The Future of Distributed Flexibility- Call for Input

This submission brings together a range of sources relating to Distributed Flexibility, based on work with IPPR, UK100 as well as knowledge dissemination and policy engagement for the Active Building Centre and Energy REV. More detail on these programmes and evidence included in the links and background below.

Section 1 – The imperative, potential and challenges of flexibility

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

While we know from the 2021 Smart Systems and Flexibility Plan 2.0 that designing and managing the future energy system to have demand variability that matches supply variability should prompt significant cost savings across the energy system (from a reduced need for generation (avoided over capacity) and fewer associated network requirements), there is also the perspective of two emerging groups of actors, householders, and local government (as leaders of communities of place).

As consumers buy into the EV transition many are gaining new insights to their energy use, i.e. they now know what a kWh is, what it means for their car, and they have a better energy use app than a smart meter. This in turn is helping many of them explore how they might deploy smart energy systems for their home to help manage energy, and the cost of energy, for them going forward.

Meanwhile the vast majority of communities, through their local authorities, have adopt climate action plans. These are leading to a close examination of local energy uses, demand, and supply, prompting a mix of energy efficiency programmes, supply projects and a growing body of work to plan energy locally. In doing so local authorities and other local actors are realising the importance of smart local energy systems to their wider local ambitions, both for net zero and co-benefits of clean air, local jobs and economic activity.

Both of these emergent groups will continue to push their expectations of the energy system and its future, a future where the purpose of the energy system is to serve users and groups of users with smart, renewable energy systems.

The work of both the Active Building Centre and EnergyREV (PfER) highlight how distributed flexibility can provide benefits for these actors (as well as offer a route to a lower cost, fairer, and more enduring net zero transition than a centralised approach, echoing the Smart Systems and Flexibility Plan).

Infrastructures and systems for flexibility

Simply put the former has been looking at building based energy demand and supply integrations that are *smart behind the meter*. Buildings that intelligently interact with the wider energy system – a 'nano-grid' connected to a local grid – allowing the building to be near net energy neutral, while reducing local peak demand. Over time that can defer or make unnecessary the need for traditional network reinforcement, while providing greater resilience and security of supply.

They are variously known as Homes As Power Stations (HAPS), Active Buildings (ABs), grid servicing buildings, as well as Building to Grid (B2G) – **there would be benefit in examining the demand and supply approaches of each and compare those to your underpinning assumptions for CER (and the DNOs for LCTs).**

The latter examines area-based energy demand and supply integrations that are *smart between the meter*, and typically described as Smart Local Energy Systems (SLES)/Zones As Power Stations (ZAPS).

Evidence from the Programmes

The work of ABC-RP includes a series of 'white papers[1]' and research papers[2]. Using the Imperial Integrated Whole Energy System model in '*The role of active buildings in the transition to a net-zero energy system*[3]' the researchers find:

[1] https://abc-rp.com/impact/white-papers/
[2] https://abc-rp.com/impact/publications/
[3] https://abc-rp.com/wp-content/uploads/2020/11/Active-Building-Centre-Research-Programme-White-Paper-The-role-of-active-buildings-in-the-transition-to-a-net-zero-energy-system.pdf

- Smart EV – Active Building (AB) combination can reduce the need for high-cost firm generation, while at the same time increasing the ability of the system to integrate more renewables (in addition to those captured by the AB) - reducing total system costs by £3 –8 billion per annum.
- Smart Thermal Energy Storage (TES) can also provide flexibility by storing electricity as thermal energy, for release when required. TES could save total system costs of £1-2billion per annum
- High levels of insulation/energy efficiency could save £6-7 billion per annum

As the decarbonisation transformation continues Active Buildings and EVs will have a greater presence on the energy system, yet the flexibility / demand side response benefits they offer the system are currently unrewarded – that must be addressed with urgency.

The work of EnergyREV[4], including its research insights[5] and tools[6], highlights the potential economic benefits of Smart Local Energy Systems – lower bills, more efficient energy system build on local optimisation – as well as highlighting a range of further co-benefits to society beyond the immediate domain of the energy system – including a faster pace towards Net Zero as many actors have agency, new opportunities for local businesses, trainers and the subsequent skilled workforce, as well as cleaner local energy facilitating cleaner air and consequential health benefits. Including specific reports on flexibility such as '*Benefits of flexibility of Smart Local Energy Systems in supporting national decarbonisation'*[7].

In each perspective, that of the energy system transition, the household and the local actor (local authority) we can see common ground in valuing the benefits of flexibility, though clearly with different expectations of where, and for whom, that value emerges.

Getting the framework for distributed flexibility could aid engagement in the Net Zero transition for each or all these groups and those like them. The work of EnergyREV on pathways to SLES highlights the importance of local actors in initiating these projects – the right framework will provide appropriate rewards and incentives and speed the benefits of distributed flexibility. This would clearly also be true for the householder, and what you describe as Consumer Energy Resources (CER).

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

Consumer Energy Resources share some of the attributes of non-consumer assets (place based, decentralised, smart) while also offering greater challenge to an energy system that tends to think with a centralised mindset; that would suggest it would be best to start with CER to ensure any solutions are capable for these more challenging cases.

In ***'A distributed energy future for the UK: An essay collection'***[8] contributors sought to provide a prompt for what a decentralised energy system might look like, and might require, in the context of a transition where everyone can see decentralising is occurring, yet for which there is perhaps only a shared centralised 'bench-mark' (aka the CEGB). While touching on how and what it also concludes on the importance of avoiding edict, a centralised approach to decentralisation, and being user led; and inter alia providing the business models that support this transition and the growth of the prosumer.

In focusing on CER there will be a particular need to consider the wider questions of the ubiquity of flexibility. The ubiquity of renewable energy is the key driver of decentralisation, any community, actor, entity, or citizen might expect an opportunity to tap into the opportunity renewable energy offers. We can see this in the UK wide distribution of smart energy projects[9]. Whether it is a local authority wishing to secure local opportunities to power its services, bus fleet, schools, or a citizen wish to directly power their EV, each will have expectations of what ought

[4] https://www.energyrev.org.uk
[5] https://www.energyrev.org.uk/outputs/insights/
[6] https://www.energyrev.org.uk/outputs/tools/
[7] https://www.energyrev.org.uk/outputs/insights/benefits-of-flexibility-of-smart-local-energy-systems-in-supporting-national-decarbonisation/
[8] https://www.ippr.org/research/publications/a-distributed-energy-future
[9] https://www.energyrev.org.uk/outputs/insights/a-gis-map-of-local-and-community-energy-projects-across-the-uk/

to be possible. This in turn would inform their investment** decisions, and which technologies, integrations and smart capabilities are locked in, or not.

If flexibility is to be valued across the system in all locations, then all actors can act, and benefit (even if to some range of degree); if flexibility is to be targeted or required in specific locations to help support constraint management, a different narrative will be required soon.

Ofgem could potentially argue flexibility is available everywhere because that's the only way to support widespread CER roll out, EV & HP uptake, the condition being all and any such consumer has to install smart systems to their homes to help manage these devices (ideally integrated) within any smart local energy system, and in support of a 'fair share' of the headroom of the local system. This would require a shift in the apparent DNO approaches, described in ED2 business plans, of considering different low carbon technologies in silos rather than as potentially integrated CER.

**In focusing on CER further thought should be given to the implications for householders and other actors who are investing non-energy system resources (not Ofgem regulated at present) for their future capabilities – that would include:

- standard setting for what can/cannot be connected to the system, given the cost implications to other consumers of inflexible demand, and excessive demand given the continued low energy efficiency of new builds, hence
- the implications for the Future Homes Standard, and
- the future development of Smart Export Guarantee

Section 2 – An approach pivot – the case for change

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

The work of both programmes supports the case for change.

Analysis by EnergyREV also confirms the need for a common vision.

We would, however, frame that less as about distributed flexibility, more as smart local energy. While the former is essential for the latter, the latter offers a more systemic vision for energy and the energy transition, including a greater sense of the co-benefits offered; while also bringing together a wider coalition of actors to the delivery.

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

In addition to how we might frame the vision the work of EnergyREV has identified a range of barriers that should be addressed in order to accelerate smart local energy. Some of these reiterate those identified in the earlier IPPR essay collection, and include:

- A clear Vision, giving clear direction from national government is critical to unlock investor and industry confidence
    - Clarification of roles and responsibilities for delivery.
    - Support for local government in terms of building capacity and skills, as well as devolved statutory powers and resources to deliver.
    - Engagement with DNOs, who are key to SLES success
    - A skills strategy that includes flexible and modular training to allow for up- and re-skilling will be key to building the industry to deliver SLES

- Market and regulatory reform
    - Current regulatory frameworks act as a barrier to SLES rather than properly valuing local generation, peer-to-peer trading, and flexibility
    - Demand ≠ supply
    - Supplier-hub reform

    - Energy Innovation Zones
    - Aligned planning across sectors and networks
    - Agile regulation to respond to rapidly evolving needs

- Better access to finance and funding
    - Investment must be de-risked for external investors, with a clear path to return on investments
    - Grants should have funding criteria tailored toward local objectives and needs rather than a one-size-fits-all approach
    - Non-competitive LA funding should be increased to provide a guaranteed-term of investment to give local investors confidence
- Improved engagement with users and communities
    - Uptake of the technologies and behaviours that underpin SLES is unlikely unless people are engaged in the development of energy smart places that provide meaningful value
    - Barriers to entry (e.g., language, behaviour change, costs) can be significant and need to be addressed and minimised
    - Under-represented and marginalised groups are at risk of being left behind

As well as a number of cross cutting issues

Centralised mindset	A linear, centralised logic pervades in the energy system. This logic permeates key decisions, such as the REMA programme and retail market reform, skewing them towards centralised and engineering solutions. The impact includes a lack of recognition of the benefits and role of distributed energy and a lack of valuation of demand-side solutions.
A lack of definition and agency of decentralised energy assets and actors	Decentralised energy assets, such as electric vehicles and behind-the-meter assets, such as batteries and heating systems, are not defined (in a legal or regulatory sense) in the same way as conventional assets, such as power stations. The impact is that they can be invisible and undervalued in the energy system and not represented in discussions about rules changes.
Coordination, transparency, and clear roles	There is a lack of clarity on the role of decentralised energy and its customers and communities in the current and future energy systems. There is also a lack of attention on how the future energy system will be coordinated across scales, including between national, regional, local and individual asset scales. The impact is a lack of clear roles and responsibilities, for example, between DNOs and local actors on energy and spatial planning.
Risk-based approaches to managing change	The overly prescriptive nature of current licensing and innovation processes is a barrier to developing new, customer- centric business models. The impact is a regulatory regime which struggles to accommodate decentralised energy customer propositions.
Resilience	The definition and approaches to energy systems and climate resilience are not keeping pace with the energy system transition.
Recognising the diverse values of decentralised energy	The energy and wider benefits of decentralised energy are not fully considered in energy systems decisions system particularly those by Ofgem and BEIS. The impact is that decentralised benefits are left off the table in decisions.

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

Yes, if suitably focused on end users. We could expect that to challenge many actors in the current system so both government and regulators will need to engage in supporting, managing and equally holding firm to the user focused smart energy system vision.

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

This section suggests a bit of a leap has been made from the need to enable distributed flexibility to needing a single (?) digital infrastructure - it feels a bit like Blair's decision to have a common data platform for the NHS in the 2000s - worth re-examining what's fundamental to the vision.

If we accept that vision is for a smart local energy system (of systems, in the context of a UK wide energy system) that inherently suggests smart 'units', be they behind or between the meter (B2G/SLES) with some shared /integrated infrastructures and governance (building owners as their own 'governance').

They all need a smart capability to function and to be interoperable, so common standards for this smart capability are essential.

Yet enabling smart local energy systems need not (yet) demand a UK wide one size fits all digital infrastructure, if we recognise much of the flexibility interaction will inherently be localised. The design and operation of smart local energy systems, and B2G, (smart 'units') is tending to prioritise the demand supply interaction *within* the unit, rather than between units or further afield. Anecdotal evidence reinforces this, highlighting current SEG payments are too low for suitably equipped households (B2G CER) to prioritise external over internal energy use.

In practice, why would we have an EV/B2G owner in Orkney being aggregated with others across the country to provide flexibility to Oxford, when Oxford (ESO) and Orkney (ReFLEX) are managing their smart local energy system for optimal local benefit?

If smart units tend towards behaviour that is seen by networks as lower net demand on the wider system, this may mean two distinct domains of digital infrastructure – one for in-unit operation, the other for system wide, unit to unit, interaction, with implications for standards, roles and functions.

Section 3 – What that future could look like?

7. *What should a common energy digital infrastructure look like, and why? Please consider the archetypes or develop your own proposition.*
8. *What is your view on the desirability and feasibility of the archetypes or your own alternative proposition?*

There is a challenge in considering these questions, reflecting the different starting points which could perhaps be described as of a centralised system becoming flexible, or a decentralised system being flexible. The former looking to manage flexibility as a whole system resource, the latter as a local resource, primarily for local use.

One option to address these coexisting perspectives could lie in the work of Thomas Morstyn, part of the EnergyREV academic consortium which seeks to coordinate markets for flexibility at different scales, and integrate local flexibility into network planning (see attached ppt deck).

There is a clear need to convene academics and practitioners from both smart unit domains (behind and between) to examine whether the two domains of in-unit and between unit operation are meaningfully different, or not. This would help clarify where common digital standards apply, the expectations to be set for any digital infrastructures, and how *Thin*, *Medium,* or *Thick,* apply.

The systems of systems nature of these smart energy units suggests the *Thick* archetype, as described, will be inappropriately centralised. It could be that case that within a smart unit there is (already) a *Thick-like* approach, while between them the approach could be *Medium/Thin*.

Section 4 – Delivery considerations

9. *Should a common digital energy infrastructure be new-build, or should it build-out from existing infrastructure?*
10. *What are the important areas for consideration when designing institutional delivery models for a common digital energy infrastructure?*
11. *What are the important areas for consideration when designing financial delivery models for a common digital energy infrastructure?*

A settled view of these questions is still dependent on a vision, and what that is; as well as related considerations of governance, ownership and regulation in a decentralising system where grid edge assets

are increasingly important (and may not all be regulated). Some of this also overlaps with the work on sub-national system governance and planning. It is likely to need to be a regulated domain, ownership is less clear cut while recognising an increased demand for independent and user (not provider) focused oversight as new actors participate, and bring their own assets and resources into play. The nature of that independence will also influence what is an acceptable financing model.

Background information

Building based demand supply integrations that are *smart behind the meter*, and are currently described as:

- Homes As Power Stations (HAPS), a specific part of the Swansea Bay City Deal
- Active Buildings (ABs), ABC demonstrators here
- Grid servicing buildings, as examined by ABC-RP here
- Building to Grid (B2G), as described by the US Office of Energy Efficiency and Renewable Energy

Demonstrator buildings include the above and those developed by the SPECIFIC research programme at University of Swansea, here. They helped a set of principles[10] of an Active Building as "*a building that supports the wider grid network by intelligently integrating renewable energy technologies for heat, power and transport*." It has six core principles:

1. Building fabric and passive design
2. Energy efficient systems with performance monitoring
3. On-site renewable energy generation
4. Energy storage
5. Electric vehicle integration
6. Intelligently manage integration with micro-grids & national energy network

Area-based energy demand and supply integrations that are *smart between the meter*, and typically described as Smart Local Energy Systems (SLES). Demonstrator areas include:

- *ReFLEX Orkney - ReFLEX aims to decarbonise the three main areas of energy use on Orkney - heat, transport and electricity - by digitally linking 100% renewable energy with demand and storage into a flexible integrated energy system.*
- *Project LEO - taking a Distribution System Operator (DSO) approach to implement new energy projects across the city, and to facilitating future forecasting and planning. A local energy marketplace will enable virtual aggregation of loads and the ability to dispatch flexibility across a range of projects, as well as execute local peer-to-peer trading.*
- *Energy SuperHub Oxford (ESO) - Energy Superhub Oxford (ESO) aims to eliminate 10,000 tonnes of CO2 emissions a year. That's the equivalent of taking 2,000 cars off the road. We have installed a giant hybrid battery to enable more clean electricity, developed a powerful electric vehicle (EV) charging network to encourage EV uptake, including the electrification of the Council's own fleet of vehicles, and implemented low carbon heating in homes.*

EnergyREV has examined the nature of, and case for, Smart Local Energy Systems (SLES) across a range of functions areas (Cyber-Physical, Skills, Business models, etc). This work has taken into account the wide range of existing examples of SLES deployments (some 750+ identified) as well as the Prospering from the Energy Revolution (PfER) programme demonstrators.

Summarised by Hywel Lloyd, May 2023.

[10] https://www.specific.eu.com/what-are-active-buildings/