for that site. However, these baselining methodologies become ineffective when the frequency of delivering flexibility increases and the typical profile for the site starts to deviate from the profile without flexibility[2]. This creates a challenge for the flexibility providers to prove that the required flexibility was delivered under the requirements for baselining using historical data.

Another challenge arises for newly built assets or sites that may not have sufficient data to establish the baseline and may be prevented from taking part in flexibility delivery until sufficient data is accumulated or become available.

Q10 - Open Networks Project will consider if differing DER types such as demand turn up, storage, generation etc should be subject to different methodologies. Do you feel this would be a fair outcome for providers or, would a simple one-size fits all approach encourage more participation?

We agree that differing DER types may have to be associated with different methodologies. Flexibility from different asset types can be provided for different flexibility services that have corresponding and distinctive parameters (e.g. notification period, ramp rate and maximum duration). Consequently, any service delivery validation (such as baselining) will also have to assess the corresponding service specific parameters of the asset that delivers flexibility. Particularly for the services with short notices (e.g. Dynamic and Restore), monitoring and

[2] California ISO Baseline Accuracy Workgroup proposal, https://www.caiso.com/Documents/2017BaselineAccuracyWorkGroupFinalProposalNexant.pdf

validation methods must be able to assess the operation of the assets in the timeframe of the service parameters. If a "one-size-fits all" approach is applied then the monitoring and validation methods would have to be applied to all asset types, regardless of whether they can deliver flexibility services on short notice, which will incur additional cost, further reducing the diminishing revenue from flexibility.

Furthermore, asset type and configuration of the service delivery monitoring would require different baselining methodologies.

- Individually monitored assets (e.g. direct control energy storage or generators) are suitable for existing history-based baselining methodology if stacking multiple services continuously. Otherwise, direct monitoring could be used for validation of single service delivery.
- Demand response behind the meter - flexible assets located behind the meter could be also penalised by the historical baselining methodology. Flexibility from these assets could be obscured by changes in operation of other co-located assets. Whilst the effect of demand reduction may not be identified by the typical baselining methodology, the total demand has been reduced when considering the contribution of the co-located assets.

To encourage participation in provision of flexibility, there must be a careful balance of simplicity and robustness of service delivery validation. Validation methods must be suitably simple and cost effective to encourage residential customers to provide and benefit from flexibility services. Equally, SME and I&C customers must be accommodated to make use of more reliable and predictable flexible assets that may deliver better value and offer more accurate monitoring. Similarly baselining methods must be sufficiently robust to accommodate the particular features of flexibility provider that may unfairly penalise them or given them unfair advantage by gaming the validation process.

Q11 - Are there any other key aspects Open Networks should consider when investigating potential methodologies?

We recommended the following aspects should be considered.

- Susceptibility to gaming

- Modifying asset operation prior to delivery of flexibility to exaggerate the level of flexibility delivered[3]

- Ease of use and accessibility to meet baselining requirements
    - Data requirements
        - Content (e.g. kW, Voltage, type of day) and format (file or API)
        - Length of historical data required to establish reliable baseline
    - Cost of data collection and transfer for validation
    - Scalability
- Standardisation of metering and monitoring
    - To increase reliability and consistency of the method
    - To avoid locking out flexibility providers with due to equipment supplier choices
- Alignment of demand response during consumers' non-peak time with system peak time
    - System peak may not align with consumers' peak demand which makes peak-demand baselining methods inaccurate, yet benefiting the wider system.

Q17 - Do you have any ideas on how we might better engage and encourage participation of residential flexibility in flexibility service provision? Can you identify any barriers that might currently exist, along with potential solutions?

We agree with this consultation's position that engaging residential flexibility is critical for the future of flexibility service provision. Expanding flexibility to the residential factor may bring about benefits to many in terms of reduced electricity bills. This is at the heart of research we carry out as part of CREDS Flexibility Theme and EPSRC funded projects on distributional effects of Time of Use tariffs (https://research.reading.ac.uk/redpeak/)

Our research shows that the timing of activities associated with electricity demand is critical in order to trigger residential flexibility. Smart meter consumption data combined with socio-

[3] https://energycentral.com/c/ec/ferc-settlements-illustrate-attempts-game-demand-response-programs

demographic characteristics alone are insufficient to determine which users may be encouraged to engage in flexibility services.[4]

Historically the absence of technology and price signals has been used to explain the low level of flexibility in residential electricity demand. The introduction of smart meters and time of day tariffs is supposed to overcome these barriers.

The delay in the smart metering roll-out represents an obstacle to the full participation of domestic users in flexibility services as fewer consumers will have access to real-time information around flexibility tariffs. Ultimately the benefits of smart meters outweigh the costs provided these enable forms of demand shifting.[5] Despite these delays, Ofgem's Half Hourly Settlement proposed reform[6] will provide incentives on suppliers for increasing demand-side flexibility offerings, for instance through time of use tariffs.

Automation, vehicle-to-grid solutions, battery storage, so-called 'smart' heating and cooling are also seen as significantly large opportunities for increasing residential flexibility. Volumes of flexible loads are expected to be higher than it is currently the case. The extent to which this flexibility potential materialises depends on regulatory decisions around standards, concerns around disbenefits and uncertainties around consumers' response.

In the future there might be a high flow of information in and out of the home. This calls for standardising information for instance through flexibility standards. In principle, standards can enable consumers to be more directly involved in managing demand through so-called 'smart appliances' that react to the availability of electricity on the grid in determining their operational cycle. In practice, especially after Brexit, appliances will need to follow EU standards in order to avoid excessive costs.

Flexibility in the residential sector is often portrayed as yielding benefits to the whole energy system, with some figures pointing to £17-40 billion cumulative benefits by the year 2050. However, the distribution of these benefits needs to be carefully researched and thought about in order to better understand win-lose aspects of demand-side flexibility. An example comes from ToU tariffs, which in principle offer significant potential benefits to the system by enabling responsive electricity demand and reducing peaks. However, the impact of more cost-reflective pricing will vary between consumers. In particular, those who consume

[4] Torriti, J., & Yunusov, T. (2020), It's only a matter of time: Flexibility, activities and time of use tariffs in the United Kingdom. Energy Research & Social Science, 69.
[5] Torriti, J. (2020), Appraising the economics of smart meters: Costs and benefits. Routledge Studies in Energy Policy Routledge pp 172.
[6] https://www.ofgem.gov.uk/publications-and-updates/electricity-retail-market-wide-half-hourly-settlement-draft-impact-assessment

electricity at more expensive peak periods, and who are unable to change their consumption patterns, could end up paying significantly more.

With regards to uncertainties around consumers' response, this is an area in which an investment does not necessarily correspond a financial return. Attempting to engineer solutions may not lead to the desired effects of higher flexibility unless there is a deep understanding of how everyday life changes along with the new technologies. If such solutions and interventions are only developed to meet current 'need' and their business case assumes this 'need' is fixed, then the risk of developing rapidly obsolete and uneconomic interventions is high.

The benefits resulting from flexing demand must be made clear and measurable. A calculation method to quantify (also in monetary terms) the flexibility service could help consumers to understand the benefits and opportunities offered by changing energy consumption behaviour. Other benefits of using the flexibility index is that it allows consumers to compare their energy consumption behaviour across different groups and guiding consumers towards the most suitable offer.

Community energy schemes and peer-to-peer energy trading represent another powerful tool in engaging consumers with flexibility. One of the key interests of the local community energy schemes is how greater flexibility could be used to unlock the deployment of low carbon energy generation technologies.