Call for Input - the Future of Distributed Flexibility (Ofgem)

Responses have been prepared by a team of researchers: Dr Anna Chatzimchali (University of Bath), Prof Sonja Oliveira (University of Strathclyde), Dr Ed Atkins (University of Bristol) as part of ongoing work within EPSRC funded project GLOW ~ ENERGY META-NESTED BIO SYSTEM FLOWS-FROM THE HOME TO THE HUB (EP/V041770/1). The views indicated below are drawn out of the project literature review and engagement with project partners and research participants (residents living in Glasgow and Bristol), initial insights may be helpful to the consultation.

Questions:

1. What do you think distributed flexibility could contribute to the energy system?

We think that distributed flexibility at a domestic context can contribute significantly to the energy system by incorporating at a practical level the complex socio-technical dimensions of energy demand. More specifically, distributed flexibility should take dynamic account for the flexibility, adaptability and resilience of the social practices that impact everyday aspects of people's daily energy use. We believe that the ability to shift in time or location the consumption or generation of energy, to meet system and network requirements need to integrate a new approach that considers the inherent behaviours of people, their routines and daily rhythms to better manage the fluidity of patterns of energy demand[1].

To achieve a distributed flexible and socially-smart energy system[2], it is essential to have a deep understanding of how daily routines and physical surroundings interact with energy use. By focusing on social practices that drive household demand and the socio-technical implications of such practices both individually and collectively, we can better interact with patterns of peak load and reduce stress on the energy system. This means that the distributed flexible energy system can *"identify "good" or "bad" locations and times to use electricity"* by also considering the importance of energy use rhythms in homes and neighbourhoods. This way, we can create an energy system which is more stable, flexible, and adaptable to the needs of the people.

2. Will a focus on CER flexibility also help enable other forms of flexibility, especially distributed flexibility?

A focus on Consumer Energy Resource (CER) flexibility can be instrumental for distributed flexibility. CER, as consumer-owned assets, can serve as an intermediary between the user and the energy system and can make "energy rhythms" apparent and more tangible. By acting as an integral component of consumer activities CER can reflect the daily, weekly, and seasonal rhythms of people's lives. Comprehending energy consumption through CER over days, weeks, and seasons, allows to recognize the rhythms of energy-using practices in everyday life and the ways they repeat, change, and alter patterns of household energy demand.

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[1] S. Oliveira, L. Badarnah, M. Barakat, A. Chatzimichali, and E. Atkins, "Beyond energy services: A multidimensional and cross-disciplinary agenda for home energy management research," *Energy Research & Social Science,* vol. 85 (2022), doi: 10.1016/j.erss.2021.102347.

[2] N. Hargreaves, T. Hargreaves, and J. Chilvers, "Socially smart grids? A multi-criteria mapping of diverse stakeholder perspectives on smart energy futures in the United Kingdom," Energy Research & Social Science, vol. 90 (2022), doi: 10.1016/j.erss.2022.102610.

F. Skopik, "The social smart grid: Dealing with constrained energy resources through social coordination," *Journal of Systems and Software,* vol. 89, (2014) pp. 3-18, doi: 10.1016/j.jss.2013.04.052.

The development of CER may also enable to promote the adoption of neighbourhood-level approaches to managing energy demand in particular locations and communities, which is a key aspect of distributed flexibility. Energy consumption patterns through CER, can further allow to identify stress locations and timings to use energy. This can promote a collective energy conscious culture and a paradigm shift for consumers. We agree that consumers are currently unaware of the 'parasitic' nature of CER and while simple strategies as incentivisation may push towards the right direction, we believe that distributed flexibility could also be driven by the collective capabilities of energy users and communities. A focus on CER flexibility can be instrumental in achieving distributed flexibility by providing a better understanding of energy consumption or home energy management patterns and promoting more localized energy demand management strategies which can be less consumption-driven but nevertheless transfers value to the community beyond incentivisation.

3. Is there a 'case for change' and a need for a common vision for distributed flexibility?

We acknowledge that there is a need for a "case for change," which may require a public interest intervention to facilitate a common vision for distributed flexibility to move forward. We also agree that the solution must be user-centric, data-rich, and digital. However, we believe that the primary focus should be on comprehending how socially smart and collectively managed energy systems[3] that integrate social, spatial, and technical energy use can operate effectively. To achieve this, at the heart of vision we must position the collective capabilities of energy users across various social contexts and spatial scales to consider the multidimensional and multimodal character of energy demand.

4. What is your vision for how to accelerate the delivery of accessible, coordinated, and trusted markets for distributed flexibility?

Accelerating the delivery of accessible, coordinated, and trusted markets for distributed flexibility requires a new vision drawn upon insights from social practices and social identities, which shape energy use patterns both within individual and collective contexts across the rhythms of everyday routines. Incorporating social practice and identity insights will enable to shape a user-centric and socially inclusive energy transition, through a bottom-up collective energy approach with increased communication between stakeholders. This vision can provide the foundation for new governance mechanisms, as well as engineering requirements that move beyond technological innovation and technical attributes and can align with the social identities, values and expectations of users.

5. Will certainty of an end vision help accelerate enabling work and make it cohesive?

Establishing a clear end vision for a distributed energy system is crucial for cohesive and effective implementation. However, significant research is required to develop a comprehensive understanding of the complex social and spatial factors influencing energy behaviour and the

[3] L. M. Camarinha-Matos, "Collaborative smart grids – A survey on trends," *Renewable and Sustainable Energy Reviews,* vol. 65, (2016) pp. 283-294, doi: 10.1016/j.rser.2016.06.093.

Hargreaves, T., & Middlemiss, L. (2020). The importance of social relations in shaping energy demand. Nature Energy, 1-7. J. S. Gregg et al., "Collective Action and Social Innovation in the Energy Sector: A Mobilization Model Perspective," Energies, vol. 13, no. 3 (2020), doi: 10.3390/en13030651.

interplay between social, spatial, and digital home infrastructure at both individual and collective scales.

Presently, there is a lack of empirical research on the socio-technical and spatial characterization of Home Energy Management (HEM) and broader Consumer Energy Resource (CER) technologies use. To establish greater certainty of an end vision, it is necessary to conduct evidence-based research using a range of mixed methods, including large-scale field studies across varying socio-economic and geographic contexts in the UK. Such analysis of empirical evidence can provide a better understanding of the socio-technical implications of an energy transition plan with distributed flexibility at its core.

6. When should a common digital energy infrastructure be in place? And therefore, when should development begin?

Given the urgency of transitioning towards a more sustainable energy system, it is important to begin development as soon as possible. Development of a common digital energy infrastructure should begin in parallel with investments in more empirical research and evidence on the interconnected "energy rhythms" and ways that people live alongside one another. This body of evidence will create a rich data environment of contextualised knowledge and will be instrument in improving decision taking across digital infrastructures.

7. What should a common digital energy infrastructure look like, and why? Please consider the archetypes or develop your own proposition.

A common digital energy infrastructure should resemble either the Hybrid, Medium or Thick archetype. More importantly, the infrastructure must prioritize the availability and interconnectedness of information and the co-creation of value with the consumer. Ideally an archetype would provide a single source of information for energy markets and can therefore reducing friction making the process easier and more efficient.

8. What is your view on the desirability and feasibility of the archetypes or your own alternative proposition?

It is important to acknowledge that there are several trade-offs to consider when evaluating the desirability and feasibility of the archetypes for distributed flexibility. However, in order to prioritize these trade-offs, it is crucial to gain a clear understanding of the needs and preferences of all stakeholders, particularly the consumers. As stated above, empirical research and robust analytical evidence must be developed to understand the dynamic and fluid nature of energy demand patterns. This body work is vital across archetypes and will help to guide policymakers and industry leaders in making informed decisions that prioritize the creation of a common digital energy infrastructure that maximizes benefits for all stakeholders.

9. Should a common digital energy infrastructure be new-build, or should it build out from existing infrastructure?

There are still significant areas of investigation needed to determine whether a common digital energy infrastructure should be new-build or built out from existing infrastructure, including empirical research and evidence as described above.

10. What are the important areas for consideration when designing institutional delivery models for common digital energy infrastructure?

When designing institutional delivery models for common digital energy infrastructure, it is crucial not only to consider a range of social, spatial, and technical factors, but also new roles that should support such transitions.

More specifically, the development of a new type of 'community energy social practice' role, can support local authorities in de-centralised and local approaches that prioritize national energy transitions. This will develop local-led understandings of factors that may drive peak load demand, promote community resilience in sudden blackouts, collective response to emergent events or even energy sharing during unstable supply due to unstable energy sources.

Additionally, it is essential to consider the social and spatial characterizations of energy use.
In terms of the social aspects, daily rhythms and energy routines across diverse types of households are essential and need further investigation in terms of digital energy infrastructure.

In terms of spatial aspects, institutional delivery can draw attention and invest on gathering analytical evidence on the ways digital energy infrastructure translates across different types of households and spatial layouts, as factors that impact energy demand. Considerations may also include interrelationships between households, streets, neighbourhoods, towns, and cities.

11. What are the important areas for consideration when designing financial delivery models for common digital energy infrastructure?

As stated above, empirical research and robust analytical evidence must be developed to understand the socio-technical of energy demand patterns to inform financial delivery models.